INTRA-REGIONAL DEVELOPMENT : AGRICULTURAL AND NODAL ADJUSTMENT IN OKLAHOMA'S SOUTHERN HIGH PLAINS

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INTRODUCTION

Rural America has been shaped by many forces, but none as pervasive as the agricultural development process. The 1862 Homestead Act was instrumental in the development of the largest portion of rural America. The number of farms in the United States increased from 2,044,077 in 1860 to a peak of 6,892,350 in 1935. With the increased farm numbers came the growth of thousands of rural communities.

The homestead era of rural American development was stimulated by the low cost of land and the period's labor intensive agricultural practices. Early in the twentieth century, America's industrial and scientific sectors produced technology which diffused into and changed the rural sector. Mechanization, improved seed varieties, fertilizers, pesticides, and irrigation have changed the structure of the farm sector. Improved transportation made possible by hard-surfaced roads, trucks, and automobiles has also affected rural America's spatial organization.

The number of the nation's farms diminished from over six million in 1935 to 2.2 million in 1982. The decline in farm numbers coincided with the concentration of population and business activity into metropolitan America. Rural America has undergone a similar reorganization as rural population and businesses have tended to agglomerate into larger rural communities.

Oklahoma's rural development process paralleled that of the United States. The state was opened for agricultural development, under the 1862

Homestead Act, with the 1890 land rush. As agricultural development proceeded, the number of Oklahoma farms peaked at 213,325 in 1935. The rapid influx of farm population into Oklahoma was the impetus for the development of thousands of rural businesses and hundreds of small rural communities throughout the state.

Oklahoma farmers have since adjusted to the same changes in input structure, substitution of capital for labor, that occurred in the rest of the United States. The large efficiency gains led to farm sector reorganization and induced a decline in farm numbers roughly proportional to the increase in farm size. Oklahoma farm numbers decreased from over 200 thousand to 70 thousand during the 1935 to 1982 readjustment era.

The development of Oklahoma's rural transportation infrastructure was occurring simultaneously with the farm sector adjustment. Thousands of miles of primary and secondary roads were constructed and most rural families procured automobiles. The improved road infrastructure accentuated the effect of a changing farm sector on the spatial organization of Oklahoma's rural businesses and communities. The readjustment of the farm and retail sectors has corresponded with the decline of many smaller rural communities and the growth of several larger rural communities.

The Problem

The economic linkage between the farm sector and the rural retail sector has not been adequately conceptualized and quantified. Currently, many rural communities are being affected by the continuing farm crisis and locally implemented farm policies. What rural community reorganization has and will

occur in the Oklahoma Southern High Plains region from the continuing farm and retail sector adjustments?

Continuing farm sector adjustments change the pre-existing number, income, and input requirements of family farms, which alters the rural population density and shopping destinations around non-metropolitan businesses located in the rural communities. Changes in the farm population density, income, and input requirements affect the economic vitality of rural businesses by altering spatial demand in the hinterland and inducing rural businesses to adjust supply.

Regional adjustments in the farm and rural retail business sectors influence which communities decline and which communities experience growth. The relative decline or growth of rural communities determines local tax bases, availability of services, and investments in education. Rural reorganization analyzed within a multicounty study area can help to predict future adjustments, not only in the Southern High Plains region but also for other regions of Oklahoma.

Objective

The objective of this study is to estimate the effect of exogenous adjustments in per farm income, farm numbers, and planted acres on the location and relocation of rural retail business activity by community size.

Hypotheses

1. The response of rural businesses to exogenous changes in farm structure differs by community size.
2. Decreasing farm numbers induce rural business activity to shift from smaller rural communities to larger rural communities.

3. Increasing farm income induces rural business activity to shift from smaller rural communities to larger rural communities.

Procedure

The procedure will be to develop a cross sectional-time series multiple regression model depicting the rural adjustment process associated with changes in farm structure. The model's temporal dimension is annual observations over a 17 year period from 1968 to 1984. The model's spatial dimension includes observations on basic industries, farms, and rural retail businesses in the three county area of the Oklahoma Panhandle. The annual number of rural retail businesses and real (deflated) sales within each community across the counties are the dependent variables. The independent variables include annual per farm real income by county, annual farm numbers by county, annual planted acreages by county, annual non-farm basic income by county, and a mobility variable. Chapter III contains a description of the variables, their formulation, and the model's mathematical specification.

Data Base

The data base was obtained from several state and federal agencies. The Oklahoma Tax Commission provided annual data on the number of retail businesses located within each community, annual sales tax data per community, annual sales tax data per business classification at the county level, and per county state road transfers. Estimates of annual farm, manufacturing, mining, and government income were obtained from the Bureau of Economic Analysis. Observations on the number of farms are from the United States

Agricultural Census. Annual observations on planted acres came from the Oklahoma State Department of Agriculture.

Study Area

The study area is comprised of the three Oklahoma Panhandle counties of Beaver, Cimarron, and Texas. The state map in Figure 1 highlights the study area. It is assumed the study area is large enough to capture the farm structure-community commerce relationship over the range of community sizes considered. Although the economic relationships extent over state borders, it is assumed the trade flows tend to cancel out and that the Oklahoma Panhandle is a representative east-west sample space across the Southern High Plains.

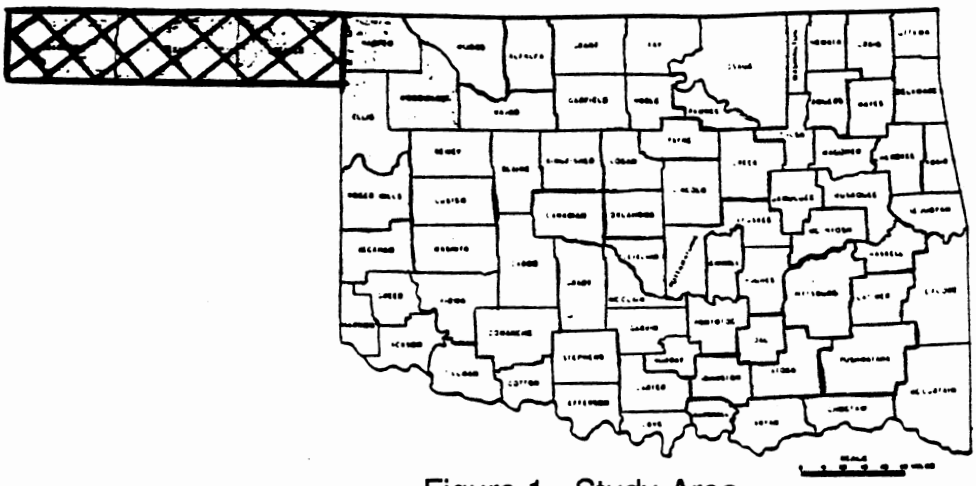

Figure 1. Study Area

Winter wheat, sorghum, and cattle are the area's primary agricultural products. The area is heavily dependent on agriculture and accounted for 16.4% of Oklahoma's Gross Agricultural Product in 1982. All three counties

were classified as agriculturally dependent in 1986 (48). Texas county is the center of the Hugoton natural gas field and all three counties produce significant amounts of petroleum products.

The area was primarily unpopulated until the Cherokee strip was opened to homesteading with the 1890 land rush. The area was then rapidly populated with homesteaders. The influx of farm population led to the development of many retail businesses and small communities throughout the three counties.

The area's farm and retail sectors have since undergone a reorganization. The number of farms decreased from 3,032 to 2,021 over the 1968 to 1984 period. The study area's retail adjustment has been predominantly a spatial adjustment to the change in the farm and transportation sectors. The retail adjustment can be characterized by a relocation of rural business activity from the smaller communities to the larger communities. Table I shows the study area's total number of businesses declined from 515 to 510. The smallest community group lost 22 businesses and the middle group lost 14 businesses. Conversely, the largest community gained 31 businesses.

TABLE I

STUDY AREA BUSINESS ADJUSTMENT

	Small Communities (0 - 48 Bus.)		Middle Communities (49 - 100 Bus.)		Largest Community (> 100 Bus.)	
Year	1968	1984	1968	1984	1968	1984
Number	142	120	187	173	186	217
% of Bus	27.6	23.5	36.3	33.9	36.1	54.1
% of Sales	13.4	17.3	32.5	23.0	54.1	59.7

CHAPTER II

LITERATURE AND THEORY

Family farms are located throughout the American countryside between rural towns. The economic linkages between farm families and rural towns constitute an integral part of the economic spatial plain of rural America. The interjacent economic linkages between farm populations and rural trade centers has been studied extensively and certain general relationships have been postulated.

The most fundamental proposition relates family farms, rural retail businesses, and trade centers. Based on a Minnesota time series study, it was inferred that the number of rural trade centers varies directly with the density of the surrounding farm population (26). A cross sectional California study of two rural towns and their adjacent hinterlands estimated that the rural town surrounded by relatively smaller farms received $68 more retail trade per $100 of farm output than did the rural town surrounded by relatively larger farms (12).

Other researchers have related the dynamics of agricultural development to the growth and decline of rural communities. Based on time series research conducted on South Dakota rural trade centers, it was concluded that as agricultural development occurred the average size of a family farm increased, farm population decreased, the number of rural retail businesses decreased, and some rural communities ceased to exist as the economic functions performed in them became obsolete (4 ,8).

Time series research conducted on a single Kansas rural community implied that as farmers homesteaded the area, farm numbers increased, farm population increased, the number of trade center economic functions increased, and a rural trade center developed. Then as agricultural development continued, the number of farms decreased, farm population decreased, the number of trade center economic functions decreased, and the small rural community declined (16).

Previous research conducted within Oklahoma on the relationship between farm structure and rural towns is consistent with the body of research conducted elsewhere in the United States. Belcher postulated community boundaries on the basis of where Lincoln county farm families procured economic goods and services (2).

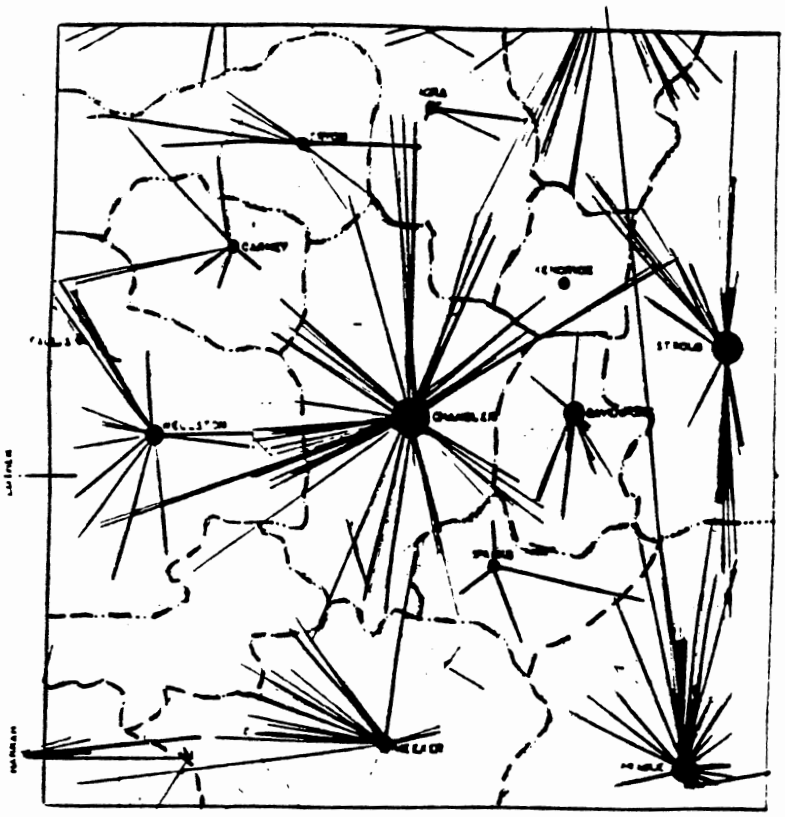

Figure 2. (reproduced from Belcher) Lincoln County Communities

From Belcher's illustration, see Figure 2, it can be seen that Lincoln county farm families procured most of their economic goods and services within a well defined geographic area with one rural town as the nucleus for the aggregation of farm family demand. Mcmillan, based on research for the whole state of Oklahoma, concluded that as agricultural development proceeded rural socioeconomic functions would become increasingly aggregated into larger and larger spatial units of organization (28).

Economics Of Farm Family-Rural Town Associations

From a purely economic perspective, a farm family may be theoretically conceptualized as a sole proprietorship which combines a profit maximizing firm with a utility maximizing family. The farm family engages in agricultural commodity production and off-farm employment to maximize profits and income which it allocates between savings for investment, used to generate future income streams, and family consumption. The farm family demands two distinct sets of goods, one being consumption goods and the other derived demand goods for investment.

The investment function will vary from farm to farm depending on the level and variety of production activities pursued by each farm operator. Regardless of the level or variety of activities pursued, each farm operator must purchase inputs which cannot be produced internally at a reasonable cost on the farm. The individual farm's demand curve for any particular input can be derived from the production function for farm output. In a perfectly competitive economy, the derived demand curve for any variable input is the value of marginal product from stage II of the production process (7). In spatially defined markets the derived demand curve will be a function of varying input and output prices (43).

The quantity summation of all individual farm families derived demand curves for a variable input , x_i, represents the aggregate demand curve for that particular input. There are as many aggregate demand curves for variable inputs as there are variable inputs into farm activities which are not produced internally on an area's farms. Most rural businesses which service the farm input demand will be located within or adjacent to the rural towns throughout the study area.

Farm and off-farm disposable income represents a budget constraint on the farm family's utility function. The individual farm family maximizes utility by allocating a constrained budget among the various economic goods and services contained within the family's utility function. A cross sectional study, based on 346 Kentucky farm families, estimated that farm families expended 28% of their disposable consumption income on food, 22% on household related items, 17% on transportation, 12% on clothing, 11% on medical care, 4% on education, 3% on personal care, and 3% on the consumption of other goods (34).

An individual farm family's consumption demand function for each good in the family's utility function depends partially on the price of each good, the income level of the family, and the proportion of the family's total budget allocated to the consumption of that particular good. An individual farm family's demand function for each consumption good could be obtained from the first order conditions of utility maximization. Each farm family will change its consumption bundle as prices and income change so as to maintain equality between the family's rate of commodity substitution and the relative price ratio for every pair of commodities (8).

If all n goods in all farm families' consumption sets are normal economic goods and if the marginal utility of money is constant, then the demand curve for

each good will be monotonically decreasing in price-quantity space. The aggregate demand curve for each commodity is the quantity summation across all farm families which have that particular good as an argument in their consumption sets. Most rural retail businesses servicing the farm consumption demand will be located within or adjacent to the rural towns throughout the study area.

Given that individual farm families demand economic goods as inputs into their respective production processes and economic goods to satisfy their respective utility functions, rural businesses located in the study area's rural towns face a diverse set of aggregate demand curves, with each aggregate demand curve representing the total demand for each particular economic good. The size of any particular business community (i.e. rural town) is partially determined by the absolute size of the set of economic goods which its businesses offer. The largest agglomeration of retail business will offer the greatest number of economic goods to the farm population and the smallest agglomeration of retail businesses will offer the least number of economic goods to the farm population.

Central Place Theory

Central place theory explains a hierarchy of communities, with the greatest variety of goods, n , being offered in the highest ordered center. As the order of a community decreases, the variety of goods offered decreases. In the middle ordered communities only n-j different goods are offered and in the lowest ordered communities n-j-i different goods are offered (5, 27). It is usually assumed that the lower order goods are purchased most frequently and that as the order of a good increases the frequency of purchases decreases.

A study conducted in South Central Oklahoma on a sample of 47 small communities ranked the sample's communities by the variety of the goods offered by each center's businesses (9). The lowest ordered goods, offered in the smallest centers, were offered by such businesses as grocery stores and gas stations. The middle order of towns offered all goods offered in the lowest ordered centers plus services from such businesses as drug stores and laundramats. The highest ordered towns had businesses which performed all the economic functions of the two lower ordered centers, plus such economic functions as legal services and jewelry stores.

Central place theory encompasses the fundamental economic principles of farm family demand and rural business supply. Central place analysis formally integrates the economic implications of space with the classical economic principles of aggregate demand, external economies, firm level entry and exit conditions, and market equilibrium. As such, the theory provides a logical framework in which economic principles operate to determine the rural retail spatial adjustments which occur in response to exogenous shifts in farm structure.

Central place theoretical analysis begins with a spatial economic plain which explicitly incorporates distance and transportation costs as endogenous variables (5, 27, 39). The inclusion of distance and subsequent transportation costs into the model gives rise to two spatial economic principles. The first is **'the ideal range of a good'** , which is the distance up to which an individual will travel to purchase a good offered at a central place, where a central place is an agglomeration of rural businesses (5). The second spatial principle is the **'threshold level of demand'** , which is the level of demand necessary for a rural business to break even in the provision of a good within any given spatial market (5).

The classical aggregate level of demand for any good i is the quantity summation across all individual's demand functions. The spatial principle of the range of a good establishes the number of individual demand curves contained within the quantity summation, i.e. the distance over which the aggregation of demand occurs for each rural business offering each good i from every rural town in the study area. The spatial principle of the threshold level of demand establishes the necessary condition that the aggregate average revenue (AAR) curve faced by any particular rural business, within its spatial market area as determined by the real range of a good, be tangent to or above its average total cost (ATC) curve of providing the good. The threshold level of demand establishes an effective constraint on the number of rural businesses which can offer a good within any given spatial market.

Range Of A Good

The range of a good is determined by the elasticity of the aggregate demand curve and the transportation costs to the consumer. It is assumed that all rural businesses offer all rural consumers one free-on-board (FOB) offer price and that rural consumers bear the transportation costs of traveling from their place of residence to the rural business (5, 6, 27). Rural consumers' transportation costs consist of the fixed costs of purchasing a mode of transportation, the variable costs of operating the mode of transportation, and the opportunity costs of allocating time to traverse the distance between their residence and the rural business (36). For illustrative purposes, a linear transportation function is assumed, although it is only necessary that transportation costs be monotonically increasing over distance.

The range-of-a-good principle for the perfectly competitive case of one business and one consumer is depicted in Figure 3. The rural business offers the quantity q^* at the prevailing FOB spatial market price p^*. If the rural consumer resides immediately adjacent to the rural business, the consumer pays the FOB offer price p^*. If the rural consumer resides distance d_1 from the rural business, the consumer pays the effective bid price p^*_1 and demands quantity q^*_1. The effective bid price p^*_1 equals the FOB offer price p^* plus the transportation costs $t_i d_1$.

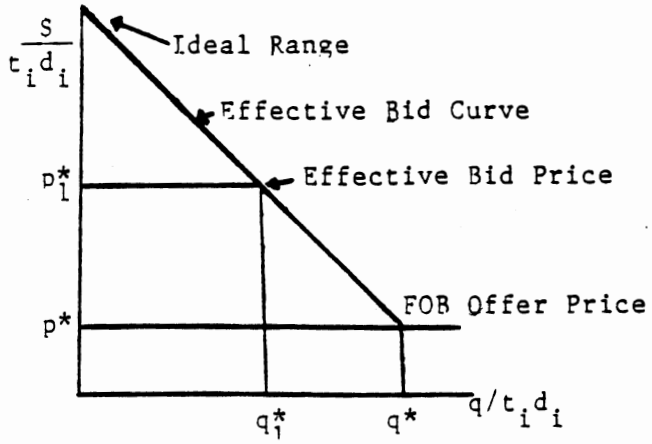

Figure 3. Range Of A Good

In general, the further the consumer resides from the rural business, the greater the transportation costs $t_i d_i$ and the greater the difference between the FOB offer price and the effective bid price. The greater the difference between the FOB offer price and the effective bid price the lower the quantity demanded.

At some distance from the rural business, called the ideal range, the quantity demanded becomes zero (5).

The range of a good i will partially depend on the elasticity of the effective bid curve. Within the set of goods demanded by rural consumers aggregate demand will vary from relatively elastic aggregate demand curves to relatively inelastic demand curves. It is assumed that those aggregate demand curves which are relatively elastic will have relatively elastic effective bid curves and that those aggregate demand curves which are relatively inelastic will have relatively inelastic effective bid curves (36).

The more inelastic the effective bid curve becomes, the greater the effective bid price increase must be to elicit a one unit decrease in the quantity demanded by the rural consumer. At a given FOB offer price, as the effective bid curve becomes relatively more inelastic the rural consumer is willing to progressively incur more and more transportation costs before decreasing the quantity she desires. A shift in the consumer's transportation function effects the elasticity of the effective bid curve and changes the range of a good by rotating the effective demand curve.

A clockwise rotation of the effective bid curve increases the range of a good, as illustrated in Figure 4. The effective bid curve clockwise rotation is the non trivial case and could conceivably be caused by at least two incipient forces. A temporal rotation could be caused by either a decreasing transportation cost function or by an increasing proportion of real income being expended on transportation by rural consumers over time.

The case of the decreasing transportation cost function is probably not relevant for the study period. There were no major technological improvements in personal transportation modes from 1968 to 1984. The road infrastructure for the sample region was already in place at the beginning of the period. In fact,

the real cost of transportation may have increased over the study period as the variable, fixed, and opportunity costs of travel have increased.

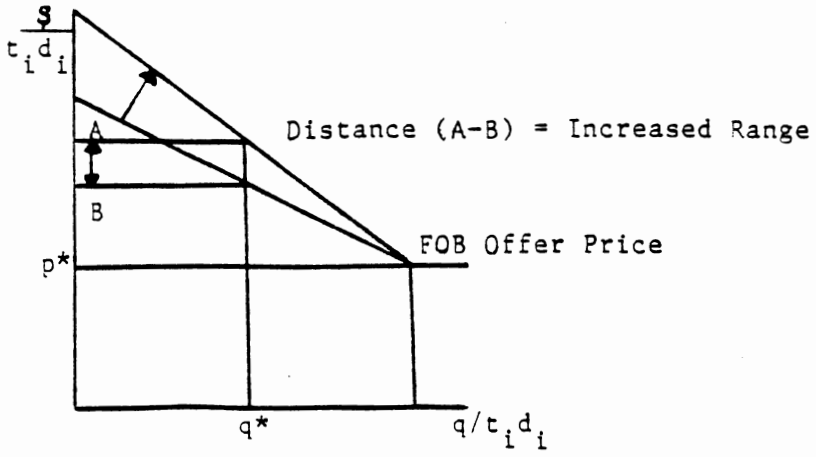

Figure 4. Elasticity And
The Range Of A Good

Given the range of a good as defined in terms of the FOB offer price plus the transportation costs, it is conceivable that the range of any good i could vary between otherwise homogeneous rural businesses. If the FOB offer price varies through the central place hierarchy, then the range of a good would also vary through the hierarchy. Figure 5 illustrates that, given constant transportation costs, the distance which an individual rural consumer is willing to travel to purchase quantity q^* is greater at a lower FOB offer price. Classical economic theory predicts that any externalities, positive or negative, could result in a varying FOB offer price.

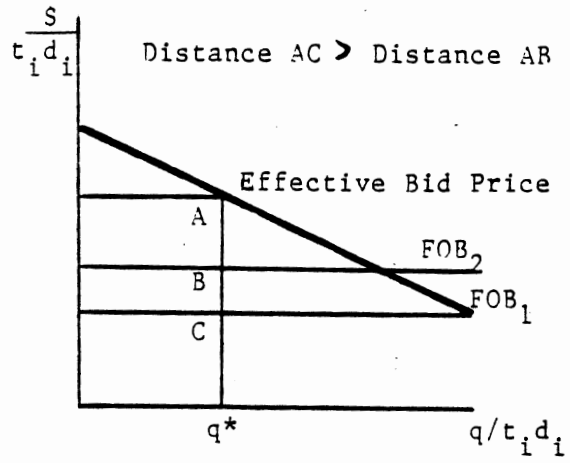

Figure 5. FOB Offer Price
and The Range Of A Good

The spatial effect of an increase in the range of a good, whether it be from varying FOB offer prices or proportional increases in transportation expenditures, is illustrated in Figure 6. Rural businesses located in community A, which had previously maintained a spatial monopoly, could find themselves in a situation where other rural businesses located in communities B, C, and D now compete for their spatial market. The increased spatial competition could conceivably lead to the decline of commerce and population in community A.

Threshold Level Of Demand

The threshold level of demand is jointly determined by the spatial market demand and average total costs (ATC) faced by a rural business. What follows is a development of the spatial economic factors which affect geographical market demand and the spatial determinants of ATC for a rural business.

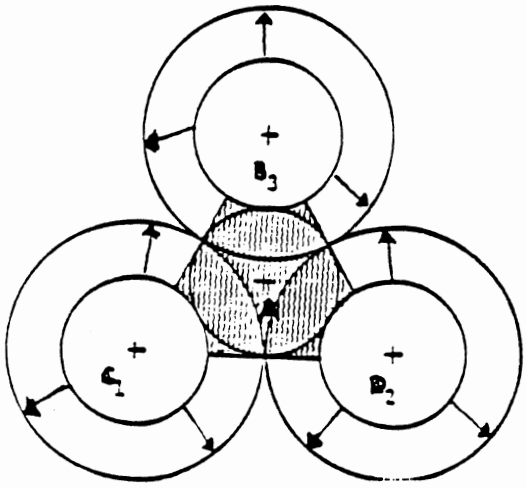

Figure 6. Increasing Range Of A Good And Community Decline

Spatial Market Demand

Two notable factors affect the level of spatial market demand faced by a rural business offering consumption goods in the study region. One factor is population density within the range of all offered goods as the population of rural towns and their farm hinterland varies across the region and through time The second factor is changes in real income as the economic base of the region develops through time.

Population And Spatial Market Demand

The consumer goods spatial market demand faced by rural businesses is an additive demand function, with farm family's consumption demand as one argument and the rural town resident's consumption demand as the other argument. The derived market demand for variable inputs into farm activities will depend totally upon farm families. Rural town resident families demand

functions will differ from farm families demand functions by inputs into the farm production process.

Within the study sample, rural town resident population varies from less than 50 persons to over 7,000 persons. As the resident population of a rural town increases, the proportion of total spatial consumer market demand for lower ordered goods faced by rural businesses from rural town residents is expected to increase. Given a particular farm structure, the farm proportion of spatial market demand is expected to be the greatest for businesses offering lower ordered goods in the smallest of rural towns and the least for businesses offering lower ordered goods in the largest rural towns.

Income And Spatial Market Demand

Increases in income are expected to have two distinct effects on the level of spatial market demand faced by rural businesses. The first effect is a disproportionate increase in the level of spatial market demand as a function of the range of a good. The second effect is the creation of new spatial market demand curves as rural consumers add new goods to the existing consumption bundle.

The Range Of A Good And Income Increases. Within the set offered by rural businesses, all farm inputs and consumption goods are assumed to be normal economic goods. Within this set, across a given community hierarchy, an exogenous increase in farm income will unambiguously have its greatest absolute impact on the highest ordered community. The highest ordered community offers the largest variety of goods and the goods with the greatest range. Ceteris paribus, the greater the number of farm families spatially aggregated, the greater the increase in spatial market demand from an

exogenous increase in farm family income. The expected larger absolute effect results from aggregating over a larger geographical market and offering an absolutely greater number of economic goods.

The Size Of The Consumption Bundle And Income Increases. A positive correlation exists between income level and the absolute size of the consumption bundle. As real farm income increases the farm family allocates more real income to consumption. Some of the absolute increase is allocated to increasing the consumption of goods in the pre-existing consumption bundle and some is allotted to the consumption of new economic goods. The increase in consumption of new economic goods increases the absolute number of economic goods within the farm family's consumption bundle. Based on the Oklahoma Sales Tax Business Code Classification, economic goods offered to the farm population in the study area increased from 57 different types to 74 different types over the study period (32).

The effect of an increasing consumption bundle on the spatial market demand faced by rural businesses depends on the order of the good which is added to the pre-existing consumption bundle. If the added good is of a higher relative order, then the increase in spatial market demand will accrue to rural businesses in the higher ordered centers. If the added good is of a lower relative order, then the increase in spatial market demand will accrue to all ordered centers. In general, the higher the order of the added good, the higher the order the center that will experience the increase in spatial market demand.

Central Places And The Level Of Average Total Costs

Thunen's isolated state central place model contains the spatial economic principles which establish the relative positions of ATC for rural businesses

(39). The model incorporates a monotonically increasing transportation function and a monotonically decreasing site rent function across space. For all firms, given their relative geographical market locations, per unit average variable costs monotonically increase with geographical distance from their suppliers and per unit fixed site rent costs monotonically decrease with distance from the suppliers so that the level of ATC are spatially constant with all firms sharing a common FOB offer price and normal profit level.

Thunen's spatial economic principle of the inverse relationship between variable transportation costs and fixed site rent costs generalizes to central place hierarchies (15). The physical distribution of retail goods tends to flow from higher order distribution centers to lower ordered distribution centers and the Thunen principle partially explains why land values, i.e. site rents, are higher in larger cities than in smaller cities (14).

Given an initial spatial Thunen equilibrium for all rural businesses and an exogenous shift in either the underlying variable cost structure or in the spatial demand plain, the Thunen equilibrium principle requires that all effected rural businesses immediately rebid their respective fixed site rent costs to establish a new spatial equilibrium. The Thunen spatial equilibrium principle operates only in the long run when all economic entities have relocated and all externalities are bid into the fixed site rent. Within central place theory, any deviation from a perfect site rent market gives rise to either real economic profits or a varying FOB offer price.

Positive Externalities And Average Total Costs

Over the study period, two sources of positive externalities could have lowered the average variable cost curves of rural businesses. One was volume

pricing and the other was agglomeration economies. If all of the positive externalities were not bid into all effected rural businesses average fixed costs via site rent, then rural businesses would not be in spatial profit and price equilibrium. Assuming that tertiary sector resources were mobile enough to impose normal spatial profits, the existence of positive externalities could have resulted in varying spatial levels of ATC, across otherwise homogeneous retail businesses, and caused varying FOB offer prices and varying ranges for a good i. The result would be different sized markets and irregular distances between centers within the central place hierarchy.

Positive Externalities From Volume Pricing. Given a spatially uniform farm population, homogeneous rural businesses offering the same good i located in rural towns of different sizes could face different aggregate levels of spatial demand. Rural businesses located in the higher ordered centers, which have a larger resident population, face a greater level of aggregate demand and would be able to procure a larger quantity of any good i from their suppliers than those businesses located in the lower ordered centers, which have a smaller resident population, and a lower level of aggregate town demand. The common business practice of volume pricing could lower the per unit average variable costs of rural businesses located in the higher ordered towns. Ceteris paribus, if this positive locational externality is not bid into the fixed costs of site rent, the otherwise homogeneous rural businesses located in the higher ordered centers would have a lower level of ATC and be able to offer the same good i at a lower FOB offer price.

Positive Agglomeration Externalities. Positive agglomeration economies shift the average variable cost curves downward for rural businesses locating

where they exist. "Positive external agglomeration economies arise when auxiliary and complementary economic functions performed in geographic proximity give rise to spatial concentration of individual economic entities" (38). Within central place theory, positive external agglomeration economies would vary directly with the order of the center within the hierarchy. The higher the order of the center, the greater the number of auxiliary and complementary economic functions performed within that center and the greater the magnitude of the positive externality to any particular rural business located within that center. Ceteris paribus, if this positive locational externality is not bid into the fixed costs of site rent, the otherwise homogeneous rural businesses located in the higher ordered centers would have a lower level of ATC and be able to offer the same good i at a lower FOB offer price.

Central Place Spatial Market Equilibrium

Central place spatial market equilibriums and disequilibriums can be represented by Chamberlin's monopolistic competition model by incorporating Christaller's threshold demand equilibrium principle. The threshold level of demand, when considered in a short-run and long-run context, conceptually establishes spatial entry and exit conditions for rural businesses within geographically defined markets. The long-run case represents a stable equilibrium where rural businesses have no incentive to spatially relocate and the short-run cases represent a dynamic unstable disequilibrium which induces rural business activity to spatially shift into different geographical markets (46).

Long-Run Central Place Spatial Equilibrium

The long-run stable spatial equilibrium case is illustrated in Figure 7. In the long-run case, the supply and demand are such that the ATC of providing a good i is tangent to the aggregate spatial market demand within the range of good i. Rural businesses offer the quantity q^*, where marginal costs equal marginal revenue and offer the good at price p^* where ATC equals aggregate spatial market demand within the range of the good (3, 5). Ceteris paribus, a rural business has no economic incentive to spatially relocate from one geographical market to another geographical market until there is an exogenous shift in the underlying market conditions.

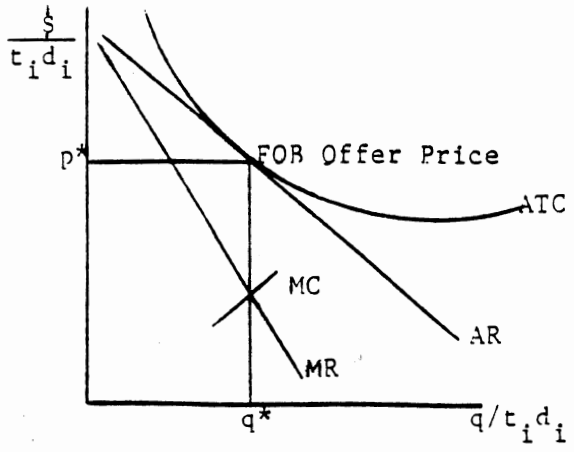

Figure 7. Long-Run Stable Central Place Equilibrium

Short-Run Unstable Dynamic
Central Place Disequilibrium

Theoretically, the predominant economic relationship between family farms and rural town businesses is a demand linkage. Farm populations demand inputs for production and consumer goods for consumption, while rural businesses supply the goods (22). Changes in farm structure are exogenous to rural businesses and are a primary source of short-run dynamic demand instability for rural businesses.

Two short-run demand disequilibrium cases are developed here. Both are partial equilibrium models where rural business supply is assumed constant and farm family demand shifts. The general farm family demand shifters can be classified into two conceptually distinct classes, with one having a negative effect and the other having an positive effect. The comparative statics framework facilitates a theoretical analysis of the response function of rural businesses given an exogenous change in farm structure. The response function of rural businesses will be characterized as entry or exit from geographically defined spatial markets.

Figure 8 illustrates the expected effect farm family demand shifters have on the aggregate spatial market demand curve faced by rural businesses. The direct local effect of a decrease in farm numbers or input usage is expected to shift demand to the left and below the prevailing ATC of providing a good and induce rural businesses to exit a geographical market. The direct local effect of an increase in farm income or input usage is expected to shift aggregate spatial market demand to the right and above the prevailing ATC of providing a good and induce rural businesses to enter geographical markets.

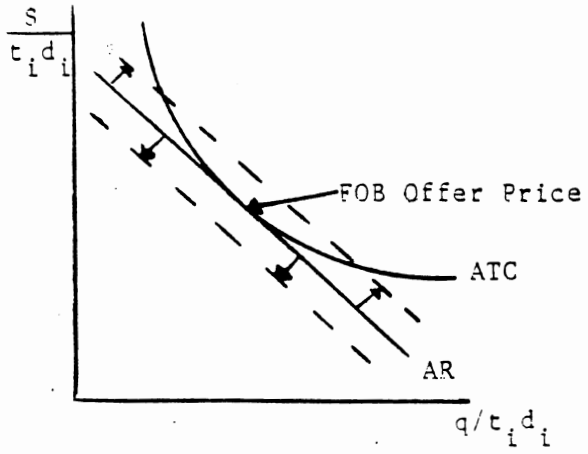

Figure 8. Farm Demand Shifters
Effects On Rural Businesses

Spatial Demand Deficiency

The firm level excess supply case provides the impetus for rural business activity to spatially shift by exiting a geographical market. Figure 9 illustrates the general case where the ATC of supplying any good i is above the spatial market demand within the range of good i. Any rural business in this short-run market situation is incurring real economic losses, area ABCD, and in the long-run is expected to exit the spatial market.

Within the study area, the spatial exiting of rural businesses typifies the experience of the lowest ordered communities. On the average, the smallest communities lost between one and two businesses per year over the study period (33). The exiting of rural businesses from the lowest ordered communities was partially caused by a decrease in farm family demand as the number of farms decreased and per farm income increased (17). As the

number of farms or input usage decreases, the local aggregate spatial market demand curve shifts to the left and below rural businesses ATC inducing rural businesses to exit some geographical markets. Ceteris paribus, a decrease in farm numbers or input usage is expected to have a negative direct local effect on the aggregate spatial market demand level faced by rural businesses.

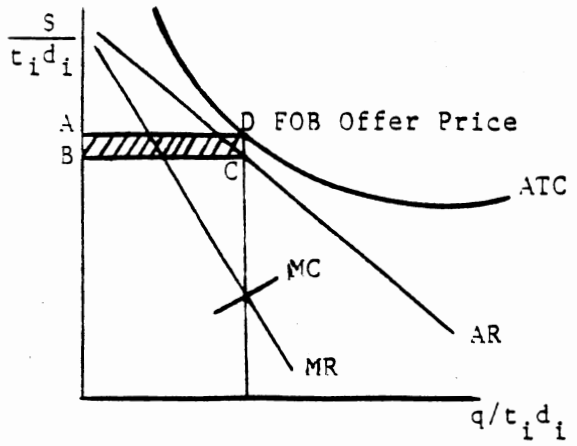

Figure 9. Spatial Market Exit Condition

Spatial Residual Demand

Within central place theory, the exiting of rural businesses from a spatial market results in a spatial residual demand which is no longer being serviced by any rural business in that particular geographical market (Figure 10). The rural consumers constituting the individual elements of the residual spatial demand must travel to some other spatial market to procure the good which is

no longer offered locally by any rural business. The spatial demand transfer will occur whether the residual demand is for a consumption or input good. The indirect central place effect of a rural business exiting a spatial market is the spatial transfer of residual demand from one geographical market to another geographical market within the central place hierarchy.

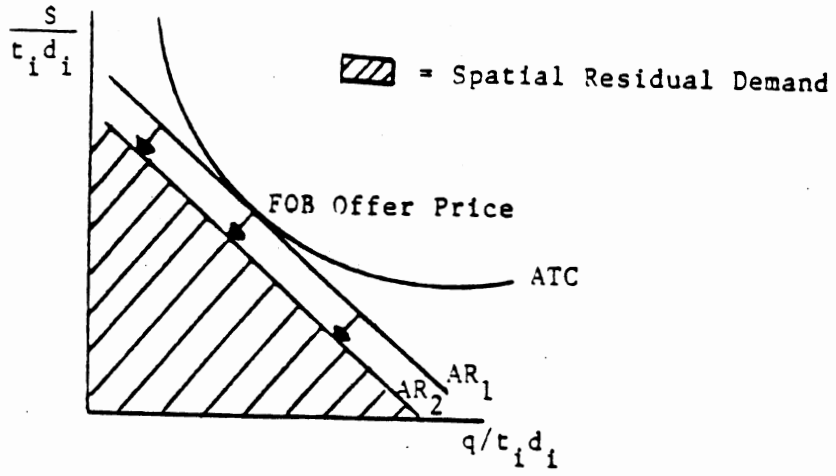

Figure 10. Spatial Residual Demand

Spatial Excess Demand

Short-run excess spatial demand is expected to cause a rural business to enter a geographical market. When short-run excess demand is present, rural businesses ATC of supplying any good i is below the aggregate spatial market demand within the range of good i (Figure 11). Any rural business in this short-run market situation is incurring real economic profits, area ABCD, and in the

long-run other rural businesses are expected to enter this particular geographical market.

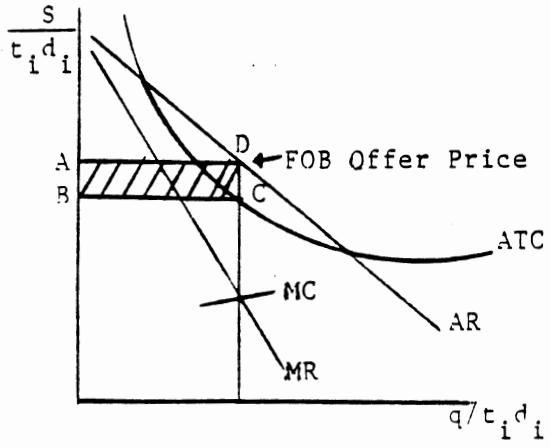

Figure 11. Spatial Entry Condition

Within the study area, the short-run excess spatial demand case is generally representative of the higher ordered communities. The largest community has gained roughly two businesses per year over the study period (33). Rural businesses located in the highest ordered community have probably benefited from the indirect spatial transfer of both consumption and input residual demand from other smaller communities, increases in the absolute size of the consumption bundle, and a decrease in ATC from positive externalities.

Consumer Behavior In Central Place Theory

Given that rural businesses are entering and exiting rural spatial markets in response to farm sector adjustments, the shopping destinations of farm families partially determine the location of rural businesses. Assuming the exiting of rural businesses from spatial markets creates unserviced farm family residual demand, where those farm families decide to shop will significantly affect the location decision of rural businesses. Central place principles provide a theoretical framework for analyzing which rural communities will attract the residual farm family demand (22).

In static central place theory, it is assumed that farm families shop at the nearest rural business which offers the desired good. It is also assumed that all rural businesses offer any good i at the same FOB offer price. Given that any good i has the same FOB offer price, then all offered good i have the same range no matter where the good is offered. The rural consumer then minimizes transportation costs by shopping at the nearest rural business which offers the desired good (5, 27).

Within any central place hierarchy, a farm family consumer could further minimize transportation costs by engaging in a multi-purpose shopping trip (14). The farm family consumer engaged in a single purpose shopping trip would pay the full transportation costs for each good purchased on each shopping trip. The farm family consumer engaged in a multi-purpose shopping trip would effectively pay only the transportation costs associated with one good and the FOB offer price for the remaining n-1 goods in the multi-purpose shopping bundle.

The one transportation cost would be associated with the good with the greatest range in the multi-purpose shopping bundle. The good with the

greatest range is the good the farm family consumer would travel the furthest to purchase. All other goods purchased during the same shopping trip are effectively purchased at their FOB offer price. The larger the bundle of goods purchased during a multi-purpose shopping trip, the greater the transportation cost savings to the farm family.

The farm family's choice of which rural community to shop at will partially depend on the order of the good being purchased. Given that most unserviced farm family residual demand has originated around the lowest ordered communities, most of the residual demand will be for lower ordered goods. It is expected that most of the residual farm family demand for lower ordered goods will be spatially transferred to the nearest community.

Farm families are also expected to engage in multi-purpose shopping trips to higher ordered communities, so that some of the farm family residual demand will accrue to the more distant higher ordered communities. Higher ordered communities offer higher ordered goods which are not available at the lower ordered communities. When a farm family engages in a shopping trip to a higher ordered community to purchase a higher ordered good which is not offered locally, the farm family could save transportation costs by purchasing their lower ordered goods while shopping at the higher ordered community.

A Dynamic Rural Central Place Theory

The dynamic structure of a rural central place hierarchy can be characterized by the spatial shifting of rural business activity within the community hierarchy over time. Ceteris paribus, within an agriculturally dependent region, changes in farm income, farm numbers, and planted acres change the economic demand plain and are a primary driving force behind a

rural area's dynamic central place hierarchy. Changes in an agricultural region's farm economic base directly effect the spatial location of rural business activity and ultimately effect the economic bases of the region's communities. Those communities from which rural businesses exit are expected to experience a decline in their economic bases and those communities where businesses enter are expected to experience increases in their economic bases.

The communities from which rural businesses exit are expected to experience a local decline in wages, interest, and profits. A decrease in wages, interest, and profits lowers the effected community's retail employment and income (29). The decrease in the effected community's retail employment and income further reduces the community's internal aggregate spatial market demand. The internal second round reduction of aggregate spatial market demand could induce other community businesses to exit the effected community's geographical market, which could induce an internal third round of decline and so on. The temporal result could be a continual cumulative exiting of rural businesses causing a continuing decline in the effected communities economic bases and a long-run decreasing growth rate.

The communities where rural businesses are entering the geographical markets are expected to experience an increase in their economic bases. The increase in their economic bases results from increased wages, interest, and profits from the community's new businesses. The new businesses increase local retail employment and income, which increases the community's internal aggregate spatial market demand (29). The second round internal increase in aggregate spatial market demand could induce more rural businesses to enter the community's geographical market, which could induce a third internal round of expansion and so on. The temporal result could be a continual cumulative

entering of rural businesses causing a continuing expansion of the effected communities economic bases and a long-run increasing growth rate.

The general cumulative dynamics for an agriculturally dependent region's central place hierarchy is that some rural communities' economic bases will continually expand while other communities' economic bases will continually contract. One basic exogenous force behind community growth or decline could be changes in the farm sector. The impact of exogenous changes in the farm sector would have a greater regional hierarchical impact because changes in the farm sector effect communities through both the direct local and the indirect central place effects, whereas community endogenous changes would tend to only impact communities through the direct local effects.

CHAPTER III

LITERATURE, VARIABLES, AND A MODEL OF INTRA-REGIONAL NODAL ADJUSTMENT

Review Of Previous Estimates

Multiple regression analysis will be used to estimate the farm structural relationship with the study area's communities commerce. The analysis is partially built upon work by previous researchers. This section includes a brief review of some regression techniques used by previous researchers to model the rural adjustment process.

Hodge was one of the earliest researchers to apply the multiple regression technique to the rural adjustment process. He analyzed a community hierarchy in the Province of Saskatchewan, Canada over the period from 1941 to 1961. He first constructed a 35 x 35 rank order matrix of community variables. Using principle axis factor analysis, the 35 x 35 correlation matrix was reduced to a 35 x 9 principle axis matrix. The varimax criterion was used to rotate the 35 x 9 principle factor matrix to an orthogonal simple structure (19).

Hodge then used the principle factor matrix as independent variables in regression models. One model estimated the number of rural businesses as a function of farm size and community population. Hodge concluded the number of businesses was less stable in smaller than in larger communities and that increased mobility and income were the underlying causes of the instability (19).

In a cross sectional regression with data from the state of Aguacaliente, Mexico, Letnik, Charnew, and Cotter estimated a relationship between per capita income, the composition of the consumption bundle, and the order of a community patronized by the rural consumer. The study suggested that relative income levels were correlated with spatial purchase patterns in a manner characterized by Engel's law. In particular it was inferred that the higher the household per capita income level, the higher the order of the central place the rural consumer tended to patronize (24).

A cross sectional regression on per capita retail sales in communities where population varied from 2,500 residents to 10,000 residents was estimated in Illinois. The development and use of a retail attraction variable as a regressor is particularly relevant to the current study. The retail attraction variable was an ordinal index and was assigned a binary value of zero or one depending on whether or not the community value was above or below the regional average. Theoretically, the variable measured the central place consumer principle that higher ordered communities offer a larger number of economic goods and attract more individual consumers than do lower ordered communities (44).

The current study builds on these previous studies by incorporating time series with cross sectional data into one estimation procedure. The current technique adds to Hodge's estimation by explicitly estimating the farm structure-community relationship over a range of community sizes. The current model adds to Letnik's, Charnew's, and Cotter's estimation by directly estimating community growth and decline over a range of community orders as a function of real basic income. The current research builds on Walzer's and Stablein's estimates by specifically incorporating all individual community's mutual attraction power into the region's central place hierarchy.

Variables and Data Sources

Dependent Variables

The number of annual businesses and the amount of annual real sales per community are used as the dependent variables. The data source is the Oklahoma Sales Tax Commission's Sales Tax Report (33) (see Appendix A). Theoretically, the number of businesses and real sales per community reflect a rural community's economic vitality. Each annual observation on the dependent variable will include community observations across the three counties. The annual community observations will be observed over the 17 year period from 1968 to 1984. The model's total degrees of freedom is n x t, where n is equal to the number of community observations and t is the 17 year study period.

Independent Variables

The independent variables are conceptually grouped into five categories. The first category is a mutually exclusive set of binary variables which divides the annual community observations into a central place hierarchy. The second category is a farm demographic variable included to estimate the effect of a changing farm population on the aggregate spatial market demand faced by rural businesses. The third category is income variables included to estimate the effect of a changing farm income and to control for other sources of basic non-farm income. The fourth category is planted acres included to estimate the effect of changing farm input demands. The last category is a mobility variable included to control for the effects of a changing transportation infrastructure.

Central Place Dummy Variable

The central place dummy matrix is constructed on the basis of each community's relative position in the study area's central place hierarchy. Within central place theory the order of a community is based on the variety of economic functions performed at each community (5). It is assumed that the number of economic functions performed at a community is directly correlated to the number of businesses at each community (23).

The annual community observations were grouped into three mutually exclusive temporally consistent groups representing a central place hierarchy for the study region. The lowest ordered group (22 communities) contains all the study area's communities with less than 48 businesses. The mid-ordered group (3 communities) contains all the study area's communities with 49 or more businesses but less than or equal to 100 businesses. The highest ordered group (1 community) contains the region's community with 101 or more businesses over the study period. The total number of communities decreases from 26 to 22 over the study period.

The central place dummy variable matrix allows the intercepts and slopes of the continuous explanatory variables to vary across the apriori defined central place hierarchy. The allowed variation controls for exogenous population and mutual attraction effects across the hierarchy while the effects of a changing farm structure are estimated. The central place dummy matrix, by controlling for community specific characteristics, facilitates direct hypothesis testing of the relationship between farm structural variables and rural communities of varying sizes.

Inherent within the central place dummy variable matrix is a control for community population. The lowest ordered communities will have, apriori, a

smaller resident population than the higher ordered communities. Any community's population is exogenous to the farm structure-community relationship and is controlled for by the central place hierarchy matrix.

Theoretically, mutual attraction is the power of a more diverse set of consumer goods offered to farm families within any given community (14). Mutual attraction is assumed to vary directly with the order of a community. The higher the order of a community the more economic goods its businesses offer and the greater their attraction power. The central place dummy variable matrix incorporates each community's attraction power into it and controls for this exogenous effect when estimating the farm structure-community relationship.

The study area consists of three counties, only one of which has a highest ordered community within it. Central place theory predicts that farm families located in the adjacent counties, which do not have a highest ordered community, will travel to the highest ordered community to purchase the higher ordered goods which are not offered in their respective counties. Theoretically, if this consumer behavior occurs, there will exist a farm flow from the adjacent counties to the highest ordered community.

The highest order dummy variable is designed to capture the farm flow from the adjacent counties to the highest ordered community. The binary central place variable assigns the continuous independent variables to the highest ordered community. The continuous transfer variables were constructed from the independent variables' average annual regional values (30, 31, 41, 42).

Farm Numbers

The farm number variable is included to estimate the farm population effect on a community. Theoretically, farm population is positively related to aggregate spatial market demand for businesses located in rural communities. Ceteris paribus, the direct local effect of a decrease in farm numbers should be a decrease in farm population which is expected to decrease spatial market demand and induce rural businesses to exit geographical markets.

The farm population effect is conceptually more complicated when rural communities are viewed as individual arguments in a regional central place hierarchy. Ceteris paribus, holding farm income constant and decreasing farm numbers implies aggregate spatial market demand must be declining in at least one geographical market. If aggregate spatial market demand declines below the threshold level of demand, a rural business will exit the geographical market in question. An unspecified number of farm families will still reside within the geographical market and will travel to some other spatial market to purchase the goods which are no longer offered in their own community. The communities to which the farm families travel are expected to exhibit an inverse relationship between farm numbers and the dependent variable, because a regional decline in farm numbers could actually increase their spatial market demand.

Annual observations on farm numbers at the community or county level do not exist, although county farm numbers are available for agricultural census years. Annual county level estimates were generated using a linear interpolation between agricultural census years for each of the three counties within the study area (41).

Real Per Farm Income

Given an exogenous increase in local real per farm income within any rural businesses geographical market, the level of aggregate spatial market demand is expected to increase. The increase in local aggregate spatial market demand is expected to induce other rural businesses to enter the geographical market in question. Ceteris paribus, the estimated direct local relationship between real per farm income and the dependent variables is expected to be positive.

Theoretically, the direct local relationship between farm income and community economic activity is inherently related to the indirect spatial transfer of residual demand from the decreasing farm population effect. The spatial transfer of farm family residual demand is not a permanent physical migration of farm populations between communities but is instead a spatial transfer of income. The estimated transfer of residual farm income is expected to follow the same general pattern as the flow of the residual farm population between rural communities. The communities from which the residual farm income is flowing are expected to exhibit an indirect inverse relationship between farm income and the dependent variables.

The direct local effect of an increase in farm income is expected to be positive for all sized communities. The indirect spatial income transfer effect is expected to be positive for the highest ordered communities as they are expected to gain from the income transfers. The indirect spatial income transfer effect for the two lower ordered groups is ambiguous and will partially depend on which effect is strongest, the direct local effect or the indirect transfer effect .

Annual data on county personal farm income came from the Bureau of Economic Analysis. The actual personal farm income data were then adjusted

to real farm income data by deflating the actual dollars by the Implicit Price Deflator to 1982 real dollars. The annual per farm real income variable was constructed by dividing the total county personal farm income number by the estimated number of farms in each county (42).

Planted Acreages

Planted acreage is an instrumental farm structural variable which can be directly effected by specific farm policies and is highly correlated to farm family derived demands. As planted acres increase farm producers are expected to purchase more inputs such as fertilizer, seed, and equipment. The expected relationship between planted acres, farm family derived demand, and the dependent variables is positive. Data for the planted acres variable were provided by the Oklahoma State Department of Agriculture. Planted acres for all crops were summed to measure total planted acres in each county (30).

Other Basic Income

Other basic income is defined as manufacturing, mineral, and exogenous government income from outside the region. The variable is included to control for the effects of changes in the other primary sectors on community tertiary business activity so the true farm structure-community parameters could be estimated. The data was provided by the Bureau of Economic Analysis and the variable was constructed by annually summing the individual components by county. Missing observations were generated using a linear interpolation between reported data points. The expected relationship between business activity in a community and other real basic income is direct (42).

Transportation Control Variable

Theoretically, the transportation control variable is included to control for changes in the transportation infrastructure over the study period. Controlling for transportation infrastructure changes facilitates more efficient estimation of the farm structure-community commerce relationship. The instrumental variable used was total state revenues transferred to counties for roads. The variable was deflated to 1982 real dollars and the data were obtained from the Oklahoma Sales Tax Commission (31).

General Procedure

The theoretical model requires the estimation technique to be capable of simultaneously estimating cross sectional and time series effects. The full model has 17 annual time series observations across 26 communities on 5 independent variables. The statistical model will use ordinary least squares estimators within a multiple regression framework to generate coefficients and the error sums of squares for testing the theoretical hypotheses. What follows are the procedures used to generate the statistics for the hypotheses testing.

Model 1

Model 1 will be used to generate statistics to test the theoretical hypothesis that a community's position in the central place hierarchy is a significant variable effecting the farm structure-community relationship. Model 1 consists of 4 separate regressions, the results of which are used to construct parameter stability tests. The statistical null hypothesis is that the intercepts and slopes are homogeneous across the study region's communities. Rejection of the statistical null hypothesis will be interpreted as statistical support for the

theoretical proposition that an exogenous change in farm structure effects community business activity differently across the various community orders.

Equation 3.1

$$y = a + bx + u$$

where

y =1 x 402 vector of observations reported on businesses or sales per community.

a = the estimated intercept.

b = 1 x 5 vector of estimated coefficients on the independent variables.

x = 5 x 402 matrix of observations on the independent variables.

u = 1 x 402 vector of error terms.

The estimated coefficients from equation 3.1 represent the aggregated parameters for the study region's central place hierarchy. All ordered communities are constrained to one common intercept and each independent variable is constrained to one common slope coefficient for all communities. The equation generates an estimate of a restricted error sum of squares which will be used in the parameter stability tests.

Equation 3.2

$$y = a_1 + d_2a_2 + d_3a_3 + b_1x + d_2b_2x + d_3b_3x + u$$

where

y = 1 x 402 vector of observations on reported businesses or sales per community.

a_1 = the estimated intercept for the highest ordered community.

$a_1 + d_2a_2$ = the estimated intercept for the middle ordered communities.

$a_1 + d_3a_3$ = the estimated intercept for the lowest ordered communities.

b_1 = 1 x 5 vector of estimated coefficients on the independent variables for the highest ordered community.

$b_1 + d_2b_2$ = 1 x 5 vector of estimated coefficients on the independent variables

for the middle ordered communities.

$b_1 + d_3b_3$ = 1 x 5 vector of estimated coefficients on the independent variables for the lowest ordered communities.

x = 5 x 402 matrix of observations on the independent variables.

u = 1 x 402 vector of error term.

The estimated coefficients from equation 3.2 represent the unrestricted disaggregated parameters for the study region's central place hierarchy. Intercept variation in the regression is allowed by incorporating the central place dummy variable matrix, with the intercept allowed to vary by community order. Estimated slope coefficient variation is allowed by cross multiplication of the dummy variable matrix with the continuous independent variable matrix. The regression estimates of the unrestricted error sum of squares will be used in the beta parameter stability tests.

The error sum of squares from the estimated regressions for equations 3.1 and 3.2 form the basis for statistically testing the null hypothesis that both the intercepts and slopes are homogeneous across all communities in the study region. Acceptance or rejection of the statistical null hypothesis is based on the following test statistic:

Test Statistic 1

$$F = (ESS1 - ESS2 / (k(p-1)) / (ESS1 / (pt - pk))$$

where

ESS1 = unexplained sum of squares from equation 3.1.

ESS2 = unexplained sum of squares from equation 3.2.

p = the number of different ordered communities(3).

k = the number of independent variables(5).

t = the total number of observations(402).

Two other variations of equation 3.2 will be estimated to facilitate a complete set of beta parameter stability tests. The first variation allows the beta

vector to vary across the community hierarchy while constraining the intercept to a homogeneity condition. The second variation constrains the beta vector to a homogeneity condition while allowing the intercepts to vary across the community hierarchy. The related F statistics are in appendix B.

Multivariant Sub-Model

The purpose of the multivariant sub-model is to generate more efficient estimators of the farm structure-community commerce relationship. The multivariant regressions allow the intercepts and the farm structural beta vector to vary while constraining the remaining control variables to a regional homogeneity condition (47). The specification facilitates more efficient estimation of the non-orthogonal farm structure beta vector by allowing the level and response of the regression to vary across community orders. The sub model's general functional form is specified in equation 3 .3 as follows:

Equation 3.3

$$y = a_1 + d_2a_2 + d_3a_3 + b_1x_i + d_2b_2x_i + d_3b_3x_i + bx_j + u$$

where

y = 1 X 402 vector of observations on reported businesses or sales per community.

a_1 = the estimated intercept for the highest ordered community.

$a_1 + d_2a_2$ = the estimated intercept for the middle ordered communities.

$a_1 + d_3a_3$ = the estimated intercept for the lowest ordered communities.

b_{1i} = the estimated marginal coefficients on the farm structural variables for the highest ordered community.

$b_{1i} + d_2b_{2i}$ = 1 x 3 vector of estimated marginal coefficients on the farm structural variables for the middle ordered communities.

$b_{1i} + d_3b_{3i}$ = 1 x 3 vector of estimated marginal coefficients on the farm structural variables for the lowest ordered communities.

b_j = 1 x 2 vector of estimated coefficients on the remaining constrained independent control variables.

x_i = 3 X 402 matrix of observations on the farm income, farm numbers, and planted acres variables.

x_j = 2 x 402 matrix of observations on basic non-farm income and the transportation variable.

u = 1 X 402 vector of error terms.

It is assumed that all the independent variables described are independent of the error term u. It is also assumed that all the estimated conditional distributions are independent of the ordinary least squares error term u so the estimation of the multivariant statistics does not violate the basic assumptions of the regression technique used (21). Given these two assumptions, the estimated coefficients are the best linear unbiased estimators available.

CHAPTER IV

DIVERGENT FARM STRUCTURE-COMMUNITY ESTIMATES : TESTING THE HYPOTHESES

This chapter presents the estimated statistics used to test the hypothesis that the farm structure-community commerce relationship varied across different ordered communities and the hypothesized farm population and farm income effects. The statistics to support or refute the hypotheses were generated from the regressions and F statistics specified in the preceding chapter and in appendix B. The organization of the chapter is to present the beta parameter stability results and then to proceed to the more specific farm population and farm income multivariant sub-model results.

Structural Models

The initial analysis begins with homogeneity tests using equations and the calculated F statistics from chapter III and appendix B. The restricted and unrestricted slope equations along with the total unrestricted model's estimated coefficients, their significance level (in parentheses), the coefficient of determination, and the Durbin Watson statistic are reported in Tables II, III, and IV. The calculated F statistics for the number of businesses per community and real sales per community for the beta parameter stability tests are reported in Tables V and VI. The structural model's error sum of squares and related F statistics are used to test the first hypothesis. The estimated statistics for the totally restricted model are reported in appendix B.

TABLE II

ESTIMATED RESTRICTED SLOPE MODEL FOR THE NUMBER OF BUSINESSES AND REAL SALES

Variable	Number Of Businesses	Real Sales
Intercept	221.08321 (.0001)	43332901.68000 (.0001)
D_2 Intercept	-158.33651 (.0001)	-38707174.90000 (.0001)
D_3 Intercept	-217.88667 (.0001)	-45765972.60000 (.0001)
Farm Income($)	.00002 (.0841)	7.14432 (.0462)
Farm Numbers(#)	.00233 (.6088)	578.26800 (.5740)
Planted Acres(acres)	.00001 (.0912)	5.80831 (.0005)
Non-Farm Basic Income($)	-1.27570E-07 (.1935)	.10243 (.0001)
Transportation($)	-7.07124E-07 (.8121)	1.15151 (.0859)
R^2	.9600	.9494
D.W.	2.1484	2.0902

D_2 = Middle Sized Communities
D_3 = Smallest Communities
Significance levels give the probability of the coefficient equaling zero.

TABLE III

ESTIMATED RESTRICTED INTERCEPT MODEL FOR THE NUMBER OF BUSINESSES AND REAL SALES

Variable	Number Of Businesses*	Real Sales*
Intercept	-61.08869	34294172.04000
	(.4317)	(.0227)
Farm Income($)	.00032	66.07524
	(.0001)	(.0001)
D_2 Farm Income($)	-.00062	-128.31000
	(.0001)	(.0001)
D_3 Farm Income($)	-.00076	-151.78800
	(.0001)	(.0001)
Farm Numbers(#)	-.09690	-6818.28000
	(.0001)	(.1674)
D_2 Farm Numbers(#)	.04398	-665.34000
	(.0705)	(.8792)
D_3 Farm Numbers(#)	.05475	-4080.56000
	(.0012)	(.2027)
Planted Acres(per acre)	.00028	62.89824
	(.0001)	(.0001)
D_2 Planted Acres(per acres)	-.00025	-54.54480
	(.0001)	(.0001)
D_3 Planted Acres(per acre)	-.00032	-68.97710
	(.0001)	(.0001)
Non-Farm Basic Income($)	-.000002	-.90540
	(.0012)	(.0001)
D_2 Non-Farm Basic Income($)	4.43428E-07	.42934
	(.2163)	(.0001)
D_3 Non-Farm Basic Income($)	.000002	.70081
	(.0001)	(.0001)
Transportation($)	.96172	-30653.28000
	(.0034)	(.5793)
D_2 Transportation($)	.000001	-3.30019
	(.8834)	(.0935)
D_3 Transportation($)	-.00002	-4.28867
	(.0001)	(.0001)
R2	.9091	.9264
D.W.	1.5777	1.2071

* = corrected for first order autocorrelation

Dummies, and significance levels defined in Tables II.

TABLE IV

ESTIMATED UNRESTRICTED MODEL FOR THE NUMBER OF BUSINESSES AND REAL SALES

Variable	Number Of Businesses*	Real Sales
Intercept	193.17795	60309269.52000
	(.0001)	(.0001)
D_2 Intercept	-177.50471	-36475019.00000
	(.0001)	(.0001)
D_3 Intercept	-198.66327	-30180720.60000
	(.0001)	(.0001)
Farm Income($)	.000007	21.60312
	(.0001)	(.0001)
D_2 Farm Income($)	-.00007	-23.84760
	(.1424)	(.0507)
D_3 Farm Income($)	-.00015	-49.19090
	(.0001)	(.0001)
Farm Numbers(#)	-.00140	3756.26150
	(.8962)	(.1698)
D_2 Farm Numbers(#)	.00581	-3749.48000
	(.6762)	(.2493)
D_3 Farm Numbers(#)	.00179	-6786.94000
	(.8337)	(.0013)
Planted Acres(per acre)	.00003	12.64872
	(.0813)	(.0110)
D_2 Planted Acres(per acre)	-.00003	-4.83869
	(.1443)	(.4103)
D_3 Planted Acres(per acre)	-.00001	-10.61710
	(.3017)	(.0140)
Non-Farm Basic Income($)	3.60631E-08	-.31440
	(.9175)	(.0007)
D_2 Non-Farm Basic Income($)	-3.44785E-07	-.00090
	(.2163)	(.9889)
D_3 Non-Farm Basic Income($)	3.27885E-07	.20033
	(.0218)	(.0001)
Transportation($)	.01350	-95400.24000
	(.9291)	(.0108)
D_2 Transportation($)	-.000004	-.48090
	(.5310)	(.7820)
D_3 Transportation($)	-.000002	.02572
	(.9683)	(.9721)
R^2	.9683	.9597
D.W.	2.3679	1.9102

*, dummies, and significance level defined in Tables II and III.

TABLE V

PARAMETER STABILITY TESTS FOR THE NUMBER OF BUSINESSES

Hypotheses	Calculated F
Homogeneous Regressions	2824.8500 (.0001)
Homogeneous B Vector (constrained intercept)	1099.5800 (.0001)
Homogeneous B Vector (unconstrained intercept)	30.0000 (.0001)

Significance level of calculated F in parenthesis

TABLE VI

PARAMETER STABILITY TESTS FOR BUSINESS SALES

Hypotheses	Calculated F
Homogeneous Regressions	2206.9800 (.0001)
Homogeneous B Vector (constrained intercept)	1393.5900 (.0001)
Homogeneous B Vector (unconstrained intercept)	30.7100 (.0001)

Significance level of calculated F in parenthesis

Parameter Stability Results

The parameter stability tests imply that both the level of the regression and the response function vary across the region's central place hierarchy. The F statistics imply the beta vector is heterogeneous in both the constrained intercept model and the unconstrained intercept model. The statistics support the first hypothesis, but provide limited information about the specific farm income and farm population effects on community commerce.

Farm Structure Community Commerce Estimates

Tables VII and VIII report the estimated coefficients, their significance levels (in parentheses), the dummy coefficients, the coefficient of determination, the Durbin Watson statistics, and the elasticities evaluated at the means for the multivariant sub-model. All estimated farm variable coefficients for the real sales model are statistically more efficient, based on estimated standard errors, than the preceding estimates from the structural models. The real sales model's estimated elasticities are used in a later policy analysis to project community sales changes.

The sub-model allows the regression level and the farm variable beta vector to vary across the community hierarchy while constraining the two regional control variables, non-farm basic income and mobility, to a regional homogeneity condition. The two constrained regional control variables decrease multicolinearity and allow more efficient estimation and hypothesis testing of the farm structure-community commerce relationship. Constraining the two independent control variables while allowing the farm independent variables to vary across community size measures the farm induced community demand shift while holding the other demand shifters constant.

TABLE VII

FARM STRUCTURE COMMUNITY ESTIMATES
FOR THE NUMBER OF BUSINESSES

Variable	Number Of Businesses*	Dummy Coefficient	Estimated Elasticity
Intercept	191.25275	191.25275	
	(.0001)		
D_2 Intercept	-96.39647	94.39647	
	(.0001)		
D_3 Intercept	-196.5877	-5.33495	
	(.0001)		
Farm Income($)	.00007	.00007	.01441
	(.0001)		
D_2 Farm Income($)	-.00016	-.00009	-.05483
	(.0006)		
D_3 Farm Income($)	-.00014	-.00007	-.46306
	(.0001)		
Farm Numbers(#)	-.00017	-.00017	-.00061
	(.9751)		
D_2 Farm Numbers(#)	-.00075	-.00767	-.09159
	(.2979)		
D_3 Farm Numbers(#)	.00183	.00200	.22888
	(.5999)		
Planted Acres(per acre)	.00003	.00003	.05928
	(.0212)		
D_2 Planted Acres(per acre)	-.00008	-.00005	-.33136
	(.0001)		
D_3 Planted Acres(per acre)	-.00001	.00002	1.27019
	(.3278)		
Non-Farm Basic Income($)	2.53273E-07		
	(.0172)		
Transportation($)	-.000002		
	(.3585)		
R^2	.9673		
D.W.	2.3407		

* = corrected for first order autocorrelation with a statistically significant coefficient
D_2 = dummy on middle sized communities
D_3 = Dummy on smallest communities
Significance level defined in Table II.
Dummy coefficient defined in equation 3.3

TABLE VIII

FARM STRUCTURE COMMUNITY
ESTIMATES FOR REAL SALES

Variable	Real Sales	Dummy Coefficient	Estimated Elasticities
Intercept	24762308.30000 (.0001)	24762308.30000	
D_2 Intercept	-22174314.00000 (.0001)	2587994.30000	
D_3 Intercept	-33904795.20000 (.0001)	-9142486.90000	
Farm Income	12.37704 (.0004)	12.37704	.01249
D_2 Farm Income	-26.71512 (.0196)	-14.33808	-.08759
D_3 Farm Income	-22.97892 (.0059)	-10.60188	-.91183
Farm Numbers	4300.21800 (.0035)	4300.21800	.07504
D_2 Farm Numbers	-4619.85600 (.0093)	-319.63800	-.03378
D_3 Farm Numbers	-4102.04400 (.0002)	198.17400	.29486
Planted Acres	16.53312 (.0001)	16.53312	.16012
D_2 Planted Acres	-17.89032 (.0001)	-1.35720	-.07961
D_3 Planted Acres	-8.97744 (.0054)	7.55568	6.23883
Non-Farm Basic Income	-.00199 (.9428)		
Transportation	2.56126 (.0001)		
R^2	.9550		
D.W.	2.0473		

D_2 = Dummy on middle sized communities.
D_3 = Dummy on the smallest sized communities
Dummy coefficient defined in equation 3.3

Farm Population Community Commerce Estimates

All estimated signs on the coefficients for the farm variables are unambiguously the same for both models, except the number of farms coefficient for the largest community. The diametrically signed number of farms coefficient implies statistical ambiguity of the effect of a change in the number of farms on business activity in the largest community. The estimated coefficients on the number of farms in the real sales model are significantly different from zero and are statistically more efficient parameters than in the number of businesses per community model.

The coefficient for the number of farms in the real sales model is significantly different from zero and unambiguously positive for the lowest ordered communities. Statistically, as the number of farms decreases around the smallest rural communities real sales decline. The estimated coefficients support the hypothesis that a decrease in the number of farms induces rural business activity to exit the smallest rural communities.

The absolute value of the estimated coefficients are the least, except on planted acres, for the small community group. The coefficient on planted acres indicates that for each acre planted small community total sales increased $7.55. The relatively large estimated elasticity implies that an increase of 16 percent in the acreage base would double small community total sales.

The coefficient on the number of farms in the real sales model is significantly different from zero and unambiguously negative for the middle ordered communities. This statistical result supports the theoretical case of spatially transferred residual demand between community orders. Statistically,

the negative sign on the estimated coefficient implies that a decline in the number of farms increases sales in the middle ordered communities.

The negative coefficient on the number of farms for the middle ordered communities suggests they receive more spatially transmitted demand from the lowest ordered communities then they lose in their own local markets from a regional decrease in the number of farms. In other words, the indirect central place transfer effect was more robust than the direct local effect from a local decline in the number of farms for the middle ordered communities. Ceteris paribus, a decline in the number of farms will unambiguously cause a decline in sales for businesses located in the lowest ordered communities and increase sales for businesses located in the middle ordered communities.

Over the study period, four of the lowest ordered communities ceased to report any business activity (33). The statistics support the postulate that farm family unserviced residual demand was spatially transferred to other communities. The statistics imply that most of the residual farm family demand was spatially transferred to the next higher ordered community.

The calculated real sales elasticities support the proposition that farm population was the major component of aggregate spatial market demand for businesses located in small rural communities. The elasticities for real sales indicate the response of rural businesses to exogenous shifts in farm population were the most elastic for the smallest communities and became more inelastic as community size increased. The elasticity of community sales with respect to the number of farms indicates a regional decline in the number of farms had the greatest negative direct local effect on businesses located in the smallest communities and the greatest positive indirect effect on businesses located in the middle sized communities.

Per Farm Income Community Commerce Relationship

The estimated per farm income coefficient for the largest community is unambiguously positive for both the number of businesses and real sales per community. Ceteris paribus, a regional increase in per farm income increases the real sales and number of businesses in the largest community. The theoretical implication is that farm family's demand more higher ordered goods and shop more frequently in the higher ordered community when per farm income increases.

The unambiguous negative signs on the estimated real per farm income coefficients for both groups of lower ordered communities implies that as real per farm income increases community business activity decreases for both smaller and middle sized communities. The estimated coefficients support the hypothesis of increasing per farm income inducing rural business activity to shift out of the smaller rural communities. Theoretically, farm families were engaging in multi-purpose shopping trips to the highest ordered community to purchase higher ordered goods and were spatially substituting the purchase of lower ordered goods from the smaller communities to the larger communities.

The elasticities of real per farm income with respect to the number of businesses per community and real sales per community indicated that relative community commerce responsiveness varied across the sample's community sizes. The proportional effect was the greatest among the smallest communities and declined as community size increased. The relative magnitude of the elasticities supports the proposition that the proportion of aggregate community demand attributable to farm demand declines as community size increases.

Farm Population And Income Hierarchy Relationships

The estimated parameters imply the declining farm population effect was relatively stronger than the increasing farm income effect for the smallest communities. The positive income effect did not totally compensate the negative population effect and the result was residual farm family demand. There was a clear statistical tendency for farm family residual demand to flow from the lowest ordered communities to the higher ordered communities.

Both the estimated coefficients and elasticities in the real sales model imply the indirect central place effect was relatively more robust than the direct local effect for the middle ordered communities. The middle ordered communities gained more sales from the indirect spatial transmission of residual demand than they lost from the direct negative local effect. Ceteris Paribus, the total effect of a declining farm population and increasing per farm income was unambiguously positively related to sales in the middle ordered communities.

The estimated coefficients and elasticities for the number of farms and per farm income in the real sales model was positive for the largest community. The positive per farm income coefficient implies the direct effect of an increase in farm income in the largest community was greater than the indirect demand transfers from the lower ordered communities. Theoretically, the largest community gained more sales from the income effect of selling more goods than from the increased sales from the residual demand transfers.

Seventeen new business codes were added to the offered set over the study period (32). Theoretically, all the new business types would have been located in the highest ordered community as businesses located in the largest

community offer all goods that are offered in the smaller communities. The additional sales from new goods demanded, as a result of the farm income increase, was greater than the additional sales gained from the spatial demand transfers for the largest community.

Summation

The calculated coefficients indicated the absolute and proportional effects of exogenous changes in the farm variables varied diametrically across the community sizes. The absolute effects varied directly with community size as the variety of goods offered increased and the number of farms included in the spatial aggregation increased. The proportional effects varied inversely with community size as the proportion of total aggregate community demand attributable to the farm decreased with ascending community order.

Both the absolute and proportional results support the hypothesis of a divergent farm structure-community commerce relationship across the region's central place hierarchy. Both the absolute and proportional results support the hypothesis that a decline in the number of farms induces rural business activity to shift from smaller communities into larger communities. Both the absolute and proportional results support the hypothesis that increases in per farm income induces rural business activity to shift from smaller rural communities into larger rural communities.

CHAPTER V

FARM POLICY AND THE FARM STRUCTURE-COMMUNITY COMMERCE RELATIONSHIPS

Generally, economic policy consists of a set of means which can be manipulated to approach a predefined goal. The values of specified economic instruments are changed to alter the underlying structural relationships directing the anticipated outcomes towards the policy goals. Historically, United States agricultural policy has used various economic instruments to induce dynamic adjustments in farm structure to achieve the policy goal of increasing efficiency while maintaining or improving equity (40).

The economic instruments used to achieve agricultural policy have been diverse and numerous. This chapter will focus on a few selected policy instruments which are or potentially will be in the near future, affecting the sample region's farm structure-community commerce relationship. The chapter is organized to first examine the effect of the current farm foreclosure moratoriums and then compares the effects of four alternative policy regimes on the farm structure-community commerce relationship.

Farm Foreclosure Moratoriums

The current farm crisis, as represented by the increased rate of farm foreclosures, affects the farm structure-community commerce relationship mainly via the farm population effects analyzed in the preceding chapter. The rate of forced exit in the early 1980's was high as compared to recent trends

(17). The high real interest rates of the 1980's decreased farm cash flows and increased farm financial stress. Many agricultural states and the federal government restrained farm foreclosures to permit delayed or partial repayment of agricultural loans to adjust the rate of farm population decline to a more acceptable level.

The short-run effects of foreclosure restraint will be additional retention of farm population. The implication from the preceding results is farm foreclosure moratoriums not only assist farm producers but also help preserve the socioeconomic well-being of rural residents in agriculturally dependent communities. Of course, creditors and taxpayers will bear the costs of foregone loan interest and principle.

The reported parameter on the number of farms in the real sales model indicates the moratoriums will decrease sales in the middle sized communities as compared to what would have occurred without the moratoriums. Middle ordered community sales were partially determined by the spatial transfer of unserviced farm family residual demand from smaller communities. The moratorium policies, by decreasing the rate of farm family population decline around smaller communities, will decrease farm family demand transfers and decrease sales in the middle ordered communities.

Selected Policy Alternatives And Rural Community Commerce

The general supply control policies compared include the current 1985 farm bill's conservation reserve program, two mandatory acreage diversion alternatives, and a free market. The impact the various policy alternatives have

on the farm structure-community commerce relationship will differ depending on the effect the individual policies have on the number of farms, real per farm income, and planted acreages. The results presented in the preceding chapter (see Tables VII and VIII) verify the empirical causation between farm structural changes and the demand faced by rural community businesses.

The alternative policies will impact both farm family consumption demand and derived farm input demand faced by rural community businesses. Agricultural policy directly affects aggregate farm family consumption demand by changing the level of real per farm disposable income, or by changing the number of farms, or by altering both simultaneously. Farm policy also directly affects farm level demand for fertilizers, pesticides, seeds, and machinery by altering the quantity of planted acres. What follows is a general outline of the four policies, whose impact on community sales is compared.

Alternative 1: 1985 Conservation Reserve Program

The 1985 farm bill's conservation reserve program (CRP) was devised in part to decrease the acreage base and commodity supply. The program is voluntary with acreage diversions obtained via a bid process. The acreage diversions are long term, typically 10 year contracts, with a 25 percent maximum acreage diversion per county although exceptions are possible under some special circumstances (49).

The CRP could affect the number of farms because whole farms are eligible and some elderly or marginal producers may use the program as a retirement option. The CRP will increase real per farm disposable income and

the level of farm family consumption demand faced by rural community businesses. The increase in real per farm family consumption demand will vary with the per acre diversion price. The CRP will also directly decrease the derived demand for agricultural inputs faced by rural agribusinesses. The decrease in derived demand is expected to be less than proportional to the percentage of diverted acres per county as some slippage will occur (40).

This analysis assumes a 25 percent diversion per county and a 20 percent reduction in derived input demand. The analysis assumes a 5 percent reduction in the number of farms as some producers are expected to use the program to aid their exit from the farm sector. Per farm disposable income is assumed to increase 10 percent.

Alternative 2: Mandatory Diversions

With Export Enhancements

This alternative parallels the proposed Harkin farm bill. The proposal includes high price and income supports with mandatory acreage diversions. The alternative also includes an export enhancement element based on either a cartel arrangement or a two-tier subsidized payment-in-kind program to maintain export market shares.

The alternative's price support component would increase commodity prices 20 percent over the 1988 target price levels (1). Real per farm disposable income is assumed to increase by 20 percent under this regime (10). Given successful export enhancement it is assumed the number of farms would remain at current levels.

The proposal includes a 35 percent per farm mandatory acreage diversion, contingent upon approval in commodity specific referendums (1). The mandatory acreage diversions would decrease the derived farm demand faced by community input agribusinesses. The analysis assumes a 35 percent acreage reduction and a 28 percent decrease in input demand.

Alternative 3: Mandatory Diversions

Without Export Enhancements

This alternative is a government imposed mandatory supply control program without subsidized exports. The most cost-efficient program to government would have restrictions on producer sales to achieve a high market price (40). The option would increase real per farm disposable income and decrease planted acres. Without export enhancements the result would be a reduction in the number of farms because of the large required reduction in output (35). The increase in commodity price and the exiting of farmers would interact synergistically to increase real per farm disposable income. The present analysis assumes a 10 percent increase in per farm disposable income and a 5 percent decrease in the number of farms.

Under this policy regime, the acreage base would need to decrease over 50 percent to raise prices to the 1988 target level (1). Derived demand for agricultural inputs faced by rural agribusinesses would also decline by roughly 50 percent (35). A 50 percent reduction in planted acreage and a 40 percent reduction in derived input demand is assumed.

Alternative 4: Free Market

The free market option represents a situation with no government supply control or export enhancement program. Prices would be established within a market context and producers would adjust supply to the prevailing market conditions. Commodity prices would move downwards, at least initially converging toward the international equilibrium level.

Real per farm disposable income could decrease substantially (40). A short-run 20 percent reduction is assumed for this analysis. The decrease in real per farm income would financially stress many family farms and increase exiting from the agricultural sector. A 10 percent reduction in the number of farms is assumed.

In the short-run, absence of acreage reductions would increase production. Planted acreages are assumed to increase by 10 percent over the run of adjustment. The derived demand for agricultural inputs faced by community agribusinesses is assumed to increase 8 percent with the 10 percent increase in planted acres.

Selected Policy Alternatives Impact On Rural Community Commerce

Table IX reports the estimated impact of the four policy regimes by farm structural variable and community size. The estimated impacts are based on the calculated elasticities from Table VIII and the percentage changes of the farm variables outlined in the previous policy alternatives. The elasticity for each farm variable was multiplied by each policy regimes assumed farm

variable change to estimate the impact on real sales for each different community size group. Community sales were evaluated at the mean sales value for each community size to estimate the 1982 real dollar change for each policy regime.

Estimated Impact On The Smallest Communities

The relatively large impact on real sales for the smallest communities reflects their heavy dependence on the farm sector. The overwhelming farm structural factor determining small community sales was planted acres. The smallest community group faired the best when farm input demand increased and the worst when the farm input economic base declined.

The estimated impact indicates a large portion of farm demand was derived demand and a relatively small proportion was farm family consumer demand for the smallest communities. The projected sales decreases were greater than 100 percent under all three acreage diversion regimes. Ceteris paribus, the projections imply that a diversion policy which retires more than 16 percent of the acreage base would cause the complete disappearance of all business activity in some small communities.

The relatively large projected changes for sales in the smallest communities result partially from the relatively high farm variable elasticities. The high planted acres elasticity reflects the reliance of the smallest communities on the planted acreage base as a primary source of business sales. The relatively large assumed decreases in the acreage base were large enough to lead to a projected long-run decline in the number of this sized community.

TABLE IX

ESTIMATED IMPACT OF ALTERNATIVE FARM POLICIES
ON THE LEVEL OF COMMUNITY REAL SALES

Community Size	Current CRP	Diversions Without Export	Diversions With Export	Free Market
Small Community				
Farm Income(%)	-11.5952	-23.1904	-11.5952	23.1904
Planted Acres(%)	-126.0832	-176.51648	-252.1664	50.4333
Farm Numbers(%)	-1.4764	0.0	-1.4763	-2.9528
Per Community				
Total % Change	-139.1548	-199.7052	-265.238	70.6708
Total $ Change	-752,209.63	-1,079,517.38	-1,433,759.79	382,015.68
Middle Community				
Farm Income(%)	-1.1141	-2.2282	-1.1141	2.2202
Planted Acres(%)	1.6088	2.2523	3.2176	-.6435
Farm Numbers(%)	.1758	0.0	.1758	-.3516
Per Community				
Total % change	.6705	.295	2.2793	1.2251
Total $ Change	51,022.23	22,448.26	173,445.14	93,223.43
Large Community				
Farm Income(%)	.1584	.3168	.1584	-.3168
Planted Acres(%)	-3.2372	-4.5321	-6.4744	1.2949
Farm Numbers(%)	-.4300	0.0	-.4300	-.8600
Per Community				
Total % Change	-3.5088	-4.2153	-6.7460	.1181
Total $ Change	-1,617,110.57	-1,942,708.00	-3,109,048.08	54,419.86

All dollars changes are in 1982 real dollars by community size group.
Elasticity percentage changes are by community size group.

Estimated Impact On Middle Sized Communities

The estimated impact on middle sized community sales was positive but moderate under all policy regimes. The middle sized communities faired the best under the mandatory control option with no export enhancement and the worst under the Harkin scenario. The middle sized communities were the only size group to benefit under the 1985 farm bill's CRP.

Both the proportional and absolute estimated impacts on community sales for the middle ordered communities was the least across all different sized communities. The positive and negative dynamic farm structural effects tended to compensate each another for a community of this size. The estimated elasticities for middle ordered community sales with respect to per farm income and planted acres were nearly equivalent and offset each other when the percentage changes were proportional.

The relatively small impacts on the middle sized communities resulted from the indirect central place effects. The consumer sales loss from the indirect income transfer to the larger community was compensated by the indirect positive transfers of input sales from the smaller communities. Projected total community sales remained relatively stable while the composition of the offered goods set shifted away from consumer goods to farm inputs.

Estimated Impact On The Largest Community

The estimated impact on real sales in the largest community followed the same general pattern as the estimated impact on the smallest communities. The proportional impacts were less and the absolute impacts were greater.

Derived input demand, as represented by planted acres, was the single most important farm structural factor.

The projections imply that a greater proportion of aggregate real sales was attributable to farm derived input demand than to farm consumer demand for businesses located in the largest community. The elasticity of sales with respect to planted acres was .16012 whereas the elasticity of sales with respect to per farm income was .01249 for the largest community. The input demand was relatively more elastic and would dominate the income effect when the assumed proportional changes are equivalent. Per farm income would need to increase 12 percent for each 1 percent decrease in the acreage base for the projected change in sales to be compensating for businesses located in the largest community.

The projections of the three acreage reduction regimes decreased total community sales and changed the composition of the offered set in the largest community. The sales and number of agribusinesses were projected to decrease and the sales and number of consumer related businesses were projected to increase. The free market alternative would have the opposite effect on both the projected total community sales and the composition of the offered set for businesses located in the largest community.

Summation

A clear relationship exists between agricultural policy, farm structural variables and community sales. The agricultural policy-community commerce demand relationship was not stable across different sized communities. The total impact of any given farm policy for a particular region would depend on the

variety of farm structural variables effected, the relative numbers and sizes of communities in the region, and the region's relative dependence upon agriculture.

The absolute impact on community sales was the greatest in the largest community where the absolute number of vertical economic linkages between the farm economic base and the final demand sector was the greatest. The relative impact on community sales was the greatest for the smallest communities where the farm proportion of demand was the greatest. Both the absolute and proportional impacts on the middle sized communities was moderate as the indirect central place effects tended to compensate one another.

The analysis implies that farm structural shifts not only impact total community sales, but also affect the composition of the offered set. The smallest community group was projected to lose both consumer and input sales. The middle sized group was projected to lose farm consumer sales and gain farm input sales. The largest community was projected to gain farm consumer sales and lose farm input sales.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND AREAS FOR FURTHER RESEARCH

Summary

The general objective of empirically determining the effects of exogenous shifts in the number of farms, per farm income, and planted acres on the number and sales of businesses by community size was fulfilled. The number of farms, farms, per farm income, and planted acres display statistically significant coefficients explaining the number of businesses and sales per community. Variation in the farm variables explained both the decline in the number of businesses and real sales for the smallest communities and the increases in the number of businesses and real sales for the largest community.

The calculated F statistics support acceptance of the hypothesis that the parameters on the number of farms, per farm income, and planted acres were different across the community sizes. The statistically significant farm structural coefficients implied the absolute value of the parameters varied directly with community size. The estimated elasticities indicated the response to a change in the farm variables was the most elastic for businesses located in the smallest communities.

The estimates support conditional acceptance of the hypothesis that a decrease in the number of farms caused rural business activity to shift into larger communities. All estimated coefficients on the number of farms for the

number of businesses per community were not statistically different from zero. The estimated coefficients on the number of farms for real sales per community support acceptance of the hypothesis that a decline in the number of farms decreases businesses activity in the smallest communities and increases business activity in the middle sized communities.

The statistically significant coefficient on per farm income for both the number of businesses and sales per community support acceptance of the hypothesis that increases in per farm income causes rural business activity to shift into the larger communities. The partial derivatives of per farm income with respect to the number of businesses and real sales per community was negative for the two smaller community size groups and positive for the largest community. The absolute effects varied directly with community size and the response became more inelastic as community size increased.

The absolute magnitudes of the parameters are limited to the sample's particular farm and community structures. The absolute value of the estimated coefficients should generalize, within a confidence interval, to the whole Southern High Plains region. It is expected that estimates from different physical regions would generate different absolute parameter magnitudes as both the economic base and community structure would vary.

Conclusions

The empirical analysis of the preceding two chapters supports the hypotheses and theoretical paradigm expounded in chapters I and II. Farm level adjustments alter the farm sector's economic base directly inducing a change in rural community tertiary sector demand. Rural community tertiary

sector demand instability is a primary determinant of community business employment and income growth or decline in the Southern High Plains region.

The region's community hierarchy is clustered at the lower end of the total central place hierarchy. The region's communities have relatively smaller resident populations, which increases the relative farm proportion of total community demand, as compared to the upper end of the total central place hierarchy. The relatively high proportion of farm demand made the region's community hierarchy more responsive to exogenous shifts in the farm sector .

Oklahoma's Southern High Plains community hierarchy dynamics were characterized by individual tertiary businesses systematically entering or exiting community markets. Rural businesses entered community markets where real economic profits were positive and exited community markets where real economic profits were negative. The changes in the number of farms, per farm income, and planted acres shifted demand curves determining the profitability of rural businesses. Businesses responded by adjusting where business activity was preformed and thereby changed community employment and income levels within the region's community hierarchy.

Shifts in farm family demand affected community business employment and income with both a direct local effect and a indirect central place effect. The direct local effect occurred in every community market with a positive correlation between the farm variables and the community variables. Increases or decreases in the local farm economic base caused increases or decreases in business employment and income for all the communities.

The indirect central place effect was the transfer of residual farm demand between communities. The demand transfers increased business employment and income in communities which received it. Both the direct and indirect effects affected business employment and income levels in all communities and

thereby partially determined community growth rates and hierarchical dynamics.

Decreasing Farm Population Effects

Ceteris paribus, the direct local effect caused by a decrease in the number of farms was negative profits and the exiting of businesses from rural communities. The exiting of rural businesses caused residual demand from the remaining farm population. The negative population effect was the strongest among the smallest communities where the proportion of farm demand was the greatest.

The positive indirect transfer compensated the negative direct local effect for businesses located in the communities which received the residual demand. Ceteris paribus, businesses located in communities where the positive indirect effect was stronger than the negative direct effect had positive economic profits and businesses entered the communities stimulating tertiary employment and income.

The larger communities accumulated more residual consumer demand than the smaller communities. The higher ordered communities were centrally located within clusters of the lowest ordered communities. The central location, along with the increased drawing power of a larger offering of consumption goods and services, attracted the residual consumer demand.

The decrease in the number of farms directly reduced tertiary employment and income in the smallest communities. The indirect effect increased tertiary business employment and income in the larger communities. The cumulative effect was a decline in the number of smaller communities and increased business employment and income in the larger communities.

Increasing Farm Income Effects

The direct effect of increasing farm income was increased farm consumption demand and increased business sales in communities of all sizes. The direct effect was the strongest for the largest community and the indirect effect was the strongest for the middle sized communities. The negative population effect was stronger than the positive income effect for the smallest communities.

The indirect farm income effect augmented the accumulation of residual demand to the higher ordered communities. Increased per farm income expanded the farm family's consumption bundle and increased the attraction of a larger offered consumption set in the bigger communities. The increased size of the consumption bundle also increased the opportunity for multipurpose transportation cost-minimizing shopping trips by farm families to higher ordered communities.

The positive direct income effect compensated the negative population effect and helped slow the rate of business decline in the smallest communities. The positive indirect effect accelerated the direct income effect in the larger communities. The dynamic cumulative effect was higher business employment and income levels in the larger communities as compared to the smallest communities.

Changing Farm Input Demand Effects

Farm input demand, as used here, was a composite bundle of demands for specific goods. The hierarchical effects of shifting demands for specific goods depends on each goods relative order. Shifting input demand for lower ordered inputs would effect all community orders whereas shifts in demands for

relatively higher ordered inputs would only effect the higher ordered communities.

A long-run structural trend of decreasing planted acres would affect the hierarchy in a manner similar to a decrease in the number of farms. The direct local effect would cause a decline in community agribusiness employment and income. The indirect effect would cause increased agribusiness sales in communities which received the residual input demand from the remaining farm population surrounding the communities which had lost agribusinesses. Ceteris paribus, agribusinesses located in the communities where the positive indirect effect was stronger than the negative direct effect would have positive economic profits and increased community agribusiness employment and income.

Farm Induced Central Place Dynamics

Farm structural shifts alter the spatial demand plain inducing differential growth rates across community orders. Ceteris paribus, the farm spatial demand flows shift rural business revenues and employment upwards through the community hierarchy. The process transfers the farm component of the hierarchy's economic base from one community order to another community order.

Lower ordered communities where the negative direct farm population effect was the strongest had negative growth rates. Some small communities which received a spatial demand transfer had positive growth rates. The farm structural change has benefited higher ordered communities more than lower ordered communities as the larger communities received more residual demand transfers. The overall dynamic farm structural effect was a decrease in

the number of lowest ordered communities and a increase in business sales for the larger communities.

Areas For Further Research

Further research could focus on which particular business activities expand and which contract as farm income and other structural variables change. Research could focus on the effects of changing farm income on the composition of the consumption bundle purchased in communities of various sizes. Future research could compare the impact of different farm types and farm sizes on the community structure. For example, does the community hierarchy's structure and dynamics differ across different farm production zones and farm sizes?

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APPENDIX A

DEPENDENT VARIABLE TRANSFORMATION

Beginning in the 1960's many Oklahoma communities imposed city sales taxes. In response an increasing number of businesses began to locate outside city limits along main transportation routes to avoid incidence of the city taxes. It was assumed that the number of these businesses was proportional to community size. What follows is an example of the data used and the procedure employed to allocate the community tax avoiding firms to the study region's communities.

RAW DATA

Cimarron County (1984)	Returns	YTD	Collections
Boise City	683.0		92,132.25
Felt	44.0		3,121.44
Griggs	2.0		94.75
Kenton	14.0		642.31
Keyes	191.0		24,159.39
Wheeless	0.0		0.0
Cimarron Co.	72.0		1,677.88
Total	1006.0		121,828.02

YTD = Year To Date
Returns = total annual number of reported business sales tax returns
Collections = 3 percent of total sales

Transformation Technique For Boise City

Boise city's Annual Number of Business	683 / 12 = 56.91667
Boise city's percent of total county businesses	683 / (1006-72) = .73126
Annual number of county businesses outside city limits	72 / 12 = 6
Number of business outside city limits allocated to Boise City	6 x .73126 = 4.38756
Boise City's transformed observation	56.91667 + 4.38756 = 61.30423

Transformed Data

Cimarron County (1984)	Returns	YTD	Collections
Boise City	735.646		93,418.52
Felt	47.386		3,165.50
Griggs	2.160		96.00
Kenton	15.082		651.40
Keyes	205.726		24,496.60
Wheeless	0.0		0.0
Cimarron Co.	0.0		0.0
Total	1006.00		121,828.02

The collection observations are in nominal terms. The transformation of the sales figures is similar to the transformation of the number of businesses with the exception that the first step is replaced with a division by 3 and a multiplication of 100 to reflect actual sales instead of sales tax collections.

APPENDIX B

TOTAL RESTRICTED MODEL RESULTS

AND F STATISTICS

TABLE X

ESTIMATED TOTALLY RESTRICTED MODEL FOR THE NUMBER OF BUSINESSES AND REAL SALES

Variable	Number Of Businesses	Real Sales
Intercept	2.17103 (.8803)	-3753273.41000 (.2028)
Farm Income	.00003 (.6234)	8.57185 (.5266)
Farm Numbers	.00309 (.8723)	-1446.17000 (.7123)
Planted Acres	.00003 (.2715)	10.47967 (.0962)
Non-Farm Basic Income	3.58389E-07 (.3824)	.00112 (.9893)
Mobility	-8.50962E-07 (.9458)	1.13382 (.6575)
R^2	.0692	.0640
D.W.	2.3307	2.2876

Significance level in parentheses
* corrected for first order autocorrelation

F STATISTIC FOR HOMOGENEOUS BETA VECTOR WITH CONSTRAINED INTERCEPT

$$F = (ESS_r - ESS_{ur} / (k - 1) (p - 1) / ESS_{ur} / (pt. - (k + (k - 1) (p - 1))$$

where

ESS_r = unexplained error sum of squares from equation 3.1.

ESS_{ur} = unexplained error sum of squares from the restricted slope model.

p = number of different ordered communities (3).

k = the number of independent variables (5).

t = the total number of observations (402).

F STATISTIC FOR THE HOMOGENEOUS BETA VECTOR WITH UNCONSTRAINED INTERCEPT

$$F = ESS_r - ESS_{ur} / (k - 1) (p - 1) / ESS_{ur} / (pt - pk)$$

where

ESS_r = Error sum of squares from the restricted intercept model.

ESS_{ur} = Error sum of squares from the totally unrestricted model.

p = the number of different community orders (3).

k = the number of independent variables (5).

t = the number of total observations (402).

APPENDIX C

COVARIANCE MATRIX

	SALE	BUS	PFY	FN	PA	NFBY	MOB
SALE	1.00000 .00000	.96542 .0001	.16193 .0011	.05589 .2636	.20137 .0001	.16701 .0008	.19198 .00010
BUS	.96542 .0001	1.00000 .0000	.16795 .0007	.03321 .5067	.18720 .0002	.15134 .0023	.19414 .00010
PFY	.16193 .0011	.16795 .0007	1.00000 .0000	-0.03426 .4933	.60748 .0001	.48475 .0001	.72449 .00010
FN	.05589 .2636	.03321 .5067	-.03426 .4933	1.00000 .0000	.38357 .0001	.70931 .0001	.35031 .00010
PA	.20137 .0001	.18720 .0002	.60748 .0001	.38357 .0001	1.00000 .0000	.78869 .0001	.84558 .00010
NFBY	.19098 .0001	.19414 .0001	.72449 .0001	.35031 .0001	.84558 .0001	1.00000 .0000	.85949 .00010
MOB	.16701 .0008	.15134 .0023	.48475 .0001	.70931 .0001	.78869 .0001	.85949 .0001	1.00000 .00000

Sale = Annual actual community sales.
Bus = Annual reported community businesses.
PFY = Annual per farm real income.
FN = Annual farm numbers.
PA = Annual planted acres.
NFBY = Annual real non-farm basic income.
Mob = Annual real state transfers for roads.

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