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Challenging the Goldschmidt Theory of Rural Purchasing Patterns

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Abstract:

This work uses unique data from three dairy dependent communities in rural Wisconsin to test established theory and empirical studies that link farm structure to local purchasing patterns and community economic development. A theoretical model of purchasing choices is developed to derive the determinants of local purchasing by dairy farms. This model is tested empirically using a double bounded Tobit model. The empirical estimations find little support for any linkage between farm size and local purchasing patterns across eleven major dairy farm inputs. The results do suggest that different community business characteristics (the supply side) and community attachment provide some explanations for diverse purchasing patterns.

Keywords: Community Economic Development, Dairy Farms, Purchasing Patterns, Tobit

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1. Introduction

Rural communities seem to suffer in tandem with their local farmers. The simultaneity of the disappearance of small family farms and main street businesses has led a number of observers to assume causality between these two sectors in farm-dependent rural communities (e.g., Goreham et al., Henderson et al., 1989; Strange, 1988; Lasley, et al., 1995). To a significant extent, the idea that farm structure and rural community well being are correlated derives from a widely cited study by Walter Goldschmidt (1946) that compared two farming communities in the Central Valley of California in the mid 1940s. Whereas Goldschmidt was primarily concerned with social conditions in rural communities, a string of subsequent research has focused more narrowly on the connection between farm structure and rural economic development (e.g., Heady and Sonka, 1974; Henry et al., 1987; Walzer, 2003). Establishing a relationship between farm characteristics and the support of local businesses (i.e., local purchasing patterns) is a common line of inquiry within this body of literature. While the follow-up studies offer a more formal and empirical treatment of the issue than Goldschmidt's initial inquiry, they neither definitively support nor reject the premise that small farms are a necessary foundation for vibrant rural economies.

The purpose of this paper is to test the conditions under which Goldschmidt's premise holds. A major shortcoming in previous studies, and a possible explanation for their contradictory findings, is the failure to address the supply side of the issue. Many rural communities may no longer offer the same variety of products and services that used to exist. The loss of main street businesses over the past two decades has been

significant in many smaller rural communities (Ayres, Leistritz, and Stone, 1992). As a result, many residents may be forced to drive to larger neighboring towns to purchase their products and services.

It is logical to assume that a farmer's local purchasing pattern is a function of his or her ability *and* willingness to buy locally. The ability will be determined by local market characteristics. The willingness to purchase local products will be a function of personal utility as well as community loyalty or attachment (Cowell and Green, 1994; Pinkerton et al., 1995; Miller, 1998). Some consumers may be willing to accept less diverse product choices and even higher prices in order to support local businesses. Some may make this choice out of convenience (e.g., they may dread a longer drive), others may have a strong civic spirit (altruistic motives). Finally, some may purchase locally because they know money spent at one business circulates within the local economy (the multiplier effect) thereby possibly supporting their own business, or their family's source for off-farm employment (as well as schools, hospitals, etc.). The structure of the business, for instance whether the business is owned locally, may also impact local purchasing decisions. In the case of agricultural cooperatives, members may have built up substantial equity investments, creating greater consumer loyalty. The relationship between farm and community characteristics and local purchasing patterns (demand) has not yet been carefully analyzed.

This paper contributes to the literature by examining the impact of farm, community, and market characteristics on a farm's local purchasing patterns. Eleven different farm goods and services are analyzed independently. In addition, we make a more careful distinction than is common in the literature between purchasing patterns and

community economic development. We derive several testable hypotheses from economic theory, which are then empirically tested in two sets of regressions using a unique data set from 141 dairy farms in three dairy dependent Wisconsin communities. In the first set, we analyze the effects of farm size, farmer characteristics, community business characteristics, and community attachment on dairy farm purchasing at local businesses. In the second set of regressions, we analyze the total local impact (the farm's own production plus any local purchases). Thus, we are able to explore the economic impact tradeoffs associated with farm size; larger farms may purchase less locally but may substitute supporting their own business over another in town (e.g., growing corn grain rather than buying it).

The paper proceeds as follows. A review of the relevant literature is presented in section two, followed by a theoretical model presenting the logic of local purchasing patterns. An overview of the data collection methodology and some descriptive statistics of the data follow. Finally, the empirical model and results are presented and discussed. The paper concludes with a brief summary of our main findings and some policy implications.

2. Previous Research

Goldschmidt's watershed research in the 1940s found that a community surrounded by relatively large farms with predominantly hired labor had fewer business establishments, less retail trade, and lower spending on household supplies and building equipment than a community surrounded by more moderate scale, family-labor farms. He also found that the small family farm town had higher levels of socioeconomic

equality, participation in community life, and other indicators of social well-being. As noted above, his main concern was the impact of farm size on social conditions within rural communities and his conclusion regarding this issue was decisive:

> "quality of social conditions is associated with scale of operations…farm size is in fact an important causal factor in the creation of such differences, and that it is reasonable to believe that farm size is the most important cause of these differences" (Goldschmidt, 1991; p. 219).

Goldschmidt formed this conclusion using a case study approach; he did not pursue any formal theoretical or empirical analysis. He controlled for the farm size effect by supposedly choosing two similar rural communities that only differed significantly in average farm size. However, Hayes and Olmstead (1984), Gilles and Dilecki (1988), and others, fault Goldschmidt's methodology demonstrating that the farms and two communities were different in other important ways, thereby possibly leading to erroneous results.

Goldschmidt's approach has left his study open to criticism and as a result, generated much re-examination (Carlin and Saupe, 1993). In the half century since Goldschmidt first published his study, a succession of studies have examined the link between farm structure and community well being (see Gilles and Dilecki, 1988 for an overview). The studies most relevant to our analysis are those focused explicitly on the relationship between farm characteristics and community economic viability, specifically analyzing differences in local purchasing patterns. In this section, a few representative pieces from this body of literature are reviewed to highlight inconsistencies in methodology and results as well as the dearth of attention afforded to differences in communities.

Marousek's (1979) input-output study of a single rural Idaho community found that small farms purchased significantly less from local farms and businesses, but spent a larger share of their production expenses in the community than large farms.[1] In terms of overall economic impact (i.e., accounting for income, output, and employment), small farms had a modest effect on the community in question. Lawrence et al.'s (1997) research takes a narrower perspective, using a logit regression model to test the factors that influence the probability that an Iowa hog producer would bypass local suppliers for a variety of products and services (not all related to hog production). They found that larger farms as well as farmers who were younger and had higher education levels were significantly more likely to bypass local suppliers.[2] Off-farm employment was not a significant factor. Although Lawrence et al. hypothesized that community characteristics would also influence local purchasing decisions they did not have the data to test this theory.

Chism and Levins (1994) offer a more comprehensive analysis of spending patterns for a variety of farm types. Although they have a limited sample (30 farmers in southwest Minnesota), they collected itemized farm expenditure information from each farm for an entire year. They found considerable variation in the proportion of local farm purchases across products and services and farms. However, farm size did explain some of the variation. The percentage of total local expenditures for smaller farms was about twice that of larger farms, although this pattern was not consistent across farm types. The percentage of local farm expenditures made by livestock farms fell sharply with increasing scales of operation. However, crop farms showed little systematic differences

[1] Marousek defines small farms as having less than $25,000 in gross sales (1974) and large farms as those with greater than $25,000 in gross sales.
[2] Size was measured by total hogs produced and total gross farm sales.

in farm business spending habits. Chism and Levins did not account for any community characteristics and simply defined "local" as a 20-mile radius around the farm. Most other studies have found no strong relationship between farm size and local spending habits (e.g., Korsching (1985) and Goreham et al. (1986)).

A few studies have explicitly recognized that the variety of products and services supplied are not equal across rural communities and therefore, this affects local demand. Henderson, Tweeten, and Schriener (1989), for example, take this approach in their study of the impact of farm structural change on three Oklahoma Panhandle counties. They used cross-section (26 communities) time series (1968-84) secondary data for a regression analysis where the dependent variable was sales per community and independent variables included farm numbers, per farm income, total planted acres and other demand-related farm characteristics as well as community size dummy variables. Although this study provided important insights into the impact of changing farm structure on community businesses over time, clearly the impact of other farm characteristics and the demand and supply for specific goods and services could not be measured in this type of aggregate analysis.

3. Theoretical Model and Hypotheses

A. Theoretical Factor Demand Model

Following Foltz, Jackson-Smith, and Chen (2002) we derive the determinants of a farm's purchasing pattern from a farm factor demand model. The farm purchases two inputs (good A and good B), good A is sold both locally and in a distant location while good B is sold only locally. Good A is assumed to have uniform quality regardless of its

source. This makes local good A and distant good A perfect substitutes in production, so the farm will buy whichever has the lowest price. For simplicity, we also assume that the farm's production requires a fixed ratio of inputs, with α being the proportion going to good A and $(1 - \alpha)$ to good B.

Since the farm is able to purchase inputs locally and in a distant location, it faces a non-linear price structure. We assume that the local inputs have higher prices than those purchased in the distant town when a larger quantity is purchased because the distant suppliers provide quantity discounts. Discussions with farmers surveyed for this study suggested that non-local suppliers were less expensive when large quantities were purchased. We also assume that local purchases have no transaction costs, since the farmer is likely to have a long-standing relationship with the company, especially if it is a co-op; distant purchases require search costs associated with finding and negotiating with a new supplier. Distant purchases also incur other costs: higher transportations costs, greater opportunity costs associated with being away from the farm, and perhaps membership costs in a new co-op.

These assumptions define a cost function for the farm with the following attributes: it is linear in good A and good B while having fixed factor proportions (Leontief) between the local and distant good A (Chambers, 1988). The differential transaction costs associated with local and distant sources of inputs create distinct cost share functions for the two types of good A purchases. Let the input prices be represented as follows:

w_1 = the price of locally purchased good A,

w_2 = the price of good A purchased in a distant location, and

w_3 = the price of good B.

Assume that the actual price our farmer will face for good A purchased in a distant town will be some function of the posted price w_2, the transaction costs she incurs, τ, and the amount she wishes to buy, which in this case can be described by the scale of production, y. For simplicity, τ represents the total additional costs associated with purchasing from a distant location (transportation, etc.). The farm's cost function can thus be written as:

$$C(w, y \mid \tau) = \alpha \min\{w_1 y, g(w_2, y, \tau)\} + (1-\alpha) w_3 y$$

where $g(w_2, y, \tau)$ is a function describing the relationship between the base price, w_2, the amount bought, *y*, and transaction costs, τ. Let the function $g(w_2, y, \tau)$ be described by the following equation:

$$g(w_2, y, \tau) = w_2 y + w_2 y^{-\gamma} + \tau$$

where γ is a positive number. The first term is the standard cost of good A, the second term a mark-up price that decays as the quantity bought increases with a fixed exogenous parameter, γ, and the last term is a fixed transaction cost incurred in the purchase. The resulting cost function,

$$C(w, y \mid \tau) = \alpha \min\{w_1 y, w_2 y + w_2 y^{-\gamma} + \tau)\} + (1-\alpha) w_3 y$$

has constant returns to scale for $w_1 y < (w_2 y + w_2 y^{-\gamma} + \tau)$ and decreasing returns to scale otherwise. Thus the average cost and marginal cost functions will be constant until a threshold point at which there is equality between the prices of local and distant good A, with the average cost function declining and the marginal cost function increasing from that point.

The local cost share equation can be derived from the farms' cost minimization problem: {min C(w, y, γ |τ) : s.t. y ≥ y_o }. Let C_L represent local purchases and C_D represent distant purchases. Then the associated local cost share function will be:

$$\frac{C_L}{C_L + C_D} = \begin{cases} 1 & \text{if } w_1 y_o < w_2 y_o + w_2 y_o^{-\gamma} + \tau \\ \dfrac{(1-\alpha) w_3 y_o}{\alpha(w_2 y_o + w_2 y_o^{-\gamma} + \tau) + (1-\alpha) w_3 y_o} & \text{otherwise} \end{cases}$$

This implies that the local cost share function will be a non-linear function of the scale of production and the transaction costs of distant purchases. This non-linearity will show up in an estimation of cost share functions being censored at 1, or 100 percent of the inputs purchased locally. The local cost share function will be increasing (more likely to be 100% local) in the transaction costs, τ, since higher transaction costs make distant purchases are more expensive. In contrast the local cost share function will be decreasing in the scale of production, y, since the scale of production will decrease the costs of the supply of distant goods.

B. Hypotheses Related to Scale and Transaction Costs

Our theoretical model leads to a set of three testable hypotheses. Initially, we are interested in how scale of operation is directly related to purchasing behavior. If there are in fact scale effects as suggested by the theoretical model, one should see larger farms buying a lower proportion of their inputs locally. Another major implication of the theoretical model is that the share of distant purchases will depend on the transaction costs involved. Transaction costs may be related to a farmer's own characteristics. We expect that younger, better-educated farmers will have lower transaction costs when making distant purchases. They are more likely to have an easier time accessing non-

local suppliers because of greater facility in traveling, reading magazines with supplier advertisements or finding suppliers through the Internet, and entering into long-distance contracts. For older farmers (assuming they also have more farming experience), the local-distant transaction cost differential may be much greater since they are more likely to have established ties in the local community.[3]

In addition, we also expect that as family members spend more time in their local town, the local-distant transaction cost differential and transportation/opportunity costs increase. The more time the farmer or spouse spends in the local community, the higher the probability that they will develop stronger ties with local businesses (and the greater the relative search costs in a distant location). Clearly, transportation costs for local purchases would also decrease, since an additional trip for many supplies would be unnecessary. We use dependence on off-farm income (i.e., the hours farm operator and spouse spend working off the farm) and grocery shopping done locally as proxies for a farm household's time spent in town. The more time spent off farm also suggests less time available for searching and traveling to alternative suppliers (the opportunity costs increase).[4]

Finally, the farther a farm is located from the center of the local town, the transportation cost differential between local and distant purchases decreases. Some farms may be technically located in a certain town (i.e., share the same zip code), but lie

[3] The support of local businesses, however, may also be a function of an individual farmer's utility. For instance, the inconvenience and opportunity costs associated with taking time away from the farm and being uncomfortable driving in unfamiliar areas (on highways), may all be factors that motivate some farmers to purchase locally. Several rural community development studies have found that younger and better-educated people are in general more likely to travel farther, more often for these reasons (Shaffer).
[4] Farmers may also weigh the fact that money spent at one business circulates within the local economy (the multiplier effect) thereby possibly supporting their own business, or their family's source for off-farm employment. Therefore, one might expect that a farm's dependence on off-farm income might increase their motivation to support local businesses.

fairly close to other towns as well. Therefore, we expect distance from town to be a factor in determining local purchases. Stated more formally, our first three hypotheses are as follows:

H1*: The proportion of inputs purchased locally declines as farm size (# of cows) increases*.

H2: *The proportion of inputs purchased locally will depend on farmer and household characteristics related to transaction costs: age, education, farming experience, dependence on off-farm income, and grocery shopping done locally.*

H3*: The proportion of inputs purchased locally will decrease as distance from farm to town increases.*

C. Empirical Purchasing Pattern Hypotheses

The premise that residents with a strong attachment to their community tend to purchase more locally has been well documented (Cowell and Green, 1994; Pinkerton et al., 1995; Miller, 1998). This literature suggests that attachment is as important a factor in local purchasing decisions as any economic reason. Some consumers may be willing to accept less diverse product choices and even higher prices in order to support local businesses.

However, in spite of community attachment or other personal motivations, some farms will simply not be able to find all of the products and services they need in their community. Economic activity in a given region continues to reorganize spatially to accommodate changes in demand (Carlin and Saupe, 1993). Central place theory helps explain the spatial allocation of businesses by recognizing that all communities are part

of a greater economic system: "No community, especially a smaller one, can provide all the goods and services necessary and desired" (Shaffer, 1989; p. 142). Rural communities form a regional supply system, where the larger towns have the greatest number of businesses (and products and services) and the smaller towns have a relatively narrow offering (Shaffer, 1989; Henderson, Tweeten, and Schriener, 1989). Therefore, we expect that farmers who live in small towns may have to drive to larger communities for some goods and services. As mentioned above, retail consolidation has exacerbated this trend, reducing the competition in small rural towns which in some cases has led to higher prices in small towns. Therefore, it is very likely that the prevalence of relevant goods and services (the central functions and units) within a community will affect a farm's local purchasing patterns.

Our data and regression analysis allows us to test the following two hypotheses empirically:

> ***H4:*** *The proportion of inputs purchased locally will increase with higher levels of community attachment.*
>
> ***H5:*** *The proportion of inputs purchased locally will increase with higher levels of business density (the number of firms in the community that sell the products and services in question).*

D. Empirical Community Economic Impact Analysis

Most studies of farm purchasing patterns ignore the farmer's ability to produce a number of important inputs in production on his or her own farm. If certain scales of farms are more likely to grow their own feed than purchase it and that

homegrown feed is not counted as purchased locally, the analysis will undercount the local impact of farms.

We explore the hypothesis that larger farms have a greater local economic impact in a second set of regressions where the dependent variable combines the percentage a farm spends locally on feed and replacement heifers with the percentage grown/raised on his or her own land. A broader economic impact perspective (beyond purchasing patterns) suggests that the relationship between farm size and community economic growth is more complex than most studies allow for. Larger farms generally hire more on-farm labor, therefore providing important employment opportunities in their communities. They also typically have higher farm and household incomes, potentially leading to a greater influx of dollars in the local economy. For example, they may use more custom and veterinary services. Also, smaller farms may be more self-sufficient, growing a higher portion of their feed than larger farms. In the case of dairy, at some scale it is cheaper to buy feed than own enough land to grow it. Zeuli and Deller (2003) and Taff (1989) point to the importance of property tax in economic growth; larger farms certainly pay more property taxes. They also capture a larger share of federal funds, which also bolsters local economies.

4. Survey Methodology and Community Background

Farm-level data was collected from 141 dairy farmers who completed a comprehensive mail survey in three Wisconsin towns: Athens, Chilton, and Richland Center. The survey, which was conducted in February 2003, elicited responses on general farm and farmer characteristics (age, education, farming experience, off-farm work, number of children,

ability to find help when away from the farm), community perception, and local spending patterns.

Survey participants were selected from lists of dairy operations (356 total farms) in three dairy dependent Wisconsin communities maintained by the Wisconsin Department of Agriculture, Trade, and Consumer Protection. The results from the data will be representative of the situation for dairy farms within each of the communities, although they are not necessarily representative of the state as a whole. In addition, the data has panel characteristics allowing us to isolate the various community effects we hypothesize will impact purchasing patters. The three communities, Athens, Chilton, and Richland Center (Map 1), were selected based on the following criteria: (a) a large number of dairy farms; (b) a town center geographically located near the middle of the community (as defined by a single zipcode); and (c) farming is a significant part of the local economy, both in terms of employment and income. They were also chosen to represent contrasting regions of the state, as well as different facets of the evolving dairy industry.

With respect to local spending patterns, the farmers were asked where they purchased eleven different farm-related products and services (over the last year). They were able to choose among the five following options: (1) not used on the dairy farm; (2) grown or raised (not purchased); (3) purchased in their home town; (4) purchased in a neighboring town; and (5) purchased elsewhere. The proportion purchased across all 5 options summed to 100 percent. They were also asked whether they purchased their groceries in their local town.

We took both an indirect and direct approach to gauge community attachment. Each farmer was asked to rank, on a scale of 1-10, with 1 = "no attachment" and 10 = "very strongly attached," how attached they feel to their respective community. We also asked an extensive series of potentially more revealing questions. For example, their feelings if they had to move, how well they know their neighbors, their sense of belonging, alignment of personal and community values, and church and association participation.

Athens (population 1,095 in 2000) is a traditional small dairy town located in the northwest corner of Marathon County, surrounded by several mid-size cities. Marathon County has 3,250 farms (1999 estimate), about 28% (901) of those have dairy cows with an average herd size of 68 cows. Marathon is the second county in the state in terms of total milk production; dairying served as the main economic activity on 39 percent of the farms and dairy sales provided 64 percent of total farm receipts.[5]

Chilton is a moderate sized (population 3,708 in 2000) commercial dairy town in Calumet County, an area witnessing considerable non-farm growth pressures. It is in the center of the county, crossed by two major thoroughfares, and is surrounded by several other small and medium-sized towns. Calumet County has 830 farms (1999 estimate) and about 28% (237) of those have dairy cows with an average herd size of 95 cows. Dairying served as the main economic activity on 44 percent of the farms and dairy sales provided 67 percent of total farm receipts in the county.

Richland Center (population 5,114 in 2000) is an area of more marginal land with many dairy farms undergoing rapid expansion and/or moving towards intensive rotational

[5] The phrase "main economic activity" represents the number of farms classified by the NAIC as "dairy cattle and milk production" farms (which means those operations account for 50% or more of the farm's total sales) in 1997 Census of Agriculture statistics; 2002 statistics are not yet available by county.

grazing. Richland Center is also situated in the center of the county, at the nexus of two major highways. Richland County is the only strictly non-metro county of the three, following the definitions established by USDA ERS (Cook, 2003).[6] It has 1,230 farms (1999 estimate), of which 20% (247) have dairy cows with an average herd size of 61 cows. Dairying served as the main economic activity on 31 percent of the farms and dairy sales provided 60 percent of total farm receipts in the county.

A complete list of businesses was obtained for each community using the ReferenceUSA[sm] database, chamber of commerce listings, and local yellow pages. The database contains detailed information on more than 12 million U.S. businesses. Relevant (i.e., farm related) businesses in each community were asked to complete a short questionnaire over the phone. They were asked to confirm whether they sold any of the eleven products or services we asked about in the dairy farm survey. If they sold any of the products or services, we asked whether most of their customers were community residents and whether or not they were cooperatives.

5. Farm and Community Characteristics

Some general descriptive statistics of our farm sample are presented in table 1. On average, the farms in Athens are the smallest (67 cows) and the farms in Richland Center the largest (114 cows).[7] The range of size for the entire sample was fairly large: from 12 to 800 cows. The histograms (figure 1), however, show that most farms in each community have fewer than 100 cows and the distribution of farm size (cow numbers) is fairly consistent across the three communities. The dependence on off-farm income, as

[6] It has an urban population of less than 20,000 and is not adjacent to a metro area.
[7] The current average herd size for Wisconsin is 83 cows (PATS Dairy Farm Poll Codebook, 2004).

measured by the percent of total hours worked per week that were worked off-farm for the farmer and spouse, was fairly consistent across communities. The smaller farms in Athens were slightly less dependent on off-farm work (10%) than in either Chilton (13%) or Richland Center (17%). This is surprising given the fact that small farms generally earn less net income and therefore, it is typical for spouses to work off-farm, especially for health care coverage (WASS 2002).[8] These statistics are also lower than the state average. According to the 2002 USDA Census of Agriculture, 72.2% of the farmers in Wisconsin that reported any off-farm work (54.6% of the farms), worked 200 or more days off-farm.

The age and education of farmers in Athens and Chilton are similar; the average farmer in either community is about 47 years old with a high school diploma (or GED). The average farmer in Richland Center is older (53) and slightly better educated (some college, but no degree). For comparison, the average age of all farmers in Wisconsin is 53 (2002 USDA Census of Agriculture). As expected, a farmer's age and farming experience were highly and positively correlated [0.799], therefore, only age is included in our analysis.

Community attachment is measured by responses to a question asking respondents to rank how attached they are to their community on a scale of 1-10.[9] On average, farmers in all three communities said they were fairly attached (i.e., they ranked their attachment as 5-6), although the range of responses in each community was

[8] Additional analysis of our sample by farm size (rather than community) showed that small farms (0-74 cows) had a higher dependence on off-farm income than medium farms (75-149 cows)—14% versus 4%--but still lower than large farms (>150 cows) at 20%.

[9] This was done for the sake of brevity as well as the fact that additional regression analysis showed a strong and significant relationship (correlation) between responses to any of the other community attachment and loyalty questions and the direct attachment question.

complete (1-10). Attachment in Athens was the lowest on average (5.5), but the average distance from farm to town was also highest (7 miles) and the most distant farm was the furthest away (22 miles versus 15 in Chilton and 17 in Richland Center). The communities vary significantly in terms of the percentage of farm households that normally do most of their grocery shopping in their town. In Athens, only 29% of the households shop there for groceries, compared to 90% in Chilton and 97% in Richland Center.

Table 2 shows that the purchasing patterns for farm-related products and services also vary across towns. Farms tend to purchase more locally in Richland Center and Athens than in Chilton. One can simply look at the number of products and services where on average farms purchased more than 60% locally. In Richland Center and Athens there are six and in Chilton four. However, in Athens, for those products and services primarily purchased locally (>60%), the average purchased is 78%, which is higher than Richland Center (69%) and Chilton (69%).[10] Note also that there are very few consistencies in terms of what is purchased locally across towns. On average, farms purchase 50% or more of their corn silage and custom harvesting services locally in all three towns. Also, on average they purchase 40% or less of their replacement heifers locally. In Athens, farmers are more likely to purchase feed products locally than any other products and services, with the exception of harvesting services. The reverse is true in Richland Center, where except for corn grain, farmers purchase significantly lower amounts of feed products locally than other products and services. In Chilton, there is no clear purchasing trend.

[10] These figures are calculated by summing the means for all such products and services and dividing by the # of those (i.e., 6 or 4).

When looking at the more comprehensive measure of local economic impact (the percent purchased locally plus the percent grown/raised on farm), Athens and Richland Center again seem to be the communities with the most local support by farmers. In Athens on average, a farm in that community will produce or purchase locally more than 78% in all five feed categories. In Richland Center, the average produced on farm or purchased locally exceeds 91% in all categories except soybeans and protein feeds, where only a small amount is grown locally. However, the most dramatic differences in terms of what is produced versus what is purchased locally occur in Chilton. In all three communities, a relatively high proportion of alfalfa and heifers are *produced* locally (compared to what is purchased locally).

Analyzing the data by farm size (table 3) gives us a different picture. It seems to support Goldschmidt's premise that large farms purchase less locally than small farms. For eight of the products and services the average small farm (<75 cows) purchases substantially more locally than the average large farm (≥150 cows). The exceptions are milk equipment and supplies, farm machinery, and farm supplies. The story becomes more complex when medium size farms are considered (75-149 cows). The typical medium sized farm buys substantially higher portions locally than small farms for seven products and services and somewhat higher portions locally than large farms for all but one product (alfalfa). When looking at what is produced as well as what is purchased locally, the impact of larger farms is more visible. Large farms grow very little soybeans but raise 75 percent of their own heifers (and purchase none locally). This relationship between farm size and local economic impact is explored more formally in our regression analysis.

Table 4 shows the number of businesses selling the products and services that farmers were asked about in the three towns. Since the data are from a survey of businesses in town but not including farms and individuals who may sell the items through less formal channels, the survey undercounts the number of places a farmer might purchase an input especially for corn silage, alfalfa, heifers, and custom harvesting services. All three towns are relatively well supplied in farm support businesses. Chilton has the greatest selection of firms selling milk equipment, farm machinery, and farm supplies, although it is the least well endowed in business that sell feed inputs (corn grain, feed supplements) and has the fewest veterinary clinics. Of particular importance for our regressions is that Athens does not have a local supplier of milking equipment.

6. Empirical Model Estimation

A. Purchasing Pattern Model

In specifying the local purchases model, we use the percent of a good purchased that was purchased in the farmer's hometown, i.e. Athens, Chilton, or Richland Center, as the dependent variable. This measures the effect on local businesses, not including the farmer's own farm, from dairy farm purchases. We asked farmers about 11 items: corn grain, corn silage, soybeans and protein feeds, alfalfa and other forages, feed supplements (vitamins, minerals, etc.), replacement heifers, veterinary services, milking equipment and related supplies, farm machinery, farm supplies, and custom harvesting services. Thus we have 11 different dependent variables and equations to describe local purchases. Note that in these regressions if a farm did not purchase any of certain product they are dropped from the data set for that particular regression.

The independent variables used in the regressions are: *Cows:* the number of cows on the farm as a measure of farm size, *Pct_Off Farm*: the percent of farm manager and spouse work time spent working off-farm, *Age*: the age of the farm manager, *Education:* an index variable measuring education[11], *Attachment*: a 1-10 self ranking on how attached the farm manager is to the community, *Distance*: the farmer reported distance in miles from the farm to the town center, *Local Groceries:* is a dummy variable equaling 1 when they report buying their groceries locally.

We run two sets of these regressions with distinctive methods of measuring the differences in local business activities. One regression includes two town dummy variables, *Athens* and *Chilton,* while the other has a count of the number of businesses that sell the particular product or service represented by the dependent variable.[12] These two methods provide two types of controls. The first controls for town specific characteristics which includes the number of businesses along with other unmeasured differences between towns such as geography and road networks. The second controls specifically for the number of businesses.

B. Community Economic Impact Model

The community economic impact regressions use the same independent variables as described above, but different measures for the dependent variable. In this case for goods that can both be produced on farm and purchased from a supplier, corn grain, corn silage, soybeans, alfalfa, and replacement heifers, we measure the percent bought locally

[11] *Education* is coded as follows: 1=attended grade school, 2=some high school, 3=high school diploma, 4=some college but no degree, 5=trade school or formal apprenticeship program, 6=completed a 2 year college degree, 7=completed a 4 year college degree, 8= some graduate school or post-graduate study.
[12] We were not able to include both the town dummy variables and the business count data because of the low variation in the business count data.

as including both what is produced on the farm and what is purchased in town. In effect we are measuring what is sold or produced locally against that which is purchased outside the town. These values give a better sense of the overall economic impact of dairy farms on the community as opposed to simply the economic impact on local businesses.[13] Note these regressions are only run for goods that can be produced on a farm.

C. Estimation Methodology

The econometric estimation procedure used, described below, is an upper and lower-censored Tobit model (see Maddala, 1983, pp. 149-150, 160-162). The theory set out a non-linear relationship between local cost shares, $C^* = C_L/(C_L + C_D)$, and farm/farmer characteristics, *X,* which describe scale and transaction costs. Local cost shares are censored from above at 100% local purchases and below at 0%. Re-scaling C^* to percentage terms, the censoring of local purchases at 100% and 0% represents a large portion of the observations for all purchase types. The scale of this censoring and the non-linearity in hypothesized spending patterns from the theoretical model necessitates an estimation procedure, a double censored Tobit, which takes this censoring into account. For an individual data point with a vector of independent variables x_i and a vector of parameters to be estimated β, a double-censored Tobit is as follows:

$$
\begin{array}{ll}
C_i^* = \beta' x_i + \varepsilon_i & \textit{where} \\
C_i = 100 & \textit{if } C_i^* \geq 100 \\
C_i = C_i^* & \textit{if } 0 < C_i^* < 100 \\
C_i = 0 & \textit{if } C_i^* < 0.
\end{array}
$$

[13] One can think of the difference in the two dependent variable measures here as most stark in the case of an autarkic farm that produces all its own inputs. In our first measure they would be seen as buying nothing locally, while in the second they would be measured as buying/producing everything locally. One can see that businesses in town would have no economic activity with the autarkic farm, but the farm would create economic activity for the community as a whole.

The estimation procedure for this model maximizes a standard Tobit likelihood function with the changes for upper censoring rather than the more common lower censoring at zero. With 100% as C^u, the upper bound of our estimation, and C^o denoting the lower bound, 0, the likelihood function is as follows:

$$\ln L = \sum_{C_i=C^o} \ln\left[\Phi\left(\frac{(C^o - \beta' x_i)}{\sigma}\right)\right] - \tfrac{1}{2}\sum_{C_i \le C^u}\left(\ln(2\pi\sigma^2) + \frac{(C_i - \beta' x_i)^2}{\sigma^2}\right) + \sum_{C_i=C^u} \ln\left[1 - \Phi\left(\frac{(C^u - \beta' x_i)}{\sigma}\right)\right],$$

where Φ is the normal cumulative distribution function and C_i is the cost share.

7. Estimation Results and Discussion

The results of the regressions appear in tables 5, 6, 7, and 8, with tables 5 and 6 showing the local purchasing pattern dependent variables and tables 7 and 8 showing the community impact results. Note that a number of regressions were dropped from the analysis due to insufficient variation in the data. They are: the corn silage regressions in both models because so little was purchased outside of town, heifers in the local purchasing model, and alfalfa in the local purchasing model. For both heifers and alfalfa the results of the community impact analysis are presented.

In general the models presented in table 5 show few significant parameters to describe farm choices of where they purchase their inputs. It becomes immediately apparent looking at the results in table 5 that there is very little evidence for Goldschmidt's primary hypothesis that large farms are less likely to buy locally. Only in the case of feed supplements is there a significant and negative parameter on the farm size variable.

For a number of the regressions, soy, veterinarians, and farm machinery the only significant variables other than the constants are the town dummy variable. In the case of soy, there is significantly more bought locally in Athens, while for veterinarian care and farm machinery there is significantly less purchased locally in Athens. Athens also has lower percentages of local purchases in milk equipment and farm supplies.

Among the other variables of interest age and education are significant and positive in the feed supplements regression, while age is negative and significant in the custom harvesting services regression. The percent of off-farm work, which is intended to proxy how important the local business climate is to their family's economic wellbeing, is only significant in the case of corn grain purchases, for which it is the only significant variable.[14]

Greater levels of attachment to the community do have a significantly positive effect some purchases: feed supplements and farm supplies. The finding with respect to farm supplies is perhaps the most important in that this is an item available uniformly in all the study towns as well as the towns that surround them and is often available at multiple outlets. Thus among all the inputs asked about, this is the one for which farmers have the most discretion on their purchases. Thus the suggestion from these results would be that community attachment matters if farmers have a lot of discretion on where they purchase their inputs. But note that one would expect the farm size variable, if it were truly important, to also matter in the case of items available all over, and this is not the case for farm supplies.

[14] Since the variable does not measure differences in where the respondent works and they may work out of town, it may be that we are partially capturing off-farm work that is in neighboring towns.

Table 6 shows purchasing pattern data with the number of businesses in the town as an independent variable. Adding the business data does not measurably change the inference about the importance of any of the other parameters, but it does provide some explanations for what is captured in the town dummy variables. For soybeans, feed supplements, milk equipment, and farm machinery having access to more outlets leads to higher local purchases. This provides an explanation why in the previous table Athens had lower local purchases of milk equipment and farm machinery: there were fewer businesses in town. In contrast the estimated parameter for the number of businesses in farm supplies is negative and significant.[15]

The community economic activity regressions are presented in tables 7 and 8. They show remarkably few significant parameters with none of them having more than one significant parameter per regression equation. For the corn grain equation farms with more off-farm labor time produce or purchase locally significantly less corn grain. In the soybean equation it is clear that Athens farmers produce or purchase locally significantly more than in Richland Center. The heifer purchase equation has a negative and significant (10% level) parameter, which does show some modest evidence for Goldschmidt's hypothesis. When accounting for own produced heifers, large farms purchase a larger percentage away from their own town. There are few observable differences between the version with town dummy variables and the version with business information. The business count parameters are not significantly different from zero and do not change any of the other parameters significantly.

[15] This particular result was robust to all of the alternative models we tried.

8. Conclusion

By investigating farm and community characteristics in three separate rural communities, our analysis finds only modest support for previous findings. We find very little evidence that large farms either purchase a smaller proportion of their inputs locally or that they produce a smaller portion on their own farms. Thus we find no evidence to conclude, as suggested in the literature, that large farms are bad for both small town businesses and the overall economic health of a community. To the contrary, our results would suggest that large farms should benefit the overall economic health of communities, since the volume of business they produce is greater even if in percentage terms large dairy farms purchase the same amount as small farms. In addition our results provide some evidence that attachment to a community does affect spending patterns, but seemingly only when there is a large choice available to consumers.

This work has also demonstrated the importance of adequately accounting for the supply side in analyzing purchasing patterns in small towns. The results presented here suggest that the characteristics of the local market may be more important than the size of the local farms to the purchasing patterns of farms. It should be noted, however, that this local market may be endogenously determined by the farm structure itself. Analyzing the long-term relationship between farm sizes and the types of businesses in a community using cross-section time-series data would be a productive avenue for future research.

While this work has managed to dispel some myths in the literature, a number of other important questions remain to answer. Although we have measured some of the input purchase choices of farmers, we have ignored the labor market effects of different scales of farm. The economic effects of differences in labor usage across farm structures

are an important issue for future research. In addition this work has shown how attachment to a community influences some spending patterns, but is not able to disentangle the various elements of attachment and how they might relate to spending patterns. Future research could help describe the determinants of community attachment as well as how attachment affects economic activities in small towns.

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Table 1: Percent Purchased Locally by Town and Farm Size

	Athens	Chilton	Richland Center	Less than 74 Cows	75-149 Cows	150+ Cows	Total Sample
Corn Grain	82	39	65	70	81	20	69
Corn Silage	100	67	50	80	100	50	80
Soybeans and Protein feeds	72	32	37	60	42	27	53
Alfalfa and Forages	73	55	23	65	43	50	56
Feed supplements	62	22	55	57	36	22	49
Replacement Heifers	40	17	30	51	6.7	0	31
Veterinary Services	38	43	61	46	48	24	45
Milking Equipment	11	72	78	35	64	57	43
Farm Machinery	15	64	67	36	55	51	41
Farm Supplies	42	52	69	49	59	52	51
Custom Harvesting	79	75	77	78	91	35	77

Table 2: Percent Purchased Locally Including Produced on Farm

	Athens	Chilton	Richland Center	Less than 74 Cows	75-149 Cows	150+ Cows	Total Sample
Corn Grain	89	78	93	86	93	82	87
Corn Silage	100	97	96	99	100	92	98
Soybeans and Protein feeds	78	56	39	66	69	35	63
Alfalfa and Forages	98	89	92	97	90	92	95
Feed supplements	64	22	55	58	36	22	50
Replacement Heifers	90	88	92	94	85	75	90

Table 3: Independent Variables by Town and Farm Size

	Athens	Chilton	Richland Center	Less than 74 Cows	75-149 Cows	150+ Cows	Total
Cows	67	91	115	46	94	341	85
Percent work time off-farm	0.1	0.13	0.17	0.14	0.044	0.2	0.13
Age	48	48	53	48	48	53	49
Education	3.4	3.8	4	3.4	4.3	3.7	3.6
Attachment*	5.6	6.6	6.5	6.1	5.9	6.4	6.1
Distance	7	6.2	6.3	6.6	7.6	4.6	6.6
Buy Groceries locally (0-1)	0.29	0.9	0.97	0.6	0.65	0.77	0.63

Education is coded as follows: 1=attended grade school, 2=some high school, 3=high school diploma, 4=some college but no degree, 5=trade school or formal apprenticeship program, 6=completed a 2 year college degree, 7=completed a 4 year college degree, 8= some graduate school or post-graduate study.

*On a scale of 1 to 10, how attached are you to your community?

Table 4: Number of Businesses Selling Farm Inputs and Services*

	Athens	Chilton	Richland Center
Corn Grain	2	1	4
Corn Silage	0	0	0
Soybeans and Protein feeds	2	2	4
Alfalfa	0	1	0
Feed Supplements	3	3	4
Replacement Heifers	0	2	2
Milking Equipment	0	5	1
Farm Machinery	2	7	6
Farm Supplies	6	6	4
Veterinarians	2	1	3
Custom Harvesting	0	0	0

*Note: Data is from a survey of businesses in town but does not include farms and individuals who may sell the items through less formal channels. This is especially relevant for corn silage, alfalfa, heifers, and custom havesting.

Table 5: Purchase Patterns (with town dummy variables): Double Bounded Tobits

	Corn Grain	Soybeans and Protein Feeds	Feed Supplements	Veterinary Services	Milk Equipment	Farm Machinery	Farm Supplies	Custom Harvesting Services
Cows in 2002	-1.297	-1.939	-0.852	-1.025	-0.599	-0.096	-0.042	-0.540
	(1.66)	(1.44)	(2.08)**	(1.55)	(1.54)	(0.95)	(0.85)	(1.64)
Percent work time off-farm	-600.623	-81.233	95.120	-181.466	-62.144	27.906	-24.466	18.533
	(1.84)*	(0.26)	(0.61)	(0.73)	(0.39)	(0.61)	(0.98)	(0.13)
Age	7.074	8.242	7.129	5.589	3.186	-1.333	0.087	-7.179
	(1.21)	(1.13)	(1.85)*	(0.97)	(0.93)	(1.40)	(0.17)	(1.94)*
Education	18.482	69.864	47.976	-30.768	2.536	3.378	1.626	36.543
	(0.58)	(1.48)	(2.03)**	(0.94)	(0.13)	(0.58)	(0.51)	(1.55)
Attachment	18.650	28.622	30.889	14.893	19.229	2.095	5.728	11.499
	(0.84)	(1.13)	(2.10)**	(0.76)	(1.61)	(0.61)	(3.00)***	(1.11)
Distance (miles)	-26.138	-7.936	-3.828	6.640	1.695	0.215	-1.757	-4.902
	(1.44)	(0.44)	(0.42)	(0.47)	(0.21)	(0.09)	(1.25)	(0.62)
Buy groceries locally	-130.221	133.244	-121.298	-145.927	-304.368	-28.872	-21.435	-39.274
	(0.72)	(0.64)	(1.13)	(0.88)	(1.83)*	(0.94)	(1.35)	(0.47)
Athens	23.017	566.895	12.071	-440.293	-695.074	-140.997	-55.455	-45.096
	(0.13)	(1.88)*	(0.11)	(2.00)**	(2.94)***	(4.10)***	(3.25)***	(0.42)
Chilton	-162.999	62.223	-246.446	-227.325	-44.765	4.502	-24.104	-74.770
	(1.05)	(0.36)	(2.23)**	(1.43)	(0.55)	(0.19)	(1.68)*	(0.82)
Constant	120.823	-906.999	-459.861	208.671	292.044	151.258	71.777	479.611
	(0.30)	(1.53)	(1.70)*	(0.56)	(1.15)	(2.19)**	(1.93)*	(1.94)*
Observations	56	80	96	99	100	100	101	69
Censoring pattern (y=0 , 0<y<1, y=1)	(15, 6, 35)	(34, 6, 40)	(44, 12, 40)	(48, 9, 42)	(51, 10, 39)	(41, 35, 24)	(16, 64, 21)	(10,10,49)
$\chi^2(9)$ test statistic	21.46**	26.04***	33.3***	11.65	67.91***	47.69***	21.35**	14.02

Absolute value of t statistics in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Purchase Patterns (with business information): Double Bounded Tobits

	Corn Grain	Soybeans and Protein Feeds	Feed Supplements	Veterinary Services	Milk Equipment	Farm Machinery	Farm Supplies
Cows in 2002	-1.293	-2.110	-0.723	-0.685	-0.041	-0.076	-0.042
	(1.65)	(1.57)	(1.89)*	(1.17)	(0.11)	(0.78)	(0.85)
Percent work time off-farm	-597.770	-142.347	114.264	-49.106	191.213	30.423	-24.767
	(1.82)*	(0.45)	(0.71)	(0.20)	(1.09)	(0.66)	(0.99)
Age	7.516	6.454	8.293	5.702	5.625	-1.132	0.100
	(1.29)	(0.91)	(2.06)**	(0.97)	(1.32)	(1.21)	(0.19)
Education	20.883	59.127	49.026	-25.415	5.333	3.571	1.604
	(0.66)	(1.31)	(2.03)**	(0.77)	(0.23)	(0.60)	(0.50)
Attachment	17.813	35.136	27.657	4.527	6.972	1.687	5.745
	(0.81)	(1.29)	(1.93)*	(0.24)	(0.51)	(0.49)	(3.01)***
Distance (miles)	-25.364	-11.182	-2.615	11.988	11.127	0.411	-1.771
	(1.41)	(0.59)	(0.28)	(0.83)	(1.07)	(0.17)	(1.26)
Buy groceries locally	-99.220	-46.364	-58.219	104.801	145.459	-20.886	-22.090
	(0.63)	(0.26)	(0.57)	(0.86)	(1.40)	(0.70)	(1.43)
Number of businesses in town selling item	41.982	108.279	61.155	91.126	75.968	29.801	-11.053
	(1.18)	(1.72)*	(2.09)**	(1.18)	(2.66)***	(4.56)***	(3.25)***
Constant	-138.245	-855.380	-936.157	-440.382	-641.934	-60.755	115.248
	(0.37)	(1.42)	(2.52)**	(1.19)	(2.14)**	(1.08)	(2.52)**
Observations	56	80	96	99	100	100	101
$\chi^2(8)$ test statistic	21.34***	22.41***	28.78***	6.75	36.41***	46.55***	21.32***

Absolute value of t statistics in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%
Note: Custom harvesting regression not reported due to no variation in the numbers of businesses across the towns.

Table 7: Community Impact Regressions (with town dummy variables): Double Bounded Tobits

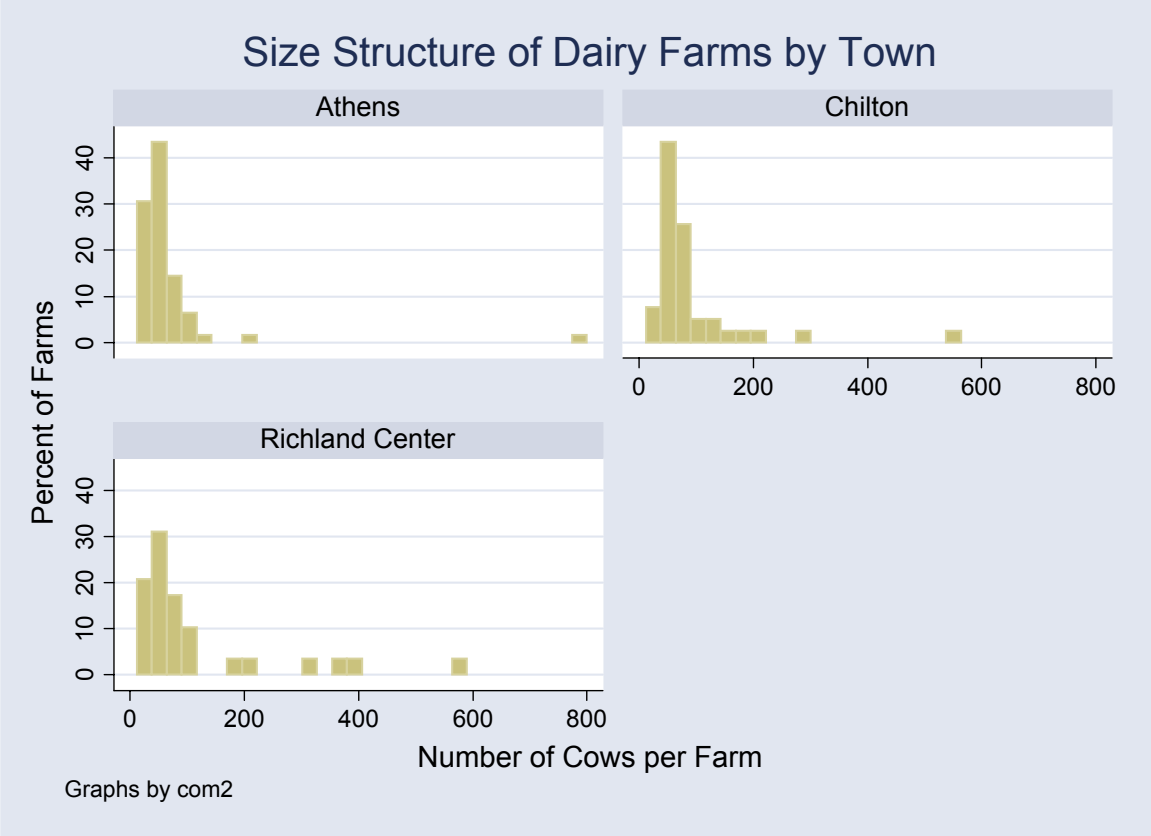
	Corn Grain	Soybeans and Protein Feeds	Alfalfa and Other Forages	Replacement Heifers
Cows in 2002?	-0.277	-0.956	1.000	-1.589
	(1.49)	(1.65)	(0.91)	(1.69)*
Percent work time off-farm	-228.744	-72.453	61.423	-235.822
	(2.01)**	(0.36)	(0.22)	(1.08)
Age	3.920	5.443	-9.584	5.093
	(1.53)	(1.26)	(1.33)	(1.14)
Education	11.828	43.801	-18.478	23.697
	(0.86)	(1.56)	(0.53)	(0.78)
Attachment	11.748	10.206	21.544	32.006
	(1.28)	(0.70)	(1.05)	(1.55)
Distance (miles)	-6.319	2.414	-6.457	49.531
	(1.03)	(0.23)	(0.45)	(1.67)*
Buy groceries locally	-99.369	147.624	251.040	-190.608
	(1.28)	(1.04)	(1.01)	(1.30)
Athens	-85.843	445.994	387.274	-723.614
	(1.07)	(2.36)**	(1.26)	(1.47)
Chilton	-90.817	129.897	-168.922	-729.480
	(1.41)	(1.18)	(1.15)	(1.56)
Constant	146.517	-609.872	593.456	540.606
	(0.89)	(1.72)*	(1.11)	(1.17)
Observations	98	92	99	85
Censoring Pattern (y=0 , 0<y<1, y=1)	(8, 13, 77)	(30, 10, 52)	(4, 4, 91)	(5, 5, 75)
$\chi^2(9)$ test statistic	12.35	24.66***	14.28	28.42***

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Community Impact Regressions (with business information): Double Bounded Tobits

	Corn Grain	Soybeans and Protein Feeds	Alfalfa and Other Forages	Replacement Heifers
Cows in 2002	-0.226	-1.205	0.751	-0.669
	(1.24)	(1.86)*	(0.68)	(1.72)*
Percent work time off-farm	-189.986	-159.436	-15.342	-62.891
	(1.75)*	(0.78)	(0.06)	(0.30)
Age	4.521	3.643	-11.559	4.028
	(1.72)*	(0.85)	(1.43)	(0.92)
Education	13.899	36.341	-11.191	14.169
	(0.97)	(1.31)	(0.33)	(0.49)
Attachment	9.587	18.111	22.104	17.989
	(1.06)	(1.13)	(1.05)	(1.05)
Distance (miles)	-5.003	1.082	-10.676	33.168
	(0.81)	(0.10)	(0.71)	(1.48)
Buy groceries locally	-48.314	-24.516	-5.083	-122.569
	(0.71)	(0.20)	(0.04)	(0.83)
Number of businesses in town selling item	8.885	54.702	-292.136	14.363
	(0.67)	(1.61)	(1.62)	(0.25)
Constant	-27.672	-378.910	1,085.612	-27.979
	(0.18)	(1.11)	(1.73)*	(0.11)
Observations	98	92	99	85
$\chi^2(8)$ test statistic	10.45	17.52**	11.51	16.56**

Figure 1


Size Structure of Dairy Farms by Town
Athens
Chilton
Richland Center
Percent of Farms
0
10
20
30
40
0
200
400
600
800
Number of Cows per Farm
Graphs by com2