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Threshold Population Levels for Rural Retail Businesses in North Dakota, 2000

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Abstract

Business and community leaders frequently question the population level necessary to provide adequate sales volume for a particular type of business. This study examines population levels associated with specified numbers of 16 business types in North Dakota towns between 200 and 10,000 population in 2000. The data used to identify the presence of particular types of businesses in a given community were records of sales and use tax permit holders by Standard Industrial Classification (SIC) group from the North Dakota State Tax Department. Threshold populations for the 16 business types were estimated using ordinary least squares (OLS) regression analysis. The resulting estimates indicate that the populations required to support various business types vary substantially. Businesses with relatively low population requirements included eating and drinking places. Department stores and variety stores had the highest population thresholds among the businesses studied. When the threshold estimates were compared with similar estimates for 1988, the threshold population to support one business had decreased for four business types (eating places, drinking places, farm supply, and drug stores), while for the other 12, the threshold populations had increased.

Key Words: retail businesses, rural business, trade and service sector

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Randal C. Coon and F. Larry Leistritz*

Changing socioeconomic conditions in many nonmetropolitan communities have created substantial pressures for adjustment by local retail firms. In North Dakota, for example, the continuing trend of agricultural mechanization and farm consolidation led to continued out-migration and population decline in most nonmetropolitan counties during the 1990s (Hodur et al. 2002, Coon and Leistritz 1998). Most of these counties had lost population during the 1980s as well. These changes have posed major challenges for business proprietors and for community leaders seeking to maintain a viable retail sector.

Changes in the shopping patterns of rural residents have exacerbated these problems, as the retail selection and prices found in larger cities prove increasingly attractive to many rural residents. As a result, merchants in smaller communities have discovered they are receiving a decreasing share of retail sales volume. For example, in North Dakota, the share of total taxable sales and purchases accounted for by the state's four largest urban centers rose from 50 percent in 1980 to 69 percent in 2000. The share accounted for by towns with populations less than 10,000 fell from 35 percent to 21 percent during the same period (Coon and Leistritz 2002).

In response to these changes, many rural communities in North Dakota and elsewhere in the Upper Midwest have taken steps to revitalize their local economies, both by recruiting new primary sector (i.e., basic sector) employers and by enhancing their local trade and service sectors. In the latter case, some towns have emphasized re-establishing a business type previously lost, such as a farm machinery dealership or a furniture store, while other communities have perceived new market opportunities for particular business types.

Whatever the initial stimulus for attempts to revitalize or diversify their local retail sector, a major question that must be addressed relates to the adequacy of the community's population base to support a given type of business. Population thresholds, the minimum number of consumers necessary to provide an adequate sales volume for a particular type of retail business, have long been a key concept in central place theory (Berry and Garrison 1958, Shaffer 1989). As community leaders evaluate their local retail sector, the threshold concept is particularly useful. This study examines the population levels associated with specified numbers of businesses of various types in nonmetropolitan communities in North Dakota.

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Objectives

The purpose of this study is to determine population levels associated with the presence of businesses of specified types in North Dakota communities. The 16 business types examined represent retail establishments frequently found in nonmetropolitan trade centers. Communities included in the analysis were North Dakota towns with populations between 200 and 10,000 in 2000. The estimates developed are compared with values previously derived for 1988 (Schuler and Leistritz 1990).

Procedures

The data used to identify the presence of particular types of businesses in a given community were records of sales and use tax permit holders from the North Dakota State Tax Department. The number of permit holders by Standard Industrial Classification (SIC) group were identified for all incorporated towns with populations between 200 and 10,000 in 2000 (U.S. Census Bureau 2000). Sixteen business types that are relatively common in the state's nonmetropolitan trade centers were used as the basis for the analysis. These are SIC 3-digit industries except for two 4-digit industries (SIC 5812 *Eating Places* and SIC 5813 *Drinking Places-Alcoholic Beverages*). A description of the 16 business types is found in Table 1.

A total of 161 communities was included in the study. The number of towns by population group is summarized in Table 2, and the number of towns having different numbers of establishments of each type is shown in Table 3.

Although the data set consists of the entire population of permit holders for the 16 business types in North Dakota cities with populations between 200 and 10,000, this data set may be regarded as a sample of two different populations. It could be considered as a sample (North Dakota) of a larger geographic area (several states) having similar trade and service activities in rural communities or as a sample of one year (2000) from a population of a number of years. In either case, the data set may be considered as a sample whose statistics could be used to make inferences regarding the values of parameters of the population that the sample represents. The inferences could involve either hypothesis tests or estimations (either point estimates or confidence interval estimates). A previous study used similar data for 1988 to develop confidence interval estimates as well as point estimates (Schuler and Leistritz 1990). In this report, point estimates of threshold populations are developed and compared with the estimates developed using 1988 data.

Definition of Threshold Population

A threshold population is generally defined as the minimum level of population required to support a business establishment at an acceptable level of return or profit (Shaffer 1989). A portion of the entrepreneur's return is a "normal" profit, i.e., the minimum return or profit necessary to retain the entrepreneur in this particular business. If this minimum or normal return is not realized, the entrepreneur will withdraw his/her efforts from this specific business and reallocate the resources to another activity.

Table 1. SIC Codes, Industry Description, Subclassifications Included in Each Category, and Number of Establishments for Each SIC Code, Included in Threshold Analysis

SIC Code Number	Industry Description	SIC Codes Included	Number of Cities with Establishments
508	Farm and Garden Mach. & Equip. Stores	5083	138
519	Farm Supply Stores	5191	118[a]
521	Lumber & Other Building Materials	5211	76[b]
525	Hardware Stores	5251	75
531	Department Stores	5311	16
533	Variety Stores	5331	20
541	Grocery Stores	5411	122[b]
554	Gasoline Service Stations	5541	122
565	Family Clothing Stores	5651	12
571	Home Furniture & Furnishings Stores	5712,5713, 5714, 5719	77
573	Radio, TV, and Electronic Stores	5731, 5732, 5733, 5734, 5735, 5736	38[b]
591	Drug Stores	5912	63
594	Sporting Goods Stores & Bicycle Shops	5941	73[b]
599	Florists	5992	44
5812	Eating Places	5812	156
5813	Drinking Places (Alcoholic Beverages)	5813	155

[a] Data showed that 123 cities had SIC code 519 permits, but 5 of those had 0 permit holders. Therefore, 118 cities actually had this SIC code business.

[b] Data for SIC codes 521, 541, 573, and 594 showed one city with a permit but had 0 permit holders.

Table 2. Number of North Dakota Cities by Population Group Included in Threshold Analysis

2000 Population	Number of Cities
200-500	67
501-1,000	50
1,001-1,500	22
1,501-2,500	16
2,501-10,000	6
TOTAL	161

Table 3. Number of Cities in North Dakota with Selected SIC Codes for Threshold Analysis, 2000

SIC Code	Industry Description	Number of Businesses for each SIC Code											Number of Cities with Establishments	Number of Businesses
		0	1	2	3	4	5	6	7	8	9	10	11 or More		
508	Farm & Garden Mach. & Equip Stores	23	26	27	24	19	15	8	3	5	2	2	7	138	550
519	Farm Supply Stores Lumber and Other	43	43	27	20	9	9	0	2	2	2	3	1	118	327
521	Building Materials	85	47	19	7	2	1	0	0	0	0	0	0	76	119
525	Hardware Stores	86	54	16	3	1	0	1	0	0	0	0	0	75	105
531	Department Stores	145	11	4	1	0	0	0	0	0	0	0	0	16	22
533	Variety Stores	141	17	2	1	0	0	0	0	0	0	0	0	20	24
541	Grocery Stores	39	98	17	6	1	0	0	0	0	0	0	0	122	154
554	Gasoline Service Stations	39	54	32	18	7	4	3	2	1	0	0	1	122	271
565	Family Clothing Stores	149	11	1	0	0	0	0	0	0	0	0	0	12	13
571	Home Furniture & Furnishings Stores	84	63	12	1	1	0	0	0	0	0	0	0	77	94
573	Radio, TV, & Electronic Stores	123	36	2	0	0	0	0	0	0	0	0	0	38	40
591	Drug Stores	98	43	15	2	3	0	0	0	0	0	0	0	63	91
594	Sporting Goods Stores & Bicycle Shops	88	36	20	12	1	1	1	1	1	0	0	0	73	142
599	Florists	117	34	7	3	0	0	0	0	0	0	0	0	44	57
5812	Eating Places	5	10	27	26	24	17	11	14	6	4	4	13	156	843
5813	Drinking Places (Alcoholic Beverages)	6	24	44	26	20	11	8	7	3	1	2	9	155	603

Although the traditional definition of threshold population implies a level of population that is barely sufficient for one business of a given type to be successful in a community, estimates derived from this study are essentially the "expected" city population associated with a given number of businesses of that type in a community. However, the existing number of businesses in most rural communities in North Dakota is probably larger than the long-run equilibrium number because of population decreases in those communities over time.

Economic theory indicates that firms will remain in operation in the short run as long as their revenues exceed their variable costs, even though they may not recover all of their fixed costs. A substantial number of North Dakota businesses may be in that situation. They may be owned and operated by people who are too old to seek alternative employment, and the business may not be an attractive investment for others. The present owners' best options may be to operate their business until they retire, but the businesses will likely not continue to operate in their present form after the retirement of the current owner. For these reasons, the "expected" city population estimates obtained in this analysis may indeed be reasonable estimates of the threshold population for selected business types in rural North Dakota communities.

Empirical Model

Previous empirical studies typically have employed models in which population is the dependent variable and the number of establishments is the independent variable (Schuler and Leistritz 1990). These models were often of the form:

$$P_i = B_0 + B_1 N_{ij} + B_2 N^2_{ij}$$

where:

P_i = population of city i,
N_{ij} = number of permit holders of SIC group j in city i, and
$B_{o,}$ $B_{1,}$ and B_2 are parameters of the equation.

While it can be argued that an alternative specification with population as the independent variable and the number of establishments as the dependent would be more consistent with economic theory, the population-dependent model is used in this analysis.

The previous analysis (Schuler and Leistritz 1990) estimated four different functional forms of the population-dependent model. These were linear, quadratic (illustrated above), exponential, and double log. The performance of the estimated models was then evaluated on the basis of the frequency with which the mean value of the population for cities with N permit holders was observed within the 95 percent confidence interval of each model. A similar procedure was employed in this study, and the evaluation revealed that the quadratic model yielded the most reliable estimates. Therefore, the quadratic model was employed to develop estimates of threshold populations for the 16 business types.

Results

Mean population for cities with 1, 2, 3, and 4 permit holders of the 16 business types are shown in Table 4. Point estimates of the threshold populations (city population required to support a given number of firms) for the 16 SIC categories are shown in Table 5. The interpretation of the values in Table 5 is that a town of 212 people could support one eating place, but a population of 2,606 would be required to support a department store. The estimates indicate that the population required to support various business types varies substantially. Businesses with relatively low population requirements include eating and drinking places. Department stores and variety stores have the highest population thresholds among the businesses studied.

Table 4. Mean Population per Cities with One, Two, Three, or Four Firms, For Selected SIC Codes, 2000

SIC Code Number	Industry Description	Number of Permits			
		1	2	3	4
508	Farm and Garden Mach. & Equip. Stores	436	632	768	642
519	Farm Supply Stores	521	758	835	1,141
521	Lumber & Other Building Materials	986	1,324	1,797	4,036
525	Hardware Stores	1,131	2,077	a	a
531	Department Stores	2,606	a	a	a
533	Variety Stores	2,324	5,061	a	a
541	Grocery Stores	709	2,059	3,303	a
554	Gasoline Service Stations	650	746	1,092	a
565	Family Clothing Stores	1,351	a	a	a
571	Home Furniture & Furnishings Stores	1,628	2,781	a	a
573	Radio, TV, and Electronic Stores	1,602	4,712	a	a
591	Drug Stores	1,065	1,769	6,551	a
594	Sporting Goods Stores & Bicycle Shops	847	1,089	1,859	2,292
599	Florists	1,287	3,855	a	a
5812	Eating Places	408	439	454	597
5813	Drinking Places (Alcoholic Beverages)	305	428	670	779

[a] The number of permit holders in the category were too few to provide reliable mean populations.

Table 5. Estimates of City Population Required to Support an Indicated Number of Establishments of Selected Business Types, North Dakota, 2000

Business Type	Number of Establishments			
	1	2	3	4
Drinking places (alcohol)	224	431	649	878
Eating places	212	344	483	890
Gasoline service stations	605	773	1,097	1,575
Grocery stores	702	a	a	a
Farm and garden machinery and equipment	579	a	612	706
Farm supply stores	575	623	819	1,089
Hardware stores	1,167	1,774	2,161	2,329
Sporting good stores and bicycle shops	836	1,207	1,668	2,222
Lumber and other building material stores	1,020	1,167	2,140	3,929
Home furniture	1,640	2,589	4,647	7,815
Radio, television, and consumer electric stores	1,602	4,712	7,823	10,933
Florists	1,287	a	3,373	4,171
Drug stores	1,022	2,141	3,763	5,886
Family clothing stores	1,928	a	a	a
Department stores	2,606	a	7,436	18,258
Variety stores	2,324	5,061	a	a

[a] Not estimated because the data set contained insufficient numbers to support reliable estimates in these categories.

The threshold populations required to support one and two businesses of each type in 2000 are compared in Table 6 to similar estimates for 1988 developed by Schuler and Leistritz (1990). For four business types (drinking places, eating places, farm supply, and drug stores), the threshold populations to support one business had decreased, while for the other 12 business types, the threshold population had increased. Threshold populations to support two businesses of a given type had decreased from 1988 to 2000 for five business types (those mentioned previously plus lumber and building material stores) and had increased for six types, while for the remaining five business types, there were too few permit holders in the sample to provide reliable estimates (Table 6).

The threshold populations required to support one business of a given type in 1988 and 2000 are further compared in Table 7. As noted earlier, threshold population estimates for four business types were lower for 2000 than for 1988. Eating places exhibited the greatest percentage decrease in threshold population, as the value for 2000 (212) was only 62 percent of the 1998 value. On the other hand, family clothing stores registered the largest percentage increase in threshold population (170 percent).

Table 6. Estimates of City Population Required to Support One and Two Establishments of Selected Business Types, North Dakota, 1988 and 2000

Business Type	One Establishment 1988	One Establishment 2000	Two Establishments 1988	Two Establishments 2000
Drinking places (alcohol)	249	224	506	431
Eating places	340	212	504	344
Gasoline service stations	455	605	485	773
Grocery stores	528	702	1,285	a
Farm & garden machinery & equipment	530	579	712	a
Farm supply	663	575	927	623
Hardware stores	763	1,167	1,333	1,774
Sporting goods stores & bicycle shops	782	836	1,122	1,207
Lumber & building material stores	793	1,020	1,480	1,167
Home furniture	1,007	1,640	1,765	2,589
Radio, television, & consumer electronic	1,044	1,602	1,574	4,712
Florists	1,093	1,287	1,698	a
Drug stores	1,103	1,022	2,305	2,141
Family clothing stores	1,135	1,928	1,804	a
Department stores	1,651	2,606	3,373	a
Variety stores	1,806	2,324	4,614	5,061

[a] The number of permit holders in the category was too small to provide reliable estimates.

Table 7. Estimated Population to Support One Establishment of Selected Business Types, North Dakota, 2000

Business Type	Threshold Population, 2000	
	Population	% of 1988
Eating places	212	62
Farm supply	575	87
Drinking places (alcohol)	224	90
Drug stores	1,022	93
Sporting goods stores & bicycle shops	836	107
Farm & garden machinery & equipment	579	109
Florists	1,287	118
Lumber & building material stores	1,020	129
Variety stores	2,324	129
Gasoline service stations	605	133
Grocery stores	702	133
Hardware stores	1,167	153
Radio, television, & consumer electronic	1,602	153
Department stores	2,606	158
Home furniture	1,640	163
Family clothing stores	1,928	170

Conclusions and Implications

Business and community leaders frequently question the population level necessary to provide adequate sales volume for a particular type of business. Further, these relationships may have changed in recent years as a result of changing shopping patterns of rural residents. This study examines population levels associated with specified numbers of 16 business types in North Dakota towns between 200 and 10,000 population in 2000.

The estimates developed in this study must be interpreted with caution for several reasons. First, this analysis, like most other analyses of threshold population levels (Shaffer 1989), is based on the number of firms offering a particular type of good or service in towns of different sizes. It does not necessarily follow that these population levels will yield sufficient sales volume to allow the business to be financially successful. Second, the analysis is based on city population, whereas the population of the trade area (i.e., the city plus the surrounding rural area) should be considered in assessing the prospects for a new business. Finally, the relationships reported here represent averages across the state. The situation for an individual community may differ greatly from state norms based on differences in population composition (e.g., age and gender distribution), in per capita income, and in the strength of competing trade centers. With these limitations in mind, however, it is hoped that the information provided will be useful to decision makers in both private and public sectors.

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