A NEW APPROACH TO DIVERSIFICATION STANDARDS: A CASE STUDY
IN SMALL COMMUNITIES

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Introduction

Economists generally consider communities whose economic base includes
a wide variety of activities to be healthier, ceteris paribus, than those
which depend heavily upon a small number of industries. Another important
consideration, especially for smaller places, is retail trade and service
activities.   Small communities cannot expect to offer the full range of
retail trade and service establishments which are available in larger
centers, however, it is in their interest to make every effort to offer as
many as possible. A large variety of these activities not only contributes
to the quality of life in these communities, but is essential to a well
rounded local economy which takes full advantage of the export income
generated by its basic employment.

Both threshold analysis and economic base studies are useful in identifying
opportunities for additional economic activity. However, neither provides a
specific indication of an appropriate level of diversification for small
communities of varying size. If diversity is a measure of economic health,
what is a healthy level of diversification and what are the variables which
need to be examined in determining this level?

Several studies have established the fact that diversity tends to vary
positively with the size of a city. A notable example is the study by
E. Ullman and M. Dacey which develops the minimum requirements technique [7].
In this procedure the lowest percentage of income or employment originating
in a specific industry group within cities of similar size serves as a standard
for the minimum requirement for that industry in all cities within a size class.

Other studies have used an arbitrary norm of equal percentages of income
and/or employment originating in each industry as a base against which to
measure industrial diversity. Still others use the national industry com-
position as a base for measuring diversity. For example, in a recent article

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by J. Marshall, he states "In what follows, a city is said to be diversified
if it resembles the weighted national profile, and specialized if it does
not" [3].

A New Approach to Diversification Standards

This study differs from prior studies in a number of ways:

1. It focuses on small towns in a specific region rather than large
   cities in a national context.

The concern with diversification in larger cities is understandable given
their importance to a nation's economy. It is also true that detailed secondary
data are generally more readily available for large metropolitan areas. However,
more than one-half of the cities in this nation have less than 1,000 inhabitants
[2]. Diversification for some of these communities is often more critical to
their economic health, as well as to the quality of life for their citizens,
than is true for larger centers.

2. It measures diversification relative to a multiple regression
   model which incorporates several variables other than population.

The original work on the minimum requirements approach by Ullman and Dacey
was properly criticized by R. T. Pratt largely on the basis of the norms used
to establish exports [5]. Pratt rightly suggests that averages are better
than minima for this purpose. Other authors have used regression models or
Gini indices to establish norms for diversification, but only population and
employment have been used as independent variables in these models [4]. It
is suggested here that many other variables, especially the distance to a city
of equal or larger size, and the ratio of the population of the larger city
to the city of origin, also have an important influence on diversification.
Further, inherent in the use of this technique is the suggestion that this
model may be peculiar to a specific region and that different, though perfectly
appropriate models might evolve for somewhat different aggregations of communities.

3. The number of two-digit S.I.C. codes represented by employers
   in a community is used as the dependent variable to indicate
   industrial diversification in this study. Most prior studies
   have used employment by broad industry groups (i.e., agri-
   culture, mining, construction, manufacturing, etc.).

In measuring diversification, it is possible to use almost any level of
disaggregation in industry groups. While the data for the case study used here
are available in a four digit S.I.C. code breakdown, this is an inappropriate
level of disaggregation for the objectives of this effort. In small towns,
a deficiency in grocery stores (S.I.C. 5411) can be offset by having groceries
available in a dairy products store (S.I.C. 5451) or a retail bakery (S.I.C.
5462). Thus, while the minimum requirements technique is not used here, the
standard being sought for small towns relates to the presence of an appropriate
variety of activity to provide a reasonable choice for the citizens of these
places. The four digit level would seem more appropriate for large cities

where greater degrees of specialization are both possible and expected.[1]

The Data Base

The data base for this case study includes all of the communities (27) in the seven county West Central Wisconsin Planning Region which employed between 150 and 750 persons in 1974. The communities had populations ranging from 579 to 2,089 persons [9]. There is a rather notable jump to the next level in the hierarchy of centers within the region with ten communities employing about 1,000 to 4,000 persons and one major metropolitan center (Eau Claire-Chippewa Falls) employing over 25,000 and having a population in excess of 50,000. The region is within the larger sphere of influence of the Minneapolis-St. Paul, Minnesota, metropolitan area.

The communities studied had per capita incomes in 1973 ranging from $2,666 to $4,118 and increases in money income per capita ranging from +6.4 to +57.0 percent in the five year period 1969 to 1973 [9]. All of these communities are properly "free standing towns" in that none are suburbs of larger centers. The closest larger communities are from 3 to 22 miles distant. Almost half of these communities (12) experienced declines in their population from 1960 to 1970 ranging from -0.5 to -9.1 percent. For the 15 communities with increases in population during that decade, the range was from +1.7 to +22.3 percent [8]. The number of two digit S.I.C. codes represented by employers in these communities ranged from 16 to 36.

The Explanatory Variables and the Model

At various stages in the development of this model, the following explanatory variables were tested:

1. Population of the communities being studied.

Because of economies of scale, agglomeration effects, and the percentage of income spent on various products, the diversity in economic activities within communities is positively correlated with population. As indicated above, previous studies have demonstrated a significant relationship between population size and diversification in metropolitan areas. This proved to be true for small towns in this case study as well. On the premise that there could be a lag in the impact of an increase or decrease in population on the

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[1]In one recent study the minimum requirements technique was used to establish local multipliers [4]. Because the multiplier is likely to be exaggerated unless a high level of disaggregation is used, no effort should be made to develop a local multiplier from this analysis. Local multipliers for each of the communities used in this case study have been identified elsewhere using four digit S.I.C. code data and the location quotient technique.

variety of firms in a city or town, the change in population of these communities was also tested as an independent variable, but it did not prove to be significant.

The population of the nearest larger community, however, did prove to have a significant impact on diversification. The relative size of the larger community proved more significant than either its absolute size or the absolute difference in the size of communities.

2. Employment in the communities studied.

Employment, like population, is both the cause and the effect of economic activity. While employment added to the explanation of diversification, it was highly correlated with population. Therefore, to avoid problems of multicollinearity, employment was eliminated because it was less significant statistically than population.

3. Distance to other large communities.

Distance is often viewed as a source of friction which discourages comparison goods shopping or commuting. It is logical, therefore, to assume that communities which are close to each other are more likely to experience intercommunity commuting and shopping than those which are more distant. Thus, it might be expected that more isolated communities would tend to have a higher level of diversification. In this case, distance to the nearest community with a larger population as well as distance to the closest metropolitan area were tested as independent variables. Only the former proved significant.

4. Income per capita in the communities studied.

The base of support for most enterprises is a combination of population and income. A given population can support a wider variety of activities if it has a higher level of income. Whether or not this occurs in the case of small towns depends upon where the higher income is spent. It was hypothesized, therefore, that a higher income per capita would provide a basis for greater diversification. Both the level of per capita income and changes in per capita income over various periods of time were tested as independent variables. While the level of per capita income was not significant, the change in per capita income in the most recent five year period did prove to be significant.

5. Traffic volume to and from the communities studied.

It was hypothesized that commuters, travelers, and tourists would influence the level of diversification in small towns. In an attempt to measure this effect, average 24-hour traffic flows on major arteries into the study communities as well as the number of such arteries were tested as independent variables. Neither measure proved to be significant in the final model.

Because the variables which evolved as significant are similar to those used in regional gravity models, and because the potential interaction between people increases exponentially as population increases, it was decided that a log-linear rather than a simple linear model was appropriate. This was supported

by the testing of both linear and log-linear forms of the model.

The final variables were identified by using stepwise regression techniques on a variety of combinations of the original variables. The final model takes the form:

$$\log S = B_0 + B_1 \log P + B_2 \log D + B_3 \log \left(\frac{P_L}{P} - 1\right) + B_4 \log$$

$$(1 + \Delta I) + \varepsilon$$

where

S = number of two digit S.I.C. codes represented by employers in a community

P = population of the community

P_L = population of the nearest community with a larger number of inhabitants

D = distance to the nearest larger community

ΔI = change in per capita income in the community in most recent five year period

ε = random error term

In this form the model explains in excess of 89 percent of the variation in the number of S.I.C. codes. An overall F-test of the regression model produced an F ratio of 21.80 with 4 and 22 degrees of freedom ($P < .0001$). The coefficients obtained (all of those for the explanatory variables being significantly [$P < .05$] different from zero) are:

B_0 = -1.17151 (0.60649)
B_1 = 0.56891 (0.09335)
B_2 = 0.11632 (0.05558)
B_3 = -0.04646 (0.01604)
B_4 = 0.76086 (0.29876)

The numbers in parentheses are the standard errors of the coefficients. Put into its original form the model can then be expressed as

$$S = 0.30989 \ P^{0.56891} \ D^{0.11632} \ \left(\frac{P_L}{P} - 1\right)^{-0.04646} (1 + \Delta I)^{0.76086}$$

As expected, the number of economic activities in a community, as reflected in the number of two digit S.I.C. codes represented by its employers, is an increasing function of the population of that community and of its distance from the nearest larger city. This measure of diversification is also an increasing function of the change in income in the most recent five year period.

A question can be raised here about the possible direction of cause and

effect, namely, is a rapid growth in income the result of diversification or is a higher level of diversification the result of faster income growth. This is a typical problem with interactive economic models, and it is likely that forces are moving in both directions.

Also, as expected, the level of diversification is inversely related to the ratio of the size of the population of the nearest larger center to that of the original community. The use of the ratio demonstrates that it is the relative difference in community size, rather than the absolute size of related communities which is most critical in influencing diversification.

An effort was made to determine whether or not the model used here would perform better in explaining the variety of retail trade and service activity as opposed to that in other sectors of the local economy. The results of this test were negative.

Reflecting on this outcome, it can be noted that most small towns in the region studied have only one or two manufacturing firms. Other activities which would not be classified as retail trade and services usually include some small scale wholesaling, special trade contractors, and agricultural services. Location choices for such firms are not unlike those for retail trade and service establishments and, therefore, gravity type models, as used here, prove to be as effective in explaining their absence or presence as they are when directed to the retail trade and services sector.

Establishing Standards for Diversification

One of the main reasons for initiating this effort was to provide a base for policy recommendations to small towns in their economic development efforts. The purpose, then, is to be able to tell the appropriate persons in these communities whether they should strive for greater diversification or be satisfied to attempt to encourage the expansion of existing enterprises. The above regression model identifies a "norm," and the number of activities in any community may be at, above, or below the number predicted by the model. This then is one possible standard. If a community is below the norm, greater diversification is in order; if above, then the community need not strive for greater variety in its economic activity. However, small deviations from the norm are usually insignificant and are not really a good basis for policy recommendations. Which communities are really far enough from the norm to be genuinely concerned?

If the communities used in the analysis are thought of as constituting a random sample from a large group of communities rather than a census, it is possible to construct confidence intervals for the mean of the predicted values for each community. Applying this technique allows somewhat more latitude in establishing norms for diversity.[2]

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[2]We take for an approximation to the confidence limits the expressions

$\exp [\hat{y}_i \pm t(\nu, 1-\alpha) \, S\sqrt{X_o' \, C \, X_o}]$ where X_o is the vector of parameters associated with the i-th community, C is the inverse of the X'X matrix associated with the log linear model, S^2 is the error mean square and $t(\nu, 1-\alpha)$ is the critical t value [1].

The choice of confidence intervals remains somewhat arbitrary, however, a 95 percent level is used in Figure 1. It may be noted that four communities fall below the 95 percent confidence interval and four are above that level.

In order to graphically display the information contained in the three sets of confidence intervals in Figure 1, the communities have been ordered on a uniform scale in the direction of increasing size of confidence intervals. The contours then represent the approximate upper and lower half lengths of each confidence interval. On the same vertical scale the residual for each community has been plotted above its relative location on the horizontal axis. Thus if a data point falls above or below the contour for a particular confidence level, it indicates that the observed number of S.I.C. codes for that community was outside that particular confidence interval for the predicted number of S.I.C. codes.

For those below the appropriate confidence interval it could be said that these communities are failing to provide a possible and appropriate variety of economic activities for their citizens; they are more vulnerable to changes which affect their individual employers; and they are not taking full advantage of the income potential generated by their economic base.

It might be assumed that those communities which are above the 95 percent confidence interval (or some other level) need not be concerned. However, to the extent that this represents an abnormal level of diversification, it might generate a higher than normal rate of business failure, especially in the retail trade and service sector.

Summary and Conclusions

The variety of economic activity (or industrial diversification) in the smaller employment centers of West Central Wisconsin is influenced not only by the population of these communities (as suggested by earlier studies) but by their proximity to larger communities and by the relative size of the nearest larger community. The level of diversification is also influenced by the rate of change in income. The combination of these four variables explains in excess of 89 percent of variations in diversification as measured by the number of two digit S.I.C. codes represented by employers in each community. When the observations of this study are formalized in a regression model, a standard is established for determining whether or not a community has a level of diversification which is appropriate to its circumstances. Past studies have relied on minima or averages using population as the sole variable in establishing standards for diversification. The use of a multiple regression model not only adds to the level of explanation, it also provides a more reasonable base for evaluating any community's level of diversification.

What is perhaps equally interesting is that some variables, which one might expect to influence diversification in the study area communities, did not prove statistically significant. For example, employment, which has been used in several earlier articles on this subject, did not remain in the model. The distance to large metropolitan areas, the absolute level of income, the direction and magnitude of changes in population, are all variables

FIGURE 1

Confidence Intervals for Number of
S.I.C. Codes Represented by Employers
in 27 Wisconsin Communities (1974)

RESIDUALS
(Observed - Predicted
No. of S.I.C. Codes)
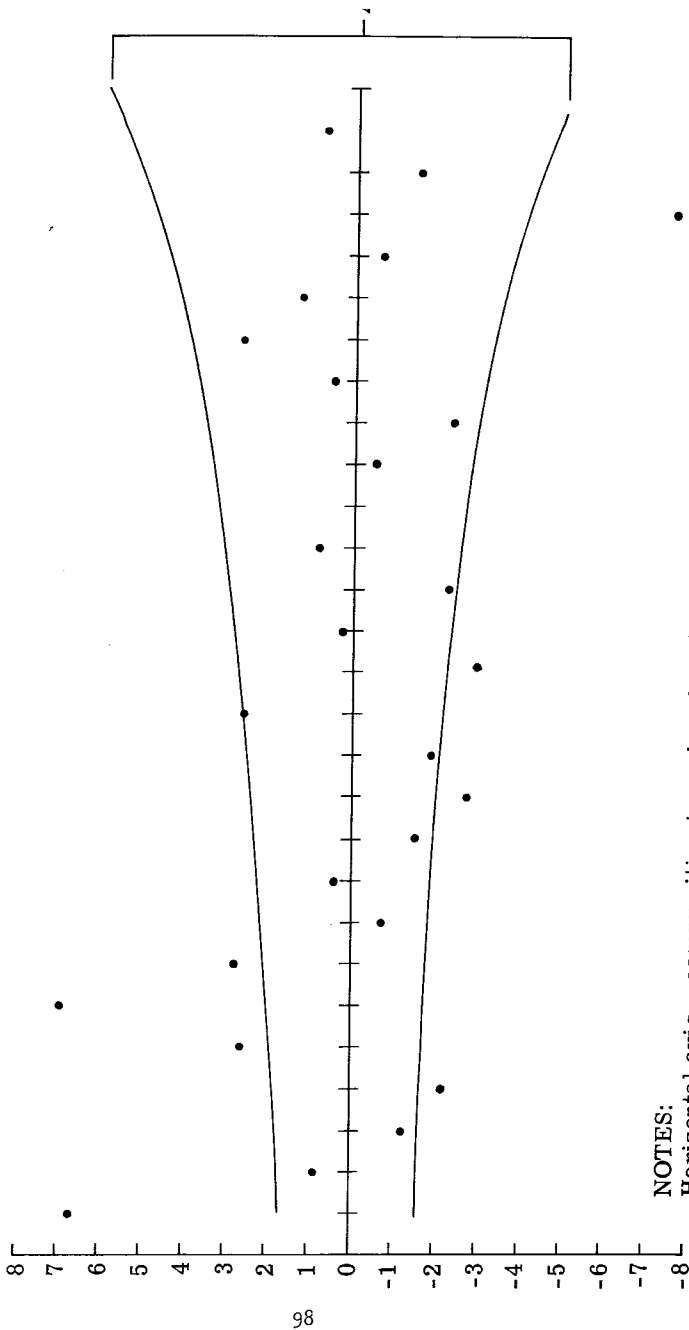
NOTES:
Horizontal axis - communities in rank order of predicted confidence interval lengths
X = observed residuals
A = 95 per cent confidence interval for predicted values

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which many people consider likely to influence diversification. When tested
by this model in West Central Wisconsin, they did not prove significant.
This is not to suggest that these variables should not be tested in other
regions. In some regions where there is a greater range in these variables,
they could prove significant.

.While a model of this type might be generalized by the use of national
rather than regional data, the results would be of largely academic interest.
For policy purposes diversification standards need to be established in each
region.

REFERENCES

1. Draper, N. R. and H. Smith. Applied Regression Analysis New York: Wiley University Press, 1966.

2. Henry, Edward. Micropolis in Transition, Collegeville, Minn.: Center for the Study of Local Government, St. John's University, 1971.

3. Marshall, J. U. "City Size, Economic Diversity, and Functional Type: The Canadian Case," Economic Geography, 51 (1), January 1975, 37-49.

4. Moore, C. L. "A New Look at the Minimum Requirements Approach to Regional Economic Analysis," Economic Geography, 51 (4), October 1975, 350-356.

5. Pratt, R. T. "An Appraisal of the Minimum Requirements Technique," Economic Geography, 44 (1968), 117-124.

6. Tiebout, Charles M. The Community Economic Base Study, New York: Committee for Economic Development, 1962.

7. Ullman, E. L. and M. F. Dacey. "The Minimum Requirements Approach to the Urban Economic Base," Papers and Proceedings of the Regional Science Association 6 (1960), 175-194.

8. U. S. Department of Commerce. 1970 Census of Population, Number of Inhabitants, Wisconsin.

9. Wisconsin State Department of Revenue. Taxes, Aids and Shared Taxes in Wisconsin Municipalities, 1973.