AN EMPIRICAL INVESTIGATION OF THE RELATIONSHIP BETWEEN COMMUNITY CHARACTERISTICS AND THE PRESENCE OF INDUSTRIAL PARKS

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Introduction

The theory and actual outcomes of business location decisions have been extensively explored in the literature of urban and regional economics. Major theoretical pieces include Fischel [4], Miller and Jensen [16], Moses [19], and Schmenner [26]. Examples of applied work include Campbell [1], Fox [5], McMillan [15], Schmenner [27], Wasylenko [28], and those referred to in Due [3]. Increasingly, attention has focused on models that acknowledge the important role of community behavior in the decision calculus (see Domowitz and Peddle [2], McGuire [13], and McHone [14]). More careful data gathering and analysis, combined with richer model formulation, have significantly increased our understanding of the business location decision. Despite this increased attention and knowledge, one particular institution that permeates the choice set from which firms make their location decision remains an empirical mystery. This institution is the industrial park.

Peddle [25] was the first attempt to empirically account for the influence of industrial parks on intrametropolitan firm location. He introduced two industrial park variables into his model: 1. the number of total acres of industrial park land in the community, and 2. the number of vacant acres of industrial park land in the community. His results indicated a statistically significant positive effect of industrial parks in a community on firm location. This effect was consistent across the three time periods investigated in the study, as well as in the panel analysis of the data. (The panel results are reported in an enhanced form in Domowitz and Peddle [2].). However, this simple introduction of industrial parks as an attribute of communities is only the tip of the iceberg. It only says that communities with a concentration of firms in a park, or at least the availability of sites that will allow such a concentration of firms, are more likely to attract firms. The more fundamental question is what attributes of a community are likely to affect the probability of there being an industrial park.

As background, this paper begins with a discussion of the economic theory motivating the relevance of industrial parks as a determinant of location choice by firms. This should also give some indication of what types of firms might be especially attracted to an industrial park. Given this theoretical base, the major focus of the paper is an empirical investigation of the characteristics that help to explain the presence or absence of industrial parks in a community.

It is well established in spatial economic theory that profit maximizing firms will seek to locate productive capacity so as to minimize the location-imposed costs of access to their factor and product markets. (See Moses [19] and Miller and Jensen [16].) It is also well settled that the criteria used in business location decision vary in a predictable manner with the level of the location decision (e.g., intrametropolitan and intermetropolitan location decisions are made using different criteria).[1] For example, local taxes appear to enter as a criterion only after other criteria have considerably narrowed the geographical area of search. The availability of an industrial park location would appear to fall into the same category as taxes, i.e., a tertiary decision criterion (Schmenner [27]), a notion supported by the results reported in Peddle [25].

As part of the decentralization/suburbanization of American cities, the industrial park developed as a particular institution that encouraged the concentration of economic activity. (See the discussion in Moses and Williamson [20] and Moriarty [18].) Two complementary explanations of the attractiveness of industrial parks are theoretically justified. First, industrial parks represent an institutional effort to meet the needs of prospective and existing firms in terms of the same basic amenities that numerous empirical and theoretical works have suggested to be relevant for business location decisions. These amenities include water and sewer lines, arterial highways, fire and police protection, and rail and air access. (See the empirical studies cited in footnote 1.) This only says that the successful industrial park will possess characteristics consonant with those typically identified with ideal industrial sites, an empirically testable proposition and the focus of this paper.[2] In addition, the presence of an industrial park in a community implies at least a passive acceptance of industrial development, although the community's willingness to accept development may be very dependent upon the ability to isolate conflicting land uses. The opportunity to isolate industrial development from other land uses is a potentially attractive feature of industrial parks.

In theory, industrial parks may be developed and/or administered either publicly or privately. In practice, economies of scale in design, construction, and administration seem to make the privately developed/administered industrial park the rule, with public parks generally an exception. However, even with private developments, the community typically exercises its influence through zoning, land use controls, and other development tools. An interesting question beyond the scope of this paper is the factors that differentiate public and private development of industrial parks.

A second more unique and nebulous explanation is the industrial park's attractiveness as a means for exploiting economies of agglomeration. Economies of agglomeration refer to the economic advantages of proximity in location. Among the benefits of proximity are potential economies of scale in such things as public services, purchase of inputs, local advertising, and private service contracts to name but a few.[3]

The Estimating Equation

The principal question investigated in this paper is that of whether the presence of an industrial park(s) in a community can be predicted on the basis of community characteristics. The hypothesized relationship is expressed symbolically in equation (1).

$$IPARKDUM = f(HWY, RR, OHARE, FIRE, PDEN, POP, AGE, PDIF) \quad (1)$$

where:

IPARKDUM	= dummy variable indicating the presence of an industrial park(s) in the community (IPARKDUM = 1 if park(s) is present).
HWY	= number of arterial highways in the community.
RR	= number of rail lines in the community
OHARE	= distance of the community from Chicago O'Hare Airport.
FIRE	= quality of fire protection as measured by the Insurance Services Office (ISO) rating for the community and translated into dollars through the independent effect of the rating on fire insurance premiums.
PDEN	= population density of the community
POP	= population of the community
AGE	= age of the community (based upon date of incorporation).
PDIF	= change in the population of the community from 1967 to 1977.

We would expect communities that are more accessible to be better candidates for the location of industrial parks and for firm location in general. In terms of equation (1), this theory would imply a positive sign on HWY and RR, while we would anticipate a negative sign on OHARE because larger values of this variable indicate greater distance from the airport and hence lower accessibility to airport services.

Communities characterized by higher quality fire protection as measured by the ISO index are more likely to have industrial parks. Thus we would expect a negative sign on FIRE, because this variable takes the ISO index and converts differences in the fire protection ratings into dollar differences in fire insurance premiums.[4]

While the first four variables included in equation (1) are familiar and relevant in the decision process of the firm, the last four may be more relevant in determining the likelihood of a park in a particular community. AGE, PDEN, POP, and PDIF represent characteristics that may capture the community's ability and/or willingness to accept the industrial park. Older communities would seem to be less likely to contain industrial parks due to the more entrenched land use patterns that occur over time. Inertia is a difficult barrier to overcome in land use and zoning. Newer communities would seem to be better candidates for the concentrated industrial development that the parks represent. This inertia effect is discernable in the cross section results reported in Peddle [25] where age consistently has a negative influence on firm location in a community.

Population density is expected to enter the equation with a negative sign. The more densely populated a community, the more difficult it is to accommodate industrial and commercial land use, because ceteris paribus higher population density implies more intensive residential land use. With widespread, intensive residential land use, one would also expect that the isolation of commercial and industrial use would be more difficult to achieve.

On the other hand, we would expect positive signs on both PDIF and POP. Growth in population would increase the number of consumers of public goods, reducing the existing taxpayer cost shares. In addition, growth in population would help fund (as well as help promote) additions to the community's infrastructure. These effects would increase the likelihood that a community could accept an industrial development, as well as increase the attractiveness of such a development to both households and firms due to the increase in infrastructure and decrease in taxpayer shares (in dollars). The effect that industrial parks have on local finances is an interesting and complicated empirical question, a question beyond the realm of this particular paper.

The size of a community must also be acknowledged as a factor affecting the probability of an industrial park. Ceteris paribus, larger communities would simply have more space and the possibility of a larger industrial base, factors that would appear to increase the probability of industrial park development. Controlling for population density, a community with a larger population will have a larger area than a community with a smaller population. Thus, by measure of population or area, larger communities will be characterized by a larger POP value in our model.[5] This translates to an expected positive sign on POP.

The Data and Estimation Methodology

The data set is comprised of observations for 182 municipalities in the Chicago metropolitan area for the years 1967, 1972, and 1977. This represents more than 95 percent of the incorporated communities in the three collar counties of Chicago. Several communities failed to file appropriate state documents with the Illinois Comptroller's Office or were not in existence over the entire time period. These problems resulted in the exclusion of about ten communities from the data set. Information on these communities and on the data sources are available from the author.

Data on industrial parks is taken from the annual industrial park surveys done by the Chicago Association of Commerce and Industry. Almost every industrial park in the data is a private development.

Because the dependent variable in equation (1) is dichotomous, the equation was estimated using maximum-likelihood probit and logit techniques. Given the very similar results of probit and logit regressions, only the former are reported.[6]

Results

Cross sectional regressions were run for all three time periods. The results are reported in Tables 1, 2, and 3. The first thing one should note in these tables is that the signs of the coefficients on all of the explanatory variables are consistent with our theoretical expectations. The second thing is that the relative magnitudes, the signs, and preciseness of estimation of the coefficients are remarkably similar across regressions. This consistency is reassuring.

More specifically, in Table 1 using 1967 data PDEN, PDIF, RR, FIRE, and OHARE have statistically significant explanatory power. A higher population density and higher fire insurance rates seem to reduce the probability that we will find an industrial park in a particular community. On the other hand, population growth, rail lines, and closer proximity to the airport seem to increase the probability of finding an industrial park in a community. The insignificant coefficient on HWY in the cross section results is somewhat surprising given the strong positive influence of this variable on business location discerned in Domowitz and Peddle [2], Moses and Williamson [20], and other studies.

Table 2 using 1972 data for the most part reinforces the results of Table 1. Two notable differences are the relatively more precise (i.e., a relatively smaller standard error of the estimate) estimates of the coefficients for POP and OHARE. Both variables enter with their hypothesized signs.

Table 3 reports the results using the 1977 data. While generally in qualitative agreement with Tables 1 and 2, a couple of distinguishing results should be pointed out. First, AGE enters with a statistically significant negative sign. Second, the coefficient on POP is now significant at the 5 percent level, while the coefficient on PDIF is less precisely measured and is only significant at the 10 percent level.

Given the intertemporal results, it would seem defensible to perform a simple pooling of the data to form a larger data set that intuitively would provide greater variance in the values of the variables, a larger number of observations, and should increase the efficiency of the estimates. The remarkably similar results across cross sections suggests that pooling might be justified. In Table 4, time dummies are introduced into the pooled regression to capture any unique attributes associated with the time period from which the observation was taken (1972 is the excluded category). These time dummies capture structural macro effects over the three time periods. Unlike the other regressors that measure individual community influences, the TIME variable allows for changes in aggregate conditions. Because none of the variables are expressed in current dollars, there is no need to deflate.

As one can quickly see, the estimates from the pooled data are much stronger, in terms of the significance of the coefficients, than those from any of the individual cross sections and exhibit theoretically consistent signs. All of the coefficients are significant (at the 5 percent level) with the notable exceptions of the TIME dummies. Once again, these results are very encouraging as they provide strong support for our a priori hypotheses regarding the influence of community characteristics on the presence of industrial parks. HWY and RR both enter with significant positive signs, and OHARE enters with a significant negative sign, supporting the theory that the accessibility of a community as measured through the availability of transportation nodes is positively related to the presence of industrial parks. FIRE enters with its expected negative sign, lending support to the notion that higher quality fire services are positively related to the presence of industrial parks (or at least that the availability of sewer and water services is). Population growth (PDIF) and PDEN also enter with their expected signs and their coefficients are significant. The results for AGE tend to support our argument that older communities would be less likely to be the location of industrial parks. The coefficients for the time variables are not significant, indicating that aggregate conditions over this time span did not represent statistically significant shift effects. The negative sign for the 1977 dummy is consistent with the results in Peddle [25] that noted overall deterioration in the aggregate economy, deterioration that might indicate that industrial parks were less likely to arise during this time period.

Conclusion

The goal of this paper was to examine the relationship between community characteristics and the probability of industrial parks. The results strongly support the extension of conventional spatial economic theory to this interesting issue. Access and amenity variables are found to be positively related to the presence of industrial parks. This reinforces the hypothesis that a successful industrial park should have the attributes of an ideal industrial site. In addition, a community's age, size, population growth, and population density are also shown to be statistically significant explanators affecting the probability of industrial park presence.

This is a small step on the way to a better understanding of the role of industrial parks in the local and regional economy. Future research must attempt to unlock the empirical mystery of the relationship between firm characteristics and industrial park locations, as well as the key issue of the effects of industrial parks on community fiscal health.

Endnotes

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1. See Pacific Consultants [22] or Peddle [25] for a summary of the findings and for specific identification of the various criteria use at different stages in the location decision. Schmenner [27] provides an excellent explanation of the multi-tiered nature of the business location.

2. Once again, characteristics widely associated with ideal industrial sites include accessibility, sewer and water hookups, and finished grading. This issue is especially well discussed in Moriarty [18] and McMillan [15].

3. Mills and Hamilton [17] identifies three particular agglomeration economies:

> 1. Sales of outputs and purchases of inputs fluctuate for random, seasonal, cyclical, and secular reasons. To the extent that such fluctuations are imperfectly correlated across firms, greater stability in output, employment, and prices can be achieved when a large number of firms and households are located in close proximity to one another.
>
> 2. When firms have complementary labor needs or utilize commodities that can be more cheaply produced together rather than separately, those firms will find cost savings to locating in close proximity to one another.
>
> 3. Spatial concentration of large groups of people permits a large amount of personal interaction, that in turn generates new ideas, products, and processes. Such technical progress is viewed as economically advantageous. (Mills and Hamilton [17, p. 18])

4. This conversion was completed through the cooperation of a State Farm Insurance Company office in Evanston, Illinois. The FIRE variable introduces a relatively continuous way of measuring the quality of fire protection in a community. The continuity and intuitive interpretation of the variable is provided through conversion into dollar terms. However, the variable is not intended to be the fire insurance premium actually faced by the firm, although ceteris paribus the fire insurance premium faced should be ordinally measured by FIRE. Fire protection ratings change very slowly over time, and thus FIRE exhibits very little intertemporal variation within a given community.

It has been suggested that the ISO rating is not a very good measure of fire protection quality due to its almost exclusive reliance on determining whether the community is characterized by the availability and proximity of water hydrants. At worst, this criticism seems to suggest that FIRE might be more appropriately viewed as a proxy for the availability of sewer and water facilities in the community, a relevant and important variable not otherwise explicitly introduced in the model. This interpretation would also be very consistent with the extremely strong performance of this variable in the reported regressions. Both fire protection and sewer/water services have been identified as basic amenities that contribute to the attractiveness of locations for business.

5. Area was introduced into the model, both in the presence and absence of the POP variable, and was found to offer no significant additional explanatory power. In addition, in the normal evaluation of regressors for potential multicollinearity problems, the introduction of both AREA and POP into the model did not seem prudent.

6. See Kennedy [9] or Maddala [11] for the econometric theory of the estimation of binary dependent variable models. Logit and probit estimations were both performed to verify the consistency of results and to allow some comparison of the answers given by the different methods. The logistic and cumulative normal functions are very close in mid-ranges and the choice of functional form essentially is irrelevant except in cases where the data are highly concentrated in the tails of the distribution(s) (Kmenta [10, p. 555]). Well-developed theory to guide the researcher in choosing between functional forms is lacking. Typically, researchers have opted for the logit model due to its computational advantages, especially in terms of the ability to avoid costly maximum-likelihood estimation through the use of the log-odds formulation. However, use of any least squares methods requires a heteroscedasticity correction and thus introduces an additional (although not costly in terms of computer time) step into the estimation process. As mentioned, this paper used maximum-likelihood econometric methodology that produces asymptotically normal estimators with all of the desirable asymptotic econometric properties. Kmenta [10] has a rigorous but readable discussion of these issues.

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Table 1
Community Characteristics and the Presence of Industrial Parks in 1967

PROBIT

Variable	Coefficient	Std. Error	Elasticity at mean
Constant	3.1394**	1.5260	3.4230
AGE	-0.00396	0.0043	-0.1931
PDEN	-0.000186**	0.0000669	-0.6217
POP	0.0000132	0.0000139	0.1529
PDIF	0.0000645**	0.0000223	0.3693
HWY	0.1172	0.08841	0.3701
RR	0.2874**	0.1102	0.4649
FIRE	-0.02219**	0.00870	-4.0543
OHARE	-0.02011*	0.01178	-0.3800

Likelihood Ratio Test (8 d.f.)	= 59.9721
Maddala R-Square	= .2807
Cragg-Uhler R-Square	= .3828
Hensher-Johnson Normalized Success Index	= .2900

NOTE; * = significant at .10 level, ** = significant at .05 level

Table 2
Community Characteristics and the
Presence of Industrial Parks in 1972

PROBIT

Variable	Coefficient	Std. Error	Elasticity at mean
CONSTANT	3.2652**	1.3334	3.0087
AGE	-0.00642	0.00453	-0.2642
PDEN	-0.000220**	0.0000615	-0.7418
POP	0.0000222*	0.0000127	0.2922
PDIF	0.0000828**	0.0000251	0.4009
HWY	0.0917	0.0852	0.2502
RR	0.2469**	0.1111	0.3350
FIRE	-0.0193**	0.00707	-2.9817
OHARE	-0.0296**	0.01215	-0.4727

Likelihood Ratio Test (8 d.f.)	=	69.9971
Maddala R-Square	=	.3193
Cragg-Uhler R-Square	=	.4282
Hensher-Johnson Normalized Success Index	=	.334

NOTE; * = significant at .10 level, ** = significant at .05 level

Table 3
Community Characteristics and the
Presence of Industrial Parks in 1977

PROBIT

Variable	Coefficient	Std. Error	Elasticity at mean
Constant	3.0237**	1.2823	2.6206
AGE	-0.0104**	0.00439	-0.4036
PDEN	0.000168**	0.0000540	-0.5470
POP	0.0000335**	0.0000132	0.4602
PDIF	0.00004050*	0.0000244	0.1844
HWY	0.0708	0.0804	0.2020
RR	0.2551**	0.1066	0.3475
FIRE	-0.01921**	0.00679	-2.0876
OHARE	-0.0111	0.0117	-0.1281

Likelihood Ratio Test (8 d.f.)	=	58.3403
Maddala R-Square	=	.2743
Cragg-Uhler R-Square	=	.3666
Hensher-Johnson Normalized Success Index	=	.2810

NOTE: * = significant at .10 level, ** = significant at .05 level

Table 4
Community Characteristics and the Presence of Industrial Parks
Pooled Time Series-Cross Section Data Set

PROBIT

Variable	Coefficient	Std. Error	Elasticity at mean
Constant	3.1086**	0.7776	2.9660
AGE	-0.006806**	0.00250	-0.2902
PDEN	-0.000186**	0.0000341	-0.6212
POP	0.0000222**	0.00000729	0.2878
PDIF	0.0000651**	0.0000134	0.3262
HWY	0.0934**	0.0483	0.2719
RR	0.2555**	0.06238	0.3679
FIRE	-0.01960**	0.00417	-3.1335
OHARE	-0.0199**	0.00680	-0.3288
TIME67	0.0154	0.1498	0.0049
TIME77	-0.2405	0.1521	-0.0765

Likelihood Ratio Test (10 d.f.)	=185.267
Maddala R-Square	= .2877
Cragg-Uhler R-Square	= .3869
Hensher-Johnson Normalized Success Index	= .2980

NOTE: * = significant at .10 level, ** = significant at .05 level