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Evaluating the Influence of Amenities on the Location of Manufacturing Establishments in Urban Areas

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Summary. Public and private planners concerned with economic growth and development are increasingly marketing intangible characteristics. This paper investigates the notion that amenities influence manufacturers' location choices in urban areas. If amenities affect wages, land values and other costs, then amenities will influence location decisions. Using urban, county-level, Census data, regression models were estimated for the location of small and medium-sized manufacturing establishments. Holding constant scale and agglomeration economies, amenities, measured by a quality-of-life index, are found to influence manufacturers' location with the effects varying by industry. Labour-intensive industries are more strongly attracted to high-amenity urban locations.

Introduction

The success of an urban area's economic development strategy in part depends on how well it addresses issues important to relocating businesses and those that are already established. To this end, subsidies, tax concessions, special financing, infrastructure development and other accommodations are used by governments to attract and retain businesses. Although these incentives are relevant, the focus of this paper is on the effects of location-specific amenities on manufacturers' location in urban areas.

Amenities affect profits much as other economic factors do. However, unlike other inputs which may be varied without moving, manufacturers vary amenities by changing location. Local amenities affect profits, specifically cost, indirectly through wages and property values. An urban area's institutional and structural features also create a local amenity, or production shifter, which potentially affects costs and profits. In this paper, a quality-of-life index is used to measure amenities in urban counties. The index accounts for three broad amenity categories: environmental quality, climate and urban conditions. Urban county-level US Census data on population, area and large manufacturers are used to capture the effects of production shifters.

Given that amenities affect production cost, they also affect manufacturers' location patterns in urban areas. Amenities are expected to have a stronger influence on the

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location decisions of labour-intensive manufacturers since amenities primarily affect wages and rents. This paper explores these contentions by analysing the effect of amenities on the location of small to medium-sized urban manufacturing establishments.

Amenities and the Location of Urban Manufacturing Establishments

The literature devoted to manufacturers' location has been dominated by studies that emphasise: output and input markets, transport cost, raw-material location, energy and water availability and community/site factors. This emphasis is understandable since these are primary factors one considers when choosing a location. However, today, because of declining transport cost and because other costs are more constant across many urban areas, factors such as amenities are becoming more important to the location decision. Despite this 'death of distance' local scale economies and agglomeration economies still lower cost and influence location.

The framework supporting the contention that amenities affect manufacturers' location in urban areas is developed in Granger (1993). To illustrate the logic of this contention, consider a situation where profit-maximising manufacturers and utility-maximising workers have a choice between two urban locations. The locations are identical except for their amenity endowment. Now, assume that one area is amenity-rich and the other is amenity-poor. Furthermore, assume that manufacturers are either labour-intensive or land-intensive and workers are identical. A combined wage and rent differential between the two locations will materialise as the labour and housing markets equilibrate.

The amenity-rich location will offer a combination of wages and rents with which the amenities are purchased. The amenity-poor location will offer a combination of wages and rents which compensate for the lack of amenities. For example, the amenity-rich location might offer lower wages and higher rents. Conceivably, this combination of wages and rents would exist if, all else held constant, most workers chose to locate in the amenity-rich location. Thus, the increased competition for jobs and land, in the amenity-rich location, would push wages down and land prices up. In other words, the increase in labour supply would cause wages to fall and the increase in demand for land would cause its value to rise. Conversely, workers' dislike for the amenity-poor location and their exodus therefrom, would cause land prices to fall and wages to rise.

Under these conditions, it is likely that the labour-intensive manufacturers would find production costs minimised where amenities are abundant. The land-intensive manufacturers would probably minimise their production costs where amenities are scarce. Since the manufacturers are assumed to be profit-maximisers, the least-cost location would be chosen.

If amenities were purchased with other combinations of wages and rents, this framework would not have implications for location preferences which are as straightforward.[1] It would still, however, suggest that agglomerative effects and amenity-compensating wage and rent differentials influence total cost and thus location.

Measures of Amenities which Influence Urban Manufacturing Location

The empirical relevance of location-specific amenities to urban manufacturing location is explored by analysing the number of manufacturing establishments in 185 urban areas. Two types of amenities are utilised: hedonically measured amenities and production shifters. The hedonically measured amenities come from a quality-of-life index (*QOLI*) and its components. The production shifters account for local scale economies and agglomeration economies. Both types of factors are expected to influence location.

Hedonically Measured Amenities: QOLI

The quality-of-life index for the urban counties is based on preferences. The value of amenities is determined by the rents which consumers are willing to pay and the wages which workers are willing to accept in order to locate in the county. Thus, wages and rents in a particular county are influenced by its amenity bundle. The values of amenities are estimated by Blomquist *et al.* (1988) by regressing wages and rents on various quantifiable location-specific amenities. Housing prices (rents) and wages are measured in terms of annual amounts. The regression coefficients are the implicit, marginal amenity values. These amenity values are used as weights to construct a quality-of-life index. Amenities are referred to as traits. By definition, the full implicit price for trait k (FP_k) is the sum of its housing market price (LP_k) and the negative of the labour market price (WP_k).

$$FP_k = LP_k - WP_k \tag{1}$$

Equation (1) implies that consumers/workers view amenities with positive (negative) full prices as beneficial (detrimental). The value of the *QOLI* is simply the sum of the full prices of the locality's traits multiplied by the locality's trait endowment. *QOLI* is created as follows:

$$QOLI_j = \sum_k (FP_k \cdot T_{kj}) \tag{2}$$

where T_{kj} represents the quantity of trait k in county j.

The *QOLI* is composed of three types of trait: climate (*CL*), urban condition (*UC*) and environmental quality (*EQ*). There are seven components of *CL*: precipitation, humidity, heating degree days, cooling degree days, wind speed, sunshine and coast. There are three components to *UC*: violent crime, teacher–pupil ratio and central-city status. There are six components to *EQ*: visibility, total suspended particulate, landfill waste, water pollution dischargers, Superfund sites and, lastly, hazardous waste treatment, storage and disposal sites. The data on *QOLI* values are from the study reported in Blomquist *et al.* (1988). The study provides values of the *QOLI*, which is a measure of amenities in each urban county included in the sample. The sample in the current study of urban manufacturing is chosen to match the sample of the earlier *QOLI* study so that the index can be used. In all, the sample contains 253 urban counties in 185 Standard Metropolitan Statistical Areas (SMSAs) across the US. Since the *QOLI* is constructed primarily from 1980 data, the manufacturing establishment and production shifter data were chosen to match this time-frame.

Production Shifters: Local Scale and Agglomeration Economies

An urban area's institutions, infrastructure, existing economic base and demographic characteristics combine to create a local advantage which potentially affects all manufacturers in the area. This advantage may augment a particular factor of production or the entire production process. In some cases, these benefits will be external to the manufacturer but internal to a particular industry. Alternatively, they may be external to both the manufacturer and the industry. The term, production shifter, is often used to describe the efficiency gains associated with these local advantages (Nicholson, 1995).

The production shifter variable attempts to account for two types of efficiency gain found in urban areas: local scale economies and agglomeration economies. Local scale economies are, in part, due to complementarity in production and in labour supply. The existence of specialised services and the progressive and innovative natures of urban areas are also contributory factors. These advantages are highly correlated with population. For this reason, SMSA population (*POP*) was chosen as a proxy for area-wide scale economies. *POP* typically will be greater than county population.

Each county contained in this study is assigned a *POP* value determined by the 1980 population of the SMSA containing that county. If there is more than one county in an SMSA, each will have the same production shifter. In this data set, 68 counties share an SMSA with at least one other county. SMSA population is also chosen because it minimises potential causality problems resulting from the possibility that business activity causes population changes. This potential problem is more likely for the aggregate industry summary, than for the individual industry classes. Industry classifications are discussed in more detail below. Causality is assumed to run from population to business. Population (*POP*) data are obtained from the *State and Metropolitan Area Data Book*.

The second production shifter accounts for agglomeration economies (*AGGL*). Large manufacturers attract smaller ones which supply them with intermediate and complementary inputs. This behaviour typifies agglomeration economies and is proxied by the number of manufacturers with 500 or more employees located in the county. When choosing the employment size class which would delineate *AGGL*, two classifications seemed intuitively plausible: establishments with 500 or more employees and establishments with 1000 or more employees. In order to avoid the empty-cell problem, a classification based on 1000 or more employees was not chosen as the primary cut-off. Regression results for the model containing *AGGL* designated at 500 or more employees are presented and form the basis for the analysis presented here. These results are compared with the results obtained when *AGGL* is omitted and when it is designated at 1000 or more employees. These comparisons will provide an insight into the sensitivity of the model to the *AGGL* variable.

AGGL provides an important link to factors not included in the model. Since very large manufacturers are less mobile at any point in time, their presence indirectly tells us about prior location decisions. These decisions were likely to have been heavily influenced by the location of markets, raw materials, the availability of energy and water and transport cost. Since these factors are not explicitly accounted for in this study, *AGGL* indirectly proxies these important location factors.[2] Using *AGGL* as a regressor and removing it from the number of establishments facilitates focusing on smaller, more mobile manufacturers. These smaller establishments are more likely to be footloose or amenity-oriented and are increasingly becoming more important to urban planners. *AGGL* values are obtained from the *County Business Pattern* data tape.

The final variable, land area (*AREA*), is used to control for county size. These values are obtained from the *County and City Data Book* data tape.

Urban Manufacturing Establishments

Standard Industrial Classification (SIC) codes 20–39 are used to group manufacturing activity. An aggregate summary variable for all manufacturing is also considered; it is designated SIC 19. The data are cross-sectional 1980 US Census data for urban counties, which match the *QOLI* data. Two models are estimated to analyse the effects that amenities have on urban manufacturers' location. In both models the dependent variable is the number of manufacturing establishments with less than 500 employees (*NOE*).

$$NOE_{ij} = \beta_{i0} + \beta_{i1}POP_j + \beta_{i2}AREA_j + \beta_{i3}AGGL_j + \beta_{i4}QOLI_j + \varepsilon_{ij} \quad (3)$$

$$NOE_{ij} = \alpha_{i0} + \alpha_{i1}POP_j + \alpha_{i2}AREA_j + \alpha_{i3}AGGL_j + \alpha_{i4}EQ_j + \alpha_{i5}UC_j + \alpha_{i6}\mathrm{CL}_j + \varepsilon_{ij} \quad (4)$$

where, the i and j subscript represent industry class and county, respectively.

In order to emphasise the manufacturer's decision to locate in a given county, the number of establishments, *NOE*, is used as the dependent variable rather than employment. Since this paper is concerned with ascertaining, generally, whether amenities affect the location decisions, the analysis was conducted at the 2-digit level. At the 3- and 4-digit levels many urban areas in the sample did not contain many of the industries. In order to avoid an empty-cell problem, the analysis is conducted at the broader, 2-digit SIC level.

Table 1. Definition of variables and units of measurement

Variable	Definition	Unit of measurement
QOLI	Quality-of-life index	1980 Dollars
EQ	Environmental quality, part of *QOLI*	1980 Dollars
CL	Climate, part of *QOLI*	1980 Dollars
UC	Urban conditions, part of *QOLI*	1980 Dollars
POP	SMSA population	Number of persons
AREA	Land area	Square miles (1 sq ml = 2.59 sq km)
ESTB	Manufacturing establishments	Number
NOE	Manufacturing establishments with fewer than 500 employees	Number
AGGL	Manufacturing establishments with 500 or more employees	Number
PPVA	Labor intensity	Annual payroll divided by annual value added

Empirical Results for Urban Manufacturing Location and Amenities

Overall Amenity Effects

The overall performance of amenity variables suggests that amenities do influence manufacturing location in urban areas and that the influence varies by industry and by type of amenity. Definitions and descriptive statistics for all variables are shown in Tables 1 and 2. Estimates for aggregate manufacturing, SIC 19, are shown in Table 3. Caution should be used when drawing conclusions from the industry summary since it contains a broad spectrum of industries. This summary classification is composed of industries that emit varying degrees of pollution, differ in factor intensity and are technologically diverse. Nevertheless, this broad level of analysis supports the notion that amenities influence manufacturers' locations.

The amenity variables, *QOLI*, *EQ* and *CL*, each had coefficients which were statistically significant in their respective equations. Holding the production shifters and *AREA* constant, the effects of *QOLI* in equation (3) and *CL* and *EQ* in equation (4) show that amenities affect manufacturers' location in urban counties. *QOLI* is a composite of three separate amenity components. In spite of this, overall results help to establish that amenities matter to urban manufacturers' location decisions.

Estimates for the individual industry classes, SIC 20–39, for the small and medium-sized manufacturers, *NOE*, are reported in Table 4. The overall composite index, *QOLI*, is positive and significant at the 90 per cent level for 8 of the 20 industry classes and is never negative and significant at a comparable level.

The effect of climate, *CL*, is positive and significant at the 90 per cent level for 15 of the 20 industry classes and is never negative and significant at a comparable level. The evidence is that the number of manufacturing establishments in a given urban county is correlated with good climate. This influence is understandable since extreme climatic conditions impose additional costs on both manufacturers and workers. Food, clothing and shelter costs will typically be influenced by regional climatic conditions. This result suggests that favourable climatic conditions improve a location's attractiveness.

It is difficult to ascertain why *UC* was insignificant. This variable was insignificant for the industry summary and for all but one industry class, SIC 32. Recall that *UC* is composed of measures of violent crime, teacher–pupil ratio and central-city status. These variables should exert a measurable influence upon the location decision. Perhaps at the 2-digit level these effects were not being captured. (Analysis at the 3- and 4-digit level was considered, but could not be

Table 2. General statistics: all variables

Variable	*N*	Mean	Standard deviation	Minimum	Maximum
QOLI	253	185.97	667.15	− 1 856.70	3 288.72
EQ	253	− 255.57	235.40	− 1 501.41	− 47.41
CL	253	− 844.07	522.42	− 2 220.25	818.69
UC	253	1 285.60	473.73	− 275.32	3 615.07
POP	253	1 258 460	1 725 100	102 930	9 120 350
AREA	253	1 057.03	1 787.20	22.00	20 064.00
ESTB	253	695.24	1 568.37	47.00	18 509.00
NOE	253	689.59	1 560.85	46.00	18 440.00
AGGL	253	5.65	9.38	0.00	86.00
PPVA	21	0.42	0.11	0.15	0.62

Table 3. Overall effects of amenities on number of manufacturing establishments (*NOE*), aggregate manufacturing: SIC 19

Variable	Parameter estimate (β)	*T*-test[a]	Observations	*F*-alue	R^2
$NOE_{ij} = \beta_{i0} + \beta_{i1}POP_j + \beta_{i2}AREA_j + \beta_{i3}AGGL_j + \beta_{i4}QOLI_j + \varepsilon_{ij}$					
QOLI	0.20080	2.887			
POP	0.00018	6.220			
AREA	0.05841	2.359			
AGGL	54.73656	25.433			
INTERC	− 378.693	− 5.842	253	253.9	0.8038
$NOE_{ij} = \alpha_{i0} + \alpha_{i1}POP_j + \alpha_{i2}AREA_j + \alpha_{i3}AGGL_j + \alpha_{i4}EQ_j + \alpha_{i5}UC_j + \alpha_{16}CL_j + \varepsilon_{ij}$					
EQ	0.57429	2.935			
UC	0.02364	0.238			
CL	0.25551	2.874			
POP	0.00016	5.604			
AREA	0.05401	2.099			
AGGL	56.04578	25.310			
INTERC	− 3.50904	− 0.021	253	174.7	0.8100

[a] H_0: $\beta = 0$ (top half of table); H_0: $\alpha = 0$ (lower half of table).

conducted due to the empty-cell problem.) Perhaps manufacturers' perceptions of urban conditions differ from the components of *UC*. The condition of infrastructure, demographic characteristics of urban residents or business environment may comprise a better measure of *UC*. These are two possible explanations for the lack of measured effect of urban conditions on location decisions.

The effect of environmental quality, *EQ*, was negative and significant at the 90 per cent level for 6 of the 20 industry classes and was never positive and significant for any industry class. As reported above, a positive sign of *EQ* was obtained when equation (4) was estimated for the industry summary, SIC 19. The mixed results probably reflect conflicting forces which affect workers and manufacturers. According to the theory of compensating differences, workers will work for lower wages in high-amenity areas and manufacturers which employ labour will be attracted to them. This force would produce a positive *EQ* coefficient. But, there are forces which work in the other direction and which are not in compensating differences. Higher levels of manufacturing activity might be expected to be positively correlated with environmental degradation. It might be that high-amenity areas have more stringent land-

Table 4. Effects by industry by amenity, significant parameters and coefficient signs (dependent variable is *NOE*)

		Equation (3)						Equation (4)							
SIC	Observations	*F*-value	R^2	*QOLI*	*POP*	*AREA*	*AGGL*	*F*-value	R^2	*EQ*	*UC*	*CL*	*POP*	*AREA*	*AGGL*
19	253	254.0	0.80	+	+	+	+	174.8	0.81	+		+	+	+	+
20	253	145.9	0.70		+	+	+	97.2	0.70				+	+	+
21	35	0.5	0.07					0.4	0.08						
22	194	18.1	0.28	+	+		+	12.0	0.28			+	+		+
23	250	19.5	0.24	< + >	+		+	13.1	0.24				+		+
24	251	52.1	0.46		+	+	+	37.6	0.48	−		+	+	+	+
25	247	43.3	0.42	+	+	+	+	31.1	0.44			+	+	< + >	+
26	232	28.3	0.33		+		+	21.6	0.37	−		< + >	+		+
27	253	317.9	0.84		+	+	+	216.9	0.84			+	+	+	+
28	253	59.4	0.49		+	+	+	40.3	0.50			+	+	+	+
29	204	21.4	0.30		+	+	+	19.5	0.37	−			+		+
30	251	55.9	0.48		+	+	+	41.9	0.51	−		+	+	< + >	+
31	170	17.8	0.30		+		+	12.0	0.31				+		+
32	253	60.8	0.50		+	+	+	45.1	0.52	−	< + >	< + >	+	+	+
33	234	61.8	0.52	+	+		+	43.2	0.53			+	+		+
34	253	174.7	0.74	< + >	+	+	+	118.5	0.74			+	+		+
35	253	123.4	0.67		+	+	+	87.6	0.68	−		+	+		+
36	249	231.6	0.79	< + >	+		+	156.1	0.79			+	+		+
37	247	138.8	0.70	+	+	+	+	94.5	0.70			+	+		+
38	236	148.6	0.72		+		+	101.3	0.73			+	+		+
39	249	24.1	0.28	< + >	+		+	16.2	0.29			< + >	+		+

\+ or − significant at the 95 per cent confidence level.
< + > or < − > significant at the 90 per cent confidence level.
AGGL Equals number of establishments with 500 or more employees.

use controls and that industries perceived as noisy, polluting or congestion-producing would be prevented from locating in such areas. In the aggregate, both of these forces would lead one to expect that the correlation between *EQ* and *NOE* should be negative. The net effect of the worker amenity/lower labour cost force and the higher non-labour, production cost force is unclear.

Estimates for the individual industry classes, SIC 20–39, for the number of manufacturers of all sizes, *ESTB*, are reported in Table 5. When the large, anchor manufacturers are included, the estimated effects of *EQ* change. It was influenced by the inclusion of *AGGL*, the number of large establishments. As can be seen in Table 5, when equation (4) is modified by including the large firms in the dependent variable, *ESTB* and dropping *AGGL*, the number of statistically significant *EQ* parameters doubles and *EQ* becomes negative in the aggregate SIC 19 regression. Also, in the aggregate regression, *QOLI* becomes insignificant as the opposite effects of *EQ* and *CL* are at work. The effects of amenities on establishment location are not the same for large and non-large establishments. However, unlike *EQ*, *CL* performed approximately the same between model specifications reported in Tables 4 and 5.

Production Shifters

The two production shifters, *POP* and *AGGL*, which represent scale and agglomeration economies, were significant and had the expected sign for the industry summary and the specific industry classes. Only one industry, SIC 21, did not have significant regression coefficients for the production shifters, *POP* and *AGGL*. These variables were included in the model to capture the influence of location factors that were not explicit in the models. Recall that in order to avoid potential endogeneity problems between *POP* and *NOE* and in order to capture area-wide economies, SMSA population, rather than county population, was used.

Clearly, *AGGL* and *POP* are rough proxies for local scale and agglomeration economies. *POP* and *AGGL* are known to be correlated with *NOE*. It is likely that unobserved factors that are correlated with *AGGL* and *POP* influence *NOE*. Therefore, putting these variables on the right-hand side of equations (3) and (4) is likely to capture the influence of location factors that were not explicit in the models.

Additionally, one could question the direction of causality between *POP* and *NOE*. It is assumed that causality runs from SMSA population to *NOE* in an urban county. Larger population bases are more likely to contain labour force characteristics desired by industry. *AGGL* is positively correlated with *NOE* since greater numbers of very large manufacturers would increase opportunities for smaller complementary establishments. All industry classes (except SIC 21) had significant regression coefficients for the production-shifters, *POP* and *AGGL*.

The final variable, land *AREA*, is used to control for urban size. The positive correlation between it and the dependent variable was expected because larger urban counties have more production sites. This variable also captures effects not picked up by *POP* and *AGGL*. When *EQ*, *UC* and *CL* replace *QOLI*, they apparently capture some of these factors. This is apparent from the industry estimates of equation (4) reported in Tables 4 and 5. There, fewer significant *AREA* coefficients are observed.

Model Overview: Effects of AGGL Specification

The agglomeration economy variable, *AGGL*, is enumerated at 500 plus employees. It is subtracted from *NOE*, total number of manufacturing establishments and is then used as a regressor to help explain *NOE*. Because the choice of *AGGL*'s value was based on intuition and pragmatism, two alternatives were tested to determine the model's sensitivity to its specification. Equations (3) and (4) were estimated without *AGGL* and with it enumerated at 1000 or more employees as a cut-off. In each model, the dependent variable is adjusted. When *AGGL*

Table 5. Effects of omitting *AGGL* by industry by amenity, significant parameters and coefficient signs (dependent variable is *ESTB*)

SIC	Observations	Modified equation (3)					Modified equation (4)						
		F-value	R^2	*QOLI*	*POP*	*AREA*	*F*-value	R^2	*EQ*	*UC*	*CL*	*POP*	*AREA*
19	252	34.1	0.29		+	< + >	22.7	0.32	−		+	+	
20	252	20.4	0.20		+	+	15.8	0.24	−		+	+	
22	193	17.2	0.21	+	+		10.6	0.22			+	+	
23	249	18.9	0.19	< + >	+		11.7	0.19			+	+	
24	250	16.5	0.17		+	+	11.5	0.19	< − >		+	+	+
25	246	18.1	0.18	< + >	+	+	13.4	0.22	< − >		+	+	
26	231	28.5	0.27		+		22.5	0.33	−			+	
27	252	37.9	0.31		+		23.6	0.32			< + >	+	
28	252	28.7	0.26		+	< + >	24.1	0.33	−		+	+	
29	203	16.1	0.20		+	+	19.6	0.33	−			+	
30	250	23.1	0.22		+	+	16.9	0.26	−		+	+	
31	169	15.6	0.22		+		9.4	0.22				+	
32	252	26.0	0.24		+	+	21.2	0.30	−		+	+	+
33	233	19.6	0.20		+	< + >	16.4	0.27	−			+	
34	252	24.3	0.23		+	< + >	19.6	0.28	−			+	
35	252	22.5	0.21		+	+	17.0	0.26	−			+	
36	248	24.1	0.23	+	+	< + >	16.3	0.25			+	+	
37	246	13.5	0.14		+	+	10.2	0.19	< − >		+	+	< + >
38	235	26.7	0.26	+	+	< + >	18.5	0.29	< − >	< + >	+	+	
39	248	27.4	0.25		+		16.5	0.25			< + >	+	

+ or − significant at the 95 per cent confidence level.
< + > or < − > significant at the 90 per cent confidence level.

is removed from the model, *NOE* contains all manufacturers in a given urban county. Likewise, when *AGGL* is modified to account for establishments with 1000 or more employees, *NOE* is adjusted by subtracting these establishments from the total. Tables 4, 5 and 6 provide a contrast between the different model specifications. Each table highlights the significant parameter estimates, R^2 values and *F*-statistics for each industry class.

Recall that the same pattern observed between the amenity variables discussed above was also observed when no agglomeration variable was included in the model (see Table 5). Aside from the industry summary and a slight decrease in *EQ*'s performance, the model's results were consistent with the original model containing *AGGL*. The original model did, however, have substantially higher R^2 and *F*-values.

The results obtained when equations (3) and (4) were estimated with *AGGL* specified at 1000 or more employees as the cut-off are presented in Table 6. Between the model using this alternative designation for *AGGL* and the original designation of 500 or more employees (Table 4) the following differences are noteworthy. First, *QOLI*'s parameter is statistically significant for one less industry; it becomes significant for SIC 27 and insignificant for SIC 33 and 39. Secondly, the number of significant coefficients for *EQ* increases from 6 to 10. Thirdly, the number of significant coefficients for *CL* increases from 15 to 16. Finally, parameters for *AREA* and *AGGL* tend to lose significance.

These new estimates, for the most part, are consistent with the pattern described above. The results are somewhat sensitive to the inclusion and choice of *AGGL*. The R^2 is much smaller and the significance of the amenity variables decreases when *AGGL* is excluded from the model. This is expected, since without it, the model must explain the location of large establishments as well as non-large establishments. When *AGGL* is designated at 1000 or more employees, R^2 values decrease, and there is a slight change in the performance of the amenity variables when compared to the model containing *AGGL* designated at 500 or more employees.

Patterns by Manufacturing Industry and by Type of Amenity

Recall that equation (3) contains the aggregate amenity variable (*QOLI*) and that equation (4) contains its components (*CL*, *EQ* and *UC*). When comparing parameter estimates of *QOLI* and its components for a given industry class, patterns are found to exist. These patterns are gleaned from Table 4. *QOLI*'s coefficient tends to be insignificant when both *EQ* and *CL* are significant. Offsetting effects occurring between *EQ* and *CL* apparently negate the performance of *QOLI*'s coefficient. Excluding SIC 19 (the summary for all manufacturing), when statistically significant, the negative *EQ* parameter and the positive *CL* parameter seem to cancel out the statistical significance of *QOLI*. *UC* may also contribute to this effect; however, it is, for the most part, statistically insignificant.

Amenities and Labour Intensity of Manufacturing Establishments

The framework described earlier suggests that labour-intensive manufacturers are more attracted to areas with large *QOLI* values. In order to investigate the relationship between industry amenity attraction and labour intensity, patterns between an industry's amenity parameters and its payroll as a percentage of value added (*PPVA*) are inspected. *PPVA* is measured by total payroll as a percentage of value added and is calculated for each industry class. Value added is derived by subtracting the cost of materials from the value of shipments. Value of shipments, measures the net selling value of products manufactured plus receipts for services rendered. The result of this calculation is then adjusted by the addition of value added by merchandising operation, plus net changes in work-in-progress and finished goods inventories between the beginning and end of the year.[3]

In Table 7 each industry is listed in descending order based on the value of its

Table 6. Effects of changing the cut-off for *AGGL* by industry by amenity, significant parameters and coefficient signs

		Modified equation (3)						Modified equation (4)							
SIC	Observations	*F*-value	R^2	*QOLI*	*POP*	*AREA*	*AGGL*	*F*-value	R^2	*EQ*	*UC*	*CL*	*POP*	*AREA*	*AGGL*
19	253	146.5	0.70	+	+	+	+	100.3	0.71	< + >		+	+	< + >	+
20	253	48.4	0.44		+	+	+	35.2	0.46	−		+	+	+	+
22	194	17.5	0.27	+	+		+	11.8	0.27			+	+		+
23	250	14.4	0.19	< + >	+			9.9	0.20			< + >	+		
24	251	12.4	0.17		+	+		9.6	0.19	< − >		+	+	+	
25	247	14.3	0.19	+	+	+		11.7	0.22	< − >		+	+		
26	232	23.5	0.29		+		+	19.3	0.33	< − >			+		
27	253	159.4	0.72	< + >	+	+	+	108.9	0.72			+	+		+
28	253	29.2	0.32		+	+	+	23.0	0.36	−		+	+		+
29	204	20.7	0.29		+	+	+	19.9	0.38	−			+		+
30	251	19.2	0.24		+	+	+	15.3	0.27	−		+			+
31	170	11.7	0.22		+			7.8	0.22				+		
32	253	20.7	0.25		+	+	+	18.3	0.31			+	+	+	< + >
33	234	41.7	0.42		+		+	29.7	0.44	< − >		+	+		+
34	253	93.8	0.60	< + >	+	+	+	65.2	0.61	< − >		+	+	< + >	+
35	253	65.2	0.51		+	< + >	+	47.7	0.54	−		+	+		+
36	249	146.2	0.71	+	+	< + >	+	99.6	0.71			+	+		+
37	247	71.5	0.54	+	+	+	+	48.9	0.55			+	+		+
38	236	72.5	0.56		+		+	50.6	0.57			+	+		+
39	249	23.1	0.28		+		+	15.5	0.28			< + >			+

\+ or − significant at the 5 per cent level.
< + > or < − > significant at the 10 per cent level.
AGGL Equals number of establishments with 1000 or more employees.

Table 7. Labour intensity (*PPVA*) vs significant amenity parameters

Standard industrial code (sic)	*PPVA* (percentage)	*QOLI*	*EQ*	*UC*	*CL*
33 Primary metal industries	62	β_4			α_6
24 Lumber and wood products	55		α_4		α_6
22 Textile mill products	49	β_4			α_6
34 Fabricated metal products	48	β_4			α_6
37 Transportation equipment	48	β_4			α_6
25 Furniture and fixtures	48	β_4			α_6
31 Leather and leather products	47				
23 Apparel and other textile products	47	β_4			
35 Machinery, except electrical	46		α_4		α_6
36 Electric and electronic equipment	45	β_4			α_6
32 Stone, clay, and glass products	44		α_4	α_5	α_6
30 Rubber and miscellaneous plastics products	43		α_4		α_6
27 Printing and publishing	42				α_6
39 Miscellaneous manufacturing industry	40	β_4			α_6
26 Paper and allied products	39		α_4		α_6
38 Instruments and related products	38				α_6
20 Food and kindred products	30				
28 Chemical and allied products	27				α_6
29 Petroleum and coal products	21		α_4		
21 Tobacco manufactures	15				

Significant amenity parameter estimates β_4 α_4 α_5 α_6

labour-intensity ratio (*PPVA*). These values range from 62 per cent to 15 per cent with a mean of 42 per cent. Of the 10 most labour-intensive industries, 7 have positive, significant coefficients for *QOLI*. In contrast, only 1 of the 10 least labour-intensive industries has a significant coefficient for *QOLI*. Another count which illustrates the importance of labour intensity is that of the 8 significant β_4 parameter estimates, 7 belong to industries with above-average *PPVA*s. This association between *PPVA* values and the occurrence of statistically significant amenity parameters is consistent with the notion that labour-intensive industries are attracted to high-amenity locations. A relevant question is whether or not this visual pattern is supported by correlation analysis?

This hypothesis could be tested by measuring the linear relationship between *QRC* and *PPVA*. However, the sample of statistically significant parameters estimates for *QOLI* is small and clustered in the upper range. At the 95 per cent confidence level, significant *QRC*s are only observed for SICs 22, 25, 33 and 37. Visual inspection of Table 7 reveals that these 4 industries are listed among the top 6 *PPVA* rankings. At the 90 per cent confidence level, 4 more SICs gain significance (23, 34, 36 and 39). This expanded set of 8, does add some variability to the sample; however, it still does not cover the lower range or the first quartile of *PPVA* values.

The location decisions of manufacturers are postulated to be influenced by an urban area's attributes. The regression coefficients for β_4 in equation (3) indicate the strength of the relationship between amenities and such location influences. Larger parameter estimates are indicative of stronger, although not necessarily more precise, relationships. Therefore, if areas with high-amenity levels are associated with a larger number of labour-intensive establishments, then *QOLI* should be positively correlated with the number of labour-intensive establishments. Notwithstanding the problems noted above, the correlation between *QRC* and *PPVA* is calculated. Zeros are used to replace in-

Table 8. *QOLI* regression coefficients(*QRC*)and payroll as a percentage of value added (*PPVA*) listed by standard industrial codes (SIC)

SIC	*QRC*	*PPVA*
20	0.00000	0.2954
21	0.00000	0.1517
22	0.00720	0.4910
23	0.04776	0.4656
24	0.00000	0.5506
25	0.01141	0.4759
26	0.00000	0.3873
27	0.00000	0.4172
28	0.00000	0.2696
29	0.00000	0.2105
30	0.00000	0.4270
31	0.00000	0.4707
32	0.00000	0.4393
33	0.00527	0.6180
34	0.01696	0.4801
35	0.00000	0.4587
36	0.00827	0.4539
37	0.01135	0.4795
38	0.00000	0.3847
39	0.01588	0.4021

	Mean	Standard Deviation
PPVA ($N = 20$)	0.4164	0.1114
QRC ($N = 20$)	0.0062	0.0114

Correlation between *PPVA* and *QRC* = 0.27

significant *QRC*s. Table 8 contains the *QRC*s, *PPVA* values and general statistics pertaining to these variables. The correlation coefficient between these two variables is 0.27. If one outlier is removed from the sample, the correlation is even higher. Only one *QRC* is more than one standard deviation from the mean of *QRC*. *QRC* for SIC 23 is 3.65 standard deviations from the mean. This outlier, 'Apparel and other textile products', is highly competitive and has been affected greatly by international competition. If it is affected more than other industries, then its location pattern may have been disrupted greatly due to departures. If the outlier is removed, the correlation coefficient increases by 32 per cent; the recalculated correlation coefficient between *QRC* and *PPVA* is 0.36.

Notwithstanding the location of *QRC* sample points, correlation analysis still supports the notion that there is a positive relationship between *PPVA* and *QRC*. Thus, it appears that manufacturing establishments with higher degrees of labour intensity are more attracted to high-amenity locations. In other words, higher values of *PPVA* are associated with larger regression coefficients for *QOLI*, holding *POP*, *AREA* and *AGGL* constant.

Discussion

The intensified effort to attract and retain industry has required that planners and policy-makers pay more attention to non-traditional location factors, in particular amenities. The findings of this research give some support to the increased attention urban amenities are receiving. Regression analysis of urban, county-level 1980 Census data with an existing preference-based index of quality-of-life shows that amenities do influence location. Overall, amenities tend to attract manufacturing. While the effect varies by industry, correlations indicate that more labour-intensive manufacturers respond more to amenities than do typical manufacturers.

An implication for public and private planners concerns expected growth in various urban areas. Locations with greater amenity endowments, especially in climate, can expect growth due to amenities. These high-amenity locations can expect more labour-intensive manufacturers to be attracted due to amenities. While amenities are a location factor, our results show that urban agglomeration and scale economies remain paramount in location decisions of manufacturing establishments. We can get estimates of the relative impacts of the factors by multiplying the coefficients of *AGGL*, *POP* and *QOLI* which are reported in the top half of Table 3 for the industry summary by the standard deviations reported in Table 2. A one standard deviation increase in *AGGL*, the number of manufacturers in the county with more than 500 employees, increases the number of smaller manufacturing establishments in the urban county by 513. A one standard deviation increase in *POP*, the population of the SMSA in which the county is located, increases the number of smaller manufacturing establishments by 311. A one standard deviation increase in the *QOLI* increases the number of smaller manufacturing establishments by 134. So, our perspective is that amenities do matter in the location of manufacturing in urban areas, but the pulls of large complementary manufacturers and the overall economies of the metropolitan area are the dominant factors.

Caution is prudent in contemplating the implied growth, as is true with any inference. This analysis is for small and medium-sized manufacturing establishments with fewer than 500 employees and takes as given the location of larger manufacturing establishments as well as population. Should some of the very large manufacturers enter or leave a county, the agglomeration advantages will change. This analysis shows that the location of non-large manufacturing establishments would be responsive. Furthermore, amenities may play a role in the location decisions of large manufacturers also, but this aspect awaits further research.

Notes

1. In a multi-market context, payment for amenities is through a combination of different wages and rents so that consumers/workers pay, on net, for the desirable residential and work location. It is not necessary that both wages be lower and rents be higher, but it is necessary that the combination be a net payment (see Blomquist *et al.*, 1988). This paper builds upon the intuitive case in which wages are lower and rents are higher in high-amenity locations.
2. The location of manufacturers with over 500 employees (*AGGL*) is taken as given. This allows *AGGL* to proxy agglomeration economies which attract small and medium-sized manufacturers. Small and medium-sized manufacturers are more likely to be attracted to amenities than very large manufacturers. A related, interesting question concerns the effect of amenities on manufacturers of any size. The same approach taken in this paper is used in Granger (1993) for manufacturing establishments of all sizes. Indications are that amenities matter, but that the effects are weaker. Interpretation is not as straightforward, however, because of possible endogeneity of *POP* with large manufacturers.
3. Value added and payroll data used to compute *PPVA* are obtained from the 1987 Economic Censuses (CD-ROM data).

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