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A MODEL OF FIRM GROWTH EXPECTATIONS FOR A LOW-TECH SERVICE PROVIDER: THE CASE OF LANDSCAPE AND LAWN CARE SERVICES

OCZEKIWANY ROZWÓJ PRZEDSIĘBIORSTW O NISKIM ZAPOTRZEBOWANIU NA TECHNIKĘ NA PRZYKŁADZIE USŁUG W ZAKRESIE PIELĘGNACJI TRAWNIKÓW I ŚRODOWISKA

Key words: Survey data, spatial modeling, location
Słowa kluczowe: dane ankietowe, modelowanie przestrzenne, umiejscowienie

Abstract. The empirical analysis of the lawn care and landscape manager expectations about the firm`s revenue growth and accounts for firm`s location modeling tis presented. Using the survey data the paper quantifies macro- and micro- economic of non-parametric elements and spatial correlation.

Introduction

Empirical studies applying aggregate data indicate that the low-tech industry growth concentrates in areas with large market demand [Feser 2001][1], while manufacturing start ups, including low-tech sectors, concentrate in urban areas anticipating growth opportunities [Honjo 2004]. Similar studies at the firm level are scarce because of the paucity of data. Yet, low-tech sectors can be regionally important sources of economic activity generating jobs and contributing to local growth. Among service industries, a low-tech sector that provides services to privately owned land is the landscape and lawn care sector. This sector, associated with the ornamental horticulture, registered an enormous growth in the past two decades, sharply contrasting with another land-dependent sector, the conventional agriculture.

Between 1995 and 1999 the percent of households engaged in lawn care declined from 53 to 43% [Statistical Abstract 2001], while the home ownership increased. During the period 1995-1998, the number of households purchasing the landscape and lawn care services increased from 5.8 to 9.0 millions [National gardening… 1999]. These trends imply that an increasing number of households transferred the function of caring for the residential landscape to contracted service providers. The growth of the landscape and lawn care maintenance sector (LLCS) has been concentrated in fast growing urban and suburban areas associated with the high density of residential, service and recreational (e.g. golf courses) real estate.

The LLCS sector is thus an intriguing case study because it permits investigation of sources of growth of a low-tech, but expanding industry. Using available information from a survey on LLCS managers about their expectations on future growth, and characteristics of the firm including location and current revenues, this paper estimates factors that contribute to firm growth based on manager's own expectations. In particular, we are able to test with micro level data the hypothesis that the low tech industry growth concentrates in areas of large demand. Note that because we use micro data based on a cross section of firms, the specification of the expectations model depends on asking managers about their expectation of future revenues. The data used are survey data from firms located in the surrounding counties of the Atlanta Metropolitan Area, and the data were collected in 1999, which coincides with a period of explosive population and income growth in the state of Georgia.

Methodologically, the paper addresses the issue of estimating the likely spatial correlation of

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1 In contrast, the location choice and growth of the high-tech industry occurs mainly in areas where the externality from knowledge is strongly diffused. This occurs in areas of main industry concentration, e.g.: Silicon Valley [Nakamura 1985, Henderson 1986, Moomaw 1988].

unobservable variables that explain firm's expected revenues, and the fact that there may be non-parametric components in the modeling of the firm expectations model. To evaluate the need for nonparametric components we use an interesting approach based on stability of parameters. Results quantify and test the relevance of different macro and micro level data in shaping expectations of growth at the firm level.

Modeling Expectation with Survey Data

In a low-tech service sector such as the LLCS industry, the location and knowledge of the trade by the firm may capture comparative advantage of the trade and, thus, may affect firm's expectations on future growth. Knowledge of the trade can be captured by the number of years the firm has been in operation. Expectations of future revenues by the firm of course depend on firm's current revenues.

Information available about the future demand that affect expectations in the LLCS industry depends on the residential and commercial growth and, hence, the macroeconomic environment influences the manager expectation. For example, information about the county income where each firm is located and the reported growth of county income may explain sources of future growth in the LLCS industry[2]. For the LLCS firms the location represents a clear comparative advantage in providing the service, and the growth of a county is essential because the demand for services increases with the number of residents and their income.

To model expected future revenues with micro level data, however, managers have to be asked directly about their expectations. The survey instrument asked managers how much they expect their current revenues to increase in the next three years. The survey instrument also probed for information about their current revenues, their address, and the years the firm has been in operation. The existing county licensing registries, which record all existing businesses within its administrative border do not provide sufficiently detailed description. +Therefore, the surveyed firms were identified with the help of three professional associations. Membership lists shared by the Georgia Turfgrass Association, the Georgia Green Industry Association, and the Metropolitan Atlanta Landscape and Turf Association provided the basis for the mailing of the survey instrument. The survey collected information about firm's revenues in the year 1998, a period of explosive population and income growth in the state of Georgia.

After verifying the possible multiple listings and a pilot test, the questionnaire was mailed to 612 LLCS firms. The initial mailing was followed by a post card reminder and the second mailing to firms which did not respond. The gross return rate was 45 percent (or 245 responses) after accounting for questionnaires that could not be delivered by the postal service or because the addressee did not provide landscape and lawn care services. Answers provided by the respondents served as the basis for the estimation of the model specified in this study. Distance across firms is measured in miles, and the location of the firm is provided by the survey where the average distance across all firms in the data set is 77 miles. Other details about data are available from the authors upon request.

The Model

Manager expectations of future revenues depend on characteristics of the firm and the macroeconomic environment affecting the firm's growth. The model formulation depends on the available data where unobserved variables are lumped in the error term of the statistical model,

$$y_{k,t+s} = f(y_{k,t}, x_{k,t}, I_{k,t}, \Delta I_{k,t}) + \mu_{kt} \tag{1}$$

where the expected future revenues of firm k is $y_{k,t+s}$; firm characteristics are captured in current revenues $y_{k,t}$, and the years the firm has been in operation $x_{k,t}$; the macroeconomic environment of firm k are observed income $I_{k,t}$, and income growth, $\Delta I_{k,t}$, of the county where the firm is located; and the econometric residual m_{kt} captures unobserved components in the model and is treated as random.

[2] We choose the income growth of the county in the period immediately preceding and including the year for (we collected data for 1998 in 1999) which data were collected, i.e. 1996-1998.

Table 1. Testing Stability of Parameters[a]

Hypothesis[b]	F- Tests	Critical value
Ha: Model 2[c]	2.05	2.60
Ha: Model 3[d]	3.45*	2.60
Ha: Model 4[e]	1.62	2.60
Ha: Model 5[f]	1.70	3.00
Ha: Model 6[g]	6.08*	3.00
Ha: Model 7[h]	1.32	3.00
Ha: Model 8[i]	1.64	3.84
Ha: Model 9[j]	3.94*	3.84
Ha: Model 10[k]	1.34	3.84

[a] Same as footnote a in Table 1.
[b] The null hypothesis is stability of parameters.
[c] In the model, the coefficient in reve-nues and the intercept term are allowed to vary across four sets of firms classi-fied by the magnitude of the revenues.
[d] In the model, the coefficient in years of operation and the intercept term are allowed to vary across four sets of firms classified by the years of operation.
[e] In the model, the coefficient in firms' county income and the intercept term are allowed to vary across four sets of firms classified by the income of the county the firm is located.
[f] In the model, the coefficient in reve-nues and the intercept term are allowed to vary across three sets of firms classi- fied by the magnitude of the revenues.
[g] In the model, the coefficient in years of operation and the intercept term are allowed to vary across three sets of firms classified by the years of operation.
[h] In the model, the coefficient in firms' county income and the intercept term are allowed to vary across three sets of firms classified by the income of the county the firm is located.
[i] In the model, the coefficient in reve-nues and the intercept term are allowed to vary across two sets of firms classi-fied by the magnitude of the revenues.
[j] In the model, the coefficient in years of operation and the intercept term are allowed to vary across two sets of firms classified by the years of operation.
[k] In the model, the coefficient in firms' county income and the intercept term are allowed to vary across two sets of firms classified by the income of the county the firm is located.
Źródło: own study.

The econometric residual in (1) is likely to be correlated across space, i.e. $Cov(m_{jt}, m_{kt}) \neq 0$, because economic factors that explain expectations of a firm are likely to be correlated with factors that explain expectations of a neighboring firm since both compete for the same market. The spatial correlation term could be negative, if the econometric residual includes market competition. That is, one firm gains on providing service to more households translates into a reduction of customers of other firms. In the service sector such as LLCS where firms compete within the same geographical markets, firms located close to each other have stronger correlation than firms located far apart.

The model in (1) is implemented to test the hypothesis that growth in a low tech industry concentrates in areas of high demand – for evidence using aggregate data Feser [2001]. Additional hypotheses about vital economic aspects of the LLCS sector are testing the average period it takes a firm to achieve the stationary growth, and whether economies of scale explain growth of a low tech service industry.

Preliminary Tests for Determining the Nonparametric Component

A priori information on nonparametric regression is needed to implement a consistent kernel estimator with a root T convergence speed for some arguments of the function [Robinson 1988]. To evaluate whether a nonparametric form is needed for any of the explanatory variables in the model, we test the robustness of the coefficients of the log linear model relative to changes in the explanatory variables. Indeed, based on the statistical theory, a nonparametric component captures heterogeneity of coefficients across firms.

Table 1 shows results of tests of stability of parameters in a loglinear model. To implement the tests of a nonparametric form for an explanatory variable, x_{it}, in the model, the data are ordered accordingly with x_{it}. Next, both the intercept and the coefficient corresponding to x_{it} in the loglinear model are tested for stability. For robustness, different subsets of the data need to be considered.

Table 1 shows results with respect to three different sets of partitions. Results show that the coefficient corresponding to the number of years the firm stayed in business varies markedly across firms and, thus, provides the statistical evidence justifying the introduction of a nonparametric component. In contrast, the coefficient corresponding to current revenues is robust across firms of different levels of revenues. The same robustness is observed in the coefficient corresponding to the county income in which the firm is located. From the results in Table 1, therefore, only the age of the firm is given a nonparametric form in the model of expectations regarding the firm's growth. From the preliminary testing, the final formulation is

$$\ln(y_{k,t+1}) = f(x_{k,t}) + \beta_1 \ln(y_{k,t}) + \beta_2 \ln(I_{k,t}) + \beta_3 \ln(\Delta I_{k,t}) + \mu_t \tag{2}$$

Estimation

The preliminary tests described in the previous section support a semiparametric form to estimate the economic model. The age of the firm enters the model nonparametrically, while all other variables enter it linearly. Because the age of the firm, measured in years it has operated, is a discrete variable, an indicator function can be used to construct weights in kernel estimation [Pagan, Ullah 1999]. Specifically, $\beta_{iq} = 1$ only if $x_{ki} \in (x_{kq} \pm .5h)$, where h is the bandwidth length, and $\beta_{iq} = 0$ otherwise.

To select the bandwidth length, we use the product of the estimated prediction error. $T^{-1}S[y_t - f(x_{kt}) - A'z_t]^2$ with Rice's T penalty term. Hardle, Hall and Marron [1998] showed that Rice's T penalty term [Rice 1984] is the best among penalty functions. Thus, to estimate (4), the bandwidth length that minimizes the Rice's penalty function is used for the final model specification[3]. Rice's T penalty term using an indicator function is $(1 - 2\,T^{-1}h^{-1}\beta_{qq})$, where T is the total number of observations.

Table 2 shows the final prediction error with Rice's T penalty term for various bandwidth lengths[4]. The Akaike information criterion (AIC) is applied to determine the robustness of the selected bandwidth length to the used penalty function. Test values in Table 3 indicate that the model that minimizes the penalized estimated prediction error (under both Rice's T and AIC) includes the spatial correlation and uses a bandwidth length of h = 9. This result shows that a nonparametric component in modeling manager expectations of the firm growth relative to its years of operation needs to be accounted when considering a mean squared error (MSE) criterion.

A parametric model incorporates spatial correlation [Kelejian and Robinson 1995]. For the $\{i,j\}$ element of the spatial correlation matrix **W** [Kelejian and Robinson 1995, Dubin 1999], this study uses $d_{ij}/S_i d_{ij}$, which represents the normalized distance from firm *i* to firm *j* [Dubin 1999][5]. The estimated spatial correlation term, r, acts then as a smoothing parameter in the estimation of the spatial correlation, given the weight function. Under the chosen weight matrix, the spatial correlation between firms i and j is the $\{i,j\}$ element of $(\mathbf{I} - r\mathbf{W})^{-1}$ where r is the spatial correlation coefficient.

Different MSE criteria in Table 2 indicate that both spatial correlation terms and nonparametric components provide useful information about the model specification. Without the spatial correlation, the optimal bandwidth length is h = 11. That is, the data need to be smoothed less through a nonparametric kernel when the data are also operated by the row standardizing matrix. Furthermore, by testing the null hypothesis of a parametric model against the alternative hypothesis of a semiparametric model [Gonzalo 1993] we obtain a calculated standard statistic of 4.02 and a critical value of 1.96.

Estimates of the model in Table 3 show that spatial correlation terms are statistically significant and demonstrate a negative spatial correlation across firms. The sign of the spatial correlation coefficient is attributed to the competition among the LLCS firms. Specifically, a negative spatial correlation coefficient indicates a tight geographical market in the landscape maintenance and

Table 2. Penalized Goodness of Fit for a Different Bandwidth Length

Bandwidth length	AIC (without spatial correlation)	Rice (without spatial correlation)	AIC (with spatial correlation)	Rice (with spatial correlation)
Parametric model	1.708	5.28	1.697	5.22
h=13	1.689	5.09	1.687	5.12
h=12	1.692	5.01	1.688	5.09
h=11	1.671	4.96	1.681	5.05
h=10	1.698	5.04	1.678	5.03
h=9[a]	1.688	4.99	1.656	4.92
h=8	1.708	5.09	1.679	5.03
h=7	1.698	5.04	1.684	5.07
h=6	1.706	4.99	1.700	5.14
h=5	1.713	5.12	1.710	5.21

[a] The bandwidth length set at h = 9 yields the best fit of the data generating process (DGP).
Source: own study.

[3] The literature in nonparametric econometrics has concluded that estimates are generally robust to the nature of the weighting matrix [see for example Silverman, 1986]. There is a general consensus about the importance of the bandwidth length in nonparametric estimation.

[4] Given the discrete nature of the data, a grid search for selecting the bandwidth length coincides with minimizing the objective function with respect to the bandwidth length.

[5] The structure gives different weights to observations subject to spatial correlation. Alternatively, the same weight can be given to all observations believed to be subject to spatial correlation [Dubin 1999].

lawn care sector, where one firm's gain in a market share implies a loss to other firms. The next section uses preliminary tests to evaluate which variable enters nonparametrically the specified model. Moreover, when both spatial correlation and nonparametric components are included, all coefficients become significant at a one percent significance level. Finally, the functional form bias appears to underestimate the elasticity of revenues with regard to expectations by 25%.

Analysis of the Estimated Semiparametric Expectations Model with Spatial Correlation

Table 3. Estimates of the Expected Growth Model for the Landscaping and Lawn Care Firms[a]

Explanatory variables	OLS estimated coefficients (t-stats)[d]	ML estimated coefficients (t-stats)	ML estimated coefficients in the semiparametric model (t-stats)[e]
Constant	-5.87** (-4.34)	-6.20** (-4.47)	
Years of Operation[b]	-0.08** (-3.75)	-0.08** (-3.82)	
Revenues	0.28** (2.47)	0.31** (2.63)	0.40** (3.88)
County Income	-0.06* (-2.07)	-0.07* (2.27)	-0.07** (-2.39)
County Growth	0.17** (2.33)	0.18** (2.4)	0.12** (2.68)
Spatial correlation[c]		-0.60 (2.24)*	-0.63 (3.12)**

[a] All variables are defined in logarithms excepting years of experience.
[b] Because years of experience are in levels and expected growth in logarithm, then under the OLS estimates, an increase in years of operation change expected growth by -0.076 x expected growth. Given that the average expected growth is 20%, the effect of years of experience on expected growth is -0.015
[c] The spatial correlation term corresponds to the average spatial correlation across firms.
[d] One asterisk indicates the coefficient is significant at the 5% level, and two asterisks indicate the coefficient is significant at the 1% level.
[e] The coefficient estimates correspond to the parametric components of the semiparametric model. The estimated effects of years a firm has been operating on expectations appear in Table 4

Source: own study.

The Effect of the Macroeconomic Environment on the Firm's Expected Growth. Interestingly, our estimated semiparametric model of manager expectations on growth of the firm shows the importance of the macroeconomic environment (e.g. county income growth) in shaping expectations (Tab. 3). In the semiparametric model, a one percent increase in the county income decreases revenues by seven percent, and a one percent increase in the growth of county income increases revenues by 12 percent. These results support the notion that the manager's expected growth of the firm is negatively related to the level of the county income, but increases with the county's income growth. The prospects of growth are higher if a firm is located in counties with the highest rather than moderate or low economic growth. Such counties are not necessarily experiencing the highest current income levels,[6] however, this result coincides with the expectations of managers which are formed using such information. Earlier studies provide evidence that the source of growth of low-tech industries concentrates in areas with growing market demand [Feser 2001]. Moreover, if the confirmed link between expectations and the county income growth implies that such a low tech service industry as the LLCS is likely to be quite sensitive to business cycles.

In addition, since the LLCS is associated with ornamental horticulture, its growth has replaced previously used land for conventional agriculture. This replacement of agriculture by the LLCS firms is thus more likely to occur in counties experiencing high income growth, and especially in counties that are not yet fully developed.

The Effect of the Characteristics of the Firm on Expected Growth. The age of the firm captures the firm's life cycle. Initially the firm growth is high and is followed by the decreasing marginal productivity of capital. At maturity the firm achieves a stationary level of growth. Table 4 illustrates the statistical significance of the effect of the age of the firm on the expected growth in the semiparametric formulation. Estimates show that expectations of managers from younger firms are not significantly changed in early years of the firm's operation. Honjo [2004] found that younger

6 Many firms, which participated in the survey were located in counties neighboring the Metropolitan Atlanta Area, which has experienced an unprecedented annual economic growth rate of 8 percent in the late 1990s.

Table 4. Test of the Effect of an Additional. Year of Operation on Revenue Growth Expectations

Age of firm[a]	t-statistic[c]
<5[b]	-1.57
6	-1.63
7	-1.89
8	-0.23
9	-1.23
10	-2.47**
11	-2.14*
12	-2.63**
13	-2.10*
14	-2.24*
15	-1.30
16	-1.23

[a] The estimate corresponds to the estimated effect of first years in operation on expectations when the firm age is x, where x 1,….,16, years.
[b] Because the bandwidth length is nine, firms with less than 5 years of opera-tion are not decomposed in estimation.
[c] One asterisk indicates the coefficient is significant at the 5% level, and two asterisks indicate the coefficient is significant at the 1% level.
Source: own study.

firms were more likely to grow as compared to older firms. However, in this study expectations of the future growth are statistically and negatively affected by the length of the time period a firm exists. Indeed, the estimated model indicates the existence of a threshold at the level of ten years, after which managers expect their firms to approach the stationary growth.

Also, from the results of the estimated model, a unit increase in total revenues increases expected revenues by 40 percent. The marginal effect of revenues on future revenues is also shown (Tab. 1) to be statistically the same across firms of different sizes. Therefore, the growth of a low tech industry such as LLCS is potentially size-neutral allowing firms of various sizes to grow at similar rates. This finding indicates the likely presence of constant returns to scale, which facilitates an unobstructed entry and exit in the LLCS industry. Indeed, anecdotal observations provide evidence that many LLCS firms are established and many cease to exist after a season or two.

Results, therefore, indicate that growth of a low-tech service industry such as the LLCS is not explained by economies of scale or from industry concentration. Consistent with previous studies, this case study shows that growth in a low-tech service industry concentrates in areas where demand is rapidly growing.

Concluding Remarks

This study was motivated by the desire to model growth expectations of a firm in a low-tech industry. The proposed estimation procedure involved the use of a semiparametric model with spatial correlation. The spatial correlation accounted for the location of firms competing for customers in the same geographical area. Results confirmed the advantage of modeling spatial location of competing firms. Specifically, ignoring the distance between two providers of the LLCS would lead to inaccuracies in inference testing. This study, using cross-sectional firm-level data, supports the findings of Chen and Williams [1999] by suggesting that highway expenditures tend to reduce low-tech business failures. A LLCS provider spends a considerable amount of effort traversing among serviced properties and an improvement in the local road system can lower travel time and improve the firm's economic performance either by reducing transportation costs, increasing revenues by maintaining more properties or both.

The empirical model was based on data from the survey of the LLCS firms. Estimation results showed that the age of a firm, measured by the number of years a firm was operating, was the only factor explaining the heterogeneity of the marginal effects of explanatory variables on the expected firm revenue growth. Furthermore, the variable representing the age of the firm captured the cycle characterized by the high growth rate in the early years of the firm's existence followed by a period of growth at a decreasing rate.

The finding that the effect of the firm revenues on the expected revenue growth was statistically the same across firms indicates the presence of the constant returns to scale in the LLCS industry. This outcome supports the observed limited size of many LLCS firms and is consistent with the site-specific nature of the provided services. Firms provide services to residential and commercial landscapes, which include a variety of plants preventing the mechanization of performed tasks.

The effect of urban growth was positive but homogenous across firms. Fast growing urban areas have been able to provide an adequate market for an increasing number of firms. In addition, consistent with the agglomeration theory, our findings showed that in a low-tech industry the growth resulted from income growth. The residual was negatively correlated across firms. Because the residual measured the spatial competition, its statistical significance suggests the existence of strong competition for customers within the same geographical area. Data used in this study were collected during the period of an economic boom. Future studies may attempt to verify the results by using data gathered during an economic contraction.

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Streszczenie

Analiza empiryczna skupia się na oczekiwaniach menadżera dotyczących wzrostu dochodow firmy świadczącej usługi małej architektury i bierze pod uwagę umiejscowienie firmy. na podstawie danych ankietowych model kwantyfikuje czynniki poziomu mikro i makro, które tłumaczą oczekiwania dotyczące przyszłych dochodów firm. Wyniki wskazują na znaczenie, zarówno elementów nieparametrycznych, jak i korelacji przestrzennej.

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