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Called up to the Big Leagues: An Examination of the Factors Affecting the Location of Minor League Baseball Teams

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Abstract

In this study we analyze the factors that determine whether a particular city has a minor league baseball team and the level at which that team competes. Using the generalized ordered logit model we determine that higher population, personal income, and time from nearest Major League Baseball team all have a positive effect on the city's having a minor league baseball team and having one at a higher level. The finding that personal income has a positive effect on the level of the baseball team, combined with past studies suggesting income does not affect minor league baseball attendance, leads us to conclude that higher income fans cannot take off more time to attend baseball games but want a higher quality product when they do attend. Rankings of the most over-represented and under-represented cities, based on the model, are presented.

Keywords: Minor league baseball, team locations

Between the 2004 and 2005 seasons, the Austin and El Paso franchises in baseball's AA level Texas League moved to Corpus Christi and Springfield, Missouri, respectively. To determine whether such moves make sense, we need to examine a number of different issues. The purpose of this study is to determine the factors that lead to the presence and level of a professional baseball team at a particular location. The results will contribute to the knowledge of which factors affect the demand for professional baseball and will suggest which locations are either under-represented or over-represented in terms of their local baseball teams. Furthermore, the results will suggest which cities should be next in line for a professional baseball team at a particular level if a team relocates or there is expansion.

The organization of the minor leagues presents a clear hierarchy we can exploit to analyze the important factors in locating teams. The minor leagues are set up with the following structure: AAA, AA, High-A, Low-A, Short Season A, and Rookie leagues in descending order. The quality of play will typically be better at AAA than at AA, better in AA than A, and so forth down the list. Also, the season is longer for the higher leagues, with the majors running at least a month longer than all of the minor leagues, and Short Season A and Rookie leagues playing two months less than the other minor leagues. The better

quality and greater quantity of baseball at the higher levels suggest that we can assume that the major league teams will be in the best locations, and the AAA teams in the next best locations.

We use the hierarchy provided by the data to estimate a generalized ordered logit model (GOLM) on various explanatory variables including population, personal income, and geographical factors. The GOLM estimates key factors on an ordinal ranking of a particular variable and allows more flexibility than the more widely known ordered logit model. Also, since the ordered logit model is a sub-case of the GOLM, the model selection criteria will select the ordered logit model if it fits the data.[1]

We find that a city's population, personal income, and time from the nearest major league city all have a positive impact on whether there is a team in the location. While the results for population and time are expected, the results for per capita personal income are not. Combined with past studies suggesting that personal income does not affect attendance at minor league baseball games, the results support a view that there is a labor-leisure tradeoff for the wealthy. Wealthier citizens may not be able to take off any more time for recreational activities like watching baseball but expect a higher quality product when they do attend. The presence or absence of alternative sports options appears to have no impact.

Institutional Structure

The number of teams in particular locations has always been restricted by the agreements between Major League Baseball and minor league baseball. The current locations of teams are influenced by these changing rule structures. Until the 1990s the rule seemed to be that teams had a 15-mile buffer in which they could restrict competition. In the 1990s the rule was extended to a 35-mile buffer area. By 2003 the rules differed between the major and minor league teams. The major league teams were assigned counties from which they could exclude either major or minor league teams. In addition, they had a 15-mile boundary beyond the county borders. According to Jim Ferguson, Director of Media Relations for minor league baseball, the minor league team rules are that a team cannot move into a county that borders another county with a minor league baseball team (CantonRep.com, 2003). These restrictive rules have effectively prevented most of the metropolitan areas that have teams from having additional teams move into them. There are exceptions. Baade and Sanderson (1997) note that the Kane County Cougars located in the far suburbs of Chicago in the 1990s. More recently the Frisco Roughriders moved into the northern edge of the Dallas metropolitan area.

The restrictive practices of the major and affiliated minor leagues, however, have given an opportunity for upstart independent minor league teams to move into under-represented areas. A number of independent minor leagues have come into existence since 1993, the first independent baseball leagues since 1954. Although the independent leagues include teams located in smaller markets not inhabited by any other teams, they consist primarily of teams in markets with major league teams that have used rules to keep out affiliated minor league teams (Cooper, 2004). In 2003, 29 of 179 (16%) affiliated minor league teams were located in metropolitan areas with a major league team, while 21 of 54 (39%) independent league teams were located in similar markets.

In an attempt to find better stadium deals and markets, the affiliated minor leagues have franchises moving almost every year. The number of moves varies from year to year, however. Between 2002 and 2003, seven franchises in the affiliated minor leagues moved; between 2003 and 2004, only three franchises moved. Also many of the franchises are quite stable, having existed in the same location for a long period of time, and Kraus (2003) stated that there has been greater stability in team locations since 1990 than there had been previously.

It is often the case that a city will see a team leave for a different location and then have a team at a different level move into it within a few years. Occasionally the moves will take place in the same year. In 2005, the AA team in Greenville, SC, moved to Jackson, MS. The same year a Low-A team moved from Columbia to Greenville.

The level of stability is much lower in the independent minor leagues than in the affiliated minor leagues. In 2003 there were seven independent minor leagues that began the season. Between 2002 and 2003, one independent league folded (Western Baseball League), one league split into two (the Northern League into the Northern and

Northeastern Leagues), one league came into being but did not finish the season (Arizona-Mexico League), and there were four expansion teams as well as six franchise moves or replacement teams for folded teams. Between 2003 and 2004, another league folded (Southeastern), three other teams folded (one of whom was replaced by a traveling team) and one franchise moved. In addition, two teams switched leagues, with Springfield/Ozark moving to the Frontier League from the Central League and Pensacola taking its place in the Central League, moving from the defunct Southeastern League.

Literature Review

Past studies use attendance data for individual teams to investigate the demand for minor league baseball. Siegfried and Eisenberg (1980) estimated the impact of a city's market size, per capita income, ticket prices, and demographic factors on attendance. They find that population and ticket prices are the two main factors affecting the attendance at minor league baseball games. They also find that higher level teams (AAA and AA) have greater attendance than lower level teams (A and Rookie). Branvold, Pan, and Gabert (1997) showed that market size and the success of the team are both important factors, but factors that affect attendance differently depending on the level of the team. Our methodology differs from those studies in that we use the presence of a team, not the attendance, as the dependent variable.

A few studies used data sets similar to the one used in this study. However, most of the analyses assessed the impact minor league teams have on the communities, rather than examining what leads a community to have a team. Baade and Sanderson (1997) found that the presence of a minor league baseball team did little to improve the economic conditions of the area. Colclough, Daellenbach, and Sherony (1994) found only minimal benefits to La Crosse, WI, in building a stadium for a Class A baseball team. From a survey of local governments that hosted minor league baseball teams, Johnson (1990) found that the leaders of those communities had an unrealistically large perception of the value of the teams to their communities. Contrary to these other findings, Kraus (2003) concluded that there are significant economic and non-economic benefits to a city of hosting a minor league baseball team.

A number of analyses have been conducted on major league sports as well. There are studies that account for the impact of the presence of sports teams (Coates & Humphreys, 1999, 2001), team success (Coates & Humphreys, 2002; Matheson, 2005; Davis & End, 2006), construction of sporting facilities (Coates & Humphreys, 1999) and major sporting events (Baade & Matheson, 2001, 2003, 2006) on the personal incomes of metropolitan areas. In this study we reverse the analysis by examining the impact of personal income (as well as other variables) on the presence of a sports team at a particular level. Bruggink and Zamparelli (1999) also reversed the analysis, using population and income variables to assess the viability of new markets for major league expansion teams.

Factors Influencing the Locations of Baseball Teams

In describing the benefits to the Frisco Roughriders' new city following their move from Shreveport, the Frisco Roughriders' President stated, "The franchise is now located in one of the fastest growing cities in America and the fan base from the surrounding counties is phenomenal. The team is great, the fans are happy and the ballpark is gorgeous" (Baseball America, 2004). The quote suggests many of the factors that would influence the decision of a baseball team to locate in a particular location: population, population growth, and quality of the ballpark.

The decision to own and locate a team in a particular city is a supply decision; however, the costs will be similar across most cities in the country. There will be some effect of travel costs for cities not located near many other cities, but for the most part there will not be many differences in supply from city to city. The largest cost to an owner of a AAA team will be the opportunity cost of not locating the team in a different city. These opportunity costs will be affected by the differences in demand in different cities. We will examine the differences in factors across cities that affect the demand for baseball.

Siegfried and Eisenberg (1980) and Branvold et al. (1997) suggested factors to include in the model, the most obvious of which is population. A larger population

should lead to greater demand for baseball and thus a higher level team in that location. In some cases the metropolitan area may be large enough for multiple teams, but in this study we simply look at the highest level team in a particular location. Another factor that might affect the demand for baseball is the income of the people in the area. Higher income could mean greater disposable income to spend on recreation and therefore greater interest in baseball.

The presence of teams in other sports is a third factor that might affect the presence of baseball teams. However, the presence of professional hockey, football, or basketball teams would likely be determined endogenously with the presence of a baseball team in the city. For example, it is not clear whether Milwaukee does not have a National Hockey League (NHL) team because it already has a Major League Baseball (MLB) team or that it has a MLB team because it does not have an NHL team. Despite these concerns over endogenicity, we include variables testing whether the presence of football, basketball, or hockey teams affects the presence of a baseball team. The hockey variable indicates the presence of a team in any of the following leagues: NHL, AHL, ECHL, WCHL, CHL, UHL, or ACHL. Any team in the NFL or in one of the three indoor football leagues, AFL, AF2, or NIFL, is indicated by the football variable. Lastly the basketball variable indicates the presence of a team in the NBA, CBA, or NBDL.

One factor that would likely be exogenous to the presence of baseball teams, however, is the presence in the location of a major college sports program. We therefore include in this analysis a dummy variable for whether there is a Bowl Championship Series (BCS) college in the location. The BCS represents the universities with the biggest and best college football programs. It is also likely a good proxy for the universities with the biggest overall college sports programs. We hypothesize that this variable or the professional sports variables should have negative coefficients because they represent alternative sports opportunities for fans.

Lastly, the location of the Combined Statistical Area (CSA) relative to other CSAs could be important. The CSAs are combinations of metropolitan areas for cities near one another. For this analysis a simple definition of distance is used. It is assumed that the major league team locations are determined first and are therefore exogenous. For each CSA the time it takes to travel by automobile to the closest major league stadium is used as an explanatory variable. Because there is a realistic limit to how far most people will routinely travel to a sporting event, the time variable is capped at 300 minutes (5 hours). A significant positive coefficient would imply that the fans of a particular team support the major league team nearby and do not need a team of their own. Alternatively we might see a negative coefficient on this variable. All minor league teams have links with major league franchises. If a team is near the city with the major league team of which it is a farm team, the fans of the major league team might be willing to visit the minor league team for a chance to see the future prospects of their team. It would also give them a chance to root for a team of the same name as their favorite team but at a cheaper price. One last consideration, as mentioned by Kraus (2003), is that teams such as those in the Eastern League are located where they are in part because nearby major league teams can conveniently call up a replacement from the minors if a starter gets hurt. The benefits of proximity to the major league teams would be limited to AAA and AA teams, as those would have players with sufficient ability to fill in at the major league level.

Data

The personal income and population data for the metropolitan areas come from the Bureau of Economic Analysis website (http://www.bea.doc.gov/bea/regional/reis/). The minor league baseball team locations are collected from the team websites and Baseball America (2004). In the analysis we use the CSA as the unit of measurement as opposed to the Metropolitan Statistical Area (MSA). The CSAs seem to be a better choice because the presence of a team in one MSA might affect the presence of teams in a neighboring MSA, but both would be in the same CSA. For instance, San Jose is a large MSA but does not have a major league team, perhaps because it is in the same CSA as San Francisco and Oakland, both of which do have major league teams. Also, using the CSA eliminates the problem of knife edge cases. Specifically, there is a minor league team in Maryland located right on the border between the Baltimore and Washington

Table 1: Metropolitan Areas with Multiple Teams Including at Least One Major League Team

Metropolitan Area	Total Teams	Breakdown
New York	14	2 Major, 2 AA, 1 Low-A, 4 Short-Season A, 5 Independent
Chicago	8	2 Major, 1 Low-A, 5 Independent
Los Angeles	7	2 Major, 5 High-A
Boston	5	1 Major, 1 Short Season A, 3 Independent
Washington	5	1 Major, 1 AA, 2 High-A, 1 Short-Season A
Tampa	4	1 Major, 3 High-A
Cleveland	3	1 Major, 1 AA, 1 Low-A
Dallas	3	1 Major, 1 AA, 1 Independent
Miami	3	1 Major, 2 High-A
San Jose	3	2 Major, 1 High-A
Seattle	3	1 Major, 1 AAA, 1 Short-Season A
St. Louis	3	1 Major, 2 Independent
Cincinnati	2	1 Major, 1 Independent
Kansas City	2	1 Major, 1 Independent
Minneapolis	2	1 Major, 1 Independent
Philadelphia	2	1 Major, 1 Independent
Pittsburgh	2	1 Major, 1 Independent

MSAs, but since those two cities are in the same CSA, the team is located near the center of that area.[2]

We make some assumptions that limit the number of teams analyzed. First, we exclude cities with major league teams, and by excluding those teams we can include the distance from the nearest major league team as an explanatory variable. Also, a simple logit estimation finds that the presence of a major league team versus no major league team is perfectly predicted by population. Therefore, it is impossible to examine further the factors that explain the presence of major league teams.

Since Canadian data is not readily available, the Canadian cities are not included in the analysis; however, at all levels these make up a small minority of the teams.[3] Lastly, since many of the CSAs contain multiple teams, each location is coded with the highest level of team in that location and any teams of equal level or lower are ignored. There are a few major cities that have two major league teams, such as New York and Chicago, but there are also a number of lower level minor league teams located in large metropolitan areas with major league teams. Given the nature of the methodology and the data available, these teams are ignored, but they are primarily restricted to the largest metropolitan areas.

The independent leagues are more difficult to classify. The playing talent falls outside of the clear hierarchy described above and varies from league to league. There may also be some appeal to the fans of seeing inferior players who have a bigger upside and a better chance of reaching the major leagues. The paper assumes that the independent leagues fall last in classification behind all of the affiliated leagues.

In addition, which leagues to include in the independent league definition is also not clear. There were seven leagues in operation at the start of 2003, but the Arizona-Mexican League folded after 2 weeks, so this study only includes the six independent leagues that finished the season: the Atlantic League, the Central League, the Frontier League, the Northern League, the Northeastern League, and the Southeastern League.

Included in the data are 145 cities with minor league teams and 561 without any team. In 2003 there were 179 minor league baseball teams affiliated with the major leagues and 54 independent teams that completed the season. Of the 88 minor league teams not included in the sample, five were located in Canadian cities, 50 in metropolitan areas with major league teams listed in Table 1, 12 in metropolitan areas with a minor league baseball team at a higher level listed in Table 2 and two traveling teams in the independent leagues lacking a home city. The remaining 19 were in the Arizona and Gulf Coast Rookie leagues, which are very different from the other minor leagues in

Table 2: Metropolitan Areas with Multiple Teams but No Major League Teams

Metropolitan Area	Total Teams	Breakdown
Johnson City, TN	4	4 Rookie
Greensboro	3	1 High-A, 1 Low-A, 1 Rookie
Bluefield, WV	2	2 Rookie
Charlotte	2	1 AAA, 1 Low-A
Columbus	2	1 AAA, 1 Independent
Raleigh	2	1 AAA, 1 AA
Rochester	2	1 AAA, 1 Short-Season A
Salt Lake City	2	1 AAA, 1 Rookie
Syracuse	2	1 AAA, 1 Short-Season A

that they are run directly by the parent club and typically play in the spring training facility of the major league club. Also they do not conduct promotions or have much interest in attracting fans to the games but are more interested in player development (see Kraus 2003, p. 43). Winfree (2005) reported that seven of the eight Gulf Coast and Arizona league teams affiliated with National League teams in 2000 were owned by the parent club. In all 19 cases, there was a team of higher level in the location as well.

For each city the driving time from the minor league city to the nearest major league team is used as a variable. This information is collected using Mapquest. The exact location for the minor league city is the center of the primary city in the CSA, whereas for the major league point the exact location of the stadium is used. The justification for using two different methods is that we are trying to determine whether there will be a team within a CSA given the locations of the major league teams.

Table 3 presents the summary means for each of the leagues. Each CSA is included only once using the highest level team within that CSA. Because there are a very limited number of observations for the Short-Season A and Rookie categories, these two categories are combined to facilitate estimation.

Methodology

For this analysis we use the generalized ordered logit model, which is similar to but less restrictive than the ordered logit model. The ordered logit model makes the proportional odds (or parallel regression) assumption that the effect of the explanatory variables on the dependent variable is independent of the value of the dependent variable we are trying to model. For example, with the data in this study, the assumption would require that the effect of log population in moving from Low-A to High-A is the same as the effect of log population in moving from High-A to AA.

In many research studies this assumption is not valid, so an alternative model (the GOLM) is used. The GOLM loosens the proportional odds assumption (see Williams, 2006; Lall et al., 2002; Peterson & Harrell, 1990). The specification of the GOLM is:

$$\Pr(Y_i>j) = \frac{\exp(\alpha_j+X_i'\beta+T_i'\gamma_j)}{1+\exp(\alpha_j+X_i'\beta+T_i'\gamma_j)}, \; j=1,\ldots,k.$$

Y is a discrete variable representing an ordinal ranking, and k+1 is the number of different values that Y can have. In our estimations the dependent variable spans from 0 to 6, so k equals 6. A value of 0 specifies that a CSA or MSA has no major or minor league team, 1 represents an independent league team, 2 represents a Rookie team or Short-Season A, continuing on up (3: Low-A, 4: High-A, 5: AA, 6:AAA). Note that the validity of the regression is dependent upon the strict hierarchy that major league is higher than AAA, AAA is higher than AA, etc., as defended in the Introduction.

X is a vector of explanatory variables under the parallel regression assumption. T_i is the vector of explanatory variables for which the proportional odds assumption is not found to hold. Therefore, γ_j represents deviations from proportionality for the particular variable in category j. To determine which T_i to include, Williams' (2006) *autofit* command in Stata is used. The procedure is a stepwise sequence of Wald tests that determines those variables for which the proportional odds assumption holds.[4]

Table 3: Means for Each Baseball Level

Level of Team	Number of Observations	Population	Per Capita Personal Income	Time to Nearest ML Team	% with BCS University	% with Hockey	% with Football	% with Basketball
No Team	561	88,981	$24,865	200.1	4%	2%	2%	1%
Independent	28	321,102	$26,975	205.0	11%	43%	25%	7%
Rookie	12	161,541	$25,783	291.3	8%	0%	17%	0%
Short-Season A	12	372,903	$26,628	189.1	17%	17%	8%	17%
Low-A	25	413,487	$27,790	155.8	20%	40%	28%	16%
High-A	17	469,097	$27,784	170.6	6%	24%	24%	6%
AA	24	766,235	$28,770	181.1	17%	67%	42%	17%
AAA	27	1,279,242	$30,348	177.2	22%	67%	56%	19%
Major League	24	5,616,900	$35,376	NA	63%	92%	96%	75%

Only highest level team within each CSA is included.
Time to ML Team is truncated so that the maximum allowed is 300 minutes (5 hours).

Results

The results of the estimations are presented in Table 4. Columns 1 and 2 present the same model but make different assumptions about which variables to include. Column 1 presents the results excluding the variables that represent the presence of rival sports teams. We use Williams' (2006) *autofit* procedure to determine which variables satisfy the proportional odds assumption. For all of the variables except time to major league stadium, the proportional odds assumption holds.

Population is positive and significant as expected. Per capita personal income is positive and significant, suggesting that wealth increases demand. Note that this finding differs from the results of Siegfried and Eisenberg (1980), who found that per capita income did not have a significant positive effect on attendance. The difference in the results could be explained by the difference in methodologies. Because they must sacrifice more income for leisure, wealthier residents might not be interested in attending a greater number of games but have a preference for superior quality games.

The coefficients for time from nearest major league team are positive and significant, but the effect is not the same across all the levels. In particular, as the level goes from Short-Season A/Rookie to Low A, the effect of time is negligible. The results suggest that being farther away from a major league location increases the level of the baseball team, as competition from the major league team is less.

In column 2 the model is re-estimated attempting to include the four variables representing teams in other sports. The football and basketball variables are not significant (p-values of .195 and .957, respectively), and to reduce the number of estimated coefficients, these variables are dropped from the model.[5] For the variables included in the first model, the results are similar to those from the previous estimation. The BCS coefficient is not significant. The hockey results are inconsistent across levels.

Table 5 presents the predicted probabilities for cities with certain characteristics based on the results of column 2 of Table 4. The first row shows the probabilities when each of the variables is evaluated at its mean value. Since the great majority of cities included in the model do not have any team, it should not be surprising that when evaluated at the mean values, the predicted probability of having no team is very high. The other rows show what happens to the predicted probabilities if one variable is changed while all of the others remain the same, except for the last two rows, in which both the population and hockey variables are changed. The values for each variable are chosen to be representative of the underlying values in the data.

The first conclusion that can be drawn from the data is the overwhelming importance of population. Metropolitan

Table 4: GOLM Estimation Results

	(1) Coefficient	Standard Error	(2) Coefficient	Standard Error
β				
Log Per Capita				
Personal Income	2.581*	0.891	2.664*	0.892
Log Population	2.362*	0.165	2.330*	0.188
Time	0.005*	0.002	0.005*	0.002
BCS			-0.480	0.359
Hockey			0.883	0.454
γ_2 (SSA/Rook)				
Time	-0.001	0.001	-0.001	0.001
Hockey			-1.147*	0.406
γ_3 (Low-A)				
Time	-0.005*	0.002	-0.005*	0.002
Hockey			-0.766	0.426
γ_4 (High-A)				
Time	-0.002	0.002	-0.002	0.002
Hockey			-0.986*	0.482
γ_5 (AA)				
Time	-0.002	0.003	-0.002	0.003
Hockey			-0.394	0.538
γ_6 (AAA)				
Time	-0.003	0.004	-0.004	0.004
Hockey			-0.800	0.652
α				
α_1	-56.832*	9.160	-57.293*	9.327
α_2	-57.204*	9.169	-57.530*	9.332
α_3	-57.000*	9.164	-57.324*	9.326
α_4	-58.275*	9.177	-58.564*	9.338
α_5	-59.014*	9.194	-59.481*	9.359
α_6	-60.088*	9.219	-60.390*	9.388

* Significant at 5% level.

(1) Estimation using generalized ordered logit model of level of team on constant, log of population, log of per capita personal income, and time to nearest major league city.

(2) Estimation using generalized ordered logit model of level of team on constant, log of population, log of per capita personal income, presence of BCS university, presence of a hockey team, and time to nearest major league city.

Both estimations include all CSA/MSAs and micropolitan areas except those with major league teams

areas with fewer than 100,000 people rarely have teams, while those with more than 750,000 rarely do not. The second conclusion is that the other factors can affect the presence of teams but are of secondary importance. The particular conclusions about the direction of the effects are similar to the conclusions drawn from the coefficients in the GOLM model.

The presence of a hockey team in a location seems to suggest a higher likelihood for a minor league baseball team. This result is counterintuitive. One explanation is

Table 5: Predicted Probabilities of Outcomes

Model	No Team	Independent	Rookie/ SS-A	Low-A	High-A	AA	AAA
All Means	93%	2.6%	2.0%	1.0%	0.68%	0.34%	0.15%
Population							
100,000	92%	3.0%	2.4%	1.2%	0.80%	0.40%	0.18%
200,000	70%	9.6%	9.1%	5.2%	3.8%	2.0%	0.89%
300,000	47%	13%	15%	10%	8.4%	4.7%	2.2%
400,000	31%	12%	17%	14%	13%	8.5%	4.3%
500,000	22%	9.8%	16%	16%	18%	13%	7.0%
750,000	9.8%	5.5%	11%	14%	22%	22%	16%
1,000,000	5.1%	3.1%	6.7%	9.9%	20%	28%	28%
PCPI							
$20,000	96%	1.5%	1.1%	0.55%	0.37%	0.18%	0.08%
$25,000	93%	2.6%	2.0%	1.0%	0.67%	0.33%	0.15%
$30,000	90%	3.9%	3.1%	1.6%	1.1%	0.54%	0.24%
$35,000	85%	5.3%	4.4%	2.3%	1.6%	0.80%	0.36%
Time							
100 min	96%	1.5%	0.55%	1.4%	0.52%	0.25%	0.13%
200 min	93%	2.6%	2.1%	1.0%	0.68%	0.34%	0.15%
300 min	89%	4.4%	4.2%	0.53%	0.89%	0.46%	0.17%
BCS							
0	93%	2.6%	2.1%	1.0%	0.70%	0.35%	0.15%
1	96%	1.7%	1.3%	0.65%	0.44%	0.22%	0.10%
Hockey (Population = mean)							
0	94%	1.9%	2.2%	0.97%	0.72%	0.31%	0.15%
1	86%	10%	0.92%	1.3%	0.31%	0.59%	0.16%
Hockey (Population = 750,000)							
0	11%	4.3%	11%	13%	23%	21%	16%
1	4.7%	14%	5.6%	18%	8.7%	32%	17%

Notes:
Based on results of estimation from column 2 of Table 4.
All other variables are at means unless otherwise noted.
Population and per capita income estimated and evaluated in log values but displayed in levels.

that the presence of a hockey team shows a city's willingness to construct facilities for sports teams, and thus the city is more likely to construct facilities for a baseball team. The other possibility is that there are idiosyncrasies in the locations of hockey leagues. At a higher population level (750,000) the presence of a hockey team reduces the probability of having a team at Rookie/Short-Season A and High-A and increases the probability of having a team in the independent, Low-A, AA, and AAA levels.

Tables 6 and 7 are based on the probabilities suggested from the model results in Table 4, column 2. Table 6 ranks the cities by the probability that they should (by the

Table 6: Top 10 Cities with Highest Probabilities to Have Team at Particular Level that do not Have Team at that Level or Higher.

	AAA	AA	High A	Any Team
1	San Antonio (7)	Greensboro (4)	Honolulu (2)	Honolulu (29)
2	Orlando (8)	Grand Rapids(7)	Grand Rapids (3)	Springfield, MA (47)
3	Hartford (17)	Albany (8)	Albany (4)	Anchorage (49)
4	Jacksonville (18)	Dayton (10)	Dayton (5)	Lafayette (57)
5	Greensboro (20)	Honolulu (12)	Allentown (6)	Gulfport (59)
6	Grand Rapids (21)	Springfield, MA (19)	Springfield, MA (8)	Fayetteville, NC (65)
7	Austin (22)	Charleston, SC (20)	Charleston, SC (9)	Reno (69)
8	Albany (24)	Allentown, PA (21)	Baton Rouge (10)	Madison (77)
9	Birmingham (26)	Baton Rouge (22)	Boise (11)	Lancaster, PA (83)
10	Tulsa (27)	Boise (23)	Jackson, MS (12)	Santa Barbara (87)

Note: Number in parentheses represents rank for particular level or above excluding teams that have a team at higher rank. The Any Team is rank among all locations.

Example: Excluding cities with major league teams, Greensboro had the 20th highest probability of having a team at the AAA level, but Greensboro does not have a AAA team. Of the 19 cities in front of Greensboro, 15 of them had AAA teams. Excluding cities with major and AAA teams, Greensboro had the third highest probability of having either a AAA or AA team.

Table 7. Top 10 Cities with Lowest Probabilities to Have Team at Particular Level that do Have a Team at that Level.

	AAA	AA	High A	Any Team
1	Scranton (59)	Altoona (226)	Kinston, NC (336)	Clinton, IA (459)
2	Colorado Springs (53)	Jackson, TN (153)	Vero Beach (114)	Richmond, IN (417)
3	Tucson (46)	Erie (110)	Lynchburg (87)	Oneonta, NY (416)
4	Syracuse (45)	Binghamton (93)	Myrtle Beach (71)	Burlington, IA (410)
5	Des Moines (44)	Norwich (84)	Visalia (68)	Kinston, NC (369)
6	Toledo (38)	Midland (77)	Wilmington, NC (60)	Rome, GA (354)
7	Fresno (35)	Reading, PA (52)	Roanoke, VA (57)	Martinsville, VA (330)
8	Albuquerque (34)	Mobile (40)	Port St. Lucie (52)	Helena, MT (306)
9	Omaha (31)	Huntsville (35)	Modesto, CA (46)	Jamestown, NY (280)
10	Oklahoma City (30)	Chattanooga (33)	Lakeland, FL(36)	Great Falls, MT (279)

Note: Number in parentheses represents rank for particular level or above excluding teams that have a team at higher rank. The Any Team is rank among all locations.

Example: Des Moines has a AAA team; however, according to the model it had only the 44th highest probability of having a AAA team, and there were four cities with lower probabilities that have AAA teams.

model) have a team at that level or higher but do not. Table 7 reports the top 10 ranking for cities that do have teams by the lowest probability of having a team at that level or higher. From these tables it appears that either the leagues and team owners are missing a good opportunity or there are factors not accounted for that are determining the locations. Some of these factors are considered below.

The results also suggest that the outliers for the lower level leagues are more severe than for the higher leagues. For example, the top two omissions from the AAA level,

San Antonio and Orlando, are the only missing cities that the model suggests should be in the top 15. However, all of the top 10 omissions in High-A would rank in the top 12 most likely locations for teams at that level.

One explanation for there being more omissions in the lower levels is that the geographical locations of the leagues are not included in the model. The two major leagues are both national, having teams throughout the country. The two AAA leagues are not individually national but between them cover the entire country. On the other hand, the three AA leagues (Texas, Southern, and Eastern Leagues) cover only about half the country among them. The same is true of the lower level leagues as well. Grand Rapids and Dayton are deserving of at least AA teams, but geographically the Low-A Midwest League would make more sense for those locations than a higher league that is not as close. The location of leagues probably affects the statistical results in the γ_j (deviations from proportionality) for the time variable. The differences in gamma at the lower league levels are correlated with the presence of leagues in remote areas. One Rookie and one Short-Season A league are located in the western part of the country, where the distances between cities are large and there are few major league teams. The Low-A league with the most teams (Midwestern League) is located in an area with many major league teams.

The study uses 2003 data because that is the most recent available for the population and income statistics. Some of the misallocations identified here have already been corrected by the teams. For instance, Austin now has a AAA team in the Pacific Coast League and Jackson, MS has a team in the AA Southern League. Of course not all of the moves that have taken place would be optimal according to this model, as a AA team in the Texas League, which was ranked 71st in the AA rankings, moved to Springfield, MO, in 2005.

The remaining exceptions identified as misallocations could be explained by variables that are impossible to include in the model. Individual tastes in sports could vary from one location to another. Even specific factors that are measurable, such as the extreme distance of Honolulu from the mainland or Greensboro's having three teams instead of one, could explain those cities' rankings. Another possibility could be the willingness or reluctance of a municipality to subsidize stadium construction. The case studies of Johnson (1993), Wessel (1993), and Turner (1993) examined the factors that led to the relocation of minor league franchises, with a key issue in each being that one location gave a better stadium deal than did the other location. Lastly there may be some idiosyncratic decisions made by an individual team owner that cause a team to choose one location over another.

Conclusion

We find that population and personal income positively affect the level of minor league baseball in a metropolitan area. Although the population effect is obvious, the personal income finding is more surprising. The driving time to the nearest major league team has a positive effect on the presence of a minor league team, but the presence of a BCS university has no effect. The presence of a major or minor league hockey team generally increases the likelihood of having a team but reduces the probability of having one at some of the levels.

Cities interested in attracting a minor league baseball team should realize from this study that even though the quality of a new ballpark is important, the underlying qualities of the city and surrounding communities are quite important for the locating of minor league baseball teams. In particular, if the population does not appear to be sufficient to support a team of a particular level, it is unlikely that the team will remain there in the long run. The tables listing the outliers that are indicated by the model do not define the only likely locations for long-term success at each level, but they are suggestive.

From these results one direction for future study would be to examine the dynamics of team movements over the entire data set of team locations for the past 30 years. For instance, Johnson (1993) asserted that in the early 1990s fundamental changes to the economics of baseball affected the ability of small markets to support minor league baseball teams. Also, a more detailed examination of the location of the leagues themselves, based on population and historical developments, would be an additional possibility for future research.

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Endnotes

[1] We also examined the data using the multinomial logit model, which is a little more flexible than the GOLM. The results from the two models are fairly similar. Those results are available upon request from the author.

[2] We will use the term CSA to represent the metropolitan areas in this study regardless of whether the particular area represents a CSA that combines MSAs or if it is just a single MSA.

[3] Toronto and Montreal are included as possibilities for nearest major league city and are the closest major league city for a number of cities in Upstate New York and Vermont.

[4] We also attempted to include a population growth rate in the model. Because the coefficient on population growth is very different for one category than for the other categories, several predicted probabilities are negative. The results from including such a variable in the multinomial logit model are available from the author upon request.

[5] The p-value on football was lower than for BCS; however, the intuition on the BCS variable was stronger, so we retained that variable instead.