

Income and the Locations of AAA Minor League Baseball Teams
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Michael C. Davis

Department of Economics and Finance
University of Missouri-Rolla
101 Harris Hall
1870 Miner Circle
Rolla, MO 65409-1250
davismc@umr.edu
573-341-6959

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Minor league baseball in the United States provides a recreational activity for fans. We focus on the possibility that higher income of the local population leads to greater demand for professional baseball, which will lead to the presence of a baseball team in the city.

Other than income, key factors include population, alternative recreational activities, and proximity to other teams. As expected, population is a key determinant of the presence of sports teams [Davis, *International Journal of Sport Finance*, 2006; Siegfried & Eisenberg, *Atlantic Economic Journal*, 1980]. The impact of income is not clear. Davis (2006) found that higher income leads to a higher level of baseball in the metropolitan area, while Siegfried and Eisenberg (1980) found that increased income does not lead to higher attendance. Davis (2006) attributed the difference to a leisure-consumption tradeoff. Wealthier fans do not have sufficient time to attend a greater number of sporting events (measured by attendance) because they have to spend as much or more time working. However, wealthier fans will demand and can afford a higher quality product (measured by a higher level of minor league baseball team).

One concern with these findings on income is that income and population are highly correlated. In a sample of all metropolitan and micropolitan areas across the country, the correlation coefficient between population and per capita personal income is 0.38. Since population is such an important determinant and it was only included in Davis' model in log-linear form, the per capita personal income (PCPI) might be picking up an additional unexplained nonlinear portion of the effect of population.

The locations of AAA baseball teams provide an opportunity to study the role of income. The two AAA baseball leagues (the Pacific Coast League and the International League) cover the entire country and most of the teams are located in cities that do not have major league teams. Since AAA is the highest level of minor league baseball, the presence of teams in lower-level minor leagues in the area is unlikely to influence the presence of AAA league teams in the city.

We performed a probit analysis to determine which factors are important for the presence of AAA baseball teams in metropolitan areas. The probit equation is $\Pr(y = 1 | X) = \Phi(X\beta)$, where y is the dependent variable, representing whether there is a team in the area, and X is the vector of independent variables, such as population and income.

The study sample includes all metropolitan and micropolitan areas in the United States that do not have any major league baseball teams and have a population of at least 100,000 people. These criteria left a sample of 298 cities. Initially, we include in the model all the variables in Davis' final model: per capita personal income, population, travel time to nearest major league city, the presence of a minor league hockey team and the presence of a Bowl Championship Series university. Since travel time, presence of a hockey team and presence of a BCS university are all highly insignificant (p-values > 0.75), they are dropped from the model, leaving just population and income (both measured in 1000s). Diagnostic statistics suggest that there is a missing variable and thus population squared is added to the model. The results:

$$\Pr(y = 1 | X) = \Phi(-5.54 + 0.058 * PCPI + 0.0051 * Pop - 0.0000015 * Pop^2)$$

When the population squared variable is included in the model, the p-value on per capita personal income increases to 0.194, compared to 0.096 when it is excluded. Thus per capita income does seem to be picking up some non-linear element of the population variable when the population squared variable is excluded. However, even though the effect is less significant the coefficient estimate is larger. When evaluated at 1 million people and a per capita personal income of \$27,000, the incremental effect of adding another \$1000 to per capita income increases the probability of having a AAA team by 2.2%, as opposed to 2.0% when population squared is not included in the model.

While per capita personal income is not found to be significant in these results, its importance can not be completely discounted. Increasing the income from one standard deviation below the mean to one standard deviation above increases the probability of having a team by ~16%. The discrepancy between the significance of income in Davis' (2006) result and the result here is likely due to the greater size of the data set used in Davis (2006). Additional research examining panel data is needed to further disentangle income from population.