Emily Jorgens
Urban Economics
March 3, 2014

Technical Presentation: "The association between urban sprawl and obesity: is it a two-way street?"

I. Research Question

Plantinga and Burnell's 2005 paper draft proposes a model that addresses how obesity and urban sprawl are related. This question arose due to the recent rise in obesity in the United States. There is ample research in the public health and urban planning realms on this topic. However, Plantinga and Bernell challenge the existing literature's conventional assumption that sprawl causes obesity.

Urban economics is perhaps a surprising avenue by which to analyze the problem of obesity. However, the analytical model put forth in this paper finds meaningful results that could have profound public health and policy implications. Urban planning specialists have drawn links between urban sprawl patterns and demographic and lifestyle characteristics.

Specifically, urban sprawl and obesity are related in three main ways. First, poor street networks and low density lead to longer travel distances. Longer travel distances mean people are forced to travel by car rather than bike or foot. Second, low density means that public transportation systems are less effective and less likely to exist. Therefore, people are traveling by car and have longer commute times and thus less time for physical activity. Lastly, sprawling areas often have poor or unsafe public parks, which discourages exercise.

The existing research holds that poor infrastructure and land use, as outline above, ultimately cause weight issues. As a result, many cities are investing in projects to encourage healthy living. For example, the Atlanta Regional Commission recently invested $1.1 billion in bike and pedestrian infrastructure. Plantinga and Bernell's model questions whether this will be effective. They assert that overweight people self-select for sprawling residential environments, and thus improving land use in these areas is futile.

Previous research has treated urban form as an exogenous variable. In other words, researchers have assumed that one's Body Mass Index (BMI) has no influence on residential location choice. This study, however, poses that BMI indicates lifestyle choices that influence residential location choice. This distinguishes whether sprawl causes BMI to rise or whether high BMI individuals choose to live in sprawling locations. Treating BMI and location preference both as endogenous variables answers this question.

II. Theoretical Background

Plantinga and Bernell use the National Longitudinal Survey of Youth from 1979 (NLSY79) together with the sprawl index produced by McCann and Ewing (2003). The resulting dataset includes variables such as BMI, income, education, county of residence, and degree of sprawl. This paper builds on the conventional model for regressing BMI on locational attributes and a composite good.

The conventional function holds that utility is maximized by considering weight, attributes of the residential location (such as walkability), and a composite good. Weight (W) is given by:

1) $$W = f(W_0, \mathbf{N}, C)$$

Where W_0 is initial weight of a person, N is a vector of locational attributes, and C is a composite good. Utility is maximized using the follow equation:

2) $$\max_{\mathbf{N},\mathbf{C}} U(W, \mathbf{N}, C) \quad \textbf{subject to} \quad \mathbf{pN} + C = I, \quad W = f(W_0, \mathbf{N}, C)$$

Given that p is a vector of prices for locational attributes and I is income. Using standard constrained optimization techniques, the following equations give the locational attributes (N^*_I) and weight (W^*_I) that result on the greatest utility for an individual.

3) $$N_i^* = N_i(W_0, \mathbf{p}, I) \qquad \mathbf{i=1,\ldots,n}$$

4) $$W^* = f(W_0, \mathbf{N}^*, I - \mathbf{pN}^*)$$

However, this paper argues that there would be codependence between the weight and locational attribute variables. Also, the researchers hold that a complete model would distinguish between people who recently moved versus have been in the same county for four years or more. This is because if land use does have an impact on weight, it would take some years to manifest. Therefore, the researchers propose a simultaneous equation model that would treat BMI and locational attributes as endogenous. They also create two different models that look at movers and non-movers separately.

III. Empirical Model

The BMI model used in this paper is as follows:

5)
$$\begin{aligned} ADJBMI_i = \beta_0 + \beta_1 DBLACK_i + \beta_2 DHISPANIC_i + \beta_3 DOTHER_i + \beta_4 DSEX_i + \beta_5 DSMOKE_i \\ + \beta_6 AGE_i + \beta_7 AGESQ_i + \beta_8 DEDUC1_i + \beta_9 DEDUC2_i + \beta_{10} WEST_i \\ + \beta_{11} NCENTRAL_i + \beta_{12} NEAST_i + \beta_{13} SEAST_i + \beta_{14} SPRAWL_i + \varepsilon_i \end{aligned}$$

given that i (i=1,…,N) indicates specific individuals, B_0 is the intercept term, B_j (j=1,…,14) are the variable coefficients, and ε_i is the error term. The explanation of variables is given in Table 1.

Due to the fact that migration is a separate decision and difficult to factor into the model, the researchers decided to define the decision to move to a county as whether it is high or low density, income, education, marital status, and more. Therefore, their model for adjusted BMI on all the other variables as a follows:

6)
$$\begin{aligned} ADJBMI_i &= \gamma_1 y_i^* + \mathbf{X}_{1i}\boldsymbol{\beta}_1 + \varepsilon_{1i} \\ y_i^* &= \gamma_2 ADJBMI_i + \mathbf{X}_{2i}\boldsymbol{\beta}_2 + \varepsilon_{2i} \end{aligned}$$

Where y^*_I is the latent variable describing choice of a low or high density county, that i (i=1,…,N) indicates specific individuals, y_1 and y_2 are parameters on $ADJBMI_i$ and $SPRAWL_i$, X_{1i} and X_{2i} are vectors of the exogenous variables, B_1 and B_2 are conformable parameter vectors (like race, sex, smoking, age, education, and regional dummies), and ε_{1i} and ε_{2i} are the error terms.

Using least squares and a probit maximum likelihood model, they created a set of covariant matrices of expected values for the endogenous variables. These estimates were made using data from the year 2000 in the NLSY79 and the sprawl index. To separate out movers from non-movers, the model was run twice, each time with only individuals who had lived in their counties for 4 years or more versus less.

IV. Results and Conclusions

The results of the simultaneous equation model suggest that BMI does, in fact, have a negative effect on whether an individual moves into a dense county. This holds true for both movers (coefficient -.789) and non-movers (coefficient -1.182). The researchers also accounted for the fact that their arguably arbitrary cutoff for density or their year cutoff for being a mover versus non-mover may have skewed the results. However, even with more conservative and liberal estimations of these cutoffs, their results generally held true. The implications of these results are that current policies about land use and public health may be misguided. Increasing infrastructure that encourages an active lifestyle in sprawling areas could just result on obese-prone people moving elsewhere.

V. Extensions

The fact that Plantinga and Bernell challenged the assumption that sprawl causes obesity could have profound policy implications. With this discovery, money will be saved on fruitless or inefficient policies. Also, researchers are one step closer to discovering the root of obesity problems. Their research helps society edge closer to the true causes and possible solutions for obesity. This investigative research model could also be applied to other public issues related to urban sprawl. For example, one could research whether violent people move to sprawling or dense areas. Does density versus sprawl cause the violence or is it a result of the type of person who chooses to live there?

TABLE 1. Summary Statistics

Variable	Description	Summary Statistics
ADJBMI	Adjusted body mass index	Mean = 28.1 Percent > 30 = 30.1 Minimum = 10.6 Maximum = 57.3
DBLACK	Dummy variable for black	Mean = 0.29
DHISPANIC	Dummy variable for hispanic	Mean = 0.19
DASIAN	Dummy variable for asian	Mean = 0.003
DOTHER	Dummy variable for white	Mean = 0.52
DSEX	Dummy variable for sex (male = 1)	Mean = 0.50
DSMOKE	Dummy variable for smoking (daily = 1)	Mean = 0.23
DMARRIED	Dummy variable for married (yes = 1)	Mean = 0.55
INCOME	Family income ($1000 per year)	Mean = $61 Minimum = $0 Maximum = $333
DCHILD0	Dummy variable for no children	Mean = 0.21
DCHILD1	Dummy variable for 1 child	Mean = 0.18
DCHILD2	Dummy variable for 2 children	Mean = 0.33
DCHILD3	Dummy variable for 3 or more children	Mean = 0.28
AGE	Age of respondent	Mean = 39 years
DEDUC1	Educational attainment less than high school	Mean = 0.09
DEDUC2	Educational attainment is high school	Mean = 0.41
DEDUC3	Educational attainment is some college or more	Mean = 0.50
WEST	Dummy variable for Western region	Mean = 0.22
NCENTRAL	Dummy variable for North Central region	Mean = 0.23
NEAST	Dummy variable for Northeast region	Mean = 0.22
SEAST	Dummy variable for Southeast region	Mean = 0.16
SCENTRAL	Dummy variable for South Central region	Mean = 0.07
DENSE	Dummy variable equal to 1 for residence in a county with SPRAWL ≥ 120	Mean = 0.26

Cited Source:

Andrew Plantinga and Stephanie Bernell, 2005, "The association between urban sprawl and obesity: is it a two-way street?". Draft. americandreamcoalition.org *

Andrew Plantinga and Stephanie Bernell, 2007, "The association between urban sprawl and obesity: is it a two-way street?" *Journal of Regional Science* **47**(5): 857-879.

*I used the 2005 draft because it explained which equations were used, while the 2007 version did not. The remainder of the article and analysis was largely the same.