Title of the Presentation

How Much Does Food Environment Matter: A Case Study of the Value of Food Environment in Dan River Region

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How Much Does Food Environment Matter: A Case Study of the Value of Food Environment in Dan River Region

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Introduction

- In 2015, an estimated 19 million people in the U.S. live in low-income and low access tracts and are more than 1 mile (urban areas) or 10 miles (rural areas) from a supermarket (Rhone, et al., 2017).
- These areas with limited access to affordable and nutritious food are referred as "food deserts".
- In 2010, the Obama Administration announced Healthy Food Financing Initiative (HFFI) to bring grocery stores and other healthy food retailers to food deserts.
- However, some quasi-experimental studies on the impact of introducing a new supermarket in a deprived area found no evidence on increased fruit and vegetable consumption for adults and children (Cummins, et al., 2008, Cummins, et al., 2014, Dubowitz, et al., 2015, Elbel, et al., 2015)
- To improve those HFFI-like policies' effectiveness, it is much needed to understand and quantify residents' preferences towards different dimensions of food environment.

Objectives

- We use hedonic property method to assess the value of each food environment dimension based on housing market prices.
- We infer the marginal willingness-to-pay of residents for an improved food environment in Dan River region, and examine its heterogeneity across urban and rural areas and across different types of food outlets.

Methods

- The hedonic property method is a form of revealed preference valuation method. It treats a property as a composite good with associated attributes, and infers from housing prices the marginal willingness-to-pay of homebuyer for the attributes.
- To control for the omitted variable issue, we consider a hedonic spatial-lag model in linear form:

$$\boldsymbol{P} = \rho \boldsymbol{W}\boldsymbol{P} + \boldsymbol{X}_1\boldsymbol{\beta}_1 + \boldsymbol{X}_2\boldsymbol{\beta}_2 + \boldsymbol{X}_3\boldsymbol{\beta}_3 + \varepsilon,$$

  where $\boldsymbol{P}$ is a $n \times 1$ vector of housing prices (n is the number of observations), $\boldsymbol{X}_1$ is a matrix of housing attributes, $\boldsymbol{X}_2$ is a matrix of neighborhood attributes, and $\boldsymbol{X}_3$ is a matrix of environmental attributes, in our example, food environment measurements. ρ is a spatial autoregressive parameter, $\boldsymbol{W}$ is a $n \times n$ spatial weight matrix, and ε is assumed to be a vector of i.i.d. errors.
- We choose $\boldsymbol{W}$ by comparing the log-likelihoods of models with binary distance, inverse distance, and inverse squared distance weight matrices in critical distances from 0.1 to 10 miles with 0.1-mile increment.
- We select the radius of food environment measurements based on the log-likelihoods of models in radiuses from 0.1 to 10 miles for urban area, and from 3 to 10 miles for rural area with 0.1-mile increment.
- Due to the endogeneity in spatial lag $\boldsymbol{WP}$ term, we apply spatial two stage least squares estimator (S-2SLS) to obtain consistent estimates.
- The marginal implicit price is $\beta_k[I - \rho\boldsymbol{W}]^{-1}$, which can be further separated into direct effect and indirect effect, see LeSage and Pace (2009) for details.

Data

- Dan River region is located near in south-central Virginia and north-central North Carolina. It is a health and economic disparate region.

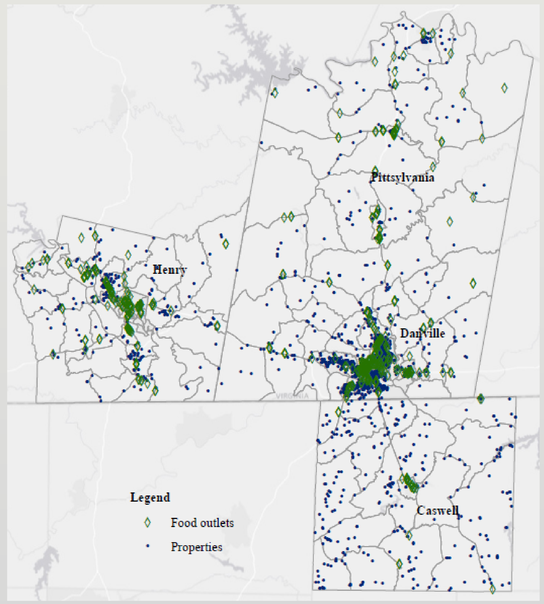

Figure 1. Food outlets and properties in the Dan River region

- We purchased property transactions data 2010-2015 from CoreLogic.
- We obtained the neighborhood information from the Census 2010 and the 2014 American Community Survey at U.S. Census Bureau.
- Our research partners enumerated and audited all 483 food outlets in this region based on the Nutrition Environment Measures Survey (NEMS) (Glanz, et al., 2007, Saelens, et al., 2007) from 2011 to 2012.
- We measure food environment in three dimensions:
  - availability: number of food outlets;
  - accessibility: average driving distance to outlets or distance to the nearest outlet if no outlet available; and
  - accommodability: inverse distance weighted NEMS score of outlets (variety, quality, price of healthy food options) or score of the nearest outlet if no outlet available;

  within a specified radius from individual property.

Results

- Fast casual restaurant and grocery store have the highest average NEMS score in the restaurant and store categories.
- The radiuses of food environment measurements with the highest log-likelihoods are 1.1 miles and 4.3 miles for urban and rural samples, respectively.

Table 1. Marginal willingness-to-pay (in thousands) of residents in urban and rural areas

	urban			rural		
variable	**direct**	**indirect**	**total**	**direct**	**indirect**	**total**
lot size in acres	1.474	0.931	2.404	1.957***	0.489*	2.446***
living space in sqft	0.028***	0.018***	0.046***	0.045***	0.011***	0.056***
number of bedrooms	-2.570**	-1.623**	-4.193**	3.912***	0.977*	4.889***
number of bathrooms	11.661***	7.363***	19.023***	13.983***	3.492**	17.476***
age of building at sale	-0.491***	-0.310***	-0.801***	-0.630***	-0.157**	-0.788***
total population in block	-0.021***	-0.013***	-0.034***	0.003	0.001	0.003
% African American in block	0.304**	0.192**	0.495**	-0.069	-0.017	-0.087
% some college or above in block	0.454*	0.286*	0.740*	0.232	0.058	0.289
yearly per capita income in thous. in block	-0.038	-0.024	-0.062	0.496	0.124	0.619
median age in block	0.857***	0.541***	1.398***	-0.904	-0.226	-1.130
% households receiving SNAP in block	0.183	0.116	0.299	-0.358	-0.089	-0.447
number of fast casual restaurants	-2.354	-1.487	-3.841	-4.483**	-1.120*	-5.602**
number of fast food restaurants	-0.936	-0.591	-1.527	-1.439	-0.359	-1.799
number of sit down restaurants	1.480*	0.934*	2.414*	1.929**	0.482*	2.411**
number of grocery stores	-2.979	-1.881	-4.859	-0.068	-0.017	-0.084
number of convenience stores	1.480	0.934	2.414	0.681	0.170	0.851
number of other-type stores	4.258*	2.689	6.947*	-0.120	-0.030	-0.150
access to fast casual restaurants	-2.245	-1.418	-3.663	-0.334	-0.083	-0.418
access to fast food restaurants	11.860*	7.488*	19.348*	2.164	0.540	2.705
access to sit down restaurants	-3.001	-1.895	-4.897	-1.309	-0.327	-1.636
access to grocery stores	2.806	1.772	4.577	-3.164	-0.790	-3.955
access to convenience stores	12.741**	8.045*	20.786**	-0.446	-0.111	-0.557
access to other-type stores	-6.231	-3.935	-10.166	0.484	0.121	0.605
accommodability of fast casual restaurants	0.266	0.168	0.434	0.407**	0.102	0.509**
accommodability of fast food restaurants	0.256	0.162	0.418	0.689	0.172	0.862
accommodability of sit down restaurants	-1.944**	-1.227**	-3.171**	-1.248	-0.312	-1.559
accommodability of grocery stores	0.058	0.037	0.095	0.363	0.091	0.454
accommodability of convenience stores	-0.088	-0.056	-0.144	-1.727**	-0.431	-2.158**
accommodability of other type stores	-0.104	-0.066	-0.170	1.437*	0.359	1.796*
observations		1300			626	

Note: The p-values are based on 500 simulations. *** significant at 1%, ** significant at 5%, * significant at 10%.

Conclusions

- Overall preferences of residents in the Dan River region for an improved food environment, in terms of availability and accommodability, are revealed as negative.
- We capture dis-amenity of living close to fast food restaurant and convenience store for residents in urban area.