The Impact of Agricultural Conservation Easement on House Prices: A New Hedonic Price Model That Incorporates Spatial Autocorrelation and Spatial Heterogeneity

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Table 5- Empirical results for Chester County

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1. Introduction

The primary approach for estimating the impact that land use has on nearby property values is through the hedonic price model. Conventionally, the hedonic price model has been estimated via the ordinary least square method. Recently, researchers have began to realize that the spatial structure of the data should be more fully explored. Two approaches have been used. In one approach, spatial correlation or dependence in house prices is modeled. Models that allow spatial correlation in the errors or spatial lags in the dependent variable are now commonly estimated. In the other approach, the assumption of stationary parameters over the space is relaxed. Geographically weighted regression is a model that allows the parameters of the hedonic model to vary over space. The primary goal of this paper is to estimate and compare models of both types, and to develop a hybrid model that allows for both spatial correlation in errors and spatial variation in parameters..

2. Objective

1. Investigate the spatial pattern of ACE(Agricultural Conservation Easement) impact on nearby property values in 2 study areas: York and Chester Counties.

2. Estimate a variety of spatial models such as SLM, SEM, and SEC, and compare them.

2. Estimate a new hedonic price model (GWR-SEC), and compare to GWR, GWR-SEM.

3.Methodology

1. SEC(Spatial Error Component Model, Kelejian and Robinson, 1993)

$$Y = X\beta + u \quad \text{and } u = Wv + \varphi, \qquad (1)$$

$$E(v) = E(\varphi) = 0 \qquad (2)$$

$$E(vv') = \sigma_v^2 \qquad (3)$$

$$E(\varphi\varphi') = \sigma_\varphi^2 I_n \qquad (4)$$

$$E(uu') = \sigma_v^2 WW' + \sigma_\varphi^2 I_n \qquad (5)$$

Regress u^2 on ww' and I, and obtain variances for error components $\widehat{\sigma_v^2}$ and $\widehat{\sigma_\varphi^2}$, and plugging these values back into (5) yields variance-covariance matrix for error components, which is expressed as $\widehat{\Omega_u} = \widehat{\sigma_v^2} WW' + \widehat{\sigma_\varphi^2} I_n$ (6)

Using GMM (Generalized Method of Moments), the consistent parameters could be calculated as:

$$\hat\beta = (X'\hat\Omega_u^{-1}X)^{-1}X'\hat\Omega_u^{-1}Y \qquad (7)$$

$$V(\hat\beta) = (X'\hat\Omega_u^{-1}X)^{-1} \qquad (8)$$

2. GWR (Fotheringham, A.S., Brunsdon, C., Charlton, M., 2002. Geographically Weighted Regression: the Analysis of Spatially Varying Relationships, John Wiley & Sons, LTD)

$$\beta(u_i, v_i) = (X'S(u_i, v_i)X)^{-1}X'S(u_i, v_i)Y, \quad \text{where } i = 1,2, \dots\dots, N \qquad (9)$$

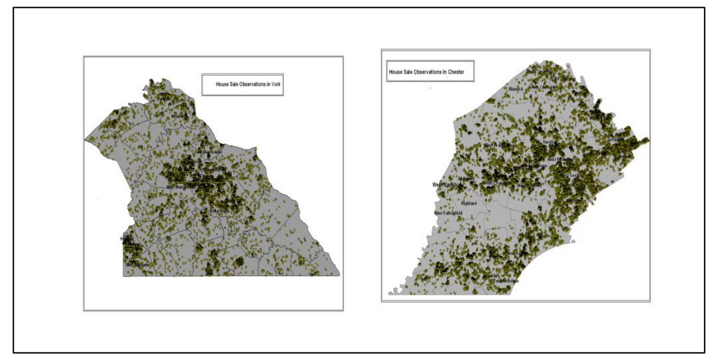
$$Cov(\beta(u_i, v_i)) = \sigma_i^2(X'W(u_i, v_i)X)^{-1} \qquad (10)$$

4. Data

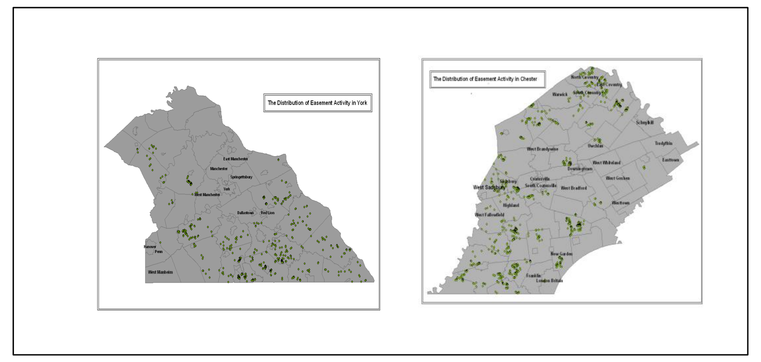
Variable	Mean Value		Description
	Chester	York	
Sale Value	451,090	243,319	Deflated house sale price (2007 $)
Structural Characteristics			
Log(Lot Size)	0.731	0.583	Log of Size of property in acres
Residential Area	2686	2052	Square footage of residential space
Basement Area	116.9	100.6	Total square footage of basement
Age	22.5	31.8	Age of house at time of sale
Locational Characteristics			
Wilmington	3.222		Natural log distance to Wilmington
Philadelphia	3.481		Natural log distance to Philadelphia
Baltimore		3.982	Natural log distance to Baltimore
Harrisburg		3.371	Natural log distance to Harrisburg
York		2.005	Natural log distance to York
Land Use			
Agricultural Land	0.2778	0.376	Proportion of undeveloped land within 800M of the house in agricultural land use
Forest	0.4295	0.2214	Proportion of undeveloped land within 800M of the house in forest land use
Other Residential	0.026	0.056	Proportion of land within 400M of the house in other resident ial use
Residential	0.436	0.450	Proportion…in residential uses
Commercial	0.1175	0.099	Proportion….in commercial uses
Industrial	0.022	0.030	Proportion….in industrial uses
Recreation	0.0149	0.027	Proportion….in recreation uses
Developable	0.304	0.316	Proportion….undeveloped but developable
ACE at time of Sale	0.0085	0.0071	Proportion….that has ACE in place at time of sale
Population Density	14.79	20.638	Population Density (1000 people per sq. mile).
PSSA score	0.779	0.7158	PSSA average score per school district /100

5. Results

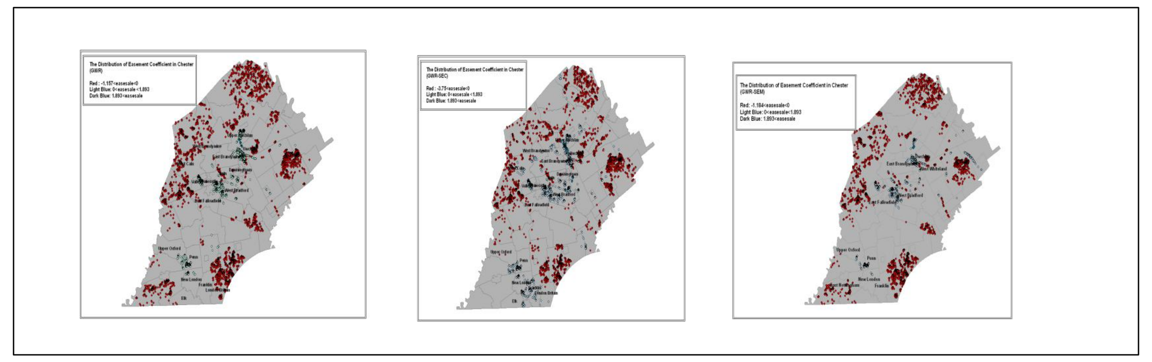
A. House Sale Distribution



B. ACE Distribution



C.The Distribution of ACE Coefficients



D. Empirical Result for Chester County

Variable	OLS	S-Lag	SEM	SEC
	Coefficient(t-stat)	Coefficient(t-stat)	Coefficient(t-stat)	Coefficient(t-stat)
Structural Variable				
Lotsize	0.0811(51.51)***	0.0805(52.15)***	0.0802(58.88)***	0.0828(51.29)***
Residential Area	0.00025(183.93)***	0.00024(192.22)***	0.00024(160.16)***	0.00024(180.19)***
Basement Area	-0.0002(-42.15)***	-0.0002(-52)***	-0.0002(-45.19)***	-0.0002(-43.11)***
Age	-0.0042(-76.38)***	-0.0043(-79.48)***	-0.0042(-101.36)***	-0.0042(-76.87)***
Locational Variable				
Wilmington	-0.1324(-33.81)***	-0.088(-13.71)***	-0.0306(-1.71)	-0.1301(-20.01)***
Philadelphia	-0.5533(-76.23)***	-0.4844(-15.58)***	-0.2385(-12.37)***	-0.5452(-54.51)***
Land Use				
Other Residential	0.1261(5.17)***	0.1432(5.99)***	0.1317(5.88)***	0.1364(5.53)***
Industrial	-0.3205(-14.91)***	-0.2898(-13.75)***	-0.2828(-14.02)***	-0.3107(-14.35)***
Commercial	-0.0296(-2.99)**	-0.0272(-2.94)**	-0.0193(-2.05)*	-0.0224(-2.24)*
Recreation	0.1246(6.19)***	0.1176(9.07)***	0.1692(9.09)***	0.1354(6.55)***
Developable	-0.04(-5.16)***	-0.0035(-4.66)**	-0.0203(2.73)**	-0.0189(-2.37*
EaseSale	**-0.093(-3.93)*** **	**-0.0886(-3.92)*** **	**-0.1303(-5.92)*** **	**-0.0904(-3.7)*** **
Forest800	0.1132(11.43)***	0.0465(5.43)***	0.0959(9.08)***	0.0925(8.53)***
Ag800	0.1183(10.34)***	0.0543(13.82)***	0.1205(9.27)***	0.1025(8.08)***
Year Dummy				
Y2006	0.04(8.02)***	0.041(12.47)***	0.0421(8.92)***	0.0408(8.64)***
Y2005	0.0632(12.72)***	0.0636(17.98)***	0.0628(13.32)***	0.0629(13.35)***
Y2004	0.0648(13.09)***	0.067(21.73)***	0.0667(14.18)***	0.0677(14.41)***
Y2003	0.0646(12.83)***	0.0658(19.46)***	0.0652(13.66)***	0.0679(14.18)***
Population Density	-0.0009(-12.31)***	-0.0008(-12.34)***	-0.0008(-11.43)***	-0.0008(-11.6)***
PSSA score	0.6573(41.57)***	0.4132(3.83)***	0.4455(14.17)***	0.6549(29.49)***
Row		0.17(9.63)***		
Lambda			0.925(1211.04)***	
Spillover Error				0.0281(64.34)***
Local Specific Error				0.0701(2.46)**

E. Empirical Result for York County

Variable	OLS	S-Lag	SEM	SEC
	Coefficient(t-stat)	Coefficient(t-stat)	Coefficient(t-stat)	Coefficient(t-stat)
Structural Variable				
Lotsize	0.0035(1.88)	0.0022(1.19)	0.0004(0.19)	0.0017(0.91)
Residential Area	0.00035(143.92)***	0.00035(144.09)***	0.00034(109.91)***	0.00034(137.12)***
Basement Area	-0.0002(-33.08)***	-0.0002(-32.89)***	-0.0002(-32.93)***	-0.0002(-32.72)***
Age	-0.004(-63.78)***	-0.0039(-63.48)***	-0.004(-63.68)***	-0.0041(-63.79)***
Locational Variable				
Baltimore	-0.4543(-25.57)***	-0.4105(1137.9)***	-0.3311(-29.98)***	-0.4468(-16.12)***
Harrisburg	-0.0231(-3.1)**	-0.0085(-2.3)*	0.0272(2.4)*	-0.0156(-1.34)**
York	0.0513(20.8)***	0.0471(19.98)***	0.0665(10.75)***	0.0511(14.01)***
Land Use				
Other Residential	-0.2968(-11.47)***	-0.3107(-12.11)***	-0.3116(-12.04)***	-0.3185(-11.76)***
Industrial	-0.4602(-17.99)***	-0.4285(-16.87)***	-0.443(-17.11)***	-0.4256(-16.31)***
Commercial	-0.2853(-16.64)***	-0.2594(-15.37)***	-0.2704(-15.72)***	-0.2563(-14.49)***
Recreation	-0.1589(-6.45)***	-0.1482(-6.06)***	-0.1433(-5.78)***	-0.1223(-4.74)***
Developable	-0.0333(-2.83)**	-0.023(-1.97)*	-0.0429(-3.59)***	-0.0478(-3.85)***
EaseSale	0.0844(2.5)*	0.1013(3.02)**	0.0724(1.94)	0.0688(1.79)
Forest800	0.0391(2.85)**	0.0229(1.68)	0.1228(6.94)***	0.1006(6.07)***
Ag800	-0.1015(-7.78)***	-0.1293(-9.95)***	-0.021(-1.28)	-0.0445(-2.91)
Year Dummy				
Y2006	0.0255(4.04)***	0.0254(4.04)***	0.0238(3.81)***	0.0227(3.71)***
Y2005	0.0229(3.61)***	0.0022(3.49)***	0.0164(2.66)***	0.0184(2.99)**
Y2004	-0.0023(-0.35)	-0.0039(-0.59)	-0.01(-1.53)	-0.0067(-1.05)
Y2003	0.0365(5.42)***	0.0356(5.32)***	0.0262(4.01)***	0.0297(4.55)***
Population Density	-0.0027(-31.22)***	-0.0027(-31.48)***	-0.0026(-31.3)***	-0.0025(28.43)***
PSSA score	0.608(32.36)***	0.5547(31.32)***	0.5643(26.5)***	0.6304(30.44)***
Row		0.07(46.56)***		
Lambda			0.744(371.6)***	
Spillover Error				0.0394(49.96)***
Local Specific Error				0.1098(4.17)***

S-L ratio comparison

	Minimum	1nd Quantile	Median	Mean	3rd Quantile	Maximum
Chester	0.0035	15.1894	52.276	262.4693	113.7029	112832.1
York	0.0092	5.4801	13.6144	124.5276	39.5248	38224.26

6. Conclusion

(1) GWR-SEC model appears to fit the best in terms of statistical fits, which shows that GWR-SEC is worth from econometric perspective, although it is computationally burdensome.

(2) Second, the impact of ACE is found to vary spatially within a county, showing amenity and disamenity impact of eased lands on property price.

(3)Third, SEC sub-sample analysis shows that error component process clearly exists at the local level.

(4) Finally, we could find that each county reveals spatial autocorrelation to a different degree via looking at the summary statistics of the ratio of local estimated variance of spillover error to local error. In this study, spatial autocorrelation is higher in Chester County than in York County.

Bibliography

1. Kelejian, H., Robinson, D.P., 1993. A Suggested Method for Estimation for Spatial Interdependent Models with Auto-correlated Errors, and an Application to a County Expenditure Model. *Papers in Regional Science* 72, 297-312.