The relationship of house price and transportation improvements in Iceland.

Vífill Karlsson

Does travel distance have an impact on housing prices in a thinly populated country? Iceland is an interesting subject for this question because it is large but thinly populated, it is geographically isolated, it has one single central business distirct (CBD), and a data sample for the entire country is available for a long period of time. This paper examines this relationship in order to capture the effect of transportation improvements in a thinly populated country and to test whether its location makes any marginal difference to the results.

According to Fujita and Thisse (2002, pp. 78-91), McCann (2001), and Fujita (1989), the price of land and real estate is highest in city centers and decreases with every unit of distance from city center. Thus, when some areas are pulled closer to the city center through an improvement in transportation, the land values in these areas increases. These researchers based their analyses on the newest extension of von Thünen's theory, the model of land rent or the bid-rent curve. The essence of the bid-rent curve reflects the fact that consumers prefer the accessibility of cities rather than the amenity value of rural districts. The formation of the bid-rent curve is sometimes called the distance gradient.

According to Baldwin (2001) and Baldwin, Forslid, Martin, Ottaviano, and Robert-Nicoud (2003), transportation improvements lead to higher local real house prices in the peripheries affected due to the increased demand which follows in the wake of lower transportation costs, and the improved access they offer to the labor market and the markets for goods and services. Baldwin *et al.* (2001; 2003) used the core-periphery model in their analyses, which Krugman (1991), as cited in (Baldwin *et al.*, 2003), has called the core of the new geographical economics. However, in this article, the relationship between transportation improvements and real house prices will be investigated on the basis of the von Thünen theory. A hedonic price model will be implemented to estimate the distance gradient.

The reseach question of this article is as follows: *Do transport improvements between conurbation and periphery areas and the capital area affect the local price of houses*? This could also be phrased as follows: Do district areas benefit from better access to relatively large urban areas due to an improved transportation system? This will be tested by an estimation of the distance gradient in Iceland. It is also interesting to investigate whether benefits is different for the CBD's nearest municipalities than municipalities farther away, due to potential access. Thus, I try to answer another research question: *Is there a marginal difference between the impact of transportation improvements on local housing prices in the conurbation and periphery areas of Iceland?*

The distance gradient based on von-Thünen's theory has been estimated in several studies. McMillen (2003), McDonald and Osuji (1995), and Cunningham (2006) did so for large American cities and their suburbs. Tyrvainen and Miettinen (2000), estimated the distance gradient for Salo district in Finland and De Bruyne and Van Hove (2006) for Belgium. These studies did not have the same focus, and only one was related to improvements in transportation. In addition, these studies cover rather densely populated countries or areas. Thus, it becomes very interesting to test whether this relationship holds for a thinly populated country such as Iceland.

Present study differentiates from previous study in five ways. First, an analysis of the distance gradient covering data sample for one country entirely is an exception within the literature and has never been implemented on panel data sample. Secondly, no study has compared the marginal impact of distance on local house prices in areas close to the CBD and areas a great distance away. Thirdly, no study has focused on a thinly populated country such as Iceland and the question of whether this relationship will be significant, given the circumstances. Fourthly, Iceland is, among islands, an unusually isolated geographically. Finally, the data sample represents an extraordinary long period, from 1981 through 2006.

The organisation of the study is as follows. Section 1 includes an introduction and description of the paper's purpose, as well as its relation to the recent literature in spatial economics, and discusses the construction of the research question. Section 2 contains a theoretical discussion of the model and several other possible approaches. Section 3 stresses the data sources, definition, construction, and transformation of the data. Section 4 contains the analysis and results, while Section 6 consists of a summary and concluding remark.

The model

The empirical model is based on von Thünen's theory of land rent, extended by Alonso (1964), Mills and Hamilton (1984), Muth (1969), and Evans (1973) for the house market, as mentioned before. Since distance between localities is the essence of this theory, its model becomes an appropriate tool for the estimation of transportation improvements, which is the main purpose of this paper.

This model has been frequently used in various versions in house price research. Furthermore, it is the most common form of the equation in comparable and related studies, e.g. in the papers of Cunningham (2006, p. 6; Kiel and McClain, 1995a, pp. 314-315), Gibbons and Machin (2005, p. 152), McMillen (2003, pp. 289, 293), Haurin and Brasington (1996, p. 356), Kiel and Zabel (1996, p. 148), and Kiel and McClain (1995a, p. 319; 1995b, p. 248). The most frequent version of the model is as following,

$$\ln h_{it} = a + r_{it}\,\beta_1 + cx'_{it} + \varepsilon_{it}, \qquad (1)$$

where x'_{it} is a vector of relevant additional explanatory variables and c is a vector of coefficients. The equation describes a non-linear relationship of the semi-logarithmic type. Selected additional explanatory variables from former studies include several local demographic factors, such as population or a change in it (Archer*, Gatzlaff, & Ling*, 1996; Cunningham, 2006; De Bruyne & Van Hove, 2006), demographics (Case & Mayer, 1996), population density (De Bruyne & Van Hove, 2006; McDonald & Osuji, 1995), the presence of a park or school nearby (McDonald & Osuji, 1995), and ethnic mix (Archer* *et al*., 1996; De Bruyne & Van Hove, 2006; McDonald & Osuji, 1995).

Indicators for house quality are relevant explanatory variables in hedonic price models, such as lot size (Cunningham, 2006; Kiel & McClain, 1995b; McMillen, 2003), house age (Archer* *et al*., 1996; De Bruyne & Van Hove, 2006; Kiel & McClain, 1995b; McMillen, 2003, 2004; Tyrvainen & Miettinen, 2000), indicators for house building material and type of construction (McMillen, 2004; Tyrvainen & Miettinen, 2000), number of rooms (Kiel & McClain, 1995b), number of bathrooms (Kiel & McClain, 1995b), number of storage areas (McMillen, 2003, 2004), existence of a garage, attic, basement, central air conditioning, fireplace, or land area (McMillen, 2004), and the existence of a building area (McMillen, 2003, 2004).

Furthermore, local economic factors can be among the relevant explanatory variables, such as supply of houses (Archer* *et al.*, 1996; Case & Mayer, 1996; De Bruyne & Van Hove, 2006), manufacturing employment (Case & Mayer, 1996), importance of agriculture (De Bruyne & Van Hove, 2006), household income (De Bruyne & Van Hove, 2006; McDonald & Osuji, 1995), unemployment rate (De Bruyne & Van Hove, 2006), municipal tax rate (De Bruyne & Van Hove, 2006), aggregate school enrolment (Case & Mayer, 1996), school-quality (Haurin & Brasington, 1996, p. 351), and interest rate (Cunningham, 2006).

Finally, indicators for some kind of amenity value reflect a significant aspect of the distance gradient, for example the presence of a lake or an attractive view (Cunningham, 2006; De Bruyne & Van Hove, 2006; Kiel & McClain, 1995b; Tyrvainen & Miettinen, 2000), arts and recreational opportunities (Haurin & Brasington, 1996, p. 351), any kind of local dangers (Cunningham, 2006), and crime rate (Haurin & Brasington, 1996).

However, standard panel data models, such as fixed- and random effect models, generally return more efficient estimators than pooled ordinary least squre (POLS) models. Furthermore, since the relationship of local house prices and transportation improvements is the present focalpoint, the fixed effect model is more appropriate where the variable coefficient returns a within individual variation or the time variation and returns the between individual variation into the individual constant term. Thus, it is reasonable to apply the following fixed effect empirical model,

$$\ln h_{it} = a + r_{it}\beta_1 + x'_{it}\beta_2 + d'_{it}\beta_3 + \varepsilon_{it}, \qquad (2)$$

where the natural logarithm of house price, h, is dependent on the distance, r, to the capital area, or CBD, several other explanatory variables, x', dummy variables, d', and relevant residuals, ε, of every municipality, i, in every single period, t. Note that a_i is the individual constant term. Total household income, age of the buildings, and population are other explanatory variables. There are two dummy variables, one for three municipalities on the east coast and another for the Whalefjord Tunnel. The dummy variable for the Whalefjord Tunnel is intended to capture the effect of a transportation improvement financed by a road toll; Whalefjord Tunnel was the only such transportation improvement in Iceland between 1981 and 2006. The dummy variable for three municipalities on the east coast is intended to reflect the fact that an unusually large-scale local investment project has been underway there since 2003. Unfortunately, limitations of the data prevented any possible estimation of the compensated good, z, lot size, s, and mortgage interest rates.

Another version of the model could be more appropriate to the data sample than the semi-logarithm version (Eq. 2). It is a model of quadratic distance version, which has been implemented at least once before by McDonald and Osuji (1995). The model is as follows:

$$\ln h_{it} = a_i + r_{it}\beta_1 + r_{it}^2\beta_2 + x'_{it}\beta_3 + d'_{it}\beta_4 + \varepsilon_{it}, \qquad (3)$$

The model is identical to the semi-logarithm model except for an additional variable for quadratic distance, r_{it}^2. The reason for its relevance is the suspicion of possible different marginal impact with respect to location.

These models (Eq. 2 and 3) are suitable for the evaluation of the relationship between house prices and transportation improvements, because the distance parameter, r, captures the relative influence of the respective factors on real house prices, and the data used to represent distance is the length of the roads between the center of each municipality and the center of the capital area, expressed in kilometres (further description of the data is in the next section). Thus, the distance parameter reflects the relative influence of single unit road shortening on the real unit price of houses, *ceteris paribus*. Furthermore, note that this evaluation is limited to transportation improvements which involve a reduction in driving distance.

Data

The data for this analysis comes from Iceland, a large but thinly populated European country. Iceland is divided into 79 municipalities[1] in this paper. However, many municipalities has been repeatedly merged for the last decades and thus the data were transformed into one identical sample of municipalities completely comparable to the situation in the year 2006.

The data on house prices[2] in this study come from the Land Registry of Iceland. The explanatory variables included in Eq. (1) are drawn from vari-

---

1 There is a two-tier governmental system in Iceland, with a central and a local level, i.e. a central government and municipalities.

2 The Land Registry of Iceland collected these data from the original source: written contracts between home sellers and buyers.

ous sources, including the Commissioner of Inland Revenue, Statistics Iceland, and the Icelandic Road Administration. Information on home age and size was obtained from the Land Registry of Iceland, along with house price data, as mentioned before. Data on road distances was obtained from Fjölvís Publishing Company, but was originally collected by the Icelandic Road Administration. The data on population and total income were obtained from Statistics Iceland. The Commissioner of Inland Revenue is the primary source for total income. The data series were annual averages, except for population and road distance, which were static variables. Data on population is for December 1 of each year, and data on road distances for January 1 each year. The data series were spatially classified by municipality, except data on road distance. Data on road distance was classified by locality. The data series were then transformed to relate to municipalities rather than localities.

The data sample for all variables covers the monthly average numbers of all Icelandic municipalities from 1981 to 2006 except for mortgage interest rate and house supply which covers only the period 1994-2006 (Table 1). Due to very complex market rules, especially regarding supply and the terms of mortgage loans, it was only possible to construct a reliable set of data for the period of 1994-2006. The construction of the dataset was based on the market's rules and traditions. The largest supplier of the most favorable mortgages in the relevant period was a public institution, the Housing Financing Fund, simply called 'government house-bonds' in the current study. The difference was commonly financed by either a commercial bank using less favorable terms or the household's own capital. Data regarding the annual average interest rate are based on information from the Central Bank of Iceland. Therefore, an estimation of mortgage interests was calculated average by letting the terms of the government house-bonds have 70% weight and the 30% to the terms of the commercial banks.

Table 1: Variable description and sample statistics.

Variable (acronym)	Description	Mean	Standard deviation
House price (HPRI)	Real price per m^2, in Icelandic krónur	69,936.2	32,770.9
Road distance (RDIS)	Average distance in kilometers of each municipality from the capital area, in absolute terms	298.6	227.7
Total Income (TINC)	Total income per capita, in thousands of Icelandic krónur	2,020.3	658.9
House age (HAGE)	Average age of houses sold, in absolute terms	28.9	15.9
House size (HSIZ)	Average size of houses sold, in square meters	143.1	69.2
Population (POPU)	Municipality population, in absolute terms	3,360.6	11,779.6
Akureyri (AKUR)	Dummy variable for a municipality outside the capital area with an unusually populous center: 1 for Akureyri and 0 for all other municipality.	0.013	0.112
Tunnel (TUNN)	Dummy variable of large transportation improvement. 1 for Whale fjord tunnel.	0.210	0.408
Aluminum East Coast (ALEA)	Large scale local investment. New aluminum smelter on the east coast of Iceland	0.004	0.066

The data in this table, i.e. mean and standard deviation, is based on annual averages transformed by means of Eq. (2).

The averages and the standard deviation of the explanatory variables as well as of the dependent variable show considerable variation (Table 1). The standard deviation of house prices is approximately 1/2 of the mean and, of road distance more than 3/4 of the mean. This is evidence of large differences which show potential for robust explanations.

Estimating the result

The empirical model was set forth in Chapter 3 (Eq. 2). Three versions of a fixed effect model will be tested, the semi-logarithm type (SLM) and two of the quadratic distance type – that is, Eq. (2) and (3). The versions of the quadratic distance model will be both of the second (QDM-2) and third degree (QDM-3). The analysis is divided into those three separate models in order to demonstrate the different effect of road distance on the nearest municipalities and the rest of the country and, thus, emphasize the diminishing marginal return of the tranportation improvement's benefit with respect to distance. This could be rephrased by claiming that the relationship between an urban area and its adjacent regions is different from its relationship with regions further away. The results are presented in Table 2, including parameter coefficients, t-value, number of observations, *n*, R square, adjusted R square, F-value, the Durbin-Watson parameter, log likelihood, and special t-statistic for testing serial correlation in panel data, as recommended by Wooldridge (2002, pp. 176-177).

Initially, the estimations suffered from serial correlation, which was sufficiently eliminated by a lagged variable of the residual, which is a method recommended by Wooldridge (2002, pp. 176-177). Furthermore, multicollinearity and heteroscedasticity (Tables 5-10) were not observable in the final results.

The results suggest that the semi-logarithm model version of the model is appropriate for the conurbation area, but the quadratic distance is appropriate the entire country. Along with the results of previous studies, whose results are based on data samples geographically limited to cities or conurbation areas, the road distance coefficient's highest t-statistics the semi-logarithm model seems to be an obvious choice in the case of the conurbation area (Model 2). However, a relatively weak and positive estimator of the semi-logarithm model for the entire country shifted the attention towards the quadratic distance models. Both better fitness to the distance parameter and better general relevance of the results recommended the qudratic distance model for the entire country. The results of the quadratic distance models, 2 and 3, are almost identical. However, QDM-2 (Model 2) seems to be the appropriate to the entire country, since the fitness with respect to distance is much better than the QDM-3 (Table 2).

Table 2: Relationship between housing prices and transportation improvements. A fixed effect panel data model comparing two approaches: a semi logarithm (SLM) and a quadratic distance model (QDM).

	Model 1 SLM.	Model 2 QDM.-2	Model 3 QDM-3
α_i	Not listed	Not listed	Not listed
RDIS	0.000506	-0.005398	-0.009099
	(0.60)	(-5.12)	(-5.78)
RDIS^2		6.98E-06	1.87E-05
		(7.15)	(5.07)
RDIS^3			-1.01E-08
			(-3.24)
TINC	0.000260	0.000259	0.000258
	(13.37)	(13.59)	(13.63)
HAGE	-0.009332	-0.009310	-0.009334
	(-7.60)	(-7.61)	(-7.73)
HSIZ	-0.000880	-0.000870	-0.000874
	(-3.32)	(-3.30)	(-3.31)
TUNN	-0.048303	-0.069028	-0.069629
	(-1.16)	(-1.65)	(-1.67)
POPU	9.11E-06	8.57E-06	8.66E-06
	(2.92)	(2.77)	(2.80)
ALEA	0.277064	0.410907	0.343217
	(5.98)	(8.22)	(6.79)
E(-1)	0.207215	0.176994	0.176725
	(5.08)	(4.35)	(4.35)
AMPD, **0-728 km**.	0.000506	-0.000317	0.004515
AMPD, **0-120 km**	0.000506	-0.004581	-0.006911
n	1139	1139	1139
R^2	0.76	0.76	0.77
Adjusted R^2	0.74	0.75	0.75
F-value	43	44	44
Durbin Watson	1.64	1.64	1.64
Log-likelihood			
Serial correlation (t-statistics)	0.53	0.48	0.44
	unbalanced	unbalanced	unbalanced

Dependent Variable: LOG (HPRI). Method: Pooled least squares. White Heteroscedasticity-Consistent Standard Errors & Covariance. Values in parentheses are t-statistics. AMPD = Average marginal propensity to distance

The result of the analysis using data from all municipalities shows a significant negative relationship between housing prices and the distance between Reykjavík and other municiplities. The marginal impact of a reduction in distance is $\partial \ln h_{it} / \partial r_{it}$ = -0.005398+0.0000014r_{it}. This relationship is strictly convex. The real price of houses reveals a clear sign of a marginal rate of diminishing return with respect to decentralized location. This could be rephrased by claiming that the value of central location in Iceland has an increasing marginal rate of return.

However, according to the results, local house price decreases by approximately 0.5% following a 1 kilometre increase of road distance from the center of the CBD within the conurbation area, *ceteris paribus* (Model 2). This means that transportation improvements that reduce the distance of municipalities in rural district of Iceland from the capital area tend to increase local real estate prices in real terms. However, when the distance exceeds 120 km. from the CBD, the impact become considerably smaller and partly positive or 0.03% on the average following a 1 kilometre increase of road distance. However, it is interesting to observe a slight change in the relationship between local house price and distance when it moves from being negative to positive in the model for all municipalities in the present result. This is different from all previous results and is to some extent hard to explain. The negative relationship reflects a population dominated by individuals with a higher preference for access over amenity value. When the distance exceeds a certain limit, the population becomes dominated by individuals with a preference for amenity value over access. Thus, the distance gradient becomes gradually positive beyond the limit. This limit is located at a distance of approximately 386 kilometres in the model for all municipalities of Iceland. This is close to the center of the Iceland, mesured by road distance from Reykjavik, the capital city.

Another and in fact more likely explanation is related to labor market boundaries and other development factors, particulary counterurbanization. Counterurbanization is urban out-migration motivated by changes in household economy or preferences such as relative housing prices, amenity values and the like. It has been detected for several decades both in Europe and USA, especially in a certain range from the CBD (Dahms & McComb, 1999; Mitchell, 2004; Stockdale, Findlay, & Short, 2000). Thus, when the distance between the CBD and other rural localities becomes shorter, it makes commuting more profitable, increasing the wealth of the existing rural population and supporting any additional counterurbanization. This development decreases marginally by distance from the CBD. This causes the negative relationship between house prices and distance to have certain limits.

The relationships between house prices on the one hand and total income, house age, house size, population, and large scale local investment on the other hand are also significant. The impact where as expected, where total income, local population, and large scale local investment have positive impact on housing prices and house age and house size have on the other hand negative impact.

This result suggests that transportation improvements, including those that shorten distances, have an impact on the local real prices of houses. Furthermore, such improvements have a generally greater marginal impact on the local price of houses close to the CBDs than those which are farther away. This is in line with the results from McMillen (2003), McDonald and Osuji (1995), and Cunningham (2006), who analyzed data from large American cities and their suburbs. Tyrvainen and Miettinen (2000), however, explored the data for one district of Finland, and De Bruyne and Van Hove (2006) explored one country, namely Belgium. The distance gradient is generally steeper in studies representing only cities and their suburbs, such as McMillen (2003), McDonald and Osuji (1995), and Cunningham (2006), compared to studies covering larger areas, such as Tyrvainen and Miettinen's (2000) study of a large district in Finland, and De Bruyne and Van Hove's (2006) study of one country.This means that two identical transport investment opportunities of different locations would have different returns, *ceteris paribus*. The return would be higher for the one which is closer to the CBD. This is logically related to the fact that the inhabitants of areas adjacent to the CBDs have higher preferences for access over amenity values compared to inhabitants of more distant areas.

Conclusion

The aim of this study was to measure the influence of transportation improvements on the local real price of houses. The analysis was based on annual average house prices, distance from the CBD (the capital area), total household income, and several other relevant explanatory variables for all municipalities in Iceland from 1981 through 2006. The data were analyzed with a fixed-effect model in several different versions. A second-degree quadratic distance model was most appropriate for the analysis.

The analysis clearly shows that the relationship between local real house prices in Iceland and transportation improvements in form of shortening the distance from the CBD, i.e. the capital area, is statistically significant and negative. A decrease of one kilometer in the distance between municipality and the CBD increased the real price of houses in that municipalities by 0.46% when the model used to analyze the conurbation area only – that is, municipalities within the range of 0-120 km from the CBD. When the geographical scope of the model was extended and the model was tested for all municipalities, the corresponding figure was 0.03% on the average. The quadratic distance model implies that the relationship is strictly convex with respect to distance. This means that transportation improvements close to CBDs generally have a greater marginal impact on the local real price of houses compared to those which are farther away. This is logical where the inhabitants of the areas adjacent to the capital area have higher preferences for access over amenity values compared to inhabitants of more distant areas. Furthermore, a certain type of interactions between citizens of the CBD and other municipalities in Iceland is limited to the distance such as commuting.

The general conclusion from this analysis is that in thinly populated countries with only one CBD, such as Iceland, transportation improvements which reduce the distance from a municipality to the CBD tend to increase local house prices within the range of 386 kilometers from the CBD, but reduce house prices beyond that. The results suggest that the increase will be largest for municipalities close to the CBD than those which are farther away.

Acknowledgements

The author is grateful for the supervision of Gylfi Magnússon and Sveinn Agnarsson. Furthermore, the author is thankful for general comments from Ívar Jónsson, Lilja Mósesdóttir, and Þorbergur Þórsson. Financial support of Regional Development Office of West-Iceland, Bifröst School of Business, the Icelandic Regional Development Institute, and the Icelandic Road Administration.

References

Alonso, W. (1964). *Location and Land Use*. Cambridge: Harvard University Press.

Archer*, W. R., Gatzlaff, D. H., & Ling*, D. C. (1996). Measuring the Importance of Location in House Price Appreciation. *Journal of Urban Economics, 40*(3), 334-353.

Baldwin, R. E. (2001). Core-periphery model with forward-looking expectations. *Regional Science and Urban Economics, 31*(1), 21-49.

Baldwin, R. E., Forslid, R., Martin, P., Ottaviano, G., & Robert-Nicoud, F. (2003). *Economic Geography and Public Policy*. Princeton: Princeton University Press.

Case, K. E., & Mayer, C. J. (1996). Housing price dynamics within a metropolitan area. *Regional Science and Urban Economics, 26*(3-4), 387-407.

Cunningham, C. R. (2006). House price uncertainty, timing of development, and vacant land prices: Evidence for real options in Seattle. *Journal of Urban Economics, 59*(1), 1-31.

Dahms, F., & McComb, J. (1999). `Counterurbanization', interaction and functional change in a rural amenity area -- A Canadian example. *Journal of Rural Studies, 15*(2), 129-146.

De Bruyne, C., & Van Hove, J. (2006, June 1-2). *Explaining the spatial variation in housing price: an economic geographic approach*. Paper presented at the ECOMOD urban and regional modeling, Brüsselles, Belgium.

Evans, A. W. (1973). *The Economic of Residential Location*. London: The MacMillan Press Ltd.

Fujita, M. (1989). *Urban Economic Theory: Land Use and City Size*. Cambridge: Cambridge University Press.

Fujita, M., & Thisse, J.-F. (2002). *Economics of Agglomoration: Cities, Industrial location, and Regional Growth*. Cambridge: Cambridge University Press.

Gibbons, S., & Machin, S. (2005). Valuing rail access using transport innovations. *Journal of Urban Economics, 57*(1), 148-169.

Haurin, D. R., & Brasington, D. (1996). School Quality and Real House Prices: Inter- and Intrametropolitan Effects. *Journal of Housing Economics, 5*(4), 351-368.

Kiel, K. A., & McClain, K. T. (1995a). The Effect of an Incinerator Siting on Housing Appreciation Rates. *Journal of Urban Economics, 37*(3), 311-323.

Kiel, K. A., & McClain, K. T. (1995b). House Prices during Siting Decision Stages: The Case of an Incinerator from Rumor through Operation. *Journal of Environmental Economics and Management, 28*(2), 241-255.

Kiel, K. A., & Zabel, J. E. (1996). House Price Differentials in U.S. Cities: Household and Neighborhood Racial Effects. *Journal of Housing Economics, 5*(2), 143-165.

Krugman, P. (1991). Increasing Returns and Economic Geography. *Journal of Political Economy, 99*, 483-499.

McCann, P. (2001). *Urban and Regional Economics*. Oxford: Oxford University Press.

McDonald, J. F., & Osuji, C. I. (1995). The effect of anticipated transportation improvement on residential land values. *Regional Science and Urban Economics, 25*(3), 261-278.

McMillen, D. P. (2003). The return of centralization to Chicago: using repeat sales to identify changes in house price distance gradients. *Regional Science and Urban Economics, 33*(3), 287-304.

McMillen, D. P. (2004). Airport expansions and property values: the case of Chicago O'Hare Airport. *Journal of Urban Economics, 55*(3), 627-640.

Mills, E. S., & Hamilton, B. W. (1984) *Urban Economics*. London: Scott, Foresman and Company.

Mitchell, C. J. A. (2004). Making sense of counterurbanization. *Journal of Rural Studies, 20*(1), 15-34.

Muth, R. F. (1969). *Cities and Housing: The Spatial Pattern of Urban Residential Land Use*. Chicago: University of Chicago Press.

Stockdale, A., Findlay, A., & Short, D. (2000). The repopulation of rural Scotland: opportunity and threat. *Journal of Rural Studies, 16*(2), 243-257.

Tyrvainen, L., & Miettinen, A. (2000). Property Prices and Urban Forest Amenities. *Journal of Environmental Economics and Management, 39*(2), 205-223.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge: The MIT Press.