Neighbourhood Characteristics and Adjacent Ravines on House Prices

Shahidul Islam
Dept. of Anthropology, Economics and Political Science
Grant MacEwan College
10700 – 104 Avenue
Edmonton, Alberta, Canada T5J 4S2
Email: islams@macewan.ca
Tel: 780-497-4792

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Introduction

Urban residential houses are segregated into neighbourhoods identified apparently by geographical locations. Households residing in a neighbourhood have similarity in socio-economic characteristics and preferences, i.e., household income, family size, anticipated services and neighbourhood characteristics including adjacency to ravines and natural areas. Such characteristics and preferences, in general, vary from one neighbourhood to another. Recognizing these inter-neighbourhood differences and intra-neighbourhood similarities, Tiebout (1956) presented his theory of local expenditure. He predicted that households with similar interests form nearly-homogeneous neighbourhoods. In urban areas, households in the same neighbourhood have similar demands for services, comparable abilities to pay for those, and analogous aspirations for environments. Lynch and Rasmussen (2004), building on Tiebout (1956) and using income as a single criterion, asserted that households demanding high quality services have natural incentives to exclude relatively low-income households from the neighbourhood.

Lower income households have less ability to pay for services sought by neighbouring high-income households. The presence of low income households in the neighbourhood is perceived to be associated with social nuisance and less demand for better neighbourhood environment. In addition, high-income households prefer neighbourhoods that are populated with high-income households with stronger desire to have high-quality neighbourhood services and environments. They have both the ability and the willingness to pay premium prices for those services in a sustainable manner.

House prices vary from one neighbourhood to the other depending on neighbourhood characteristics and environments. Brasington and Hite (2005) presented that the price of a house depends on two broad factors. One, the expenditure on a number of characteristics of the dwelling unit itself, such as number of rooms, number of bathrooms, size of dwelling unit and other inner facilities, which constitute the tangible part. The other less tangible component includes neighbourhood services and environment including average income of households in the neighbourhood, house and lot size of the neighbours, accessibility to main arterial roads, adjacency to green spaces, ravines and natural areas, availability of good schools and community centres, adjacency to nuisances, such as, electric power lines, industrial areas, etc.

Expenditures made on the first set of factors are tangible and are determined easily by observed market conditions, which are primarily impacted by the price of constructional materials and labour. Expenditures on the second set of factors are difficult to obtain as market conditions for these goods and services are difficult to observe. In the absence of direct market prices, measures of willingness to pay, travel costs, hedonic price measurement, household production approach, etc. have been used by different researchers to come up with prices for such variables and ultimately their impact on house prices. For newly constructed houses, these effects are reflected entirely within higher lot prices.

House prices do not reflect the arbitrage of tradable divisible commodities and therefore the law of one does not hold (Allen et al. 2006). This holds true for both pre-owned and newly-constructed houses. Using data from six major metropolitan areas in Ohio, Brasington and Hite (2005) demonstrated that there are significant spatial effects on house prices - closer the point-source of pollution lower is the house price. Similar studies were conducted to determine the impact of overhead power lines (Sims and Dent, 2005), nearby rail transit (Hsu and Guo, 2005), adjacent subway lines (Lin and Hwang, 2004), adjacency to elementary schools (Gibbons and Machin, 2003) and environmental contamination and positive environmental amenities (Simons and Saginot, 2006) on house prices. However, the impact of adjacent ravines and natural areas along with other neighbourhood characteristics on house prices are scanty. The principal objective of this study is to estimate the impact of adjacent ravines and natural areas along with other neighbourhood characteristics on the average price of detached residential houses in Edmonton, Alberta, Canada.

Model and Data

House prices in purely residential neighbourhoods and those in mixed residential and commercial neighbourhoods are different. Neighbourhood characteristics and environmental amenities in those types of neighbourhoods are different and should be modelled separately. For homogeneous residential neighbourhoods, the price of a house and its different characteristics can be depicted in a simple generalized model as: $P = f(H, N, E, O)$ where, ***P*** denotes the price level at a particular time; ***H*** represents a vector of the characteristics of the house – number of rooms, bath-rooms, arrangements, kitchen areas, other rooms, construction materials, etc. etc.; ***N*** is a vector of neighbourhood characteristics – demographic, economic, social and others – neighbourhood crimes; ***E*** is a vector of environmental characteristics – both macro- and micro-environmental qualities including overall air-quality, proximity to schools, community halls, shopping centres, ravines, natural areas, rivers, etc.; and ***O*** denotes a vector of other factors not included in any of the categories.

It is important to note that the actual buying or selling price of a house depends on market conditions, interaction of supply and demand. Both the demand for and the supply of residential housing are affected by several factors. Factors affecting either supply or demand for or both influence the housing market causing changes in the price level. However, we can assume that such factors will affect housing prices with the same proportion, and use the generalized equation mentioned above to examine the contribution of individual factors on house prices. Another note to this simple model is that every house is unique in its characteristics, and capturing price through characteristics will be subjected to errors. Such errors are assumed to be small for most housed although an outlier containing a large error is not impossible. To further dilute such errors, an average of major characteristics can be used. Many researchers use aggregate data to minimize such uniqueness of individual observations.

Level of aggregation is another point of contention. A seemingly comprehensive study including all neighbourhoods of a city or metropolitan area would be of relatively less value. Separate studies for separate categories of neighbourhoods, residential, commercial, industrial, mixed, etc. would be more appropriate to determine the impact of neighbourhood characteristics on house prices. This study focuses purely on residential neighbourhoods by eliminating all commercial or semi-commercial neighbourhoods from the sample.

The standard residential neighbourhood definition developed and followed by the City of Edmonton was used and spatial data for 192 mature residential neighbourhoods were used. Immature neighbourhoods having median construction age of less than five years (median construction year after 2000) were not included in this study due primarily to three reasons. First, data on newer neighbourhoods are scanty and often erratic. Second, newer neighbourhoods have little or no developed green areas, parks, ravines or natural areas. Third, for new houses, lots and buildings are priced separately and adjacency to ravines or natural areas is included in the lot price only.

Data on 192 neighbourhoods were obtained from several sources including published reports on the City of Edmonton Community Profiles, the Edmonton Police Service, City of Edmonton Planning and Development department and observed data from the official map of the City of Edmonton. As there are substantial variations among neighbourhoods in different quadrants of the city, the neighbourhood were categorized into four quadrants, north-east, north-west, south-east and south-west.

The regression equation used to estimate the model is as follows:

$$VAL = \beta_0 + \beta_1 RAV + \beta_2 DSE + \beta_3 DNE + \beta_4 DSW + \beta_5 INC + \beta_6 PDET + \beta_7 PDEN + \beta_8 BER + \beta_9 POWN$$
$$+ \beta_{10} DARA + \beta_{11} CAGE + \beta_{12} STAB$$

A description of these variables is provided in the table below:

VAL	Average value of detached houses in the neighbourhood as determined by the City of Edmonton's Assessment and Taxation department
RAV	A dummy variable for adjacency to ravines or natural areas; 1 having an adjacent ravine or natural area and zero otherwise
DSE	A dummy variable for the neighbourhood being in south-east quadrant of the city; 1 if the neighbourhood is in south east and zero otherwise
DNE	A dummy variable for the neighbourhood being in north-east quadrant of the city; 1 if the neighbourhood is in north east and zero otherwise
DSW	A dummy variable for the neighbourhood being in south-west quadrant of the city; 1 if the neighbourhood is in south west and zero otherwise [A dummy variable for north-east was not included to avoid singularity problem]
INC	Average annual household income reported in the City of Edmonton's community profile, which was taken from Federal Census 2001.
PDET	Percentage of detached housing in the neighbourhood obtained from community profile
PDEN	Population density – number of person per hectare as reported in the Federal Census 2001
BER	Number of residential break and entry reported in the Neighbourhood Crime Statistics by the Edmonton Police Service
POWN	Percentage of owned single detached houses
DARA	Average area devoted to each dwelling unit – single detached houses
CAGE	Median construction age of the neighbourhood
STAB	Percentage of stable population – percentage of population did not move during the past year.

As indicated in the table above, data for this study were obtained from several sources. The dependent variable, pre-owned detached house price, was obtained from the Assessment and Taxation department of the City of Edmonton. This price level is more relevant as it includes prices of all detached houses in the neighbourhood. An alternative would have been to collect the actual sale price from the Edmonton Real Estate Board, which would provide skewed information depending on what category of houses were sold during the period of data collection or the period of study. Also the price level of residential properties in Edmonton has been anything but stable. In this kind of highly inflationary market, actual price data from one time can not be comparable to that of another time.

The set of selected independent variables including dummy variables for residential neighbourhoods in north-east, north-west and south-west (As in many other cities, residential property values in Edmonton differ from one quadrant to the other. A house with same characteristics will sell more in south-west than in north-east.). A dummy variable for north-west was not included to avoid perfect multicollinearity and singularity of the matrix. Average annual income, proportion of detached residential units, population density, percentage of owned residential units, total area allocated to each household, median age of construction and proportion of stable residents in the neighbourhoods were obtained from the reports on Community Profiles published by the City of Edmonton. Data on average number of residential break and entry were obtained from Edmonton Police Service. Adjacency of each neighbourhood to ravines and natural areas were recorded from the official map obtained from the City of Edmonton.

A multiple regression analysis was computed using house price as the dependent variable and the set of selected relevant neighbourhood characteristics and environmental amenities including adjacency of ravines and natural areas as independent variables. These variables were selected from a number of possible contributory variables. The selected relevant independent variables mentioned earlier were identified following three model selection criteria – adjusted R-square values, Akaike Information Criterion and Schwarz Criterion. For the appropriate functional form specification, the F-test for joint exclusion restriction was used.

Results and Discussion

Results of the regression analysis are presented in Table 1. As expected, income and adjacency of neighbourhoods to ravines and natural areas positively affected detached house prices. But adjacency to ravines and income are positively correlated and without one, the other variable significantly contributed to house price. Once both variables are included in the model, estimated coefficients become smaller and respective standard errors become larger because of multicollinearity problem. As both variables significantly contribute to house prices, avoiding one would cause a biased estimate for not including a relevant variable. As inclusion of an irrelevant variable is less problematic than exclusion of a relevant variable, both variables were included. Instead of leaving either variable out of the model, a panel data using additional observations may provide further precise information.

The smaller coefficient (1.22) relative to other variables should not be mis-understood as it indicates that for every dollar increase in income, house price afforded by residents go up by $1.22. This makes sense as income increases, people by more and more expensive houses with an increasing proportion. One should also consider the financing option too as hardly any one would buy a house with cash. Nearly hundred percent of the buyers borrow money from a financial institution and pay it back with interest every month or every two-weeks depending on the payment plan agreed upon between the house buyer and the financier. Therefore, when a buyer makes a decision on purchasing a house, (s)he considers the mortgage payment more than the actual price of the house.

Table 1 Multiple regression analysis using house price as the dependent variable.

Variable Name	Estimated Coefficient	Standard Error	t-ratio
RAV	4891.90	4041.00	1.21
DSE	-5779.90	4498.00	-1.28
DNE	-7527.30	4102.00	-1.83
DSW	14188.00	4911.00	2.89
INC	1.22	0.10	12.12
PDET	-286.29	225.70	-1.27
PDEN	126.14	203.00	0.62
BER	-205.37	86.47	-2.37
POWN	109.87	160.00	0.69
DARA	1.13	0.56	2.02
CAGE	-9.54	15.77	-0.60
STAB	-766.77	345.70	-2.22
CONSTANT	121810.00	25670.00	4.74

As expected, the dummy variable for SW has positive contribution and the other two have negative contribution to house price. On average, people living in the south-west part of the city have higher income than other quadrants. Average area allocated to each house also has a positive impact indicating that larger the lot size higher the price. The two variables making significant negative contribution to the house price are number of break and entry and proportion of stable residence. The former is expected. The later, however, can be explained that many older neighbourhoods with smaller lots and smaller house sizes are stable. It can be concluded that the adjacency of houses to ravines and natural areas increase house price as those are inhabited by high income households.

Table 2 Correlation coefficients among all variables

	VAL	RAV	DSE	DNE	DSW	INC	PDET	PDEN	BER	POWN	DARA	CAGE
RAV	0.484											
DSE	- 0.144	0.032										
DNE	- 0.292	- 0.075	- 0.301									
DSW	0.626	0.315	- 0.309	- 0.343								
INC	0.872	0.515	- 0.087	- 0.241	0.543							
PDET	0.277	0.155	0.082	- 0.026	0.043	0.436						
PDEN	- 0.312	- 0.200	0.103	0.045	- 0.115	- 0.359	- 0.550					
BER	- 0.498	- 0.157	- 0.082	0.187	- 0.342	- 0.480	- 0.288	0.361				
OWN	0.483	0.232	0.076	- 0.046	0.144	0.639	0.761	- 0.485	- 0.529			
ARA	0.487	0.291	- 0.071	- 0.039	0.156	0.522	0.498	- 0.728	- 0.399	0.534		
CAGE	- 0.1096	- 0.049	- 0.061	0.064	- 0.096	- 0.100	0.017	- 0.022	0.044	- 0.042	- 0.019	
STAB	0.384	0.193	0.099	- 0.098	0.118	0.571	0.665	- 0.399	- 0.420	0.830	0.397	- 0.036

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