Implementing a Land Value Tax in Urban Residential Communities

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Abstract

This paper describes the results of a research project conducted under a John C. Lincoln Fellowship for the Lincoln Institute of Land Policy (Cambridge, Massachusetts, USA) on the potential for modern mass appraisal methods to separate values for residential properties between land and buildings. The Lincoln Institute has had a long-standing interest in land use and policy, including a land value tax. The research project involved an empirical determination of the feasibility of using multiple regression analysis (as well as the adaptive estimation procedure or "feedback") to decompose estimated residential property values between land and improvements.

Both vacant and improved residential sales data were obtained from three North American communities. As a benchmark, a traditional additive model was developed for each community using the improved sales only. Using both vacant and improved sales, a nonlinear model separable into land and building components was then developed. A comparison of results revealed that a combined model built from both vacant and improved sales need not sacrifice predictive accuracy for improved properties.

Analysis of land and building values from the nonlinear models suggests that land may constitute a higher percentage of total value for residential properties than commonly believed, in part because of a potential premium in value for improved over vacant sites. Tax shift analyses indicate that implementation of a land value tax would be less advantageous to lower-value than higher-value residential properties.

About the Author

Robert J. Gloudemans is a consultant and partner in Almy, Gloudemans, Jacobs & Denne, a firm specializing in assessment policy and procedures. He began as a research associate for the International Association of Assessing Officers (IAAO) in 1973. From 1978 to 1989 he worked for the Arizona Department of Revenue as Supervisor of the Computer Assisted Appraisal Unit and later as Administrator of Research and Equalization. He has consulted and taught for a wide variety of state, provincial, local, and overseas governments in the areas of property assessment and mass appraisal techniques. He has been active on IAAO Committees and is the author of much of the IAAO educational literature, including the recently published textbook, *Mass Appraisal of Real Property* (1999).

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Implementing a Land Value Tax in Urban Residential Communities

Introduction

Well over half the property tax base in most communities is attributable to residential land and buildings. In many urban areas most land has been improved and there are no or relatively few vacant land sales to help develop land values. From the perspective of a land value tax, this reality creates practical difficulties in determining land values, particularly for built-on land. At the same time, assessment jurisdictions worldwide have made great strides in the last twenty years in using statistical analyses to estimate total values (land plus buildings). This paper explores the possibility of using modern mass appraisal techniques to develop separate estimates of land and building values for residential properties, and analyzes the tax shifts inherent in implementation of a land tax.

The research analyzed data from three large North American metropolitan areas: Ada county (Boise), Idaho; Edmonton, Alberta; and Jefferson county (suburban Denver), Colorado. Each jurisdiction provided the author with sales for both vacant and improved residential sales from a multi-year period for purposes of the analysis. The data included sale price and date, location, improvement characteristics, land size, and available site characteristics. In each case, a traditional "additive" multiple regression model, similar to that used by assessment authorities, was developed and the accuracy of the results analyzed in terms of ability of the model to predict actual sales prices. Next, a "hybrid" model using *nonlinear* regression analysis was developed for the vacant and improved sales combined. Unlike additive models, nonlinear models have no constant and can be decomposed into land and building values (they are also more flexible in specification and can accommodate both dollar-per-unit and percentage adjustments). Results of the nonlinear models were tested on the combined sales and separately on the improved and vacant land sales. Finally, estimated values were separated between land and building components and tax shifts inherent in phase-in of a site value tax analyzed. This analysis included a determination of the tax impact on both vacant and improved land, as well as relative winners and losers among improved properties in terms of land area, house size, building age, construction quality, neighborhood, and value range.

This paper describes the analyses for the Clareview (Edmonton) data and compares results to those obtained for the other two databases. Section 2 below describes the Clareview database, section 3 presents results for the additive model using improved sales, section 4 contains the nonlinear model results for vacant and improved sales combined, section 5 presents the tax shift analysis, and section 6 summarizes results and conclusions based on the analyses conducted for all three communities.

Clareview (Edmonton) Database

The City of Edmonton, Alberta is divided into twelve market areas for residential modeling purposes. Clareview is one of the largest. Located on the City's north side, it is a steadily growing area comprised of predominately standard and semi-custom built homes. The area was chosen because it has many vacant land sales, although about half of neighborhoods in the area are virtually fully developed with no remaining vacant lot sales. The City of Edmonton provided a data file of all validated vacant and improved residential sales that occurred in the Clareview market area over the period, July 1996 through June 1999, which is the same sales period used to develop the City's assessment year 2000 models. In conformance with Alberta statutes, the City updates values annually based on the current market.

There were 3,482 improved and 900 vacant (20.5 percent) residential sales suitable for analysis over the 3-year period. Figures 1(a) and 1(b) contain a histogram of sales prices and a bar charts of median sales prices by neighborhood for the improved sales. Figures 2(a) and 2(b) contain comparable summaries for the vacant land sales. Overall, the average sale price is $124,179 for the improved sales and $43,849 for the vacant lots (1 Canadian dollar equals approximately 0.73 Euro dollar and 0.67 U.S. dollars). In both cases, sales prices vary considerably among neighborhoods (notice that only 17 of the neighborhoods are represented by vacant lot sales).

Figure 1a: Distribution of Improved Sales

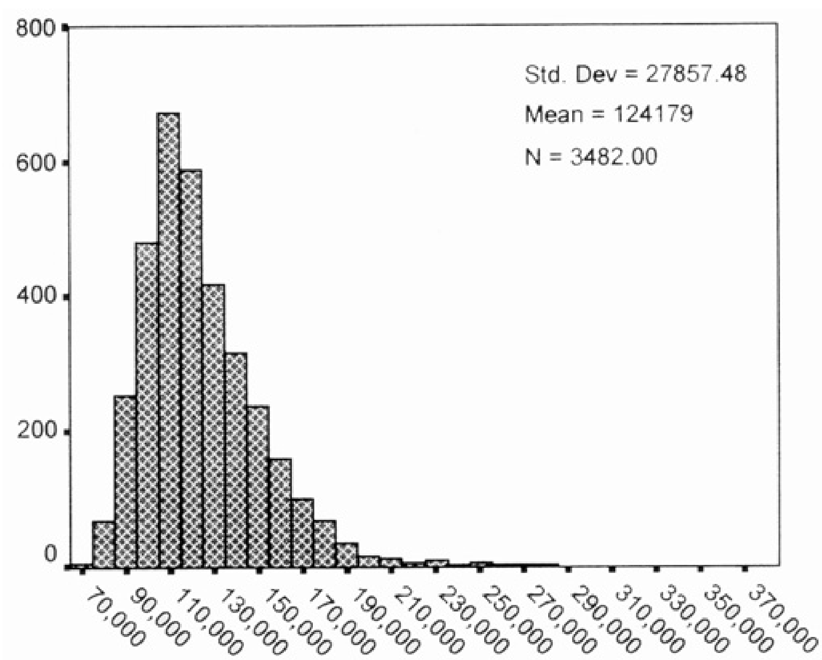

Figure 1b: Improved Sales by NBHD

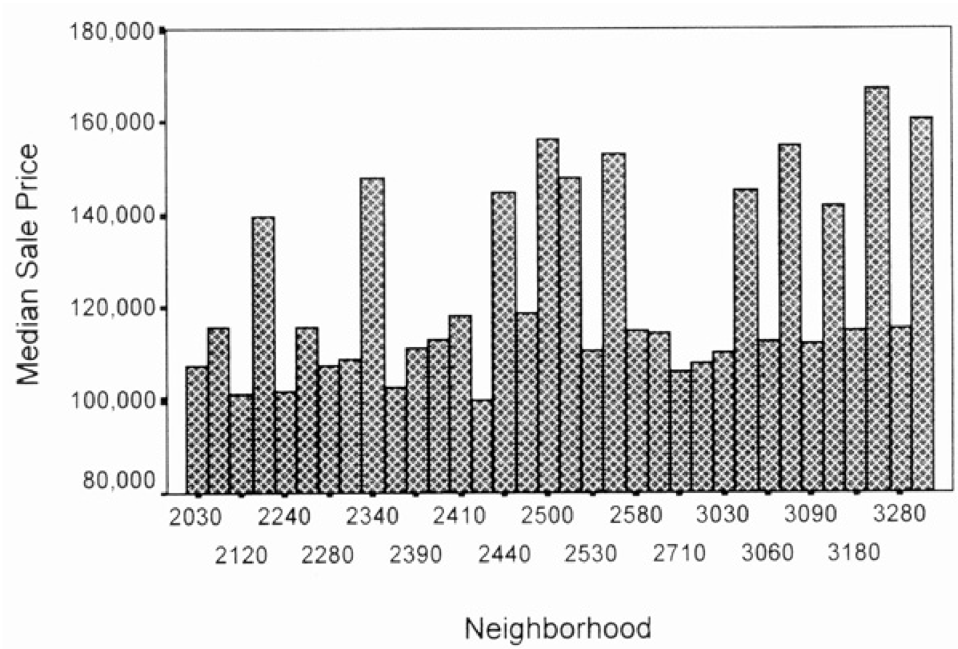

Figure 2a: Distribution of Vacant Land Sales

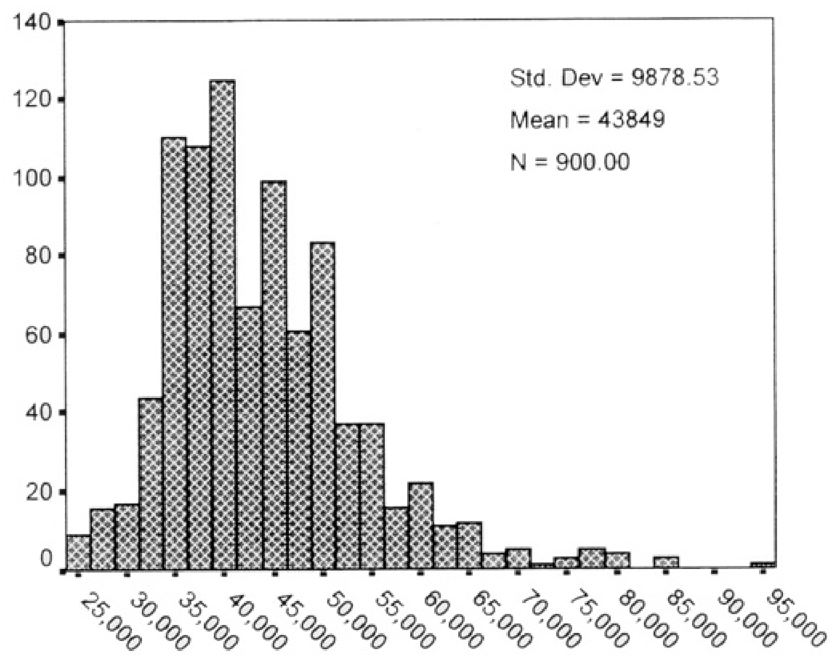

Figure 2b: Vacant Sales by NBHD

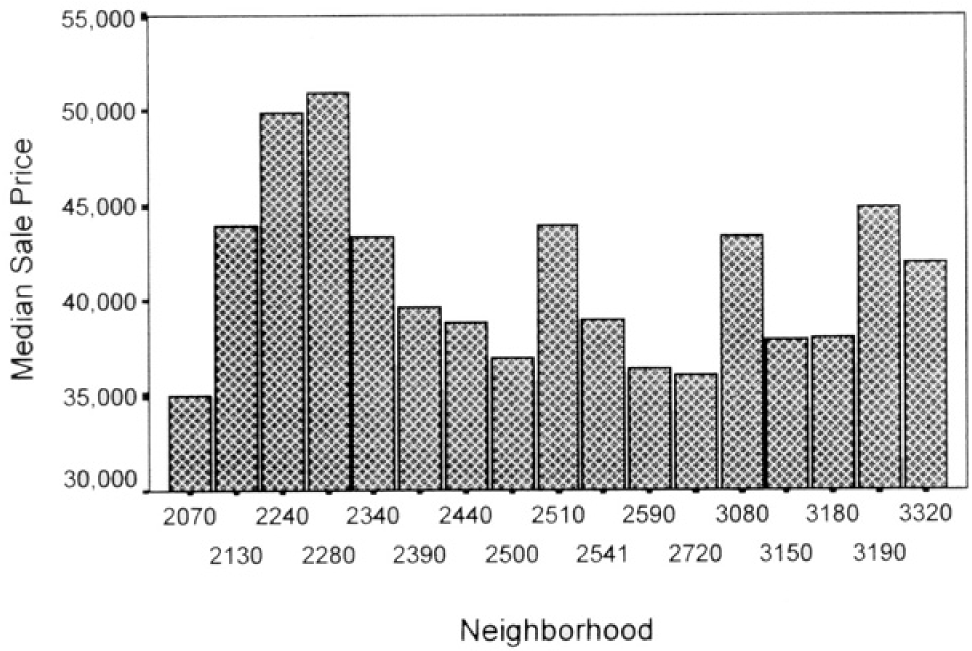

Figure 3 contains descriptive statistics for the improvement related variables and lot size. Available Improvement characteristics include construction quality, design type (MBC or market building class), roof type, heating type and air conditioning (Y/N), year built and effective year built, fireplaces, main living area, total and finished basement areas, garage and carport sizes, and secondary areas and features (such as solariums, loft areas, and swimming pools). The average main living area is 120 square meters (all sizes are in metric). In addition, virtually all the homes have basements, of which about three-fourths are fully or partially finished. The homes were all built in the 1950s or later with the average being 1981. The average lot size is approximately 550 square metes (median size is 540 square meters).

Figure 3: Descriptive Statistics—Improved Sales

QUAL

			Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4	STANDARD	2930	84.1	84.1	84.1
	5	SEMI-CUSTOM	531	15.2	15.2	99.4
	9	CUSTOM	18	.5	.5	99.9
	10	GOOD CUSTOM	3	.1	.1	100.0
	Total		3482	100.0	100.0	

MBC Market Building Class

			Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	1 STY w. BSMT	1474	42.3	42.3	42.3
	1	1 STY w/o BSMT	1	.0	.0	42.4
	2	BILEVEL	523	15.0	15.0	57.4
	3	SPLIT	543	15.6	15.6	73.0
	4	SPLIT w/ CRAWL	279	8.0	8.0	81.0
	5	1.5 STY w/ BSMT	7	.2	.2	81.2
	9	2 STY w/ BSMT	636	18.3	18.3	99.5
	10	2 STY w/o BSMT	19	.5	.5	100.0
	Total		3482	100.0	100.0	

AIRCOND

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	3460	99.4	99.4	99.4
	1	22	.6	.6	100.0
	Total	3482	100.0	100.0	

ALLBRICK

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	3476	99.8	99.8	99.8
	1	6	.2	.2	100.0
	Total	3482	100.0	100.0	

ROOF

			Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	ASPHALT SHINGLE	3476	99.8	99.8	99.8
	2	TILE	6	.2	.2	100.0
	Total		3482	100.0	100.0	

FPMASON masonry fp

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	3008	86.4	86.4	86.4
	1	431	12.4	12.4	98.8
	2	42	1.2	1.2	100.0
	3	1	.0	.0	100.0
	Total	3482	100.0	100.0	

FPZERCL zero-clearance fp

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	2017	57.9	57.9	57.9
	1	1408	40.4	40.4	98.4
	2	56	1.6	1.6	100.0
	3	1	.0	.0	100.0
	Total	3482	100.0	100.0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Standard Deviation
SALE_PRI	4382	25000.00	375000.00	107680.1400	41109.8300
LOTSIZE lot size	4382	233.29	1290.68	550.6919	135.5342
LIVAREA main living area	3482	51.79	330.00	119.8380	33.6469
LLFINSZ lower level fin area	734	21.60	91.52	50.3099	8.7329
LOFTAREA loft area	3	12.40	22.57	18.0900	5.1918
BSMTAREA total bsmt area	3450	25.30	202.48	90.7270	28.9064
FBSTAREA fin bsmt area	2311	5.19	161.98	59.7923	23.7761
SOLARSZ solarium area	3	15.12	19.24	16.6533	2.2529
ATTGARSZ att gar area	1582	21.50	112.93	41.4288	7.5824
DETGARSZ det gar area	1429	13.75	110.24	50.0290	8.8437
CARPRTSZ carport area	14	8.76	51.10	25.9071	10.2349
POOLSZ pool area	13	26.00	55.55	41.3900	9.1930
POOLBLDZ pool bldg area	2	80.30	81.74	81.0200	1.0182
YRBLT year built	3482	1956	1998	1982.0000	8.7700
EFFYRBLT eff year build	3482	1956	1998	1982.0300	8.7400
PRVLAND prev LV	900	28141.00	84571.00	45297.4278	9072.6218
PRVASMT prev TV	3482	75000.00	307500.00	125772.9800	26187.0600
SPPSM sale price psm	3482	532.91	1845.47	1059.5947	163.9682
Valid N (listwise)	0				

Figure 4 shows the distribution of selected site characteristics. Commonly found features in Clareview include lake, river, ravine, park, traffic, commercial, multi-family, and institutional influences. Note that valuers rate these influences as 0 (none), 1 (moderate), 2 (strong), or 3 (very strong).

Figure 4: Distribution of Site Characteristics

LAKE * IMPROV Cross tabulation

Count

		IMPROV		Total
		0	1	
LAKE	0	826	3438	4264
	1	8	6	14
	2	5	11	16
	3	61	27	88
Total		900	3482	4382

RIVER * IMPROV Cross tabulation

Count

		IMPROV		Total
		0	1	
RIVER	0	893	3467	4360
	1		1	1
	2		9	9
	3	7	5	12
Total		900	3482	4382

RAVINE * IMPROV Cross tabulation

Count

		IMPROV		Total
		0	1	
RAVINE	0	892	3467	4359
	1		5	5
	3	8	10	15
Total		900	3482	4382

PARK * IMPROV Cross tabulation

Count

		IMPROV		Total
		0	1	
PARK	0	882	3430	4312
	1	4	30	34
	2	2	10	12
	3	12	12	24
Total		900	3482	4382

WALKWAY * IMPROV Cross tabulation

Count

		IMPROV		Total
		0	1	
WALKWAY	0	861	3438	4299
	1	39	44	83
Total		900	3482	4382

TRAFFIC * IMPROV Cross tabulation

Count

		IMPROV		Total
		0	1	
TRAFFIC	0	789	2557	3346
	1	76	557	633
	2	34	300	334
	3	1	68	69
Total		900	3482	4382

COMM commercial influence * IMPROV Cross tabulation

Count

		IMPROV		Total
		0	1	
COMM commercial influence	0	893	3423	4316
	1	7	57	64
	2		2	2
Total		900	3482	4382

MULI multi-family influence * IMPROV Cross tabulation

Count

		IMPROV		Total
		0	1	
MULTI multi-family influence	0	895	3198	4093
	1	5	268	273
	2		11	11
	3		5	5
Total		900	3482	4382

INSTNL institutional influence * IMPROV Cross tabulation

Count

		IMPROV		Total
		0	1	
INSTNL institutional influence	0	900	3404	4304
	1		77	77
	2		1	1
Total		900	3482	4382

Additive Model—Improved Properties

An additive model using stepwise regression analysis for the 3,482 improved sales in the market area was developed patterned after the City's most recent model for the 2000 assessment year. Figure 5 contains the model results. Improvement variables important in the model include living area (one variable per quality class), lower level and basement areas, attached and detached garages, the square root of age (multiplied by square meters of living area), fireplaces, and binary variables for design types, all brick exterior, and premium (tile) roof. Of several lot size variables tested, the log of lot size (LOGLSIZE) produced the best fit. Site variables were included for lake, river, ravine, park, traffic, and multi-family influences. The time variable enters at $2.18 per square meter per month, suggesting modest price appreciation of 0.2% per month (2.18 x average living area of 120 square meters ÷ average sale price of $124,179). A binary variable for sales occurring in the winter (November through February) is strongly significant with a coefficient of -$2,674. Twenty of thirty-three neighborhood binaries entered significantly (neighborhood 2410 served as the base neighborhood).

The model produces an overall median ratio of 1.0006 and an excellent average error as measured by the coefficient of dispersion (COD) of 5.87. Comparable CODs were 8.82 in Ada County, for which land variables other than land size and broad market areas were not available, and 5.75 in Jefferson County, where variables were similar to those in Clareview. In all three communities, a further analysis of the resulting ratios showed strong equity with respect to lot size, living area, construction quality, age, location, and other relevant characteristics.

Figure 5: Additive Regression Model—Improved Properties

Model: 35

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	67435.907	1624.263	.109	41.518	.000
LOGLSIZE ln (lotsize)	12857.931	972.453	.832	28.742	.000
LIVAREA4 qual 4 psm	539.015	18.754	.832	28.742	.000
LIVAREA5 qual 5 psm	552.782	17.029	1.282	32.462	.000
LIVAREA6 qual 6 psm	673.211	17.835	.419	37.748	.000
LIVAREA7 qual 7 psm	706.378	23.589	.234	29.945	.000
LLFINSZ lower level fin area	53.240	20.179	.040	2.638	.008
BSMTAREA total bsmt area	68.112	17.032	.073	3.999	.000
FBSMTAREA fin bsmt area	69.087	6.056	.085	11.408	.000
ATTGARSZ att gar area	364.440	14.995	.278	24.305	.000
DETGARSZ det gar area	208.170	10.565	.189	19.704	.000
SQRAGESM sqrt (effage) x sqm	-72.377	1.828	-.411	-39.590	.000
BILEVEL	908.096	549.896	.012	1.651	.099
SPLIT	6699.765	1350.387	.087	4.961	.000
SPLTCRAWL	7703.584	1407.683	.075	5.473	.000
TWO_STY	-3846.127	1190.385	-.054	-3.231	.001
ALLBRICK	6341.993	4061.717	.009	1.561	.119
PREMROOF	8358.495	1310.624	.043	6.377	.000
FPMASON masonry fp	3711.597	512.615	.052	7.241	.000
FPZERCL zero-clearance fp	3145.388	396.551	.060	7.932	.000
LAKE	6802.086	639.161	.070	10.642	.000
RIVER	2190.535	1137.857	.012	1.925	.054
RAVINE	1792.356	1056.569	.011	1.696	.090
PARK	1688.265	765.775	.014	2.205	.028
TRAFFFIC	-1499.016	238.034	-.039	-6.297	.000
MULTI multi-family influence	-908.721	574.693	-.010	-1.581	.114
MONTHSSM months (1-36) x sqm	2.184	.132	.114	16.533	.000
WINTER	-2674.237	404.973	-.040	-6.603	.000
NB2350	-12710.043	1346.201	-.059	-9.441	.000
NB2430	-8941.185	944.420	-.061	-9.467	.000
NB2280	-8107.090	985.231	-.051	-8.229	.000
NB2390	-7541.579	942.821	-.052	-7.999	.000
NB3180	-6516.795	788.020	-.053	-8.270	.000
NB2070	-7577.487	1168.808	-.040	-6.483	.000
NB2400	4037.455	1484.177	.017	2.720	.007
NB2320	-9512.409	1612.225	-.036	-5.900	.000
NB2030	-7346.407	1106.379	-.043	-6.640	.000
NB3280	-5940.447	1024.843	-.036	-5.796	.000
NB2590	-7265.422	1384.862	-.032	-5.246	.000
NB2130	-5777.261	1532.855	-.023	-3.769	.000
NB2120	-10591.662	2445.119	-.027	-4.332	.000
NB2710	-7509.571	1710.026	-.028	-4.391	.000
NB2450	-3112.608	705.698	-.029	-4.411	.000
NB3030	-3575.012	769.053	-.030	-4.649	.000
NB3060	-3440.665	874.581	-.025	-3.934	.000
NB3090	-3744.417	973.832	-.024	-3.845	.000
NB3190	4093.971	1521.199	.017	2.691	.007
NB2500	2848.414	1116.239	.016	2.552	.011

Excluded Variables

Model: 36

	Beta In	t	Sig	Partial Correlation	Collinearity Statistics
					Tolerance
NB2240	-.007	-1.043	.297	-.018	.796
NB2260	-.005	-.734	.463	-.013	.855
NB2340	-.007	-1.067	.286	-.018	.819
NB2440	.008	1.264	.206	.022	.937
NB2510	-.004	-.566	.571	-.010	.832
NB2530	.000	.060	.952	.001	.873
NB2541	.002	.308	.758	.005	.976
NB2580	.002	.290	.772	.005	.891
NB2720	-.007	-1.101	.271	-.019	.884
NB3040	-.001	-.094	.925	-.002	.740
NB3080	.010	1.642	.101	.028	.932
NB3150	-.001	-.142	.887	-.002	.887
NB3320	.006	.983	.326	.017	.888
STY_15	.002	.362	.717	.006	.923
FIREHYD	.006	.906	.365	.015	.977
WALKWAY	-.004	-.610	.542	-.010	.959
COMM commercial influence	-.007	-1.098	.272	-.019	.960
AIRCOND	.005	.768	.443	.013	.979
POOLSZ pool area	.006	1.006	.315	.017	.966
INSTNL institutional influence	.000	.027	.978	.000	.945
BERM	-.004	-.622	.534	-.011	.774
BUS	.007	1.170	.242	.020	.981

Model Summary

Model: 36

R	R Square	Adjusted R Square	Standard Error of the Estimate
.936	.876	.874	9882.33

Statistics

RATIO

N	Valid	3482
	Missing	0
Mean		1.0057
Median		1.0006
Standard Deviation		7.761E-02
Minimum		.68
Maximum		1.41
COD		5.87

NLR Combined Model—Vacant and Improved Properties

A non-linear regression (NLR) analysis using the 3,482 improved sales and 899 vacant land sales (one vacant lot sale with incomplete data was dropped from the analysis) was run to develop land and building values. The model took the following format:

$$V = \pi GQ * ((\Sigma LA * \pi LQ) + (\Sigma BA * \pi BQ))$$

where

πGQ = product of global qualitative factors (time and winter).

ΣLA = sum of land additive components = $\Sigma(B_i * NBHD_i) * (LOTSIZE/540)$^LSIZE_EXP. *Note*: $NBHD_i$ are neighborhood binaries, B_i are their corresponding coefficients (base lot values), and 540 is the typical lot size (square meters).

πLQ = product of land qualitative factors (lake, river, ravine, park, traffic, and multi-family). In addition, a binary variable was specified for improved parcels to represent the incremental value (if any) of improved versus vacant land.

ΣBA = sum of building additive components (main living area, total and finished basement areas, lower level area, attached and detached garage areas, and fireplaces). To account for possible economies of scale, both a coefficient and exponent were specified for main living area:

$$B_1 * \text{LIVAREA\^{}BSIZ\_EXP}.$$

πBQ = product of building qualitative factors (construction quality, design, all brick exterior, tile roof, and percent good).

Exhibit 6 contains the results of the NLR model. The R-square is .9507. Note the following:

1) Main living area is calibrated as $1428 * LIVAREA^{.788}$. Thus for example, a 150 square meter home would have an initial value of:

$$1428 * 1500^{.788} = 74{,}043 \text{ or } 494 \text{ per square meter.}$$

2) The percent good multipliers, initially specified as 1-age/100, are expanded:

$$\text{Percent Good} = (1\text{-AGE}/100)^{1.69}.$$

Thus, a 20 year old home would have a multiplier of:

$$(1\text{-}20/100)^{1.69} = 0.686.$$

3) Lake is the strongest location factor with a type 3 rating (88 sales) taking on a multiplier of 1.335 (1.101^3). Over 1,000 sales are affected by traffic with multipliers of .967 for level 1 to .904 for level 3 ($.967^3$).

4) Base values for a 540 square meter lot (median) range from $33,085 (neighborhood 120) to $47,201 (neighborhood 400).

5) The land size exponent is .286. Thus, for example, a 1,000 square meter lot in neighborhood 400 would have an initial value, before adjustment for GQ and LQ factors, of

$$LV = 47{,}201 * (1000/540)^{.286} = 56{,}297.$$

6) The GQ factors for time and winter are very similar to those suggested by the additive model.

7) The factor for improved land is 1.35, suggesting a 35% premium for comparable improved over vacant land.

Figure 6: Combined Vacant/Improved Hybrid NLR Model

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Run stopped after 8 model evaluations and 4 derivative evaluations.
Iterations have been stopped because the relative reduction between
successive residual sums of squares is at most SSCON += .00010000

Nonlinear Regression Summary Statistics   Dependent Variable SALE_PRI

Source               DF        Sum of Squares      Mean Square

Regression           63        5.784710E+13        918207930809
Residual             4318      364769476224        84476488.2409
Uncorrected Total    4381      5.821187E+13

Corrected Total      4380      7399114594590

R squared = 1 - Residual SS / Corrected SS =       .95070
```

Parameter	Estimate	Asymptotic Std. Error	Asymptotic 95 % Confidence Interval Lower	Upper
B1	1428.3648367	359.67670094	723.21379913	2133.5158743
BSMT	49.724944583	21.030430160	8.494501772	90.955387394
BSMTFIN	82.251832405	7.052066734	68.426160178	96.077504632
LOWERLV	25.088385398	23.885482381	-21.73942591	71.916196709
ATTGAR	448.72893370	18.000087576	413.43951852	484.01834889
DETGAR	292.72116581	14.223266065	264.83626028	320.60607133
FP_MAS	6073.0343649	737.16233031	4627.8176446	7518.2510852
FP_ZERO	4057.5723925	467.15631261	3141.7061223	4973.4386627
Q5	1.035363147	.008031230	1.019617812	1.051108482
Q6	1.285332096	.021936840	1.242324624	1.328339568
Q7	1.369137593	.044999181	1.280916091	1.457359095
BILEB	1.013268588	.011137383	.991433599	1.035103577
SPLITLEV	1.123412462	.033991241	1.056772175	1.190052750
SPLCRWL	1.152710095	.036195804	1.081747732	1.223672458
TWOSTY	.928760026	.018370027	.892745340	.964774712
BRICK	1.090745242	.061634129	.969910699	1.211579786
TILEROOF	1.102657609	.017011016	1.069307281	1.136007936
PCTGOOD	1.691529547	.082988896	1.528825694	1.854230400
BSIZ_EXP	.787960908	.044976101	.699784653	.876137163
LAKE_FAC	1.100873100	.005933087	1.089241202	1.112504998
RIV_FAC	1.053590596	.016293622	1.021646731	1.085534461
RAV_FAC	1.060527125	.013980715	1.033117743	1.087936507
PARK_FAC	1.030061610	.009891162	1.01669853	1.049453366
TRAF_FAC	.967077506	.004017351	.959201435	.974953577
MF_FACT	.978274802	.001273349	.958133763	.998415842
N2030	35978.260315	858.40334848	34295.348938	37661.171691
N2070	35738.723807	681.70759440	34402.226846	37075.220767
N2120	33085.164028	1672.1617742	29806.868250	36363.459806
N2130	37644.579282	1014.3481832	35655.935948	39633.222616
N2240	45224.043511	491.44549746	44260.557965	46187.529056
N2260	42446.138556	793.34528085	40890.774402	44001.502711
N2280	35531.846888	768.90919869	34024.390003	37039.303773
N2320	34011.343171	1148.6649765	31759.369947	36263.316396

Parameter	Estimate	Asymptotic Std. Error	Asymptotic 95 % Confidence Interval Lower	Upper
N2340	40908.861729	568.57571492	39794.161348	42023.562109
N2350	33192.961181	977.16614890	31277.213727	35108.708634
N2390	35745.885418	759.83855933	34256.211644	37235.559192
N2400	47201.416285	1193.4974009	44861.548486	49541.284084
N2430	34294.422595	813.48519883	32699.573859	35889.271332
N2440	40064.808353	703.51462567	38685.558413	41444.058293
N2450	38218.662126	612.65639733	37017.540971	39419.783280
N2500	42196.442208	728.39935730	40768.405415	43624.479001
N2510	40840.633673	498.00171817	39864.294568	41816.972778
N2530	43179.023374	819.36984231	41572.637714	44785.409033
N2541	40384.316396	1658.4805502	37132.842843	43635.789949
N2580	43605.479842	927.42551780	41787.249568	45423.710115
N2590	36072.769309	899.66216066	34308.969474	37836.569145
N2710	36311.670457	1153.7212914	34049.784259	38573.556655
N2720	42764.431377	788.89978807	41217.782671	44311.080083
N3030	38898.487467	670.88213039	37583.213976	40213.760959
N3040	41028.519010	850.55837516	39360.987810	42696.050210
N3060	40023.219047	751.29822224	38550.288719	41496.149374
N3080	42939.979864	854.70363680	41264.321822	44615.637905
N3090	38508.227357	786.83560258	36965.625515	40050.829200
N3150	40718.314685	692.46687767	39360.724005	42075.905366
N3180	36469.324414	681.24611547	35133.732190	37804.916639
N3190	44073.353633	889.46547619	42329.544535	45817.162731
N3280	36991.387926	807.61788656	35408.042135	38574.733717
N3320	41902.596592	785.23042969	40363.141713	43442.051471
N2410	43591.873196	749.51980655	42122.429477	45061.316916
LSIZ_EXP	.286044397	.017122522	.252475461	.319613333
TIMEFAC	1.002475212	.000118869	1.002242168	1.002708257
WINT_FAC	.980484664	.002916269	.974767280	.986202048
IMP_FAC	1.353591867	.062649377	1.230766916	1.476416817

Sales Ratio Statistics—All Sales

RATIO2 NLR Sales Ratio

N	Valid	4381
Mean		1.0087
Median		1.0007
Standard Deviation		.0936
Minimum		.5999
Maximum		1.8471
COD		6.77

Sales Ratio Statistics—Improved Sales

RATIO2 NLR Sales Ratio

N	Valid	3482
Mean		1.0054
Median		1.0005
Standard Deviation		.0787
Minimum		.6864
Maximum		1.42361
COD		5.97

Sales Ratio Statistics—Vacant Sales

RATIO2 NLR Sales Ratio

N	Valid	899
Mean		1.0214
Median		1.0031
Standard Deviation		.1361
Minimum		.5999
Maximum		1.8471
COD		9.85

The model produces a median sales ratio of 1.0007 and a COD of 6.77. The COD for the improved sales is 5.97, just slightly above the COD of 5.87 for the additive model developed from improved sales alone. For vacant land, the COD is 9.85, also very good. For all three databases analyzed, results were as follows (recall that there were no site variables and only broad geographic areas for Ada County):

	Clareview	Ada County	Jefferson County
Sales Used in NLR Model	4,381	15,005	4,836
Percent Vacamt	20.5	14.1	4.5
Overall COD	6.77	10.54	6.64
Improved only COD	5.97	8.99	5.55
Vacant only COD	9.85	18.70	15.31

Figures 7(a), 7(b), and 7(c) present graphs of the ratios for the vacant lot sales against lot size, value, and neighborhood, respectively. The scatter plots of the ratios with lot size and value both show good equity. However, while generally good, the box plot of the ratios by neighborhood indicates that in some neighborhoods ratios are generally low (neighborhoods 2130 and 2280) and in others they are generally high (2500 and 2720). (In a box plot, the box represents the interquartile range and the dark line in the box is the median). This suggests that premiums for built-on land may vary, perhaps with the level of site improvements, landscaping, and the like.

Figure 7a: Graph of Vacant Land Ratios with Lot Size

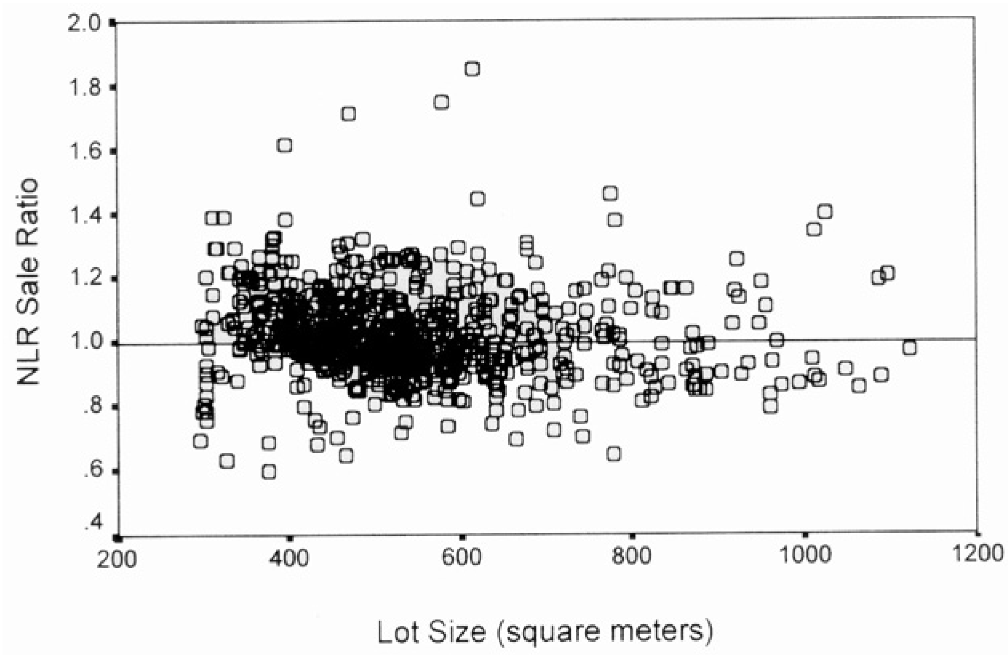


Figure 7b: Graph of Vacant Land Ratios with Value

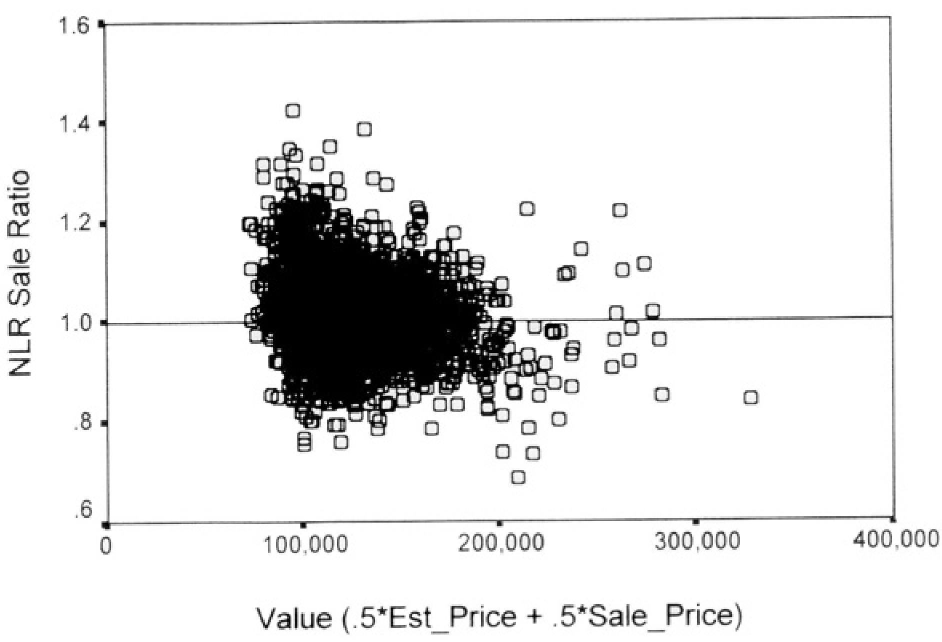
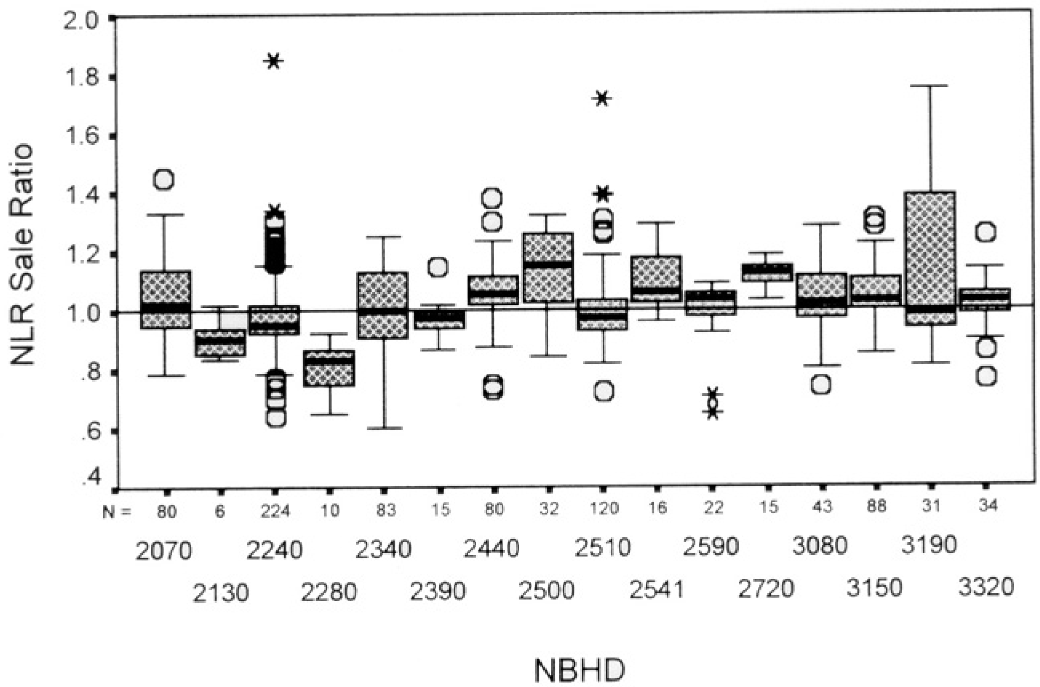


Figure 7c: Graph of Vacant Land Ratios with NBHD



Shift Analysis

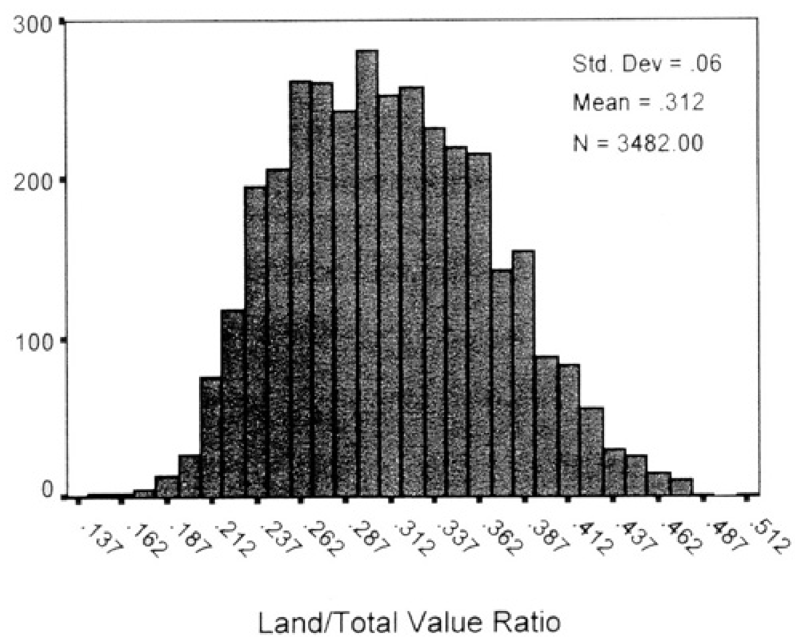
As shown in figure 8, the total estimated value of all 4,381 sales used in the analysis was $513.5 million, of which 181.5 million, or 35% is estimated to be land value (the corresponding percentage for improved property only is 30%). Thus, if the sales were representative of the general distribution of values, a land-only tax would remove some 65% of the value of residential property in the Clareview market area from the tax roll. This implies that tax rates would have to increase some 286 percent (1/.35) to maintain the same expenditure and service levels. Absent offsetting factors elsewhere, taxes on vacant land would increase by this percentage. Given an overall land/total value ratio of 35%, owners of improved properties with lesser land-to-total value ratios would stand to benefit while those with higher ratios would likely see increased property taxes. (Such analyses are further complicated by the complex overly of taxing jurisdictions, each with different land-to-building ratios, which would have to be considered in a final analysis).

Figure 8: Decomposition of Land and Building Values—Combined NLR Model

		Land Value	Building Value	Total Value
0 = No	Minimum	33,011	0	33,011
	Maximum	68,282	0	68,282
	Mean	43,000	0	43,000
	Sum	38,656,976	0	38,656,976
	N	899	899	899
1 = Yes	Minimum	28,130	35,676	68,351
	Maximum	76,662	649,642	412,176
	Mean	41,022	95,355	136,378
	Sum	142,840,061	332,027,709	474,867,770
	N	3,482	3,482	3,482
Total	Minimum	28,130	0	33,011
	Maximum	76,662	349,642	412,176
	Mean	41,428	75,788	117,216
	Sum	181,497,037	332,027,709	513,524,746
	N	4381	4381	4381

The histogram in figure 9 shows the distribution of land/total value ratios of the 3,482 improved sales. As can be seen, ratios range from less than 15% to over 50%. The average ratio is 31.2% and 26.8% of homes have ratios that exceed the calculated break-even ratio of 35%.

Figure 9: Land/Total Value Ratios—Improved Sales



Figures 10(a) and 10(b) present graphs of land-to-total value ratios with lot size and total estimated value. As figure 10(a) shows, there is almost no correlation between land/total value ratios and lot size. However, land/total value ratios are highly related to living area (r = .627), year built (r = .713), and building quality (r = .636). Thus, among improved properties, a land-only tax would be least favorable for smaller, older, and low or standard quality homes. New, large, and higher quality homes all have relatively low land-to-total value ratios and would thus stand to benefit most. In all three databases analyzed, land/total value ratios also vary markedly with neighborhood and, in the present case, range from 25% to 40%. Perhaps most important, however, n all three jurisdictions the highest single correlation is with total value. In the present case, the R-square of .632 in figure 10(b) implies a correlation coefficient of .795 (square root of .632). With relatively large land-to-total value ratios, lower value homes are likely to pay an increased percentage of a site value tax and higher value homes would likely pay a reduced percentage.

Figure 10a: Graph of L/V Ratios with Lot Size

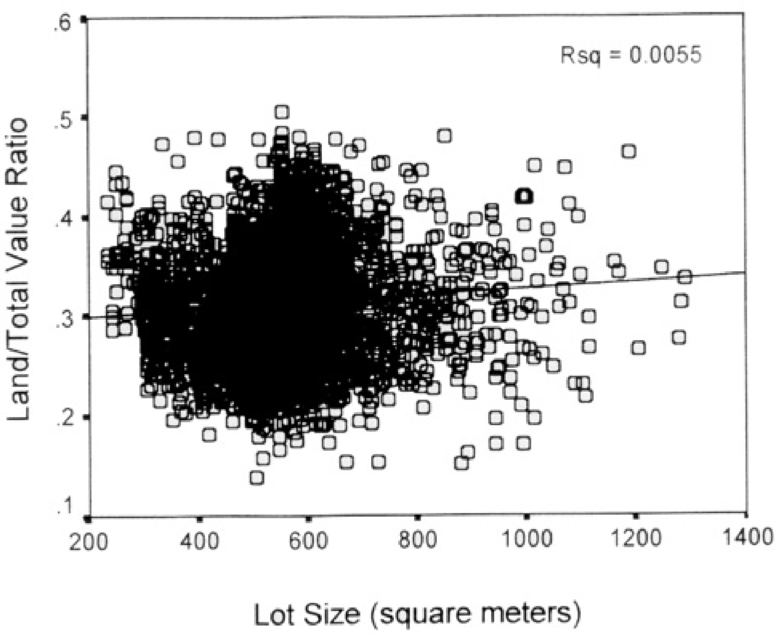
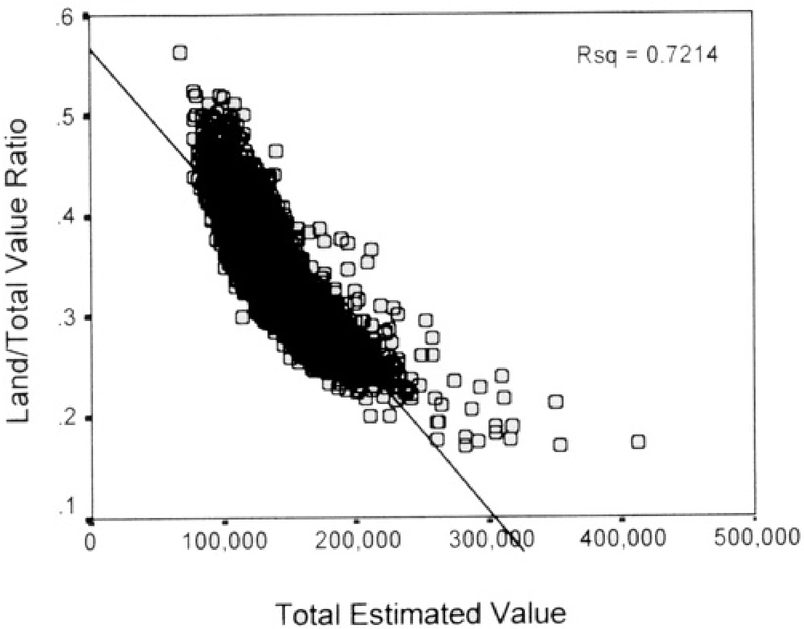


Figure 10b: Graph of L/V Ratios with Value



Summary and Conclusions

Regardless of whether total property value or land value only is subject to tax, accurate estimation of land values is important in property assessment. Fortunately, this paper suggests that modern mass appraisal methods can be adopted to estimate both vacant and improved residential land values with reasonable accuracy, even when there are no or few vacant land sales in certain areas. Traditionally, land values have been estimated based on an analysis of vacant land sales only. However, a combined model affords the possibility of providing market data in built-up areas with few vacant lots, while still using those that are available to ensure that models will, on average, neither under- nor over-estimate vacant land values. The results also indicate that a combined model need not result in significant deterioration of accuracy in predicted values of improved properties (in Jefferson County results actually improved).

To help discern any premium (or decrement) in value for improved over vacant lots, variables were included in the combined models for the fact that a parcel was vacant or improved. In Clareview, the NLR combined model indicated a premium for improved lots of 35%. In contrast, no premium was indicated in Ada County, while in the Jefferson County model the suggested premium was as much as 90 percent. A good part of these variations may be attributed to differences in the desirability of remaining vacant versus improved sites. In general, improved land can be expected to command premiums for in-place site amenities and development time and costs. In any case, the nature and extent of differences in value between vacant and improved sites is an intriguing issue with obvious implications for a land value tax that heretofore has been largely unexplored. Additional work in this area could prove valuable.

Finally, values obtained from nonlinear MRA in all three data bases were decomposed into land and building components and an analysis conducted to determine tax shifts implicit in a land value tax. Based on the available sales, the percentage of total value estimated to be in land was 29% in Ada county, 35% in Clareview, and 43% in Jefferson County. If a land value tax system were phased in, property owners would see their relative tax obligations rise or fall relative to the percentage of their property value attributable to land. Those with land-to-building ratios higher than the norm could be expected to pay more. Those with lower ratios could be expected to pay less. In all three databases analyzed, higher land ratios showed strong *negative* correlations with size of improvement, construction quality, year built, and total value. Thus, some taxes would likely be shifted to properties with smaller, older, or otherwise less valuable improvements.