

# EFFECT OF TAX-RATE ON ZONE DEPENDENT HOUSING VALUE

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## ABSTRACT

*This study explores the role of zoning effect on the housing value due to different zones. In general, housing value may depend on various internal and external factors and zoning being one of them. Zoning differentiates land use as designated by its categorization. Different zoning categorizations have different conditions and characteristics. Thus, implementation of zoning on a certain land for its designated purposes reduces the availability of the land. In turn, this results in increased price value of the property. Therefore, this research observes the effect on housing value due to different zoning classifications. As a result, this research will help the policy makers to modify and improve long term policy decisions in urban planning. In this paper, we provide evidence of zoning effect on the housing value for two different zoning classifications. The observations are taken from different parcels of neighborhoods. We use associative model to explore the effect of zone and understand its impact on the housing value. In particular, statistical significance and magnitude of zone dependent housing factors on the “value of the house” is observed. Moreover, after controlling for lot dimensions, bedrooms, bathrooms, square footage, and other related factors, higher tax-rate is found to be instrumental in affecting the housing value more in multi-family zone.*

## INTRODUCTION AND RESEARCH BACKGROUND

This study explores the role of zoning characteristics and other information externalities in the determination of home value. Housing price depends on various internal and external factors. These factors may contain zoning information as well as physical characteristics of the home. Zoning differentiates land use as per its classifications. Different zoning classifications have different conditions and characteristics (see, Phoebe, Koenig, and Pynoos 2006; Shoked, 2011). Any major alteration or modification to a structure needs to have permission from the appropriate authority depending on the zone the structure is located. Thus, zoning limits the functionality and affects the value of the property. Zoning restricts the use of land differently due to different classifications. Implementation of zoning thus helps to use of a certain land for its designated purposes and thus reduces the availability of land. As a result, the process of zoning increases the value of the land an indirect effect of urban planning.

Due to increased urban planning, relationship between different types of zones and its effect on the price of house has been studied by many researchers (Cho, Kim, and Lambert,

2009; Mukhija, Regus, Slovin, and Das, 2010). Studies suggest that zoning significantly affects housing prices (see, Chressanthi, 1986; Glaeser and Gyourko, 2002). Thus, the empirical results of these studies tend to confirm that major zoning changes significantly affect housing prices. The evidence also suggests that zoning is responsible for higher housing costs and plays a dominant role in inflating house prices. Although, other factors such as, inventory of houses on the market and housing starts may affect the current housing value in a longitudinal study (see, Choudhury, 2010); our research is primarily focused on the zoning patterns and its effect on the housing value for single-family and multi-family housing. Different zones are created for different land use purposes in an urban planning. Even though the price differential of a house is primarily due to the zoning factor; other factors, such as, location may also contribute to its price variations.

In this study we have used the following zones in our analysis:

- A. Single family housing zone.
- B. Multi family housing zone.

Internal factors that are considered:

Age of the house, Number of bedrooms, Number of bathrooms, Condition of the house (0.00 to 0.99), Lot dimension-A (Frontage/width), Lot dimension-B (depth/side), Total building square footage.

External factor that is considered: Tax rate.

Zoning's stated purpose is to protect residential property from the negative externalities associated with neighboring commercial or other development and this may be the reason that studies on zoning's impact have focused on whether zoning is effective in raising the economic value of a home. Pogodzinski and Sass (1990) in their paper have extensive discussions on the economic theory of zoning and the effects of zoning on six economic agents. In their review of the zoning literature they have examined the strengths and weaknesses of theoretical models on the effects of zoning. In general, housing prices differ in different areas depending on the zoning classification. Groves and Helland (2002) in their study estimated the transfer of wealth between owners of existing homes that results from the creation of zoning ordinance. They have observed that properties best suited for residential use gains in value while property with relatively higher potential as commercial property experiences a decline in the value and therefore, they conclude that zoning is distributive. Their results indicate that zoning does in fact redistribute wealth between existing homeowners.

This research will use associative models to analyze how zoning affects the housing value. We will build two different models, one for single-family zone classification and the

other for multi-family zone. Regression model of the value of house will be estimated using multiple predictor variables. The interesting observation of this research would be the findings in usage of different zone in different neighborhoods and its value that are dependent on tax-rate.

## DATA AND METHODOLOGY

For our analysis data is obtained from the local county assessor's office. The data set includes the entire population of residential properties in this town. However, only two different types of residential properties data are used in the analysis. In addition, any observation with missing data was eliminated. For the first model, the sample includes only those residential properties with a single-family detached building. For the second model, the sample includes residential properties which have multi-family building.

<b>TABLE-1A: Summary Statistics of single-family housing zone.</b>					
<b>Variables</b>	<b>N</b>	<b>Mean</b>	<b>Std Dev</b>	<b>Minimum</b>	<b>Maximum</b>
<b>LOTDIMA</b>	3887	87.46	29.45	22.00	600.00
<b>LOTDIMB</b>	3887	141.07	45.53	15.00	644.40
<b>LOTSQFEET</b>	3887	12784	12600	1350	386640
<b>CONDITION</b>	3668	0.88	0.08	0.34	0.99
<b>BATHROOMS</b>	3878	2.36	0.84	1.00	7.00
<b>TOTBLDGFT</b>	3878	1612	584.11	288.00	4542
<b>BEDROOMS</b>	3878	3.22	0.63	1.00	6.00
<b>VALUE</b>	3887	57474	18114	1166	218434
<b>AGE</b>	3878	38.84	20.23	1.00	192.00
<b>TAXRATE</b>	3887	7.68	0.05	6.82	7.69

### Variables and Statistical Techniques

To isolate the effect of zoning on the value of the house, we control for variety of internal factors, such as, age of the house, number of bedrooms, number of bathrooms, lot dimension-a (frontage/width), lot dimension-b (depth/side), total building square footage, condition of the building. Location characteristics, such as, recreational facilities, roads, shopping centers, etc. may be relevant in analyzing zoning effect on the housing value. However, they may impact the value both positively and negatively and thus offsets each other in its outcome. Therefore, they are not considered in this study. Public policy constraints and subsidies that include all types of land-use regulation and taxes will affect the value of a property by increasing or decreasing the incentive to obtain the property. One must also consider the influence of public good provision and the presence of amenities. They generate appealing differences between properties and thus create differences in price value. Therefore, tax-rate is also considered as an external factor in

our study to observe any tax dependent effect on the housing value. Cross-section data on these factors that are stated above are collected and analyzed using associative models. Our research considers two separate modeling to study the zoning effect; one for single-family housing and the other for multi-family housing. For each model, the dependent variable is the total property value.

<b>TABLE-1B: Summary Statistics of multi-family housing zone.</b>					
<b>Variables</b>	<b>N</b>	<b>Mean</b>	<b>Std Dev</b>	<b>Minimum</b>	<b>Maximum</b>
<b>LOTDIMA</b>	622	84.86775	85.78059	11.00000	1320
<b>LOTDIMB</b>	622	148.26273	73.66276	11.50000	1150
<b>LOTSQFEET</b>	622	13853	24132	989.00000	334208
<b>CONDITION</b>	584	0.86567	0.11512	0.45000	0.99000
<b>BATHROOMS</b>	617	2.07780	0.85115	1.00000	6.00000
<b>TOTBLDGFT</b>	617	1402	459.69175	583.00000	3336
<b>BEDROOMS</b>	617	3.00486	0.69668	1.00000	6.00000
<b>VALUE</b>	622	94200	189030	797.00000	2975037
<b>AGE</b>	617	44.20421	25.58777	1.00000	122.00000
<b>TAXRATE</b>	622	7.69186	0.00343	7.60654	7.69200

To observe the association between housing value and the internal-external factors; two separate analyses were performed. First, correlation analysis is done (see Table-2A and Table-2B) to examine the direction of the association between factors. Second, housing value (amount of assessed value of the property) is regressed on the predictors to observe the difference in association between two different zones separately for single-family and multi-family. Thus, there are two separate regression models estimated in this study. In general, it is assumed that there is a difference between excellent and poor condition of the building in the process of estimating the value of the house and therefore, condition is introduced into the model as an independent variable. However, these differences may affect single-family houses more compared to multi-family houses.

Thus, a multiple regression model was run using SAS software (see, SAS/STAT User's Guide, 1993) on several different independent variables separately for single-family zone and multi-family zone. These separate analyses by zone are to observe the differential effect of zone on the value of houses due to zone differences. This measure is designed to test the hypothesis that housing value fluctuation is zone dependent. Specification of the regression models are of the following form:

$$Value = \beta_0 + \beta_1 Lot\ dim\ a + \beta_2 Lot\ dim\ b + \beta_3 Bathrooms + \beta_4 Bedrooms + \beta_5 Totbldgft + \beta_6 Taxrate + \beta_7 Age + \beta_8 Condition \dots\dots\dots (1)$$

Where:

**Value:** Total dollar value of the property (building and land) as assessed by county authorities.

**Age:** The age of any building (number of years) included in the property.

**TOTBLDGFT:** The area in square feet of all buildings on the property.

**Bathrooms:** Number of bathrooms on the property.

**Bedrooms:** Number of bedrooms on the property.

**Condition:** Condition of the building ranges from 0.00 (poor) to 0.99 (excellent)

**TaxRate** The tax levy rate for the property (as a percentage of value).

**Lotdima:** Lot dimension (Frontage/width)

**Lotdimb:** Lot dimension (depth/side).

TABLE-2A: Correlation Matrix of single-family housing zone.

	Lotdima	Lotdimb	Lotsqfeet	Condition	Bathrooms	Totbldgft	Bedrooms	Value	Age	Taxrate
<b>Lotdima</b>	1.00000	0.33250 <.0001	0.80045 <.0001	0.03265 0.0480	0.07746 <.0001	0.10778 <.0001	0.04649 0.0038	0.32152 <.0001	-0.0407 0.0113	-0.3413 <.0001
<b>Lotdimb</b>	0.33250 <.0001	1.00000	0.68294 <.0001	-0.01725 0.2962	0.04200 0.0089	0.13521 <.0001	0.00241 0.8809	0.18416 <.0001	0.03940 0.0141	-0.3019 <.0001
<b>Lotsqfeet</b>	0.80045 <.0001	0.68294 <.0001	1.00000	0.01298 0.4320	0.04182 0.0092	0.08230 <.0001	0.01474 0.3587	0.25780 <.0001	-0.0089 0.5800	-0.3994 <.0001
<b>Condition</b>	0.03265 0.0480	-0.01725 0.2962	0.01298 0.4320	1.00000	0.47683 <.0001	0.34241 <.0001	0.26947 <.0001	0.35625 <.0001	-0.8962 <.0001	-0.0149 0.3668
<b>Bathrooms</b>	0.07746 <.0001	0.04200 0.0089	0.04182 0.0092	0.47683 <.0001	1.00000	0.63378 <.0001	0.44350 <.0001	0.38587 <.0001	-0.4893 <.0001	0.01158 0.4708
<b>Totbldgft</b>	0.10778 <.0001	0.13521 <.0001	0.08230 <.0001	0.34241 <.0001	0.63378 <.0001	1.00000	0.50916 <.0001	0.47505 <.0001	-0.3316 <.0001	-0.0111 0.4898
<b>Bedrooms</b>	0.04649 0.0038	0.00241 0.8809	0.01474 0.3587	0.26947 <.0001	0.44350 <.0001	0.50916 <.0001	1.00000	0.23686 <.0001	-0.2298 <.0001	0.02400 0.1351
<b>Value</b>	0.32152 <.0001	0.18416 <.0001	0.25780 <.0001	0.35625 <.0001	0.38587 <.0001	0.47505 <.0001	0.23686 <.0001	1.00000	-0.3609 <.0001	-0.0290 0.0707
<b>Age</b>	-0.0406 0.0113	0.03940 0.0141	-0.00889 0.5800	-0.89619 <.0001	-0.48928 <.0001	-0.3316 <.0001	-0.2298 <.0001	-0.3609 <.0001	1.00000	0.01750 0.2758
<b>Taxrate</b>	-0.3413 <.0001	-0.30192 <.0001	-0.39936 <.0001	-0.01491 0.3668	0.01158 0.4708	-0.0111 0.4898	0.02400 0.1351	-0.0290 0.0707	0.01750 0.2758	1.00000

An increase in either land area or building area should increase the value of a property; however, the effect diminishes as they grow larger. Similar effect is expected for an increase in the number of bathrooms or bedrooms. As property's age increases, the value of the property is expected to decrease. An increase in tax rate should decrease the value of the property also, since

higher tax burden will be capitalized into a lower value of housing. To test these hypotheses in our study we have employed associative models in our analysis.

**TABLE-2B: Correlation Matrix of multi-family housing zone.**

	<b>Lotdima</b>	<b>Lotdimb</b>	<b>Lotsqfeet</b>	<b>Condition</b>	<b>Bathrooms</b>	<b>Totbldgft</b>	<b>Bedrooms</b>	<b>Value</b>	<b>Age</b>	<b>Taxrate</b>
<b>Lotdima</b>	1.00000	0.20129 <.0001	0.75208 <.0001	-0.05613 0.1755	-0.01674 0.6782	0.03187 0.4293	-0.1192 0.0030	0.40648 <.0001	0.08086 0.0447	-0.0668 0.0961
<b>Lotdimb</b>	0.20129 <.0001	1.00000	0.67727 <.0001	-0.01864 0.6531	-0.05003 0.2146	0.02145 0.5948	0.00316 0.9376	0.69244 <.0001	0.02052 0.6109	-0.5462 <.0001
<b>Lotsqfeet</b>	0.75208 <.0001	0.67727 <.0001	1.00000	0.00213 0.9590	0.03946 0.3278	0.07506 0.0624	-0.0468 0.2451	0.83157 <.0001	0.00810 0.8409	-0.4124 <.0001
<b>Condition</b>	-0.0561 0.1755	-0.01864 0.6531	0.00213 0.9590	1.00000	0.52433 <.0001	0.20811 <.0001	0.16940 <.0001	0.00083 0.9841	-0.9240 <.0001	-0.0448 0.2801
<b>Bathrooms</b>	-0.0167 0.6782	-0.05003 0.2146	0.03946 0.3278	0.52433 <.0001	1.00000	0.49911 <.0001	0.36073 <.0001	0.03849 0.3399	-0.5197 <.0001	-0.0437 0.2786
<b>Totbldgft</b>	0.03187 0.4293	0.02145 0.5948	0.07506 0.0624	0.20811 <.0001	0.49911 <.0001	1.00000	0.53177 <.0001	0.06398 0.1123	-0.1366 0.0007	-0.0785 0.0513
<b>Bedrooms</b>	-0.1191 0.0030	0.00316 0.9376	-0.04686 0.2451	0.16940 <.0001	0.36073 <.0001	0.53177 <.0001	1.00000	-0.0071 0.8598	-0.0766 0.0571	-0.0576 0.1530
<b>Value</b>	0.40648 <.0001	0.69244 <.0001	0.83157 <.0001	0.00083 0.9841	0.03849 0.3399	0.06398 0.1123	-0.0071 0.8598	1.00000	-0.0068 0.8646	-0.5695 <.0001
<b>Age</b>	0.08086 0.0447	0.02052 0.6109	0.00810 0.8409	-0.92403 <.0001	-0.51974 <.0001	-0.1366 0.0007	-0.0766 0.0571	-0.0068 0.8646	1.00000	0.05863 0.1458
<b>Taxrate</b>	-0.0667 0.0961	-0.54615 <.0001	-0.41239 <.0001	-0.04477 0.2801	-0.04369 0.2786	-0.0784 0.0513	-0.0576 0.1530	-0.5695 <.0001	0.05863 0.1458	1.00000

## EMPIRICAL RESULTS

Descriptive statistics for the various measures of dependent and independent variables are calculated (see, Table-1A and Table-1B). Relatively larger differences in standard deviations (18114 and 189030) of property values with averages of 57,474 and 94,200 do indicate much fluctuations in the aggregate property values due to different zones. However, tax rate ranges from 6.82 to 7.69 for single-family zoned houses compared to multi-family zoned houses of 7.61 to 7.69 respectively. Similar differences also observed with other factors as well. This suggests that due to some unobservable factor(s) housing value may differ in different zone. Thus, the idea of this exploratory analysis is to observe the association between housing value and its related characteristics for two different zones.

**TABLE 3A: Regression results of Housing Value on Property Characteristics (Single-Family Zone).**

<b>Analysis of Variance</b>					
<b>Source</b>	<b>DF</b>	<b>Sum of Squares</b>	<b>Mean Square</b>	<b>F Value</b>	<b>Pr &gt; F</b>
<b>Model</b>	8	4.562487E11	57031088931	268.44	<.0001
<b>Error</b>	3659	7.773584E11	212451062		
<b>Corrected Total</b>	3667	1.233607E12			
<b>R-Square</b>	0.3698		<b>Adj R-Sq</b>	0.3685	
<b>Parameter Estimates</b>					
<b>Variables</b>	<b>DF</b>	<b>Parameter Estimates</b>	<b>Standard Error</b>	<b>t Value</b>	<b>Pr &gt;  t </b>
<b>Intercept</b>	1	-267854	39134	-6.84	<.0001
<b>LOTDIMA</b>	1	171.58830	8.94319	19.19	<.0001
<b>LOTDIMB</b>	1	37.88942	5.84738	6.48	<.0001
<b>BATHROOMS</b>	1	994.93068	399.75903	2.49	0.0129
<b>BEDROOMS</b>	1	-871.53211	456.68758	-1.91	0.0564
<b>TOTBLDGFT</b>	1	10.63388	0.56662	18.77	<.0001
<b>TAXRATE</b>	1	36813	4983.58417	7.39	<.0001
<b>AGE</b>	1	-157.57846	27.15388	-5.80	<.0001
<b>CONDITION</b>	1	12839	6196.73099	2.07	0.0383

Simple pair-wise correlation analysis (see Table-2A and Table-2B) among the variables, reveal that housing value is negatively impacted by the tax rate in both zone. The impact is much larger for the multi-family zone ( $r = -0.57$ ,  $p < 0.001$ ) compared to single-family zone ( $r = -0.03$ ,  $p < 0.10$ ). Age of the property and the property value are negatively correlated for both zone. However, the correlation is not statistically significant for the multi-family zoned properties. It is possible that understanding the importance of other unobserved factors and including them in the analysis may change the outcome. Similar results also observed between the relationships of housing value and condition of the property and thus supporting our above hypothesis of differences in housing value is due to differences in zone classification.

Results of multiple regression analysis are reported in Tables 3A and 3B. All these models appeared to fit well in estimating the housing value. Reported coefficients of determination ( $R^2$ ) are 0.37 and 0.62 respectively for single-family zone and multi-family zone, with highly significant F values. Results indicate that age of the property in general is less likely to impact the housing value in multi-family zone (not statistically significant) than single-family zone (see, Tables 3A and 3B). Analysis also reveals that, better condition of the property impacts single-family zone housing value positively as opposed to multi-family zone.

<b>TABLE 3B: Regression results of Housing Value on Property Characteristics (Multi-Family Zone).</b>					
<b>Analysis of Variance</b>					
<b>Analysis of Variance</b>					
<b>Source</b>	<b>DF</b>	<b>Sum of Squares</b>	<b>Mean Square</b>	<b>F Value</b>	<b>Pr &gt; F</b>
<b>Model</b>	8	1.364092E13	1.705115E12	115.96	<.0001
<b>Error</b>	575	8.454915E12	14704199326		
<b>Corrected Total</b>	583	2.209583E13			
<b>R-Square</b>	0.6174		<b>Adj R-Sq</b>	0.6120	
<b>Error! Bookmark not defined.Parameter Estimates</b>					
<b>Variables</b>	<b>DF</b>	<b>Parameter Estimates</b>	<b>Standard Error</b>	<b>t Value</b>	<b>Pr &gt;  t </b>
<b>Intercept</b>	1	120409954	13162365	9.15	<.0001
<b>LOTDIMA</b>	1	640.62390	59.41244	10.78	<.0001
<b>LOTDIMB</b>	1	1240.53349	81.05502	15.30	<.0001
<b>BATHROOMS</b>	1	16567	8375.62381	1.98	0.0484
<b>BEDROOMS</b>	1	-3041.04346	8886.21686	-0.34	0.7323
<b>TOTBLDGFT</b>	1	-1.18725	14.08491	-0.08	0.9329
<b>TAXRATE</b>	1	-15661486	1710779	-9.15	<.0001
<b>AGE</b>	1	-353.85837	526.70784	-0.67	0.5020
<b>CONDITION</b>	1	-111043	117054	-0.95	0.3432

Therefore, the property characteristics affect the housing value differently given that which zone they belong. Specifically, after controlling for lot dimensions, bedrooms, bathrooms, square footage, etc., tax rate has a very large impact on the value of the house negatively for multi-family zone. Another interesting finding is that lot dimensions impact housing value differently for different zoning. As for example, frontage/width lot dimension affects the housing value more for single-family house as opposed to the depth/side dimension. This result is opposite for multi-family zone. A number of possible explanations can be explored for this dimension dependent zone effect. However, considering that the maximum housing value is about 3 million for multi-family zoned housing compared to 2 hundred thousand for single-family zoned housing, direct comparison may be complicated. Nonetheless, this study suggests that housing value is zone dependent and more specifically the zone effect is significantly substantial with tax rate for the multi-family category.



## CONCLUSION

This study, examines the internal and external characteristics based zone effect on the housing value. In particular, statistical significance and magnitude of zone dependent housing factors on the “value of the house” is observed. As expected, after controlling for lot dimensions, bedrooms, bathrooms, square footage, etc., higher tax rate is found to be instrumental in affecting the housing value in multifamily zone. This suggests that tax rate influence on the housing value is zone dependent in this sub-population of neighborhoods. Thus, we may conclude that property characteristics affect the value of the housing differently depending on the zone they belong. Although the data indicate much variability in the property values due to different zones, zone effect is substantially higher for multi-family zone for most of the factors considered in this study. This differential effect of zone on the value of the housing is most significant when tax-rate is incorporated.

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