Estimating the Responsiveness of Residential Capital Investment |to Property Tax Differentials

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Lincoln Institute of Land Policy
Working Paper

Lincoln Institute Product Code: WP11JG1

Abstract

The New View of property tax incidence implies very specific impacts on the investment decision faced by developers and thus implications for tax policies enacted by local policy makers. Unfortunately, there is little to no conclusive evidence that the New View is valid and, if so, how significant the theatrical implications of the New View are in practice. This paper begins to fill this void by testing the main implication of the New View that higher (lower) than average property tax rates imply lower (higher) than average capital investment rates using data from three of the counties that make up the Saint Louis MSA. Using the total square footage of living space as a measure of capital investment, this paper shows that when using correct instruments for the property tax endogeneity, the tax elasticity of residential capital is about -0.20 and that this rate depends on the specific area by investigated.

About the Author

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Introduction

The growth of the urban space is a major concern among governments, academics and activists in the United States. The importance of this issue is increasing with the greater concerns of the environmental impacts of this expansion, rising transportation costs, and more focus by policy makers on how to best attract growth to a given area. A key policy question is how choices made by government decision makers impact and/or guide this growth. While previous studies focus on the role of regulatory policies such as zoning and other land use controls (Anas & Pines, 2008), one tool that has received relatively little investigation is the property tax. The property tax, which serves as the primary source of revenue for most local governments, is believed to be, at least partially, a tax on residential capital that both reduces the price of residential capital globally and changes its distribution across the economy (Mieszkowski & Zodrow, 1989).

The New View of property tax incidence argues that the relationship between property taxes and residential capital is negative with higher than average property taxes pushing residential capital out of a jurisdiction all else equal (Mieszkowski & Zodrow, 1989). Building on this assumption, the urban economics literature argues that higher property taxes create an incentive to both reduce residential capital investment per acre and reduce the population density of a city (Brueckner & Kim, 2003; Song & Zenou, 2006; Song & Zenou, 2009) resulting in a net decrease in urban sprawl. Unfortunately, there is little empirical evidence to support the core of these claims that residential capital decisions respond negatively to property tax differentials (Wassmer, 1993; Zax & Skidmore, 1994). Empirical validation of this theory and a better understanding of its magnitude are necessary for governments to understand the unintended or intended effects of property tax policy decisions and to understand the impact of these policy decisions on the spatial structure of the urban environment and the residential composition of their own community.

This paper aimss to fill this gap in the literature by employing house-level data from three counties located within the Saint Louis MSA to test the responsiveness of residential capital to property tax differentials. Specifically this paper finds that the tax elasticity of residential capital ranges from -0.20 to -0.40 depending on the instrument used to control for the endogeneity of the property tax rates. Well-suited instruments reduce this range to between -0.20 and -0.25. These elasticities correspond to a loss of about ninety square feet for a one standard deviation increase in the tax rate above the market mean.

Other contributions to the literature from this paper include the use of the percentage of the tax base exempted from taxation as an instrument for property tax differentials. Various specifications and sub-samples show that this instrument performs better than the intergovernmental revenue received by school districts; an instrument more generally used in the literature. The analysis also shows, however, that land use exemptions (such as churches or schools) are not a valid instrument and produce biased estimates. Finally, this analysis shows that use of the school revenue instrument biases the tax responsiveness estimates toward zero as does the use of aggregated home characteristics data.

The next section briefly reviews the literature on property tax incidence and reviews the only direct and several indirect tests of the theory. The third section outlines the model being tested, the econometric specification and controls and summarizes the data employed in this test. The fourth section summarizes the results from the estimation of the model and the fifth section closes with a summary and suggestions for further improvements.

Previous Research

Analytically, much work exists linking the property tax to the development of the urban space. Bruckner and Kim (2003) show in a mono-centric city model that that a higher property tax reduces the amount of capital per unit of land that a developer wishes to invest lowering the structural density of the urban space and increasing sprawl. This is referred to as the capital density (CD) effect. Simultaneously, a higher property tax reduces the size of residential structures (i.e. residential capital) that home buyers demand resulting in higher residential density (RD) and lowering the amount of sprawl. The model, however, cannot determine which of these two effects dominate without further assumptions on the functional forms of the model.

Extensions by Song and Zenou (2006 & 2009) seek the necessary conditions for conclusive analytical results and then empirically test those predictions. The first extension assumes a Constant Elasticity of Substitution (CES) utility function in a mono-centric city and shows that the RD effect dominates the CD effect when property taxes are increased resulting in a net decrease in urban sprawl. The authors empirically test this hypothesis by estimating the impact of the property tax on the spatial size of the urbanized area for more than four hundred urbanized areas in the United States and show that a one percent increase in the tax rate reduces the spatial size of the city by about .45 percent. Subsequent work (2009) utilizes a duo-centric city model and empirical tests the predicted negative relationship between the ratio of the two "cities" property taxes and the extent of their urban boundaries.

Work by Turnbull (1988) shows that property taxes affect the optimal timing decision for property development in certain cases. The model finds an inverse relationship between the optimal development time and the rate of the property tax on improvements. The driving force behind these analytical results is that residential capital investment decisions are impacted by the property tax as laid out by Mieszkowski and Zodrow's (1989) New View of property tax incidence. In this New View, a higher property tax in some districts decreases the return to capital owners, causing them to seek higher returns in areas with lower tax rates. As a result, the supply of residential capital moves across districts until the net return on capital investments across all districts is equal.

In contrast, the Benefit View argues that differentials in the property tax are fully capitalized into the price of homes leaving no reason for capital to relocate. If the Benefit View is correct then there is no response in capital investment to property tax differentials thereby negating or dampening the effects outlined in the Bruckner and Kim (2003) and Song and Zenou (2006, 2009). If, on the other hand, the New View holds then it is important to know the magnitude of the response of capital to the property tax differentials to have a clearer picture of the actual incidence of a change in the tax policy.

Despite the long-standing argument between supporters of the New View and the Benefit View, there is little hard evidence that the New View's capital effect exists, and if so, the magnitude of this effect. The empirical work by Song and Zenou (2006; 2009) provides some indirect support to the implications of the New View; however, Wassmer (1993) performs the only direct test. Wassmer utilizes a five-equation simultaneous model using aggregated MSA level data to test for both the change the value of the property tax base (predicted by both views) and the movement in capital (predicted by the New View). Using three rounds of survey data from the U.S. Census of Governments Wassmer finds evidence of the capitalization of property taxes into values but is unable to find economically significant evidence of property taxes affecting the amount of capital invested.[1]

There are two potential critiques of Wassmer's approach. First is the choice to estimate the model across MSAs rather than focusing within a given MSA. It seems more reasonable that developers focus on differentials within a given MSA than between MSAs given the information costs associated with moving capital across MSAs. The second critique is that Wassmer uses a simple count of the number of homes within a given MSA to measure the level of capital investment. An increase in the number of homes does not necessarily; however, imply higher capital investments if the capital employed to build the new home is not greater than the capital loss due to depreciation and foregone maintenance. This paper specifically addresses these two critiques in its analysis.

Model and Data

Model

The motivation adopted herein follows the theory of the New View proposed by Mieszkowski and Zodrow's (1989) and graphically explained in Wassmer (pg. 138, 1993). Assume that a given market is comprised of a number of sub-markets, each with a different demand for public goods but identical otherwise. Assume that residential capital can be freely invested in any of these sub-markets and the rate of return is equal in equilibrium. If each district has a zero property tax rate, then the supply of residential capital is equal across districts, all else equal. If the districts then impose different

[1] Wassmer finds a short-run tax elasticity of about -0.01 and a long run tax elasticity of -0.02.

property tax rates on the residential capital base, the net rate of return is different across the sub-districts in the economy forcing developers to reallocate their investments from areas with higher than average rates to districts with lower than average rates so as to maximize after-tax returns. This shifts the supply of capital resulting in a change in the pre-tax, or gross, return to capital and the adjustments continue until the after-tax returns are once more equal across all sub-markets (at a rate equal to that of the sub-market with the average tax rate).

The testable implication of this theory is that those districts with negative tax differentials, or rates lower than average, should see higher than average capital investment while those with positive differentials should see lower than average investments of capital, all else equal. The ideal empirical test of this hypothesis is to estimate how the levels of residential capital react to property tax differentials while controlling for all other factors. Implementing this test, however, faces two major complications. The first is the measure of residential capital and the second is the endogeneity of the property tax differential.

The challenge of measuring residential capital investment is due to residential capital, unlike financial capital, being significantly less liquid making the removal of capital from a given district or market either impossible or, at best, unobservable. Previous work has attempted to measure capital as a simple count of either the number of homes or the number of new building permits (Wassmer, 1993; Lutz, 2008). Using these measurements the argument is not so much that capital "leaves" a higher than average tax district, but rather experiences lower than average rate of new capital investment resulting in a lower net supply of capital.

The primary pitfall with employing count measures is that they may falsely assign an increase in an area simply due to an observed increase in the raw number of homes or permits despite the newer homes being smaller than average. This mismeasurement results in a downward bias in the estimated impact of property tax differentials on residential capital. To avoid this bias this paper measures residential capital using the total square footage of living space in each home and argues that this is a superior to a simple count of the number of new homes or permits.[2] The New View implies, with this measure, that districts with higher (lower) than average property taxes should see lower (higher) than average home square footages.

Just as important as the choice of capital measurement is the definition of the relevant market used to define the market average. Previous studies have used either a set of MSAs (Wassmer, 1993; Lutz, 2008; Song & Zenou, 2006) or a manufactured Central City/Suburban market division (Song & Zenou, 2009). These definitions raise the question of what the investors and developers define as the market. It seems most reasonable that a given developer defines their market as, at most, the MSA or the specific county within which they operate. Movements outside of these areas are likely to

[2] One possible problem with this measure is the panel data is not readily available to measure how the amount of capital changes with respect to property differentials and there are questions as to the relevant lag time between an observed differential in the tax rate and the response of capital (Groves, 2009).

impose additional information costs to the developers reducing their net returns. Therefore this project defines the market as the MSA from which the county data is obtained.[3]

The second challenge faced when estimating this model is the possible endogeneity of the property tax. While the New View predicts that lower than average property taxes lead to higher than average levels of capital investment, higher than average capital investments require a lower than average property tax to generate the same level of revenue. Previous work has either exploited an exogenous policy change (Anderson, 2006) or used a measure of state funding to public schools (Song & Zenou, 2009) as instruments.[4]

Unfortunately exogenous policy changes are hard to find on a large scale and while inter-governmental transfers to schools may be an instrument for the school district property tax rate, it has little to no relationship to the property tax rate extended by other government or taxing districts. The instrument needed in a variable that relates to the extended property tax rate but not to the investment decision made by local developers. This paper proposes the use of the property value exemptions made available by governments for various reasons including use, owner-occupied, age, or veteran status as an instrument for the property tax rate.

The rationale for this choice is as follows: when a district extends a property tax on a home it calculates the rate by dividing the levy for the district by the total taxable property value with the district boundaries. This total taxable property value is the raw assessed property value (the simple sum of all assessed values) minus any value exemptions granted by the government to properties within that district. The correlation between the exemptions and the actual extensions is then a case of basic math. The purpose and timing for the exemptions is what ensures they uncorrelated with the level of capital investment. The two most common exemptions are for the use of the property (which, as discussed later, may be not be an ideal instrument) and owner-occupied or homestead exemptions. These latter exemptions are only for owner-occupied, single family housing and provide tax relief rather than investment incentives and are not available to renter, landlords or developers. Two other common exemptions are available to those over a given age threshold or veterans of the armed services and, like the homestead exemption, offer property tax relief rather than investment incentives. Therefore is seems reasonable to assume that exemptions, at least of the latter types, are uncorrelated with investments while very correlated with the annual tax rate extended to properties.

This instrument is used to estimate the model expressed in equation (1) below where *dif_lnsfla* denotes the difference of the natural log of home *i*'s living square footage from the market average of the same measure. The variable *dif_tax* denotes the differential of

[3] While the market area definition is important to help define the relevant study area, if the differentials are defined at the MSA or county level the addition of a constant term or county level fixed effects is sufficient to ensure the estimates on the variable of interest are stable across market definitions.
[4] Even in Wassmer's five-equation model, the intergovernmental revenues to education are one of the key identifiers for the property tax equation.

the tax rate faced by home *i* from the market average and is the primary variable of interest.

$$dif_{lnsfla_i} = \alpha + \beta * dif_{tax_i} + \delta C_i + \gamma * S_i + \sigma * EXP_i \quad (1)$$

The row vector **C** represents home level characteristics that are believed to also determine the total size of the home such as number of bedrooms, number of rooms, number of stories and age. Each of the home level measures is differenced from the market average. The row vector **S** denotes a set of population and socioeconomic controls that might impact the size of homes in a given area. These variables include percentage of the population that is eighteen years of age or younger, the percentage of the population that is aged sixty-five years or older, the percentage of the population that is white, the percentage of the population that is black and the median household income. Due to issues of data censorship, these variables are measured at the census tract block group level and are differenced from their mean calculated using all block groups included in the market. Finally, the row vector **EXP** measure the differential between the spending for the government or taxing districts extending a tax on home *i* from the mean of the spending of all government or taxing districts within the market.

The model expressed in equation (1) is estimated using the GMM instrumental variable method. The GMM process is preferred over the more general two-stage least squared method if one believes that heteroskedasticity is present in the data in which case the former is more efficient (Baum, Schaffer, & Stillman, 2003). This is believed appropriate in this case given that some of the data is applied to individual homes despite it being aggregated at a slightly higher level (such as tract block group).[5]

As discussed previously, the model employs an instrumental variable to avoid bias caused by the endogeneity of the tax differential variable. There are three potential variables used as instruments in this study. The first, described above, is the percentage of the assessed value of the area within which home *i* is located that is exempted from property taxes and is denoted as *dif_exemp*. The second is more in-line with previous studies and is the differential of the intergovernmental revenue received by the school district within which home *i* is located (denoted as *dif_sch_igr*). The third potential instrument is meant to address one of the shortfalls addressed with using the school revenue measure and is the differential of the intergovernmental revenue received by the municipal (and township when appropriate) to which home *i* belongs (denoted as *dif_muni_igr*). The model is estimated using various combinations of these instruments and diagnostic statistics are calculated to determine the validity of the instruments used.

Data

The study area for this paper includes three of the five counties and one major city that compose the Saint Louis MSA. Specifically the counties are: Saint Clair and Madison

[5] Diagnostic statistics verify the presence of heteroskedasticity in the data used to estimate the model.

counties from Illinois and Saint Louis County from Missouri.[6] The three primary sources for the data include the County Assessor Database used for the Computer Assisted Mass Appraisals (CAMA), the 2000 U.S. Census of the Population and the 2007 U.S. Census of Governments.

The location for each home within the Illinois county provided by the Assessor's office is determined by geocoding the data and dropping any unmatched observations.[7] The locations for the homes from the Saint Louis County data are determined using GIS parcel map provided by the county planning office. Point locators are generated for each parcel (defined as the center of each parcel polygon) to ensure that errors in map generation do not cause a single parcel to be assigned to more than one district or municipality. Intersecting boundary maps for school districts, municipalities and, for the two Illinois counties, township with the location data determines which tax districts extend rates to which homes.[8] The map data is then joined with the house-level data included in the assessment database using the unique parcel identifier created by the county dropping any observations missing relevant house-level data or any parcels containing a property not designated as a single-family residency.

The house-level data included in each county assessor database includes the location, total living area, type of home, number of stories and the total number of plumbing fixtures in the home. The Missouri data also includes the number of rooms and bedrooms in the home; however, assessors in the Illinois counties do not collect this data. To resolve this problem, the GIS map locating each observation is overlaid with the census block group map and each home in a given block group is assigned the average number of rooms and average number of bedrooms as measured by the 2000 Census.[9]

The tax extension data is obtained from the County Clerk office for each of the counties included in the study and is expressed in mills. Each county in the study area assesses residential property at thirty-three and one third percent of market value allowing the use of the raw mill rates rather than effective property tax rates. The rate assigned to each home is the sum of the rate extended by township (when applicable), municipality and school district to which the home is assigned. These rates are defined as the zone tax rate where each unique combination of the township, municipality and school district define a

[6] The original grant proposal included Saint Charles County and Saint Louis City. The data from Saint Louis City was not complete enough to provide enough observations to include them in the analysis and the data from Saint Charles County did not include any information on exemptions and provided poor estimates of the model. Additionally, diagnostic tests showed that neither of the intergovernmental revenue instruments sufficiently identified the model when using the Saint Charles data. The results from Saint Charles County, however, are available from the author upon request.

[7] Geocoding was necessary due to the inability to obtain the parcel GIS files from the Illinois counties. The most common reason for a failure to match in the geocoding process was missing house numbers or streets that were too recent to be included in the Tiger line files.

[8] The boundary maps are provided by the U.S. Census Bureau's Tiger Line Files.

[9] It was suggested by several discussants to impute the number of bedrooms for the Illinois county data using the Missouri county data. At this point, however, there are not sufficient variables to identify the imputation equation shared across both datasets. This is, however, an area of future work.

unique tax zone.[10] The market mean used to calculate the differential is defined as the mean of all the unique tax zones represented in the dataset.

The differentials are calculated by subtracting each observed value from the calculated market mean of that variable. In all cases the market mean is calculated by joining all of the individual county datasets together and calculating the mean.[11] In the case of house-level data, each unique home is used to calculate the market mean. For the socioeconomic and population controls, each home is matched with the census block group based on its location and the homes are each assigned the value that corresponds with the assigned block group. The socioeconomic and population controls used for this analysis include: percentage of the population that is white (*perwhite*), percentage of the population that is black (*perblack*), percentage of the population that is eighteen years of age or younger (*per18*), percentage of the population that is sixty-five years of age or older (*per65*), and the median household income (*income*). The market mean for these variables is defined as the mean of the entire set of census block groups included in the data.

To measure the level of public goods provided by each district, the total expenditures for each district (township, municipality and school district) are calculated using the 2007 Census of Governments data provided by the U.S. Census Bureau. In all cases expenditures are defined as outlined by the U.S. Census Bureau. The total expenditures for the township and municipality are summed to form the municipal expenditure measure (*muni_exp*) and the per-student expenditure is used for the school district expenditure measure (*sch_exp*).[12]

Tables 1 and 2 show the summary statistics for each county and the full sample for the raw data variables (i.e., not differenced) and the differentials when using the full-sample market mean respectively. Table 1 shows that Saint Louis has the smallest tax rate in 2009 while Saint Clair County has the largest with the average tax rate around 5.4219 mills. Homes in Saint Clair County are slightly smaller, on average, compared to the two remaining counties and the number of bedrooms and total rooms using the census data is largest in Madison followed by Saint Clair. Saint Louis and Saint Clair counties have the oldest homes in the sample, which is not surprising given that these two counties contains some of the first developments in the area.

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[10] Currently only the tax extended in 2009 is included in the analysis, however, data from previous years will be added in subsequent extensions.

[11] Originally the market average and differentials were calculated a second way using only the specific county observations to determine the market average and differentials for the observations within that given county. The results, however from these models are identical to those using the full sample average save the constant term or any county specific identifiers. Additionally the calculated elasticity for the tax differential was the same across methods.

[12] The per-student calculation uses the reported enrollment in the 2007 survey.

Table 1								
Summary Statistics - Base Data								
	Saint Louis County		Saint Clair County		Madison County		Full Sample	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Tax Rate	4.8279	1.0484	7.4548	2.2757	5.4400	1.1233	5.4852	1.7210
LN Square Footage	7.3032	0.4731	6.9982	0.3262	7.2916	0.4466	7.2402	0.4578
Stories	1.2232	0.4057	1.2137	0.3624	1.1963	0.3528	1.2153	0.3862
Bedrooms (Census)	2.8504	0.5553	2.6414	0.3346	2.6769	0.3265	2.7701	0.4829
Total Rooms (Census)	6.0543	1.0767	5.5454	0.6201	5.6447	0.6042	5.8618	0.9379
Fixtures	8.2863	3.9087	6.5050	2.1967	7.2487	2.7543	7.7011	3.4658
Age	53.4423	22.0430	54.8245	32.3820	48.2146	28.7331	52.5450	26.0596
Percent Below 18	0.2680	0.0613	0.2916	0.0697	0.2618	0.0492	0.2713	0.0615
Percent Above 65	0.1451	0.0742	0.1329	0.0647	0.1435	0.0599	0.1423	0.0696
Percent White	0.7274	0.2997	0.6520	0.3454	0.9186	0.1260	0.7553	0.2960
Percent Black	0.2322	0.3070	0.3152	0.3555	0.0565	0.1215	0.2092	0.3010
Median Income	5.9389	3.2784	4.0300	1.5718	4.5586	1.3135	5.2518	2.7863
Muni. Exp.	1.7582	1.4263	2.9378	1.8607	3.6719	3.2898	2.4205	2.2233
Sch. Exp.	0.0011	0.0002	0.0015	0.0004	0.0010	0.0002	0.0012	0.0003
Madison	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.2240	0.4169
St. Louis	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5780	0.4939
St. Clair	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.1980	0.3985
Exemptions	0.0037	0.0183	0.1876	0.0828	0.1543	0.0614	0.0738	0.0962
School IR	38877.1	23950.7	44845.7	34093.0	24225.8	10430.6	36777.3	25235.2
Muni. IR	7411.4	7876.0	10147.5	7265.6	16521.6	18697.7	9993.9	11748.1
Bedrooms (act)	2.9906	0.8261	-	-	-	-	-	-
Total Rooms (act)	6.5762	1.6270	-	-	-	-	-	-

The demographic variables show that Saint Louis and Saint Clair are very similar with the exception of median income where Saint Louis reports a median income about $10,000 higher than Saint Clair County. The age distribution in Madison County is also similar; however, the racial makeup is significantly skewed toward whites over blacks.

The public good distribution is also very interesting with the school funding being about equal across all three counties and the municipal spending being very high in Saint Louis County followed by Madison and then Saint Clair. These summary statistics give a very realistic picture of the Saint Louis MSA and the relative positions of the counties with respect to each other. The table also shows that more than one-half of the total sample observations are from Saint Louis County with Saint Clair and Madison splitting the remaining forty percent.

The first three rows below the thin line (and county identifiers) are the three instruments used in the model with Saint Louis County showing a very small percentage exempted differential while Saint Clair and Madison showing between fifteen to eighteen percent of the total residential value exempted. The intergovernmental revenue is highest in Saint Clair County for the school district followed by Saint Louis County and then Madison County with the latter taking in the largest intergovernmental revenue at the municipal level and Saint Louis County taking in the least. The last two rows show the actual measure of the number of bedrooms and total rooms reported only in the Saint Louis County data.

Table 2								
Summary Statistics - Full Sample Differentials								
	Saint Louis County		Saint Clair County		Madison County		Full Sample	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Tax Rate	-0.8539	1.0484	1.7729	2.2757	-0.2418	1.1233	-0.1967	1.7210
LN Square Footage	0.0578	0.4731	-0.2472	0.3262	0.0462	0.4466	-5.21E-03	0.4578
Stories	-0.0261	0.4057	-0.0356	0.3624	-0.0529	0.3528	-3.40E-02	0.3862
Bedrooms (Census)	0.1556	0.5553	-0.0534	0.3346	-0.0179	0.3265	0.0753	0.4829
Total Rooms (Census)	0.3476	1.0767	-0.1612	0.6201	-0.0620	0.6042	0.1551	0.9379
Fixtures	1.6487	3.9087	-0.1327	2.1967	0.6111	2.7543	1.06E+00	3.4658
Age	6.7226	22.0430	8.1048	32.3820	1.4949	28.7331	5.83E+00	26.0596
Percent Below 18	-0.0049	0.0613	0.0186	0.0697	-0.0112	0.0492	-0.0017	0.0615
Percent Above 65	0.0048	0.0742	-0.0073	0.0647	0.0032	0.0599	0.0021	0.0696
Percent White	-0.0071	0.2997	-0.0825	0.3454	0.1841	0.1260	0.0208	0.2960
Percent Black	0.0020	0.3070	0.0850	0.3555	-0.1736	0.1215	-0.0209	0.3010
Median Income	1.1353	3.2784	-0.7736	1.5718	-0.2450	1.3135	0.4481	2.7863
Muni. Exp.	-1.0476	1.4263	0.1319	1.8607	0.8661	3.2898	-0.3854	2.2233
Sch. Exp.	-0.0056	0.0234	0.0355	0.0384	-0.0187	0.0239	-4.01E-04	0.0329
Exemptions	-0.1156	0.0183	0.0683	0.0828	0.0351	0.0614	-0.0454	0.0962
School IR	6168.19	23950.72	12136.77	34092.98	-8483.17	10430.59	4068.30	25235.20
Muni. IR	-4262.81	7875.97	-1526.73	7265.63	4847.38	18697.65	-1680.37	11748.09
Bedrooms (act)	-0.0773	0.8261	-		-		-	
Total Rooms (act)	0.0388	1.6270	-		-		-	

Table 2 shows the differentials for the variables used in the analysis when the market average is calculated using the full data sample. Upfront the initial argument being made in this paper is observed as Saint Clair County has the only positive tax differential while also having the only negative square footage differential. Additionally, Saint Louis County has the largest negative tax differential and the largest positive square footage differential. This relationship, however, may be due to the endogenous nature of the property tax. The remaining variables show differentials corresponding with the relative comparisons discussed above.

Results

Full Sample Estimation

Table 3 reports the results when equation (1) is estimated using the full sample and differentials calculated at the MSA level. The first column corresponds to the estimation using three instruments (differential of percentage of exemptions (*dif_exemp*), municipal intergovernmental revenue differential (*dif_muni_igr*) and school district intergovernmental revenue differential (*dif_sch_igr*)) for the tax differential; the second column uses only the exemption and school district intergovernmental revenue (IR) differential and the third column replaces the school district IR with the municipality IR differential. The fourth column uses only the exemption differential and the fifth uses only the school district IR differential. In all cases the results are shown with robust standard errors clustered at the zone level and the model is estimated using GMM.

Across all five columns reported in Table 3 most of the control variables have the expected signs. Positive differentials in the number of stories, rooms, and fixtures predict higher square footage differentials while areas with a higher than average number of

Table 3 Full Sample - MSA Differentials					
	(1)	(2)	(3)	(4)	(5)
Estimated Elasticity	*-0.1081*	*-0.0933*	*-0.0878*	*-0.0587*	*-0.1739*
2009 Property Tax	-0.0197**	-0.0170*	-0.0160*	-0.0107	-0.0317*
	[0.0083]	[0.0097]	[0.0089]	[0.0106]	[0.0184]
Stories	0.1781***	0.1688***	0.1787***	0.1627***	0.1635***
	[0.0327]	[0.0375]	[0.0327]	[0.0377]	[0.0380]
Bedrooms	-0.1869***	-0.1902***	-0.1823***	-0.1900***	-0.1632***
	[0.0408]	[0.0424]	[0.0418]	[0.0435]	[0.0526]
Total Rooms	0.1722***	0.1735***	0.1711***	0.1742***	0.1571***
	[0.0217]	[0.0222]	[0.0221]	[0.0228]	[0.0289]
Total Fixtures	0.0679***	0.0679***	0.0679***	0.0679***	0.0680***
	[0.0030]	[0.0029]	[0.0029]	[0.0029]	[0.0030]
Age	-0.0007*	-0.0007*	-0.0006*	-0.0007*	-0.0005
	[0.0004]	[0.0004]	[0.0004]	[0.0004]	[0.0004]
Percent 18 or Younger	-0.2227**	-0.2213**	-0.2097**	-0.2042*	-0.1622
	[0.1061]	[0.1056]	[0.1059]	[0.1054]	[0.1265]
Percent 65 or Older	0.1409*	0.1435*	0.1436*	0.1481**	0.1636*
	[0.0760]	[0.0754]	[0.0748]	[0.0743]	[0.0838]
Percent White	-0.2520**	-0.2473**	-0.2725**	-0.2704**	-0.2270*
	[0.1236]	[0.1234]	[0.1247]	[0.1247]	[0.1304]
Percent Black	-0.21	-0.2106	-0.2450*	-0.2548*	-0.1668
	[0.1298]	[0.1293]	[0.1334]	[0.1335]	[0.1425]
Median Income/10000	0.0119***	0.0124***	0.0114***	0.0124***	0.0119***
	[0.0043]	[0.0045]	[0.0043]	[0.0045]	[0.0046]
Municipal Expend/10000	0.0062**	0.0064**	0.0058**	0.0061**	0.0057*
	[0.0025]	[0.0026]	[0.0025]	[0.0025]	[0.0029]
School Expend/10000	-0.1386	-0.1313	-0.2381	-0.239	-0.2854
	[0.2593]	[0.2585]	[0.2706]	[0.2672]	[0.3255]
Madison	0.1784***	0.1844***	0.1733***	0.1837***	0.1537***
	[0.0287]	[0.0312]	[0.0284]	[0.0307]	[0.0484]
Saint Louis	0.0546*	0.0642*	0.0535**	0.0706**	0.0221
	[0.0279]	[0.0336]	[0.0270]	[0.0333]	[0.0592]
Constant	-0.1589***	-0.1661***	-0.1559***	-0.1685***	-0.1373***
	[0.0249]	[0.0285]	[0.0240]	[0.0278]	[0.0452]
Observations	*281874*	*281874*	*281874*	*281874*	*281874*
Partial R^2	0.3816	0.3416	0.3258	0.2900	0.1313
Cragg-Donald F-Statistic	32.82	43.76	31.95	59.36	10.39
Hansen J-Test	1.6600	1.4600	0.7200	-	-
Hansen P-value	0.4400	0.2300	0.4000	-	-

Standard errors in brackets are robust and clustered at the zone level; * significant at 10%; ** significant at 5%; *** significant at 1%; estimated elasticities measured at sample means; Column one instruments - dif_exemp, dif_sch_igr, dif_muni_igr; column two instruments - dif_exemp, dif_sch_igr; column three instruments - dif_exemp, dif_muni_igr; column four instrument - dif_exemp; column five instrument - dif_sch_igr; all diagnostic stats provided by ivreg2 package in STATA 11

older residents, incomes and expenditures at the municipal level also see greater than average square footages. One unexpected result is the negative sign on the number of bedrooms; this could be either a consequence of using the census data or a sign of a trade-off between bedrooms and square-footage. This latter explanation seems supported by the negative sign also found on the percentage of the population that is under the age of eighteen and the negative coefficient on the school expenditure variables (both measures likely correlated with number of bedrooms). Another unexpected result is the significant negative sign on the race measures and there is no good explanation for these results. Neither the significance nor size of the tax differential variable is significantly altered, however, if these to variables are removed from the model.

The tax differential estimate is significant at either the five or ten percent levels in four of the five columns in Table 3. The only time the coefficient is insignificant is in the fourth column however the point estimate is only slightly lower than those found in columns one through three. The only outlying point estimate is found in column five which, while significant at the ten percent level, is almost three times in the size of the estimate in the previous columns. Recall the key difference between the columns is the instruments used to control for the endogeneity of the tax differential variable.

In the cases when more than one instrument is employed the diagnostic tests show that the over identification assumptions cannot be rejected meaning the instruments cannot necessarily be used as control variables themselves. To guard against weak instruments, the partial R-squared and F-statistic from the Cragg-Donald F-statistic test are reported (Baum, Schaffer, & Stillman, 2003). The general rule of thumb is for the Cragg-Donald F-statistic to be at least 10.0 before an instrument can be considered reasonable for a given endogenous variable. The results from the first three columns report rather good R-squared statistics ranging between 0.32 and 0.38 and the F-statistics are well in the thirties or forties. This yields strong support for the validity of these instruments and the estimated coefficients on the endogenous variable.[13] The fourth column, where the coefficient is not significant, the diagnostics show a rather good fit for the instrument with a slightly lower R-squared but significantly higher F-statistic. Finally, in the fifth column where the point estimate is extremely high, the diagnostics show that the instrument used (*dif_sch_igr*) may not be a very good instrument and may thus be adding bias to the point estimate of the tax coefficient. Specifically the partial R-squared is rather low (at only about.13) and the F-statistic is just at the 10.0 benchmark calling into question the validity of the school intergovernmental revenue measure as an instrument for the tax differential.

To measure the economic significance of the tax differential coefficients the predicted elasticity of the square footage in response to a change in the tax rate is calculated.[14] In

[13] The tax differential is tested for endogeneity and in all cases, the null hypothesis that the variable can be treated as an exogenous variable is rejected. These results are available from the author upon request.

[14] The elasticities are calculated using the following method: Step one is to predict the square footage differential given the coefficients and the averages reported in Table 2. Based on the average square footage from Table 1 the predicted "observed" square footage is calculated. Step two is to predict the model once more using the same values for all the variables except for the tax differential which is increased by one percent (the mean reported in Table 2 is multiplied by 1.01) and the observed square footage is calculated again as is the percentage change in the square footage. Step three calculates the elasticity of the tax differential using this calculated percent change divided by the percentage change in the average tax implied by the one percent increase in the tax differential. The elasticity are to be read as representing the percentage change in the square footage of a home given a one percent increase in the tax above the average tax rate.

columns one through three are -0.108, -0.093 and -0.0878 respectively. In the fourth columns, despite the statistical insignificance of the result, the estimated elasticity is only slightly smaller than the previous results at about -0.0587. The elasticity from the weaker fifth column estimate jumps significantly to -0.1739. The elasticities from the first three columns imply a one standard deviation (as reported in Table 1) of the tax rate above the mean results in a loss of about 43.5 square feet or an area of about 6.5 feet square. If the tax rate were to increase from the mean to the maximum rate, all else equal, the loss in square footage would be almost 500 square feet or about one quarter the average home size.

These results show a significantly larger impact from property tax differentials than that found in the Wassmer paper where the estimated point elasticity was -0.01 (1993). While Wassmer offered no interpretation as to the economic significance of his estimated elasticity, the data from this analysis implies an elasticity of -0.01 would result in a loss of about four square feet; barely enough space for a refrigerator. While these results do prove to be more substantial than those found by Wassmer, they also still rather inelastic implying that capital movement, while measurable, is not going to be enough to remove the differences in the rates of return in a short period of time without some other intervening factors.

County Specific Results

Saint Clair County

There are two potential concerns with the results presented in Table 3. First is the loss of significance when the instruments are altered, especially in the case of column four, and second is that the different counties may react differently to changes in the property tax given their very different make-ups as outlined in Tables 1 and 2. To address this, the estimations reported in Table 3 are estimated again for each county individually.

The first county focused on in the data is Saint Clair County located in Illinois. This county is located to the southeast of the Center of the Saint Louis MSA and includes the City of East Saint Louis. Table 1 shows that Saint Clair County has the largest average tax rate in the sample with the smallest homes compared to the other counties in the sample. Additionally the data shows a slightly higher percentage of blacks living in Saint Clair County compared to the other counties and an average median household income of about $40,000. The results from Saint Clair County are shown in the Table 4.

Table 4					
Saint Clair County - MSA Differentials					
	(1)	(2)	(3)	(4)	(5)
Estimated Elasticity	*-0.2474*	*-0.2467*	*-0.2616*	*-0.2586*	*-0.1714*
2009 Property Tax	-0.0332***	-0.0331***	-0.0351***	-0.0347***	-0.023
	[0.0079]	[0.0076]	[0.0084]	[0.0081]	[0.0155]
Stories	-0.3502***	-0.3380***	-0.3536***	-0.3418***	-0.3397***
	[0.0433]	[0.0449]	[0.0436]	[0.0453]	[0.0450]
Bedrooms	-0.1027***	-0.0945**	-0.0943**	-0.0871**	-0.1130***
	[0.0381]	[0.0380]	[0.0402]	[0.0399]	[0.0409]
Total Rooms	0.1524***	0.1457***	0.1548***	0.1481***	0.1545***
	[0.0209]	[0.0216]	[0.0213]	[0.0220]	[0.0231]
Total Fixtures	0.0594***	0.0590***	0.0596***	0.0592***	0.0600***
	[0.0018]	[0.0018]	[0.0018]	[0.0018]	[0.0024]
Age	-0.0017***	-0.0017***	-0.0017***	-0.0017***	-0.0017***
	[0.0002]	[0.0002]	[0.0002]	[0.0002]	[0.0002]
Percent 18 or Younger	0.1114	0.1138*	0.1142	0.1154*	0.1090*
	[0.0700]	[0.0689]	[0.0706]	[0.0694]	[0.0653]
Percent 65 or Older	0.1529**	0.1766**	0.1595**	0.1808**	0.1810**
	[0.0713]	[0.0747]	[0.0720]	[0.0750]	[0.0756]
Percent White	-0.043	-0.0242	-0.0279	-0.0098	0.0417
	[0.1157]	[0.1128]	[0.1191]	[0.1164]	[0.1364]
Percent Black	-0.0033	0.0122	0.0173	0.0316	0.0505
	[0.1014]	[0.0993]	[0.1063]	[0.1046]	[0.1054]
Median Income/10000	-0.0219**	-0.0207**	-0.0249**	-0.0235**	-0.0186**
	[0.0090]	[0.0088]	[0.0099]	[0.0098]	[0.0082]
Municipal Expend/10000	0.0066*	0.0070*	0.0058	0.0062	0.0037
	[0.0040]	[0.0040]	[0.0042]	[0.0042]	[0.0061]
School Expend/10000	-0.309	-0.3186	-0.2917	-0.2974	-0.0724
	[0.2741]	[0.2630]	[0.2798]	[0.2688]	[0.4208]
Constant	-0.1718***	-0.1706***	-0.1701***	-0.1694***	-0.1914***
	[0.0181]	[0.0175]	[0.0185]	[0.0178]	[0.0333]
Observations	*55818*	*55818*	*55818*	*55818*	*55818*
Partial R2	0.3491	0.3261	0.3390	0.3200	0.0642
Cragg-Donald F-Statistic	18.92	31.67	21.55	45.88	7.67
Hansen J-Test	1.4700	0.4400	0.9400		
Hansen P-value	0.48	0.51	0.33		

Standard errors in brackets are robust and clustered at the zone level; * significant at 10%; ** significant at 5%; *** significant at 1%; estimated elasticities measured at sample means; Column one instruments - dif_exemp, dif_sch_igr, dif_muni_igr; column two instruments - dif_exemp, dif_sch_igr; column three instruments - dif_exemp, dif_muni_igr; column four instrument - dif_exemp; column five instrument - dif_sch_igr; all diagnostic stats provided by ivreg2 packag in STATA 11

One of the first differences compared to the full sample results is the number of coefficient estimates that are not statistically significant. The impact from both race variables is insignificant as is, surprisingly, the impact from school spending. Similar to the results in Table 3 more bedrooms imply lower square footages while more rooms increases the square footage across all variations of the model and newer than average homes tend to also be larger. The one surprising result in Table 4 is that a positive stories and median income differential both reduce the square footage of the home. One possible explanation for the impact of the number of stories is the prevalence of split-level and one and one-half story homes in Saint Clair County. Split level and one and one-half story homes are registered as a 1.5 story home; however, they tend to be smaller than single story homes.[15] There is no clear indication as to why the income coefficient is negative in these results.

The coefficient on the tax differential is estimated as negative and significant in the first four columns in Table 4 and, while negative, is not significant in the fifth column. The estimates are rather stable across the first four columns at between -0.0339 and -0.0367 and in the fifth column the estimate drop to -0.0230. Again, however, the instrument variable diagnostics lends suspicion on the validity of the instrument in the fifth column with a partial R-square at 0.06 and an F-statistics less than ten.

The diagnostics on the first four columns, as with those in Table 3, show that when a set of instruments are used the over identification assumptions remain valid and, across the columns, the partial R-squared of the instruments and the Cragg-Donald F-statistics are all good. As was the case in column four in Table 3, the use of only the exemption differential instrument, while producing a lower R-squared, has the largest Cragg-Donald F-statistic showing the strength of that measure as an instrument for the tax differential.

Of the four results that are significant, the estimated tax elasticities are all around -0.25 which is larger than those found in Table 3 implying that there may be some differences between counties. Based on the estimated elasticities and the mean values in Saint Clair County, a one standard deviation increase in the property tax rate above the county mean results in a loss of about eighty square feet or an area about nine feet by nine feet (about the size of a small bedroom). A move from the mean to the largest tax rate in the county would result in a loss of about 550 square feet or about one-half the size of the average single story home.

Madison County

The second county focused on is Madison County. This is the second Illinois County in the dataset and is located to the northeast of Saint Louis City across the Mississippi river. Table 1 shows that Madison County has the second highest tax rate in the sample while significantly lower than the rate in Saint Clair County. The area has only slightly larger homes than those in Saint Clair County and is mostly agricultural. The county is almost completely white with an average median household income of about $45,000.

[15] The average square footage of single story homes in St. Clair County is about 1130 square feet while 1.5 story homes have an average square footage of 956 square footage and two story homes have an average square footage of 1175.

Table 5					
Madison County - MSA Differentials					
	(1)	(2)	(3)	(4)	(5)
Estimated Elasticity	*-0.2628*	*-0.2464*	*-0.3449*	*-0.4064*	*0.1665*
2009 Property Tax	-0.0483***	-0.0453***	-0.0634***	-0.0747***	0.0306
	[0.0121]	[0.0135]	[0.0150]	[0.0212]	[0.0350]
Stories	0.3422***	0.3412***	0.3457***	0.3497***	0.3514***
	[0.0262]	[0.0263]	[0.0262]	[0.0265]	[0.0263]
Bedrooms	-0.1980***	-0.1908***	-0.1756**	-0.2072***	-0.0646
	[0.0688]	[0.0733]	[0.0690]	[0.0784]	[0.1105]
Total Rooms	0.1364***	0.1334***	0.1217***	0.1357***	0.0890*
	[0.0353]	[0.0371]	[0.0355]	[0.0389]	[0.0496]
Total Fixtures	0.0773***	0.0774***	0.0784***	0.0785***	0.0799***
	[0.0021]	[0.0022]	[0.0022]	[0.0023]	[0.0021]
Age	-0.0017***	-0.0017***	-0.0015***	-0.0015***	-0.0015***
	[0.0002]	[0.0002]	[0.0002]	[0.0002]	[0.0002]
Percent 18 or Younger	-0.0476	-0.0739	0.0465	0.177	-0.4469*
	[0.1855]	[0.1970]	[0.2007]	[0.2580]	[0.2483]
Percent 65 or Older	0.1315	0.1018	0.1103	0.2029	-0.1114
	[0.1568]	[0.1731]	[0.1750]	[0.2149]	[0.1983]
Percent White	0.0983	0.104	0.1026	0.1168	0.171
	[0.2256]	[0.2255]	[0.2306]	[0.2391]	[0.2282]
Percent Black	0.2351	0.2348	0.2167	0.2257	0.1355
	[0.2165]	[0.2162]	[0.2223]	[0.2330]	[0.2244]
Median Income/10000	0.0312***	0.0318***	0.0275***	0.0239**	0.0359***
	[0.0092]	[0.0094]	[0.0097]	[0.0109]	[0.0103]
Municipal Expend/10000	0.0029	0.0031	0.0012	0.0005	0.0087**
	[0.0025]	[0.0025]	[0.0030]	[0.0036]	[0.0038]
School Expend/10000	0.3364	0.2939	0.8447**	1.0415**	-1.3193*
	[0.3648]	[0.3685]	[0.4218]	[0.5108]	[0.7920]
Constant	0.0525***	0.0500***	0.0471**	0.0495**	-0.006
	[0.0157]	[0.0162]	[0.0194]	[0.0239]	[0.0238]
Observations	*63138*	*63138*	*63138*	*63138*	*63138*
Partial R2	0.6494	0.4956	0.5312	0.2982	0.1516
Cragg-Donald F-Statistic	30.4	19.8	27.9	27.52	4.6
Hansen J-Test	10.52	10.45	1.32		
Hansen P-value	0.01	0	0.25		

Standard errors in brackets are robust and clustered at the zone level; * significant at 10%; ** significant at 5%; *** significant at 1%; estimated elasticities measured at sample means; Column one instruments - dif_exemp, dif_sch_igr, dif_muni_igr; column two instruments - dif_exemp, dif_sch_igr; column three instruments - dif_exemp, dif_muni_igr; column four instrument - dif_exemp; column five instrument - dif_sch_igr; all diagnostic stats provided by ivreg2 packag in STATA 11

Table 5 reports the results from the estimations when using only data from Madison County in the five different specifications reported in the previous tables. The control variables that are significant follow their expected sign and parallel the results from the full sample. The key difference is the lack of significance of most of the population and spending controls with school spending only significant in the last three columns. These results, however, are not surprising if one considers the rather homogenous population implied by the summary statistics in Table 1.

The tax differential is significant in all five columns but it is only negative in the first four columns. The positive value in the fifth column is not of concern given the poor performance of the *dif_sch_igr* variable as an instrument in the previous estimates and in this estimation. The partial R-squared is only 0.15 and the F-statistic is less than half the lowest level recommended in the literature. As a result, the estimates from column five are expected to be biased.

Unlike in the case of the Saint Clair data, the coefficient on the tax differential varies rather sustainably across the specifications shown in Table 5. The results are similar to those in Table 4 in the first two columns of Table 5, however the diagnostic statistics show that the over identification assumptions are strongly rejected in those columns despite the high partial R-squared and F-statistics. There is not sufficient data to reject the over identification assumptions in the third column implying less potential bias in those estimates which are slightly larger than those shown in Table 5 lending some support to the idea that different counties may react differently to tax differentials. The increase is not that large, however, with an estimated elasticity of about -0.34 or a loss of about ninety-five square feet with a one standard deviation increase in the tax rate and a loss of just over 400 square feet for a move to the highest tax rate. The estimate from the fourth column is even higher with an estimated elasticity of -0.40, however the diagnostics show a smaller partial R-squared and a smaller F-statistics compared to the results in column three.

<u>Saint Louis County</u>

The final county included in the data is Saint Louis County and is the largest in the sample. Saint Louis County is located in Missouri and surrounds the City of the Saint Louis (a separate entity) to the west. Saint Louis County contains all of the suburban communities to the City of Saint Louis, which includes more than ninety incorporated cities and more than twenty school districts. Table 1 shows that Saint Louis County has the lowest tax rate in the sample with homes that are larger than those in the Illinois counties and has an average median household income of about $59,000.

Table 6 shows the first set of results reporting the estimations using Saint Louis data only of the same models used previously and the differences are striking. One key difference between Missouri and Illinois to keep in mind is that Missouri does not offer the same set of exemptions that Illinois offers. There is data, however, provided by Saint Louis County as to the percentage of specific parcels that are exempted from taxation for a variety of reasons ranging from special considerations to use exemptions. Therefore, while the calculation of the percent exemption variable is the same, it is likely not measuring the same effect in the Missouri counties as it is in the Illinois counties.[16]

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[16] Missouri does offer some circuit breaker programs; however, these are administered at the State level and thus have no impact on local revenues or extensions.

Table 6					
Saint Louis County - MSA Differentials					
	(1)	(2)	(3)	(4)	(5)
Estimated Elasticity	*-0.0198*	*-0.0246*	*0.0623*	*1.1585*	*-0.0241*
2009 Property Tax	-0.0041	-0.0051	0.0129	0.2402	-0.005
	[0.0153]	[0.0160]	[0.0745]	[6.3730]	[0.0160]
Stories	0.2528***	0.2549***	0.2530***	0.2294	0.2550***
	[0.0150]	[0.0172]	[0.0143]	[0.6678]	[0.0172]
Bedrooms	-0.1931***	-0.1911***	-0.2080***	-0.4239	-0.1907***
	[0.0438]	[0.0440]	[0.0772]	[6.0654]	[0.0443]
Total Rooms	0.1906***	0.1886***	0.2000***	0.3457	0.1884***
	[0.0244]	[0.0253]	[0.0483]	[4.0942]	[0.0254]
Total Fixtures	0.0642***	0.0643***	0.0646***	0.0681	0.0644***
	[0.0028]	[0.0028]	[0.0033]	[0.0985]	[0.0028]
Age	0.0007**	0.0007**	0.0007	-0.0003	0.0007**
	[0.0003]	[0.0003]	[0.0004]	[0.0263]	[0.0003]
Percent 18 or Younger	-0.2496**	-0.2533**	-0.2484**	-0.1873	-0.2531**
	[0.1005]	[0.1020]	[0.0985]	[1.6974]	[0.1020]
Percent 65 or Older	0.2360***	0.2332***	0.2639*	0.6517	0.2332***
	[0.0631]	[0.0644]	[0.1349]	[10.8767]	[0.0644]
Percent White	-0.5496***	-0.5424***	-0.6687	-2.2722	-0.5412***
	[0.1725]	[0.1761]	[0.5365]	[44.9006]	[0.1765]
Percent Black	-0.5632***	-0.5549***	-0.7042	-2.5993	-0.5537***
	[0.1858]	[0.1899]	[0.6299]	[53.0370]	[0.1904]
Median Income/10000	0.0092**	0.0092**	0.0097**	0.0153	0.0092**
	[0.0038]	[0.0038]	[0.0042]	[0.1575]	[0.0038]
Municipal Expend/10000	0.0087**	0.0081*	0.0066	-0.0126	0.0081*
	[0.0044]	[0.0048]	[0.0102]	[0.5407]	[0.0048]
School Expend/10000	0.4201	0.4274	0.3819	-0.2092	0.4291
	[0.2669]	[0.2696]	[0.3100]	[16.5004]	[0.2703]
Constant	-0.0898***	-0.0913***	-0.0804*	0.0575	-0.0914***
	[0.0127]	[0.0140]	[0.0418]	[3.8698]	[0.0140]
Observations	*162918*	*162918*	*162918*	*162918*	*162918*
Partial R2	0.2603	0.2001	0.0226	0.0000	0.1986
Cragg-Donald F-Statistic	4.80	4.75	0.47	0.00	9.44
Hansen J-Test	0.0800	0.0100	0.0100		
Hansen P-value	0.9600	0.9300	0.9400		

Standard errors in brackets are robust and clustered at the zone level; * significant at 10%; ** significant at 5%; *** significant at 1%; estimated elasticities measured at sample means; Column one instruments - dif_exemp, dif_sch_igr, dif_muni_igr; column two instruments - dif_exemp, dif_sch_igr; column three instruments - dif_exemp, dif_muni_igr; column four instrument - dif_exemp; column five instrument - dif_sch_igr; all diagnostic stats provided by ivreg2 package in STATA 11

The significant results on the control variables in Table 6 correspond with those found in the full sample estimation. Specifically the number of stories, rooms, fixtures and income all increase the size of the home while the number of bedrooms and a higher percentage of younger individuals reduce the square footage. As in several previous cases, the current expenditures by either the municipality or the school district are insignificant with the exception of columns two and five where the former is significant at the ten percent level. The significant, yet small, estimate on the age variable due to the large age distribution of homes in Saint Louis County and that many of the older home located near the Central Business District are as larger, if not larger, than many of the newer homes located on the western most fringes of the county.

The results from Table 6 for the tax differential show negative estimates in columns one, two and five but positive estimates in columns three and four and, in all cases, the estimates are not significant. Paired with these unexpected results is the poor performance of the instruments. The instrumental diagnostics show that while over identification is not a problem (with the solid failure to reject the validity assumptions), the instruments all show poor predictive power in the first stage estimation with small partial R-squared terms and extremely small F-statistics. The only F-statistic that is reasonable close to the 10.0 benchmark is in the fifth column when *dif_sch_igr* is used. In this case, while the estimate of the tax effect is statically insignificant, the sign is more in-line with expectations as it is negative with an estimated elasticity is about -0.02.

While the results from Table 6 are disappointing, they do provide some very usefully information. First and foremost is that not all exemptions are the same. It seems likely that the reason the exemption variable is performing so poorly in this case is that, as discussed previously, the exemptions in the Saint Louis County data are not the same type of exemptions in the Saint Clair and Madison County data. The Saint Louis exemptions are more generally land use exemptions that have little, if any, correlation with the annual tax rate given their perceived permanence (or lack sufficient variation to be useful as an instrument). The weakness of these types of exemptions is clear in column four where the partial R-squared is essentially zero compared to the results in column four from Table 4 and 5 where the partial R-squared and F-statistics are much stronger. Therefore, the results from Table 6 show that care must be taken when considering what exemptions to include when using these as an instrument for the tax differential.

The second piece of information from Table 6 is that, in the absence of these exemptions, the school intergovernmental revenue, while not perfect, is likely the next best alternative as shown in columns one, three and five. The corresponding results from Tables 4 and 5 imply, however, that the results when using this instrument biased slightly toward zero. This is evident by the lack of significance of the results in column five in Tables 4, 5 and 6. The remarkable similarity between the estimated elasticity of the results in column five of Table 6 and those found elsewhere in the literature also imply that the use of the school IR variable (or one very similar to it) as an instrument may be partially to blame for the very small estimated tax impact on residential capital. Verification of this conjecture, however, requires further work.[17]

[17] Estimates where carried out using only the two Illinois counties and results show that, compared to Table 4, the estimated coefficient on the tax differential variable across all columns as more negative, more significant and the exemption instrument (column four) performed very well as an instrumental variable. The results are available from the author upon request.

Table 7					
Saint Louis County - MSA Differentials					
	(1)	(2)	(3)	(4)	(5)
Estimated Elasticity	*-0.2221*	*-0.2294*	*-0.1719*	*-2.7766*	*-0.2385*
2009 Property Tax	-0.0460*	-0.0475*	-0.0356	-0.5737	-0.0494**
	[0.0239]	[0.0247]	[0.0616]	[3.2829]	[0.0248]
Stories	0.1613***	0.1637***	0.1624***	0.1967	0.1623***
	[0.0131]	[0.0164]	[0.0137]	[0.2398]	[0.0165]
Bedrooms (act)	0.0574***	0.0576***	0.0572***	0.0774	0.0576***
	[0.0052]	[0.0053]	[0.0051]	[0.1300]	[0.0053]
Total Rooms (act)	0.0925***	0.0925***	0.0930***	0.0696	0.0917***
	[0.0030]	[0.0030]	[0.0041]	[0.1389]	[0.0031]
Total Fixtures	0.0395***	0.0395***	0.0397***	0.0324	0.0396***
	[0.0014]	[0.0014]	[0.0016]	[0.0456]	[0.0014]
Age	0.0005	0.0006	0.0005	0.0022	0.0006
	[0.0004]	[0.0004]	[0.0004]	[0.0106]	[0.0004]
Percent 18 or Younger	-0.1479	-0.1476	-0.1467	-0.1758	-0.1676*
	[0.0965]	[0.0972]	[0.0932]	[0.5888]	[0.0994]
Percent 65 or Older	0.1931**	0.1856*	0.2065	-0.8069	0.1797*
	[0.0983]	[0.1034]	[0.1290]	[6.2564]	[0.1037]
Percent White	0.0003	0.0183	-0.0715	3.6856	-0.0037
	[0.2082]	[0.2204]	[0.4161]	[22.7708]	[0.2220]
Percent Black	0.0788	0.0982	-0.0085	4.3884	0.0695
	[0.2219]	[0.2344]	[0.4847]	[26.5531]	[0.2368]
Median Income/10000	0.0255***	0.0253***	0.0261***	-0.0141	0.0249***
	[0.0027]	[0.0028]	[0.0048]	[0.2480]	[0.0029]
Municipal Expend/10000	0.0049	0.005	0.0038	0.0546	0.0062
	[0.0058]	[0.0058]	[0.0087]	[0.3058]	[0.0060]
School Expend/10000	0.8092***	0.8082***	0.7787***	1.6108	0.7377***
	[0.2582]	[0.2611]	[0.2714]	[4.9820]	[0.2709]
Constant	-0.0675***	-0.0684***	-0.0616	-0.3894	-0.0682***
	[0.0228]	[0.0234]	[0.0384]	[2.0371]	[0.0235]
Observations	*162918*	*162918*	*162918*	*162918*	*162918*
Partial R2	0.2837	0.2242	0.0283	0.0000	0.2229
Cragg-Donald F-Statistic	4.91	4.83	0.51	0.03	9.60
Hansen J-Test	1.1200	1.0300	1.2200		
Hansen P-value	0.5700	0.3100	0.2700		

Standard errors in brackets are robust and clustered at the zone level; * significant at 10%; ** significant at 5%; *** significant at 1%; estimated elasticities measured at sample means; Column one instruments - dif_exemp, dif_sch_igr, dif_muni_igr; column two instruments - dif_exemp, dif_sch_igr; column three instruments - dif_exemp, dif_muni_igr; column four instrument - dif_exemp; column five instrument - dif_sch_igr; all diagnostic stats provided by ivreg2 package in STATA 11

The data from Saint Louis County may also shed some light on the potential bias in the estimates when using the Census values as proxies for the number of bedrooms and total number of rooms of a home. As mentioned previously, this data is not collected by the Illinois counties but is included in the Saint Louis County data. Therefore the five specifications are estimated once more using the actual number of bedrooms and total rooms for the Saint Louis County data and the results are shown in Table 7.

Notice the inclusion of the actual values for the number of bedrooms and total rooms deflates most of the other coefficient estimates with the largest impact being on the census measures and the number of stories. This makes sense given the former variables are measured on the same scale while the latter was likely taking up any house specific error from using the proxy measures and is likely correlated with both number of rooms and bedrooms. The inclusion of the actual values, however, does not change the significance on any of the control variables with the exception of the number of bedrooms and race measures with the latter two completely losing significance.

Introducing the actual values causes the coefficient on the property tax differential to become significant and more negative. Recall the only difference between the results shown in Table 6 and 7 are the use of the actual values for the number of bedrooms and total rooms. The inclusion of these measures does not change the performance of the instruments (as expected) but it does shift the point estimates for the tax differential more negative implying that the use of the census measures bias the results toward zero. Therefore, it is reasonable to take the results reported in Tables 3 through 6 as lower bounds for the capital responsiveness to changes in the property tax rates and that replacing the census proxies with the actual room counts will result in an even more elastic response of capital to tax differentials.

Conclusion

How residential capital investment decisions respond to changes in the property tax are clearly an important theoretical issue and practical policy making concern. Economic theory is unable, by itself, to come to a definitive conclusion on this question leaving the question to empirical analysis. While the New View makes a reasonable argument as to why residential capital responds to tax rate differentials across various districts, the Benefit View makes just as reasonable arguments as to why this is not the case. While other papers focusing on the impact of property taxes on urban sprawl or the timing of development have attempted to either assume the true incidence theory is something between the New and Benefit Views or attempted to test the idea indirectly, only one previous study has addressed the question directly. In that test, Wassmer (1993) found weak support for the New View estimating a tax elasticity of residential capital at -0.01 or -0.02 in the long run.

This paper addresses the impact of property tax differentials on the residential capital investment decision by using data from three counties within the Saint Louis MSA to directly test the relationship between the two variables. This paper describes three improvements in testing this relationship. The first is the use of micro, house-level data within the same MSA which seems to both be a more reasonable study area and of a level of aggregation to observe finer adjustments to tax differentials. Secondly, this research improves the measure of residential capital investment by using the square footage of living space rather than a simple count of the number of homes or building permits in a given district. Finally, this research improves the analysis by submitting an improved instrument to control for the endogeneity agreed to exist when testing the impact of the property taxes on investment or property values. Specifically this paper proposes the use of the percentage of the property tax base that is exempted from taxation as an instrument and shows, when using exemptions other than land use exemptions, the variable performs very well as an instrument and performs better than a measure of intergovernmental revenues received by school districts, a measure more generally employed.

This paper reports that the average tax elasticity of residential capital investment is likely to be between -0.20 and -0.40 depending on the specific region being tested. The result from the full sample produce smaller elasticities, however by breaking the data into the respective counties show that the full sample estimates are biased toward zero by the inclusion of the data from Saint Louis County and the use of Census proxies for total bedrooms and total rooms in a home. The bias from the former is caused by Saint Louis County only reporting land use exemptions while the latter is verified using the Saint Louis County data where the actual bedroom and total rooms counts are reported by the County Assessor.

When the two Illinois counties are estimated separately they produce rather similar tax effects on the range listed above (when when estimated as a joint sample). The variation that remains across the two counties is due to the significant differences in the makeup of the two counties as evident in the summary statistics describing the two locations.[18] The estimated elasticities result in an expected loss of about ninety square feet for every one standard deviation increase in the tax rate above the estimated mean. This is equal to the size of a small bedroom in the average home.

One potential concern with the results found in this study is the reliance on aggregated measures for the number of bedrooms and total rooms in homes located in Illinois. While the data from Saint Louis County shows a potential for an underestimation of the effects (in absolute value), more concrete evidence from the Illinois counties would be preferred. Another potential concern not addressed in this analysis is the role of historic trends in the property tax differentials for a given district. The analysis herein is a snap shot of the development picture and attempts to assign incidence using a single point in time. Further work using a panel of data is needed to determine how the responsiveness of capital changes over time and as developers learn about the tax reputations of given districts. Even with this snap shot, however, the analysis has shown much more creditability for the New View theory of tax incidence and that residential capital decisions are responsive to tax differentials.

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[18] The model is estimated using only the two Illinois counties and the estimated elasticity for the three columns employing the exemptions instrument are consistently in the range -0.21 and -0.25. These results are available from the author by request.

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