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Property Taxes and Residential Rents

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Abstract. Property taxes are a fundamental source of revenue for local governments, comprising 73% of local government tax revenue in the United States. In this paper, we empirically investigate the impact of residential property taxes on residential rents. Using data from the American Housing Survey and the National League of Cities, we estimate numerous specifications of a hedonic rent equation with comprehensive unit-level, neighborhood-level and city-level controls. We find that a one standard deviation increase in the property tax rate raises residential rents by roughly $400 annually.

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I. Introduction

Property taxes are a fundamental source of revenue for local governments, comprising 73% of local government tax revenue in the United States (Statistical Abstract, 2006), and an extensive literature examines their economic impacts. By extending and empirically testing the Tiebout (1956) model, much of this research investigates the extent to which property taxes and public services are capitalized into house prices, and whether household mobility and local government competition can lead to an efficient provision of local public services. Dowding, John and Biggs (1994) and Zodrow (2001, 2006) provide excellent reviews of the literature and insights into the three views of property tax incidence: the traditional view, capital tax view and benefits view. Although the three views generate alternative predictions of who ultimately bears the economic incidence of the property tax, each view implies the possibility that property taxes may be capitalized into local house prices, residential rents and wages (Zodrow, 2001).

There is a large body of empirical research that examines the impact of property taxes in markets where the user of housing services and the property owner are one in the same: the owner-occupier. In particular, the extent of capitalization of property taxes into house prices has been examined in numerous studies, and there is consensus that such capitalization occurs: if two communities have a similar provision of public services, but different effective property tax rates, then the community with the higher property taxes will have lower house values, all else equal. Indeed, recent research suggests fairly high house-price capitalization rates (Palmon and Smith, 1998a, 1998b), confirming that higher property taxes lower buyer willingness to pay and result in lower equilibrium house prices.

This paper provides a first examination of the impact of property taxes in markets where the user of housing services and the property owner are not the same individual. We examine the impact of such taxes on tenants: those who use the housing services, but do not own the property. The finding from other studies that property taxes reduce house prices *ceteris paribus* suggests there may be long run impacts on residential rents through changes in the local housing stock, and we empirically investigate the impacts on local residential rents. We do so by examining the rental market directly. Using housing unit data from American Housing Survey data for a sample of U.S. cities in 1999, 2001, and 2003, and city-level data provided by these cities, we estimate multiple specifications of a hedonic rent equation that controls for detailed unit attributes, neighborhood attributes, and city-level expenditure data on public services to identify the impact of effective tax rates on rents.

The extent to which property taxes impact residential rents is an important question. Daskal (1998) examines housing conditions in 45 metropolitan areas and finds record growth in the number of low-income renter households and the shortage of affordable housing units. If local property taxes contribute to higher tenant costs then they are also contributing to the shortage of affordable rental units. In terms of the broader economic incidence of the tax, if housing consumption is proportional to household income, then according to the traditional view of the property tax literature, the portion of the tax falling on structures constitutes a proportional tax. If the Tiebout model applies, then the property tax is considered a benefits tax. However, low-income renters may be less mobile that higher income households, suggesting a more regressive impact of the property tax. Understanding the extent to which property taxes are passed through to renters through higher rents thus has important policy implications regarding the use of taxes on residential property to fund local government services. The rest of the paper is organized as follows. Section II provides background on the capitalization literature and the process by which higher property taxes result in higher residential rents. Section III details our data and econometric approach. Section IV presents our empirical results, and section V concludes.

II. Background

House-Price Capitalization Literature

There is a vast amount of empirical work investigating the impact of property taxes on house prices, beginning with the work of Oates (1969), who finds that property taxes and the value of public services are capitalized into house prices. Several studies by Ihlanfeldt (1982, 1984, and 2004) are consistent with Oates' capitalization findings. Yinger, Bloom, Borsch-Supan and Ladd (1988) provide a comprehensive review of the property tax literature as well as generate their own estimates of the impact of property taxes on house values, controlling for other factors, in seven Massachusetts cities. They conclude that the capitalization rate varies by communities and ranges from 16 percent to 31 percent: that is, for every $1 increase in the present value of the stream of property tax payments on the house, the value of the house is decreased by 16 cents to 31 cents. More recent research by Palmon and Smith (1998a, 1998b) finds that capitalization of the property tax into the housing rent-to-value ratio is between 62 and 100 percent. A capitalization rate of 100 percent implies that the long-run rent-to-price ratio will fall by the same percent as the decrease in property taxes. Palmon and Smith's approach does not allow them to identify the separate impact on rental costs. Nonetheless, this high rate of capitalization for the rent-to-value ratio suggests that the amount of property tax passed onto the renter may be substantial.

Process of Capitalization

Taxing residential property may result in higher residential rents. To see why this is so, consider the standard model of local housing market dynamics.[1] In the short run, implementing or raising a property tax decreases the consumer's willingness to pay for new or expanded housing according to the present discounted value of the tax liability. For example, suppose that a house is expected to generate $12,000 in housing services for 25 years net of existing property taxes. If the housing market is competitive and assuming a discount rate of 10% on future housing services, then a buyer would be willing to pay $108,924 for the home.[2] Now consider an increase in the property tax burden of $500 per year. The buyer's willingness to pay will fall by the present value of all the additional future tax payments, and the buyer's new willingness to pay for the home is equal to only $104,386.

The stock of housing is fixed in the short run, thus the tax results in disequilibria in the housing market. Because supply is fixed, the price of housing falls by exactly the amount of the tax liability. This constitutes full capitalization of the tax into house prices.[3] To the extent that the supply side of the market can adjust, however, the tax may or may not remain fully capitalized. The local suppliers of housing who supply at marginal cost suffer short run losses and disinvest in the local housing market. The long-run stock of housing decreases until normal accounting profits are restored.

If the housing industry is a constant cost industry, then the long run supply of housing is perfectly elastic, and, in the long run, the equilibrium purchase price of housing will return to its

[1] See Sheffin (1996) for a presentation of this model. De Leeuw and Ozanne (1981) apply a static version of this model to examine the impact of inflation and federal tax reform on long-run equilibrium rents in the housing market.

[2] Willingness to pay, *P*, is computed as: $P = R_0 + \frac{R_1}{(1+r)} + \frac{R_2}{(1+r)^2} + ... + \frac{R_{25}}{(1+r)^{25}}$. Assuming a discount rate, *r*, of 10% and housing services, *R*, valued at $12,000 per year for 25 years thus gives a willingness to pay of $108,924.

[3] In a dynamic context, house prices would not increase by the full amount of the reduced tax liability, since the market takes into account the expected decrease in house prices resulting from the transition to the new equilibrium.

pre-tax change level.[4] The long run equilibrium price of housing is thus unchanged by the tax policy and, in this case, there is zero long-run capitalization of the tax break. This would not be the case if the housing industry is not constant cost or is subject to local growth restrictions. Whatever the structure of the housing industry, the tax generates a decrease in the housing stock. Because of the resulting smaller flow of housing services, the rental value on a given unit will be higher than the pre-tax change level. The long-run process is reflected in the change in the ratio of rental cost to purchase price. We examine the impact of a change in property taxes on rental values directly – comparing long-run equilibriums across cities, to identify the extent of the pass through of the tax change to renters.

III. Data and Econometric Model

We use two datasets in our analysis: (i) unit-level data from the American Housing Survey (AHS); and (ii) city-level data from the National League of Cities (2005) for years 2001 and 2003 and from the cities themselves for 1999. We discuss each of these datasets in turn. The AHS, conducted by the U.S. Bureau of the Census, consists of two surveys, a national AHS survey and a metropolitan survey, that differ geographically and temporally. The national survey interviews a random sample of housing units across the United States every other year. The metropolitan survey is a random sample of housing units in forty-four metropolitan statistical areas (MSAs). Households in the metropolitan survey are sampled on a rotating basis, with approximately eleven MSAs surveyed in any given year. Both surveys sample new construction. Thus the samples grow over time and continue to be representative of the housing stock (Turner, 2003). An advantage of the AHS for estimating hedonic rent equations is the wealth of unit-level and neighborhood-level data collected in the survey.

[4] Dipasquale (1999) evaluates the evidence and concludes that both single-family housing starts and new multifamily construction are price elastic.

We select data from both AHS surveys and include housing units in primarily Midwestern cities in the years 1999, 2001, and 2003. We select all Midwestern cities in the national sample that do not substantial geographical features limiting urban growth and that have at least 100 rental units surveyed per year. In addition, we add into our sample renters in Denver and Oklahoma City to boost sample size.[5] We select single-detached and multiplex rental units, and we exclude mobile homes and condominium units due to the possibility that the rent includes additional fees for landlord-supplied services such as yard maintenance. In addition, we delete rental units with a 2003-inflation-adjusted rent of less than $600 per year or having square footage over 10,000 square feet. The resulting sample consists of 7,902 rental units across the 14 cities and three survey years.

Effective Property Tax Rates

To examine the impact of property taxes on residential rents, we need a measure of the effective property tax rate on residential rental properties. However, the AHS only collects property tax and property value data for owner-occupied properties. No such data are collected by the AHS for rental properties. Since we do not have the data to generate a renter-specific, effective property tax rate measure, we create a city-level measure using the property tax data for owner-occupied units in the AHS. Data cleaning of homeowners includes deleting homes valued at less than $10,000 from the sample, as well as those reporting less than $500 of property taxes paid per year, giving us over 18,000 homeowners in the 14 cities at three points in time. We first compute the annual effective tax rate on each owner-occupied unit as total real estate taxes

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[5] Specifically, the sample includes rental units in 12 Midwestern cities: Chicago, Cincinnati, Cleveland, Columbus, Detroit, Grand Rapids, Indianapolis, Kansas City, Milwaukee, Minneapolis-Saint Paul, Omaha, and Saint Louis. All units are surveyed in the national survey in 1999, 2001 and 2003. Additional units in Cincinnati and Minneapolis come from the metropolitan survey in 1998; additional units in Columbus, Kansas City, and Milwaukee come from the metropolitan survey in 2002. We also include units in Denver and Oklahoma City in 1999, 2001 and 2003 from the AHS national sample to boost sample size, for a total of 14 cities.

reported on the unit divided by house value. We then compute the city-level average effective tax rate by taking the average of the homeowners' effective tax rates. Thus, to identify the impact of effective property tax rates on residential rents, we will use variation in the tax measure across cities and over time, while netting out the impacts of unit attributes and neighborhood attributes.

Because the effective tax rates on owner-occupied and rental properties will differ when there is property tax relief provided to owner-occupiers and not to landlords, we check whether such state-level property tax relief may skew our tax measure, and we find that it does not. The units in our sample are indeed located in states that provide property tax relief for homeowners through such programs as the so called circuit-breaker program.[6] However, this does not pose a problem for our analysis as the relief in these states is provided in the form of a rebate or income tax credit, and the AHS reports the pre-relief level of real estate taxes owed.

The use of effective tax rates on owner-occupied properties as a proxy for the rates on rental properties may be problematic, however, if the stocks of owner-occupied and rental housing differ. We first check for differences in the composition of housing in our sample. We find that the stocks of rental and owner occupied housing are similar in age and adequacy. The fractions built according to four age categories (prior to 1930; from 1930 to 1970; from 1970 to 1990; and after 1990) are nearly identical for rental and owner-occupied units. Regarding adequacy, in our sample 97% of owner occupied housing is rated as adequate, and 90% of the rental units are rated as adequate. (As we describe below, a unit is deemed adequate based on the physical condition of the housing unit as assessed by the AHS interviewer).

We also check for differences in the type of housing: single family detached units versus multi-unit properties. Here the stocks of rental and owner occupied housing differ in our

[6] Sexton (2003) and Baer (2003) provide excellent summaries of the property tax relief programs available in each state.

samples. 97% of the sample of owner-occupied units are single-family detached whereas only 25% of the sample of the rental units are single-family detached units. However, we nonetheless use the effective property tax rates for single-family, owner-occupied units as a proxy for the effective tax rates on rental units in the hedonic rent equations since no data are available that includes both rents and rental-unit specific property taxes.[7]

Expenditure Data

We expect that residential rents will be higher in cities that provide amenities, all else equal. Moreover, controlling for the provision of local government services allows us to identify the impact of property taxes on rents, net of these services. We focus on expenditure categories that directly affect quality of life. Specifically, we focus on four broad categories of expenditure (expressed per capita): parks, recreation and culture; police and fire protection; public works such as maintenance on sanitation, water, sewer and transportation; and economic development. We obtain the expenditure data for 2001 and 2003 from the National League of Cities (2005). In accordance with federal regulations implemented in 2000, cities must annually complete a Comprehensive Annual Financial Report (CAFR). Expenditure data for many cities are collected from these reports and published by the NLC. The 1999 data, however, are not available from the NLC, so we contacted the city governments directly for these data.[8]

Econometric Approach

We examine the impact of property taxes on residential rents using two approaches: (i) a

[7] Recent work by Goodman (2006) using newly available data from the 2001 Residential Finance Survey suggests that effective property tax rates vary by property type (owner-occupied, single family units versus multiplexes) and property value (low, medium and high). Although a clear pattern does not emerge, Goodman finds that the effective tax rate on apartments differs from that on houses for both low and high valued properties. The tax rates on medium valued properties are similar, however, across property type, controlling for other factors.

[8] The authors gratefully acknowledge the individuals in these 14 cities who helped us obtain the 1999 data.

two-stage estimation strategy that separates the unit-level analysis and city-level analysis; and (ii) a one-stage estimation procedure that includes both unit and city level controls in the same regression and implements a cluster correction.[9] The econometric results, especially the key findings, are affected very little or not at all by our choice of econometric method, and we thus present the two-stage estimation strategy and results in the paper. The one-stage estimation results are available upon request.

Two-Stage Hedonic Rent Model

The first stage uses the AHS rental unit data to estimate the average rent in a city at a point in time, net of rental unit attributes and neighborhood characteristics. We include city/time binary variables to control for the unit being in a particular city at a particular point in time and allow for rental markets to differ across cities and years. The second stage uses city-level data and regresses the average rents from the first stage on the city-level variables, including the effective property tax rate. The first stage estimation is at the level of the housing unit:

$$R_{ijt} = \alpha + X_{ijt}'\beta + Z_{ijt}'\theta + \sum_{\substack{j=1 \\ t=1}}^{\substack{T=3 \\ J=14}} \gamma_{jt} * C_j * D_t + u \qquad (1)$$

where R_{ijt} is the rental price on housing unit *i* in city *j* at time *t*. *X* is a vector of attributes of the rental unit and includes: the number of baths and rooms in the unit, the square footage of the unit, the adequacy of the unit, and amenities of the unit (central air, working fireplace, parking, balcony,

[9] The one-stage, household-level, hedonic rent equation with the city-level controls added in, results in correlated error terms within the city/year groupings of renters and therefore standard errors that are downward biased (Moulton, 1986). We implement the Moulton correction to provide correct standard errors.

and the lot size for detached units).[10] The adequacy variable equals one if the unit is deemed adequate and based on the physical condition of the housing unit as assessed by the AHS interviewer.[11] The parking variable is a binary variable indicating whether the unit has reserved or covered parking. Increases in or additions of these variables are expected to increase the rental price on the unit. We also control for the age of the unit using four indicator variables: built before 1930, between 1930 and 1970, between 1970 and 1990, and after 1990. We include both multiplex rental units and detached units in the sample, and control for the difference in these types of units with an indicator variable equaling one if the unit is detached and zero otherwise.

It may be that some amenities are more valuable in either hot or cold climates. To allow for this, we estimate a specification that controls for the following interaction variables: (i) air conditioning and hot summer temperatures, where a city is deemed hot if it has an average July temperature exceeding 86 degrees (Fahrenheit); (ii) working fireplace and cold winter temperatures, where cold constitutes an average low temperature in January of 17 degrees (Fahrenheit) or less; and (iii) parking and cold winter temperatures. We expect that fireplaces will be more valued in colder climates, but this may not be the case if the presence of a fireplace in a rental unit is picking up strictly an income effect. Fireplaces are common in warmer climates in coastal areas, for example.

Z is a vector of attributes of the neighborhood of the rental unit and includes the following binary variables: if the unit is located in the center of the city; if the neighborhood has crime; if the neighborhood has bad odor; and whether there is green space or water within ½ a block of the rental unit. Each of these is constructed based on the resident's response. For example, the crime variable

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[10] Approximately 3000 multiplex rental units are missing square footage data. For these observations, we impute the missing square footage data by using the data reported on the approximately 3,500 multiplex units for which we have square footage data. The details of our approach are provided in the appendix.

[11] Specifically, the surveyor is provided with a list of unit deficiencies, and the presence of any one deficiency would lead the surveyor to classify the unit as inadequate. For example, a unit is deemed inadequate if the unit lacks complete plumbing facilities, has no electricity, has exposed electrical wiring, or lacks complete kitchen facilities.

equals one if the respondent answers yes to the AHS question, "Is there crime in this neighborhood?" and zero otherwise. Although the subjective nature of these data is a limitation, they are the only neighborhood controls we have available that capture crime and amenities. In addition, we control for whether the neighborhood is "poor quality" in general as measured by the presence of any one of the following: abandoned buildings, bars on windows, or trash in the streets; or the unit is adjacent to a four-lane highway, a railroad or an airport. The poor quality measure is an objective measure based on the AHS surveyor's observations of the neighborhood.

J is the number of cities in the sample, C_j represents the city binary variables, and D_t represents the binary variables for the three time periods examined. The γ_{jt} represent the coefficients on the city/year interaction terms to be estimated. The 14 cities at three points in time thus generate 42 city/year binary coefficients. The resulting city/time coefficient estimates (γ_{jt}) provide a measure of the average rental price in city j at time t, net of housing unit and neighborhood attributes.

In the second stage, the estimated city/time coefficients are regressed on effective property tax rates and local government expenditures on public goods such as water treatment, parks, and fire and police protection. We control for the extent of restrictions on housing expansion using the Malpezzi index. Specifically, we construct a binary variable, REG, that indicates if a city has a relatively high degree of regulation. It equals one if the value of the Malpezzi index for the city exceeds the sample average value and zero otherwise.[12] For city j at time t, we have:

$$\gamma_{jt} = \alpha_0 + \alpha_1 PTAX_{jt} + \alpha_3 REG_j + W_{jt}'\delta + \varepsilon \qquad (2)$$

[12] The Malpezzi index is constructed to capture the extent to which metropolitan and state-level regulations constrict local housing supply. See Malpezzi (1996) for a careful description of the index.

The coefficients on each of the explanatory variables in equation (2) represent the change in average city rents with respect to a change in effective property tax rates, the extent of regulation, and the various expenditures categories, denoted by the vector W_{jt}. This approach allows us to identify the impact of property taxes *ceteris paribus* on residential rents. An α_1 that is positive and statistically significant indicates that the effective property tax rate increases residential rents. We expect positive signs on all of the expenditure coefficients. Increases in city expenditures are expected to improve quality of life and thereby increase rents. We expect that greater regulation will lead to less growth in a city's housing stock and thus higher rents all else equal.

Note that the second stage estimates are based on estimates of the city/year interaction variables. This implies that the error term in the second stage includes both a true error component and a component due to the sampling error from the first stage, and thus the second stage errors will not have constant variances (for example, see Page, 1995). Instead, the variances will depend on the accuracy of the first stage regression. Following Page, in order to efficiently estimate equation (2), we weight each observation by the inverse of the square root of the sum of the estimated variances of each component.

We estimate multiple versions of both the first stage and the second stage models, including first-stage specifications that are run in linear and log form. All variables expressed in dollar terms are adjusted to 2003 dollars. To do so, ideally, one would use a non-shelter, renter CPI to deflate rents in the first stage model. However, the Bureau of Labor Statistics (BLS) does not provide such an index. Instead, the BLS provides two related deflators: the Renter Consumer Price Index (CPI), which tracks inflation in the goods and services bought by renters, and the BLS non-shelter CPI, which tracks inflation in all non-housing goods and services bought by both renters and homeowners. Arguments can be made for use of one over the other. We run the models based on each deflators. We report only a subset of the results in the next section, but it should be noted that our key findings are robust to these various specifications.

IV. Results

Household Level

We first present the unit-level hedonic rent equations, based on 7,902 rental units. Means for the entire sample of rental units and those in high and low effective property tax rate cities are shown in table 1. The mean effective property tax rate for the sample is roughly 1.5%. A unit is considered to be in high tax (low tax) city if the city-level effective tax rate lies above (below) the sample mean across cities. Rents are reported in 2003 real dollars, using the BLS Renter CPI.

Referring to table 1, the mean real annual rent in the sample is $7,347, with a range from $600 to $34,580. The mean number of bathrooms, rooms, and square footage are 1.12, 4.3, and 1,002, respectively. Forty-one percent of the rental units have central air conditioning. A working fireplace, covered parking, and some sort of balcony are present in 8%, 85%, and 61%, respectively, of the rental units in the sample. Eighty-nine percent of the rental units in the sample are considered adequate, according to the AHS surveyor. The average lot size for detached units is 13,448 square feet, and 24% of the units in the sample are detached units. Most rental units, 42%, were built between 1930 and 1970. Pre-1930s units comprised 19% of the sample, and units built between 1970 and 1990, as well as those built post-1990 made up the rest of the sample at 31% and 8%, respectively. Over 72% of the rentals are classified as central city units, and about 27% of the rental neighborhoods have crime. Eighteen percent have bad odors, and over 42% are designated as poor quality neighborhoods, as defined previously. The fraction of rental units close to a green space is 33%, and 14% are near a body of water. About 19% of the sample rental units in hot areas have central air conditioning. Roughly 2% and 29% of units in cold areas have a working fireplace and covered parking, respectively.

Table 2 reports the regression results for the hedonic models. Each model includes the city/year binary variables.[13] The model we report as the base model has controls for unit attributes, neighborhood attributes, interaction variables as well as the city/time indicator variables. In model (2), we exclude the fireplace, air conditioning and parking interaction variables. In our sample of 7,902 rental units, using the $600 annual rent as a sample restriction results in 537 rental units, or 7% of the sample, in which the occupant(s) receive some form of government assistance to pay their AHS reported rents. We control for this in model (3), which includes a binary variable equaling one if the household receives government rental assistance and zero otherwise. Model (4) reports the hedonic model using the log of rents as the dependent variable.

We focus our discussion on the results that are robust across models. Most of the results are robust and as expected. The coefficients on number of bathrooms, number of rooms, square footage, central air, fireplace, unit being built between 1930 and 1970 (relative to after 1990) and unit being built between 1970 and 1990 (relative to after 1990) are all positive and statistically significant across models. An additional bathroom, having air conditioning, or having a fireplace each have particularly large impacts on rental prices. For example, a unit with a fireplace rents for $660 to $1,050 more per year, all else equal, depending on the model, with the log model impacts computed using the sample average rent of $7,347 annually. The square footage variable also has a fairly sizable impact. Referring to model (1), an additional 1000 square feet raises the rental price by roughly $300 annually in the linear models and $230 annually in the log

[13] The city-time coefficient estimates are not reported here, but are available from the authors upon request.

models. The year-built indicators have sizable impacts across models and may be reflecting a location advantage, with the units built between 1930 and 1990 being nearer to city amenities than units built after 1990, and thereby commanding higher rents.

The coefficients on the binary variables representing crime, odor and poor quality neighborhood in table 2 are negative, statistically significant and economically meaningful across models. The units in neighborhoods with crime, for example, rent for roughly $400 less per year. Being located near a green space or body of water significantly increases the rental value of a unit. For example, units located near a green space rent for $204 more per year, and units near a body of water rent for $440 more per year, all else equal, according to model (1). Contrary to expectations, covered or reserved parking is not statistically significant. The control variables for balcony, adequacy, detached lot size, detached unit, central city and the interaction terms are also not statistically significant in all models. The air conditioning, fireplace and parking interaction variables are not consistently significant and referring to model (2), we see that excluding them from the analysis has little impact on the other estimated coefficients. Note that in model (3), with a statistically significant coefficient of minus $1,643, the rent subsidy variable indicates that rental units occupied by households receiving rental assistance command a substantially lower rent, all else equal.

City Level

Forty-two observations are included in the city-level sample for the 14 cities at three time periods (1999, 2001, and 2003). Means for the entire sample of cities and by property tax status are shown in table 3, with all dollar values expressed in 2003 dollars using the Renter CPI. At the city level, the mean effective tax rate is about 1.4% and ranges from 0.1% to 2.3% for the entire sample. The standard deviation is 0.34%. The mean annual expenditure on public safety is over $340 million and ranges from $62 million to $1.65 billion. The mean expenditure on public works, including streets and sanitation, transportation, water, and sewer, ranges from about $30 million to over $1.1 billion, with a mean of $210 million. The average amount spent on cultural and recreational activities for citizens is about $52 million, ranging from $0 to over $153 million. City expenditures on economic development range from $0 to over $234 million, with a mean of about $59.4 million. The city regulation index averages 18.2 with a minimum of 13 and maximum of 22, with higher values of the index indicating greater regulation.

Table 4 reports the second stage estimates. Note that second-stage models reported in table 4 correspond directly to the first-stage models reported in table 2. Each of the second-stage models controls for the effective property tax rate, per capita government expenditures and the regulatory status of the city. Referring to table 4, we see that, across models, the coefficient on the effective tax rate is positive, significant and robust. To interpret the magnitude of the coefficient estimates, we consider the impact on rents of a one standard deviation increase in property tax rate: an increase of 0.34% in the property tax rate from its sample mean of 1.4% increases rents by an amount between $402 and $451 annually.[14] The expenditure coefficients are not statistically significant except in model (1), where per capita expenditures on public works have a negative impact, and expenditures on culture and recreation have a positive impact on city rents, all else equal. The lack of significance is likely because the expenditure variables are correlated with one another. Surprisingly, the regulation control indicates that cities with greater regulation, as measured by a value of the Malpezzi index exceeding 18.2, results in substantially lower rents. This negative correlation may be occurring because the Malpezzi

[14] In the linear models, we compute the marginal effect of a one-standard deviation increase in the property tax rate by multiplying the coefficient estimate by one standard deviation or 0.0034. For the log models, we multiple the coefficients by 0.0034 and the average sample rent of $7,347.

index primarily captures the speed of residential zoning approval and permit issuance, which may occur more slowly in cities with large housing stocks.

V. Conclusion

Property taxes provide the primary source of revenue for local governments in the U.S., yet we have little understanding of the extent to which such taxes result in higher residential rents. Studies examining the capitalization of property taxes into house prices suggest that the residential rent impacts may be significant. Using data from the American Housing Survey and fourteen cities over time, this paper finds that this is indeed the case. Using multiple estimation strategies, including a two-stage hedonic approach and a one-stage model with cluster correction, both including comprehensive unit-level, neighborhood-level and city-level controls, and we find that a one standard deviation increase in the property tax rate raises residential rents by between $402 and $450 annually. In light of the preferential tax treatment of certain types of property in the U.S such as agricultural land (Tsoodle, 2005), these results are particularly pertinent for urban metropolitan areas and counties with significant acreage zoned non-residential.[15] Reducing the preferential treatment of other types of property and using the revenue gains to reduce residential property taxes may allow cities and counties to achieve lower residential rents. Future research should examine the extent to which the current tax structure for local government financing thus presents an undue burden on urban renters.

[15] For example, the two most densely populated counties in Kansas, Johnson County and Sedgwick County, have 45% and 74% of the land zoned for agricultural use, respectively.

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Appendix: Imputation of Missing Square Footage Data.

Approximately 3,000 multiplex rental units are missing square footage data. To use these observations, we impute the missing square footage data by using the data reported on the approximately 3,500 multiplex units with square footage data. The model used to impute square footage for the missing data is:

$$UNITSF = \sum_{i=1}^{n} X'\beta . \qquad \text{(A1)}$$

Here *UNITSF* is the square footage of the i^{th} rental unit. X is a vector of attributes that we expect will impact square footage and includes: the total number of rooms, bathrooms, half bathrooms, dining rooms, living rooms, and dens. We also include a binary variable for the presence of a laundry room, and we control the age of the unit, which we incorporate as three binary variables: built before 1970, between 1970 and 1990, and after 1990. Notice that equation (A1) includes several variables not present in the first-stage hedonic model. The R-squared for equation (A1) is 0.67. We estimate equation (A1) for multiplex units only and use the fitted equation to predict the square footage for the 3000 multiplex units for which we are missing data.

Table 1.
Sample Means. American Housing Survey.
Rental Units in Primarily Midwestern Cities in 1999, 2001 and 2003.

Variable Definition	**All Renters**	**Renters High Tax**	**Renters Low Tax**
Annual rent	7,347	7,552	7,105
Number of bathrooms	1.12	1.10	1.14
Unit square footage	1,002	1,017	984
Number of rooms	4.27	4.31	4.22
Central air conditioning	0.41	0.35	0.49
Fireplace	0.08	0.06	0.11
Parking	0.85	0.80	0.90
Balcony	0.61	0.61	0.62
Adequate units	0.89	0.88	0.91
Lot size for detached units	13,448	13,853	12,970
Detached unit	0.24	0.20	0.30
Built prior to 1930	0.19	0.21	0.17
Built between 1930 and 1970	0.42	0.43	0.41
Built between 1970 and 1990	0.31	027	0.35
Built after 1990	0.08	0.09	0.07
Central city	0.72	0.83	0.59
Crime	0.27	0.29	0.25
Odor	0.18	0.08	0.08
Poor quality	0.42	0.44	0.39
Green space	0.33	0.30	0.37
Body of water	0.14	0.14	0.15
Central Air conditioning * hot temperature	0.19	0.01	0.39
Fireplace * cold temperature	0.02	0.01	0.02
Parking * cold temperature	0.29	0.30	0.29
Sample size	7,902	4,272	3,630

Note: the rent and income variables are adjusted to 2003 dollars using the Urban Rental CPI.

Table 2.
Hedonic Rent Estimations.
AHS Renter Households in 14 cities, 1999, 2001 and 2003.

Variables	**(1) Base Model**	**(2) Exclude Interaction Terms**	**(3) Rent Subsidy Control**	**(4) Log(Rent)**
Number of bathrooms	1969.4***	1987.2***	1931.37***	0.19***
	(107.7)	(107.8)	(106.69)	(0.02)
Number of rooms	414.8***	413.9***	412.95***	0.06***
	(32.30)	(32.32)	(31.97)	(0.005)
Unit square footage	300***	295***	281***	0.032***
(in thousands)	(500)	(544)	(538)	(0.008)
Central air	1916.3***	1665.4***	1877.66***	0.22***
	(98.78)	(83.68)	(97.84)	(0.01)
Fireplace	1050.3***	1000.5***	968.71***	0.12***
	(145.83)	(131.17)	(144.52)	(0.02)
Parking	71.76	5.26	53.49	0.02
	(122.60)	(104.01)	(121.39)	(0.02)
Balcony	85.34	73.71	6.64	0.05***
	(73.77)	(73.75)	(73.32)	(0.01)
Adequate units	35.76	33.76	43.22	0.008
	(108.99)	(109.06)	(107.90)	(0.02)
Lot size (in tens of	-6.23	-6.23	6.24	-0.00065
thousands)	(4.0)	(4.4)	(0.0004)	(0.00062)
Detached unit	39.22	66.84	26.06	-0.02
	(93.69)	(93.64)	(92.80)	(0.01)
Built prior to 1930	-83.99	-71.62	-108.69	-0.03**
	(94.89)	(94.92)	(93.96)	(0.01)
Built between	583.53***	586.45***	698.38***	0.05***
1930 and 1970	(86.14)	(86.22)	(85.76)	(0.01)
Built between	978.10***	996.08***	1058.29***	0.12***
1970 and 1990	(139.87)	(139.80)	(138.62)	(0.02)
Central city	-14.51	13.04	-3.42	-0.02
	(92.81)	(92.34)	(91.89)	(0.01)
Crime	-427.87***	-435.42***	-384.77***	-0.06***
	(80.11)	(80.15)	(79.39)	(0.01)
Odor	-340.36***	-335.77***	-316.53**	-0.06***
	(125.31)	(125.39)	(124.08)	(0.02)
Poor quality	-236.31***	-236.14***	-225.51***	-0.04***
	(70.52)	(70.58)	(69.83)	(0.01)
Green space	204.02***	205.01***	212.93***	0.02**
	(74.74)	(74.81)	(74.01)	(0.01)
Body of water	439.97***	450.51***	430.02***	0.06***
	(102.97)	(102.99)	(101.95)	(0.01)
Air conditioning *hot	-763.40***		-707.71***	-0.0002
temperature	(160.87)		(159.32)	(0.02)

Table 2 (Continued).

Fireplace *cold temperature	-50.31 (303.59)		-20.25 (300.56)	-0.02 (0.04)
Parking *cold temperature	-232.01 (215.30)		-191.20 (213.17)	-0.04 (0.03)
Rental subsidy			-1643.00*** (132.84)	
Adjusted R-squared	0.870	0.870	.873	0.998

Standard errors are in parentheses. ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.10 levels, respectively. All models include city-time indicator variables.

Table 3.
Sample Means. City-Level Data.
14 Primarily Midwestern Cities in 1999, 2001, 2003.

Variable Definition	**All Cities**	**High Property Tax Cities**	**Low Property Tax Cities**
Effective property tax rate	0.014	0.016	0.012
Public safety expenditure (millions)	342	443	240
Public works expenditure (millions)	210	245	175
Cultural & recreation expenditure (millions)	52.4	40.3	64.5
Economic development expenditure (millions)	59.4	62	56.5
Population	715,163	888,849	541,478
Regulation index	18.2	18.0	18.4
Sample Size	42	21	21

Note: the table reports the expenditure variables in millions of 2003 dollars; however, we convert the expenditure data to per capita terms for the regression analysis. The expenditure variables are provided by the city governments. The effective tax rate is computed using American Housing Survey data on owner-occupied housing units. High tax and low tax cities are those that lie above and below, respectively, of the average city-level effective tax rate in the sample. The rates for high and low cities range from a high of 2.3% and to a low of 0.1%.

Table 4.
City-Level Regressions.
14 Primarily Midwestern Cities in 1999, 2001, 2003.

Variables	**(1)** **Base Model**	**(2)** **Exclude Interaction Terms**	**(3)** **Rent Subsidy Control**	**(4)** **Log (Rent)**
Intercept	75.23	266.74	314.60	7.91***
	(1488.87)	(1611.84)	(1464.62)	(0.22)
Effective property tax rate	121478*	111719*	118463*	18.02*
	(62360)	(67528)	(61341)	(9.42)
Public safety per capita	1.55	1.51	1.55	0.00010
	(2.05)	(2.23)	(2.02)	(0.00031)
Public works per capita	-1.26*	-1.21	-1.18	-0.00019
	(0.75)	(0.82)	(0.74)	(0.00011)
Culture and recreation per capita	6.47*	4.09	6.30	0.00092
	(3.86)	(4.18)	(3.80)	(0.00058)
Economic dev. per capita	-0.12	0.23	-0.33	0.000094
	(2.80)	(3.04)	(2.76)	(0.00042)
Regulatory status	-1322.03***	-1321.02**	-1328.17***	-0.16**
	(475.25)	(515.84)	(467.41)	(0.07)
Adjusted R-squared	0.24	0.17	0.24	0.15

Standard errors are in parentheses. ***,**,* indicates statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.