Financing Residential Development with Special Districts

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Abstract

This paper empirically examines the extent to which the property tax liability created by financing residential infrastructure using special district bonds is capitalized in house prices. We compare house prices for single-family detached homes built within development districts to similar properties located outside development districts. Our hedonic specification includes the usual housing characteristics and controls for the influence of spatial attributes using Census Block Group 'neighborhood' fixed effects. The preferred empirical specification restricts the data to neighborhoods that have numerous sales of recently constructed single-family detached homes located both within and outside development districts. The empirical results indicate that house prices for homes located within development districts are lower than house prices for similar homes located outside of development districts, but the amount of property tax capitalization is significantly less than full. Results depend on our Generalized Methods of Moments estimator, which instruments property tax rates using the characteristics of development districts. We identify valid instruments by restricting transactions to properties located in rapidly growing suburban developments.

JEL Classification: R3, R5

Keywords: financing infrastructure, special districts, property tax capitalization

1 Introduction

There are four mechanisms typically used to finance the development of residential infrastructure: municipal bond financing (with bonds securitized by a municipality's general revenues), the developer (either using construction loans, equity, or some combination of both), development impact fees, and special district bonds. Special districts [1] are created by property owners to provide specific public services. They are governed by a board of directors or supervisors and have the authority to issue debt securitized by expected retail sales and property tax revenues as well as by anticipated tolls, user fees, tap or other impact fees.[2] Financing public services, including the development of residential infrastructure, using special districts has become a fairly common practice in some parts of the United States. The Special District Association of Colorado, for example, reports that there are over 1,800 special districts currently operating in the state.

This paper examines whether the property tax liability generated by development district financing is capitalized in the price of new, owner-occupied homes. It compares the prices of recently constructed, owner-occupied homes built in development districts (where infrastructure was financed with development district bonds) to the prices of otherwise similar homes built outside development districts (where the infrastructure was typically developer financed). Since all the homes in the sample have infrastructure (i.e. water, sewer, roads, etc.), this analysis avoids the problem of how homeowners value the benefits provided by the infrastructure and focuses on how homebuyers capitalize the expected future property tax liability in the price of new, owner-occupied housing.

This paper makes four contributions to the literature. First, it examines whether the property tax liability associated with development district bonds is capitalized in the price of new homes. We compare the prices of homes located in development districts to prices of similar homes where infrastructure was financed with some combination of the developer's equity and construction loans.[3] We find that homebuyers fail to fully capitalize the future property tax liability in house prices. Bradley (2011) suggests several reasons why property tax capitalization may be less than full. From his perspective, "the most relevant explanation may be that homebuyers have imperfect information about the property tax system and thereby form incorrect expectations about their future tax obligations" (Bradley (2011) p. 14.) Another possible explanation is that homebuyers do not go to the trouble of evaluating every line item in their total property tax bill when purchasing a home (e.g. county tax, municipal tax, water district tax, school district tax, recreation district tax, development district tax, etc.). Homebuyers simply look at the bottom line tax liability and proceed with the purchase when the mortgage underwriter concludes the monthly housing expense falls within acceptable underwriting guidelines. This result has important public policy implications (e.g. should government require explicit disclosure of the tax liabilities associated with owner-occupied housing). Second, most of the existing capitalization literature examines the extent to which the property tax liability associated with ongoing public services (e.g. education, police and fire protection, etc.) is capitalized in house prices. Property taxes that pay for local public services may be positively capitalized in house prices, negatively capitalized, or have no influence on house prices depending on how taxpayers value the benefits provided by those services.[4] Development district bonds have finite maturities and finite repayment obligations. This research avoids the homeowner valuation of benefits problem and examines how the finite-term property tax liability is capitalized in house prices. Third, we empirically illustrate the importance of controlling for spatial attributes by estimating parameters for several hedonic house price specifications that impose increasingly more restrictive controls for neighborhood amenities. We test for differences across specifications using a spatial application of the Wald test. Fourth, to control for possible correlations between unobserved neighborhood characteristics and tax rates, we instrument property tax rates using development district attributes. The validity of the instruments depends on the selection of submarkets (rather than on the choice of variables). Valid instruments for the property tax rate are identified by restricting the sample of transactions to rapidly growing suburban residential developments.

The remainder of this paper has six sections. Section 2 provides a brief review of the relevant literature. Section 3 provides an overview of how special districts are created and provides information on the debt issued by some Denver area development districts. Section 4 describes our empirical approach and data. Sections 5 and 6 provide results and concluding remarks.

2 Literature Review

There are three branches of literature that are relevant for this research: (1) the literature that compares cost sharing techniques to land use extraction methods for financing residential development; (2) the literature that examines whether land use extraction methods, like development or impact fees, influence land and house prices; and (3) the property tax capitalization literature.

Brueckner (1997) theoretically compares impact fees to two cost-sharing techniques for financing development: one where all taxpayers in a jurisdiction pay the infrastructure cost at the time the cost is incurred and a second where taxpayers finance the cost. He concludes that since impact fees are paid by the eventual consumer (e.g. the homeowner), impact fees are more efficient than cost-sharing financing techniques. He also concludes that impact fees generate slower rates of growth and yield higher aggregate property values relative to cost-sharing methods. Peiser (1983) compares patterns of residential development in two Texas cities: Houston, a city that uses local municipal utility districts (MUDs) extensively, and Dallas, a city that relies on much larger, regional utility districts (RUDs) for financing residential development. Peiser argues that economies of scale make RUDs more efficient than MUDs in the long run, but that RUDs also constrain the supply of developable land and increase land prices in the short run. He argues that MUDs permit developers to use less expensive land to develop lots and market competition forces developers to pass those cost savings onto homebuyers. Finally, he concludes that MUDs are particularly effective at supporting rapid, short-term, residential development.

A number of papers have empirically examined the influence that land use extraction fees have on land and house prices.[5] Delaney and Smith (1989) compare house prices in Dunedin, Florida, a city that began using impact fees to finance residential infrastructure in June of 1974, to house prices in Clearwater, Largo, and St. Petersburgh, three Florida cities that did not implement impact fees. They use a hedonic house price model to estimate coefficients in these places and then 'price' a fixed bundle of housing characteristics across cities. They conclude that the Dunedin impact fee increased house prices by an amount that significantly exceeded the fee. Singell and Lillydahl (1990) report that house prices in Loveland, Colorado increased by 7% after that city imposed impact fees in July of 1984. Yinger (1998) notes that the Delaney and Smith (1989) study may have overestimated the effect of impact fees because the authors held land prices constant when they priced housing characteristics across the four markets. If impact fees are anticipated by developers, then developers will reduce the price they pay for raw land. Yinger (1998) also noted that both the Delaney and Smith (1989) study and the Singell and Lillydahl (1990) study did not adequately control for the influence that neighborhood attributes have on house prices. Using data on undeveloped land prices and prices for new and existing homes in Dade County, Florida, Ihlanfeldt and Shaughnessy (2004) report that a dollar of impact fee reduces land price by an equivalent amount and increases the price of both new and existing housing by $1.60.

Beginning with Oates (1969), there are numerous papers that examine whether property taxes are capitalized in house prices.[6] Yinger et al. (1988) summarizes the econometric approaches, data (e.g. aggregate vs. micro) and resulting property tax capitalization rates reported by thirty empirical studies of property tax capitalization published prior to 1988. Based on different methodologies, types of local governments (e.g. municipalities, school districts, special districts), study areas, the assumption of a 3% discount rate and an infinite time horizon of the tax liability, estimates of property tax capitalization range from 15% capitalization to 120%.

3 Development Districts

Develpoment districts are playing an increasingly important role in financing residential infrastructure. Extending water, sewer, and drainage facilities to undeveloped parts of a jurisdiction can be very expensive. Historically, residential infrastructure has been financed using cost-sharing methods, like general obligation municipal revenue bonds, municipal impact fees or the developer's funds (using some combination of short-term construction loans and the developer's equity). Cost-sharing methods typically involve bond financing by an existing general purpose municipal or county government. These general obligation bonds are repaid by all property owners in the jurisdiction. With cost-sharing, the consumers of the new infrastructure are subsidized by all taxpayers in the jurisdiction. Impact fees are upfront fees paid by the developer to cover infrastructure costs. These fees increase the cost of developing residential lots, increase lot prices and eventually increase house prices (relative to cost-sharing alternatives). Some developers have the capital capacity to finance infrastructure development themselves. Residential infrastructure can be financed with short-term construction loans, with the developer's own funds, or with some combination of both.

Table 1 illustrates the growth in special districts, in general, and in development districts, in particular, over the 1992-2002 period. A development district is any special district that provides utilities, sewerage, solid waste management, water, or a natural resource function such as irrigation or flood control. New Mexico added 512 special districts between 1992 and 2002–a four-fold increase in the number of special districts over this ten year period. 510 of these were development districts.

Special districts offer local governments and developers the opportunity to finance residential infrastructure with relatively inexpensive long-term debt while passing the obligation to repay that debt directly onto the ultimate consumer–the homeowner. Special districts in Colorado were first authorized by Title 32 of the Colorado Revised Statute to extend public services to rural and unincorporated parts of the state. They became increasing popular in Colorado following the passage of the Taxpayers' Bill of Rights (TABOR) in 1992. TABOR limits the growth in government revenues to the sum of the population growth rate plus the rate of inflation. Any increase in government revenues over this limit must either be refunded to taxpayers or approved by popular vote in a general election. TABOR applies to the entire State of Colorado as well as to all counties and municipalities within the state. TABOR has made it exceedingly difficult for local jurisdictions to finance residential development using general obligation bonds, as increasing taxes above the TABOR limit requires the approval of a majority of all residents.[7]

What effect does development district infrastructure financing have on house prices? We expect Colorado house prices for homes built in development districts to be lower than house prices for similar homes built outside development districts. Since TABOR, cost-sharing methods (e.g. municipal bond financing) are no longer a viable financing vehicle in Colorado. The primary ways to pay for the construction of residential infrastructure are: (1) at the time of construction using (short-term) developer financing or impact fees; or (2) financing infrastructure development with (long-term) development district bonds. When developers finance the construction of residential infrastructure, they will be reimbursed for this expense when the developed lots are sold. Higher prices for improved lots yield higher prices for completed homes. Similarly, impact fees/connect charges are passed along to homebuyers as part of the construction cost. Alternatively, when development district bonds are used to finance infrastructure, repaying this debt is spread out over a long period of time (e.g. 30 years) and the liability for repaying the debt is passed onto homeowners. This future property tax liability should be (negatively) capitalized in house prices.

The choice between direct developer and special district financing is idiosyncratic to individual developers. The use of development district bonds depends on the developer's understanding of the process for forming a special district, on prevailing interest rates for both construction loans and special district bonds as well as the developer's liquidity constraints and tax liabilities. In addition, the process of underwriting special district bonds carefully examines the financial health/reputation of the developer. Typically, only developers with strong balance sheets and favorable reputations for completing residential land developments are approved for special district bond financing.

In Colorado, special districts are local governments created to provide *at least one of* the following services: water facilities or services, sanitation facilities or services, flood control, streets, roads, alleys, walkways, transit, parks and recreation facilities, golf courses, fire protection, security, insect and animal control, libraries, emergency medical, hospitals, soil and water conservation, television relay and transmission facilities or open space. Special districts that provide multiple services are labeled metropolitan special districts. Real estate developers frequently use special districts to finance the construction of the infrastructure needed to support vertical residential and commercial development.

Special districts are created in four steps. First, district property owners must petition their local government(s) (e.g. municipality or county) to establish a district. If the petition is approved, the district's governing body, usually a board of directors elected by property owners, must submit a service plan to all counties and municipalities that have jurisdiction over the district. The service plans typically include district maps and agreements that explicitly describe which jurisdiction (e.g. county, municipality or service district) will provide what services. Third, the proposed district must be approved in an election of district property owners by either 20% of the eligible voters or by 200 voters, whichever is smaller. In the case of special districts used to finance infrastructure, most of the eligible voters are district land owners. It is possible for the population of 'eligible voters' to consist of one taxpayer–the land-owner/developer. Finally, once the special district is approved by district taxpayers and by all local governments that have jurisdiction, the district is filed with the local court and with the county assessor. After the district is filed with the local court, it may issue bonds. Special districts created to finance infrastructure usually have finite lives.

We define a development district as a metropolitan district with no single-family properties prior to the creation of the district that provides at least two of the following facilities or services: public improvement, street maintenance, public works, water facilities, sewer, storm drainage or transportation. Table 2 lists 45 'high growth' development districts created in the Denver metropolitan area between 1980 and 2002 that have issued bonds to finance the construction of residential infrastructure.[8] A development district is labeled 'high growth' if it is located in a Census Block Group (CGB) that had at least twenty recently built single-family homes sold between 2002 and 2004 and those twenty properties represented at least twenty percent of the year 2000 CBG housing stock. The table provides the district name, location, size (in square miles), the year the district was created and the 2003 development district property tax rate. Nearly three-quarters (33 of 45) of the development districts are located in Douglas and Adams Counties, two rapidly growing suburban counties located south and east of the City/County of Denver. Development district sizes range from 0.35 square miles (224 acres) to over 9 square miles (over 5,760 acres). The average district size is 2.65 square miles. About half (22 of 45) of the development districts were created in the 1980s, 19 were created in the 1990s and 4 were created after 2000. The across development district average property mill levy in 2003 was 35.7 mills and development district property tax rates ranged from 6 to 90 mills.

Table 3 provides descriptive information for the bonds issued by these development districts. The table includes the bond CUSIP[9] code, the issue date, maturity, term, the aggregate amount of the bond (or bonds), whether the coupon rate was fixed or variable, and, for fixed rate bonds, the interest rate. While all of the development districts in Table 2 issued bonds to finance infrastructure, some of these bonds were privately placed. Consequently, descriptive information for these district bonds is not publicly available. Table 3 provides information for the 33 districts that sold bonds to the public. Some of the districts issued multiple bonds. For these districts, the CUSIP, issue date and maturity refer to the most recent issue prior to 2004 while the bond amount is the total amount of all bonds issued by the district. Bond amounts range from $1.2M to $72.2M. The average amount issued was $12.2M. Bond maturities range from six to forty years. Seventy-five percent of the bonds had maturities between twenty and thirty years. The average maturity was twenty-four years. Most of the bonds paid a fixed coupon. The average fixed-rate coupon was 6.87%. Any concern that the use of development districts is determined by the attributes of a residential development (e.g. land area or number of housing units) is addressed in Table 2, which highlights a range of development district attributes.

For some districts, there is a big disparity between the date the district is created and the time the bonds are issued. Development district bonds are issued just prior to (and sometimes just after) infrastructure development begins. Once the bonds are issued, the bond repayment clock starts and properties must be built, sold, registered on the assessor's file and begin generating property tax revenues to repay the debt. Development district bonds are typically created with interest reserve accounts adequate to pay interest for the first few years of the bond. Interest reserve accounts may be created with terms of up to three years.

As an example, the Brighton Crossing Metropolitan District was created in 1985. The development district covers 7.78 square miles in Adams County, Colorado. Within this area, a developer has proposed a residential development encompassing 771 acres. The developer plans to build 3,555 single-family homes on 547 acres and 927 multifamily units on 91 acres. The developer allocated 108 acres to parks, trails and recreation facilities and 25 acres to streets and walks. The water, sewer and flood control infrastructure for this development costs $45.7M. The district issued its first bond for this development in December 2004–twenty years after the district was created. The bond amount was $13.8M and the bond maturity was 30 years. The Brighton Crossing Metropolitan District tax rate was 38 mills in 2003.

4 Empirical Approach

This paper empirically examines the effect that financing residential infrastructure using development districts has on house prices. We employ a hedonic house price model to examine the extent to which development district property taxes are capitalized in house prices.[10] We begin with our hedonic house price model. Let the natural log of the price for house i in period t be represented by:

$$ln(P_{i,t}) = \alpha + \beta X_i + \eta N_i + \gamma G_i + \tau T_i + \Sigma_{j=2}^{N} \delta_j D_{i,j} + \varepsilon_{i,t} \tag{1}$$

where

$P_{i,t}$ = the transaction price for house i in period t;

X_i = a vector of structural characteristics for property i;

N_i = a vector of neighborhood characteristics for property i;

G_i = a vector of government characteristics for property i;

T_i = the property tax mill rate;

$D_{i,j}$ = 1 if property i sold in period j (j = 2,. . . , N), and equals 0 otherwise;

α = the hedonic equation intercept;

β = a vector of structural characteristic hedonic coefficients;

η = a vector of neighborhood characteristic hedonic coefficients;

γ = the vector of government characteristic hedonic coefficients;

τ = the hedonic coefficient for the property tax rate;

δ_j = hedonic coefficients for sale period j binary variable (j = 2,. . . , N); and

$\varepsilon_{i,t}$ = error term for property i in period t.

The structural characteristics include the usual variables: lot size, square feet of living space, number of bathrooms, etc.[11] Since many of the neighborhood amenities that influence house prices are not observed, we control for spatial variation in neighborhood characteristics using Census Block Group (CBG) fixed effects.[12] The incorporation of neighborhood level fixed effects control for any neighborhood characteristic that is observable or unobservable (e.g. type and density of land use, distance to the Central Business District (CBD) and household incomes). This limits identification to only intra-CBG variation. Controls using neighborhood effects is well suited for examining infrastructure financing districts because they lack potential spillovers across development district boundaries. The roads, curb, gutter, water, and sewer constructed within a development district are typically not accessed or used by neighboring residential developments. Given the large number and spatial variation of local governments in Colorado highlighted by Billings and Thibodeau (2011), we also include dummy variables for other, non-development district, special districts and municipalities that provide services.

Our data consists of 34,048 transactions of recently built single-family homes sold in the Denver metropolitan area. Properties were recently built and subsequently sold during the 2002-2004 period. The Denver-Boulder-Greeley Consolidated Metropolitan Statistical Area (CMSA) consists of the City/County of Denver, its bedroom communities, and nearby employment centers.[13] A transaction is classified as a new property if it was less than or equal to three years old at the time of sale. In addition, the data is limited to properties situated on between 0.05 and 5 acre lots and with transaction prices between $\$100,000$ and $\$1,000,000$. All data on special districts is current as of 2003. The original government dataset was provided by the Department of Local Affairs, State of Colorado, in shapefiles for jurisdictional boundaries and electronically for mill levies. It was further supplemented with paper records from files in the Denver, CO office.[14]

According to the Colorado Department of Local Governments, there were 672 special districts and 377 metropolitan districts in the Denver metropolitan area in 2003. We classified 84 of these as development districts. Forty-four of these development districts were created since 1993 and the remaining 40 development districts pre-date 1993. During the twenty year period prior to TABOR, development districts in Colorado were created at an annual rate of 1.9 per year. Following TABOR, development districts were created at the annual rate of 4.4 districts per year. More recently created development districts are likely not fully captured in the dataset due to the time lag between the creation of a development district and the sale of a new home.

Since property transactions and development districts are based on the entire Denver urban area, the observations included in the empirical analysis represent the full choice set for households in the market for new homes. This represents an improvement over existing studies, which commonly limit hedonic estimates to a single county (see Yinger et al. (1988)). The use of a single county has the potential to generate varying elasticities of demand and property tax capitalization depending on the housing stock and on the property tax burden of residential units available in neighboring counties within the same metropolitan area. Ignoring this spatial dependency between neighboring counties will lead to inefficient estimators and even biased regression coefficients.[15]

Yinger et al. (1988) note two major criticisms of studies that estimate property tax capitalization: (1) the lack of controls for the public services financed by the property tax; and (2) failure to adequately control for differences in neighborhood characteristics associated with different property taxing jurisdictions. The first concern is partially mitigated by focusing on newly constructed homes and property taxation associated with financing development infrastructure. A series of control variables for the existence of other municipal or non-development special districts will further alleviate this concern. To address the second criticism, we control for variation in neighborhood amenities that influence residential property values by including fixed effects for CBGs. To further control for unobserved neighborhood characteristics that may be correlated with property tax rates, we spatially subsample all single-family sales based on CBGs that experience high rates of new residential construction. We partition the data into three increasingly restrictive subsamples: the first consisting of all 2002-2004 sales of recently constructed homes built on lots between 0.05 and 5 acres with transaction prices between $\$100,000$ and $\$1,000,000$; a second sample limited to recently built properties located in CBGs that had at least twenty sales over the 2002-2004 period and with those sales representing at least 20% of the CBG housing stock (as reported by the 2000 Census); and a third sample that further restricts the data to only those transactions in CBGs that included at least 20 sales located both within and outside development districts and with these sales representing at least 20% of the year 2000 CBG housing stock.[16] The first sample contains 34,048 transactions with 84 development districts and 654 CBGs. The second sample contains 27,869 transactions with 69 development districts and 81 CBGs. The third sample contains 16,543 transactions with 45 of the 50 development districts located in 23 CBGs listed in Table 2.

Table 4 provides summary statistics for the three samples. The top panel summarizes the data for all 2002-2004 transactions; the middle panel summarizes the data for the CBGs with at least 20 sales and with sales representing at least 20% of the year 2000 neighborhood housing stock; the bottom panel summarizes the data for just those CBGs that have at least 20 sales with sales representing at least 20% of the housing stock and with at least 20 transactions located both within and outside development districts. For the entire sample of 34,048 sales, there were an average of 52.1 sales per CBG. The sales rate increased to 344.1 sales per CBG for the second sample and to 722.2 sales per CBG for the third. Population densities decreased significantly as the data were restricted to CBGs containing development districts as these places were in the process of building out. The population densities were 3,294 people per square mile for the 654 CBGs; 1,109 for the 81 CBGs and 552 for the 23 CBGs in the most restrictive subsample. Spatially disaggregated subsamples better controlled for differences in the number of homes sold within versus outside a development district for a given CBG. A test for differences in means between the number of homes sold inside and outside development districts was significant at the 5% level in only the full sample of CBGs.[17] This indicates that these sub-samples can adequately control for the size of new developments located both inside and outside development districts within the same CBG. This sub-sampling becomes essential in later IV regressions in order to construct valid instruments for the tax rate. Restricting our analysis to similar homes and residential developments allows us to remove correlations between any omitted variables captured in our error term and our instruments based on the attributes of development districts.

Table 5 provides the definitions of variables employed in various hedonic specifications. This table defines four categories of variables: (1) house price; (2) property characteristics including lot size, square feet of living area, number of bathrooms, dummy variables for garage, forced air heat and fireplaces; (3) dummy variables for sale quarter; and (4) government variables including development district property tax rate, the number of local governments/special districts serving the property, the total annual property tax liability and the total annual taxes paid to the development district. Local governments serving a property always include the county government and the school district and may include a municipality and other non-development special/municipal districts (e.g. recreation, security, etc.)

Table 6 provides summary statistics separately for all transactions located within development districts and for all sales located outside development districts. There are 13,582 transactions of recently built single-family homes located within development districts and 20,466 sales located outside development districts. The mean transaction price for properties located inside development districts is slightly lower than the mean transaction price for properties located outside development districts ($\$318,622$ vs. $\$322,347$). Homes built inside development districts are slightly larger and the mean per square foot transaction price is lower for development district homes ($135 per square foot vs. $144 per square foot). Development district homes are located on slightly smaller lots (0.20 acres vs. 0.27 acres) and more of the development district homes come with garages, forced air heat and fireplaces, but there is likely to be significant spatial variation in these attributes that is not taken into account in these summary statistics. Properties located within development districts also have more local governments providing services and pay higher property taxes on average. The average development district tax rate *across transactions* is 36.7 mills.

5 Results

As noted by Yinger et al. (1988), one of the inherent econometric difficulties in estimating tax capitalization is the simultaneity between house prices and tax rates. The simultaneity occurs because higher property values provide more property tax revenue for a given tax rate. Since infrastructure such as water, sewer and roads have similar fixed costs for both high- and low-valued properties, lower mill rates can cover the costs of infrastructure in neighborhoods with higher property values. To account for this simultaneity as well as unobserved public good heterogeneity, we estimate property tax capitalization using an instrumental variable for the tax rate.

An appropriate instrument for the tax rate is one that influences the tax rate, yet is uncorrelated with the error term in Equation 1. Characteristics likely to influence a development district's tax rate, but not specific home prices are those that influence the per home cost of the infrastructure, but not local amenities that could be capitalized in home prices. We hypothesize that the overall size and buildout of a subdivision will impact the cost of repaying the SD bond, but not the level of infrastructure provision for an individual home. The three variables used to instrument tax rates (mill levies) are: (1) the number of homes sold within the development district between 2002 and 2004; (2) the land area of the development district (in square miles); and (3) the number of years since the development district was created. We generate instrumental variable (IV) results across the three spatially sub-sampled datasets and report test statistics that examine the validity of these instruments.

Since most house price hedonic models exhibit heteroskedasticity[18], we are concerned that a standard two stage least squares IV estimator may produce inconsistent standard errors. Therefore, we employ a Generalized Methods of Moments (GMM) estimation techinque which allows for efficient estimation even in the presence of heteroskedasticity of unknown form.[19] We test the need to incorporate instrumental variables with a Hausman-Wu-Durbin test, which confirms the endogeneity of the mill levy variable in all specifications.[20] Given that our model contains more instruments than endogenous variables, we implement a Hansen J Test, which uses the overidentification in our instrumental variable model to test if the instruments are correlated with the error term in the house price equation (Cameron and Trivedi (2005)). A Hansen J Test p-value greater than 0.05 accepts the null and concludes that the instruments are valid. Test results are provided for each model and indicate that the GMM-IV technique is only appropriate for the final two models and that the estimated coefficients for property tax capitalization in the first two models are biased. Finally, the p-values for the F-statistics and Shea's partial R-squared measure the explanatory power of the instruments for $DevDistMillLevy$. The significance level of the F-statistics as well as the the instruments ability to explain property tax rates (given by a Shea's R-squared of around 0.4) indicates sufficiently strong instruments.

We estimate the influence that the development district property tax liability has on property values for three different subsamples, with each subsample imposing more restrictive controls for neighborhood characteristics. The final subsample represents the model used for interpreting results and has the advantage of limiting identification to comparing developments within a CBG in rapidly growing suburban areas. Therefore, the elasticity of supply will be similar between development districts and non-development district subdivisions. In addition, the results can be interpreted as the effect of moving a house from a development district to a non-development district. The variables included in the hedonic house price equation include a standard bundle of housing characteristics; dummy variables for transaction sale quarter; a set of dummy variables that indicate whether a property is served by a municipality, fire, recreation or a non-development based metropolitan special district; and, for three of the four specifications, dummy variables for CBG. In order to control for the noncoterminous boundaries of school districts and CBGs, regression specifications include dummies for each unique combination of CBGs and school districts.[21]

We report estimated coefficients for each of four alternative hedonic house price models using both OLS and Generalized Methods of Moments-Instrumental Variables (GMM-IV). Table 7 provides regression results. Model 1 in Table 7 provides results for all 34,048 sales without any controls for CBG fixed effects but includes variables that control for distance to downtown Denver (in miles) and distance to downtown squared. The first column lists OLS estimates and the second lists GMM-IV estimates. This model indicates a smaller tax coefficient of -0.000336 for OLS and a relatively large negative tax coefficient of -0.002112 for the GMM-IV model. Evaluated at the mean transaction price for development district homes ($\$318,622$) and the mean development district tax rate ($36.7 mills$), the average single-family property tax capitalization is 1.23% or $\$3,929$ for the OLS estimate and 7.75% or $\$24,697$ for the GMM-IV estimate. Residential properties in Colorado are assessed at 7.96% of their market value, so the mean assessed value for development district properties is $\$25,362.31$. With an average development district property tax rate of 36.7 mills[22], the average annual development district property tax liability is $930.80.

So how much of this annual development district property tax liability is capitalized in house prices? The amount of capitalization depends on two things: (1) the discount rate that homeowners use to convert the future tax liability to a present value; and (2) the remaining term of the tax liability. We assume, for simplicity, that homeowners can take full advantage of the property tax deduction and that homeowners discount future property tax liabilities at the after tax mortgage interest rate.[23] The average nominal mortgage interest rate for thirty-year, fixed rate mortgages over the 2002-2004 period was 6.07%. So households in the 28% tax bracket discount future expected development district property taxes at 4.37%. If we further assume that the annual property tax is an annuity (e.g. that mill rates will decrease if property values increase to provide a constant payment) and discount the annual annuity of $930.80 at 4.37% over 19 years (the average *remaining term* for the district bonds listed in Table 3), homeowners value the future development tax liability at $\$11,850$. Under these assumptions, Model 1 estimates that **33.2**% of the development district tax liability is capitalized in the price of new single-family homes using OLS and **209**% using GMM-IV. The range of estimates is attributed to two problems estimating the parameters in the first model. First, unobserved neighborhood heterogeneity, where in-fill new homes in bedroom communities such as Boulder, CO are treated comparably to suburban subdivisions. The higher land rents for in-fill development likely biases the tax coefficient downward because development districts are commonly used for suburban subdivisions. Second, since the Hansen's J Test rejects the null hypothesis of valid instruments, the instrumental variables adopted in Model 1 are inappropriate and the estimated tax coefficient obtained using GMM-IV is biased. All of the other estimated coefficients in Model 1 are statistically significant at conventional levels.

The second model estimates parameters using *the same* 34,048 transactions and the same instruments, but incorporates better controls for variation in neighborhood amenities by including fixed effects for CBGs.[24] Hansen's J Test also rejects the null hypothesis that the selected instruments are valid in Model 2. The GMM-IV estimated coefficient for the development district tax rate decreases to -0.000379. With this (biased) estimate, the house price discount is reduced to 1.39%, or $4,432, and, using the same set of assumptions used to estimate property tax capitalization for Model 1, the rate of property tax capitalization declines to 37.4% (from 209%)! The dramatic change in estimated capitalization is the result of controlling for spatial variation in neighborhood amenities using CBG fixed effects. The estimated coefficients for lot size (in acres) are virtually identical in Models 1 and 2, but there are significant differences in many of the other estimated coefficients. In Model 2, estimated coefficients for all structural characteristics are statistically significant at conventional levels. Including CBG fixed effects significantly improves the model's goodness of fit with R-squares increasing from 76% of the variance in the natural log of transaction price explained to 88%.

Since GMM-IV estimates are only valid for the third and fourth models, we focus our attention on the results generated by these models. The subsampling of homes in only CBGs with development districts and high rates of new housing construction provides sufficient controls for unobserved variables to remove the correlation between the hedonic house price error term and the three instruments for mill levy included in GMM-IV estimation. Model 3 restricts the data to transactions in CBGs with at least 20 sales and with those sales representing at least 20% of the year 2000 neighborhood housing stock. This subsample increases the magnitude of the the estimated coefficients for both the development district tax rate and for lot size. The estimate of the house price discount generated by GMM-IV estimates in Model 3 is $4,432 and the estimated development district property tax capitalization is **37.4%**. This is in stark contrast to the insignificant OLS coefficient of -0.000105 .

Model 4 further limits the sample to those homes built and sold in CBGs with at least 20 sales located both within and outside development districts.[25] Relative to OLS Model 4, GMM Model 4 increases both the estimated property tax capitalization effect and the marginal value of land.[26] The estimated house price discount is 1.83%**, or** $5,812, and the estimated development district property tax capitalization is **49.0%**.[27] The estimated coefficients for square feet of living space squared and attached garage become statistically insignificant. Unreported coefficients for government variables were statistically insignificant except that fire special districts and non-development metropolitan special districts negatively influence house prices.[28] In addition, while the first three models indicate that house prices were increasing throughout the 2002-2004 period, the fourth specification indicates that house prices were basically flat for the first five quarters of the 2002-2004 period suggesting developers were unable to increase house prices as the rapidly growing developments were being built out.

The estimated coefficients for lot size, ForcedAirHeat and Garage vary significantly across all models in Table 7. The estimated coefficients for the other structural characteristics were similar across the three samples given by Models 2, 3 and 4. Given the similarity of a number of coefficients in Models 2, 3 and 4, the sampling of subsequently smaller numbers of CBGs may represent the same underlying data generating process. The three subsamples given in Models 2 through 4 represent a full model and two spatially restricted models. The restricted models assume a structural break based on the rate of development (e.g. high-growth versus low-growth CBGs). In order to test this assumption, a Wald test is used to compare the estimated coefficients for all property and tax variables in Model 4 to the estimated coefficients generated by the samples of observations in Models 2 and 3 that were excluded from Model 4. The Wald test yields a $\chi^2 = 208.3$ ($p = 0.000$)

and rejects the null hypothesis that Model 4 is structurally equivalent to Model 2 at a 1% level. The Wald test between Models 3 and 4 yields a $\chi^2 = 206.4$ ($p = 0.000$) and rejects the null hypothesis that Model 4 is structurally equivalent to Model 3 at a 1% level.

The empirical results reported above depend on two criteria for delineating submarkets: (1) the minimum number of transactions in the CBG; and (2) the share of home sales used to delineate high growth areas. To examine the sensitivity of our results to these criteria, we estimated the parameters of Model 4 under a variety of alternative assumptions. Table 9 shows the robustness of the empirical results to variation in the minimum number of transactions both within and outside development districts and the percent of CBG homes sold. Estimated tax coefficients for Model 4 vary by less than 5% across these four different assumptions.[29]

Table 10 provides estimated capitalization effects for each of the 33 Denver area development districts highlighted in Table 3.[30] For each development district, the table lists the average transaction price, the development district tax rate, the estimated house price discount obtained using the parameter estimate from Model 4 (our preferred specification), the annual property tax, the term remaining on the development district bonds, the present value of the future development district tax liability (assuming households are in the 28% marginal tax bracket and can take full advantage of the property tax deduction), and the percent property tax capitalization. The presence of greater than or almost 100% capitalization for some development districts is due to the use of the mean estimated tax coefficient for development districts with few years remaining on the terms of the bond as of 2004.[31]

Another way to interpret this result is to compute the length of time necessary to justify the estimated capitalization given the annual tax liability and the homeowners' discount rate.[32] At a discount rate of 4.37%, about 7.4 years of annual property tax payments are capitalized in house prices; at 6.07% (assuming the household either does not itemize or cannot use the property tax deduction), about 8.1 years of property taxes are capitalized.

6 Concluding Remarks

This paper empirically examines the extent to which property taxes associated with development district financing of residential infrastructure is capitalized in the price of new, owner-occupied homes. We estimate the parameters of a hedonic house price model and control for variation in neighborhood attributes using CBG fixed effects and by restricting the sample to single-family homes built in CBGs containing numerous sales of properties located both within and outside development districts. We find that about half of the future property tax liability is capitalized in house prices. Alternatively, homebuyers capitalize between 7.4 and 8.1 years of property tax liability in the purchase price. We also find that our estimates are very sensitive to the sample used, with the most accurate capitalization rates estimated from the sample that provides the best empirical controls for neighborhood attributes and area growth rates.

A hedonic house price specification that fails to adequately control for neighborhood amenities and/or provide inadequate controls for the endogeneity of property tax rates can yield biased estimates of property tax capitalization. Two elements of our empirical model address these potential biases. First, we limit the data to rapidly growing residential developments and control for variation in neighborhood amenities using CBG fixed effects. Second, we incorporate instrumental variable estimation of development district property tax rates. Statistical tests for instrument validity indicate that it is necessary to restrict the estimation sample to rapidly growing suburban areas to attain valid instruments for the property tax rate. The final estimate of development district property tax capitalization is about 50%. Given our estimation targets new suburban developments, our estimated tax capitalization rate provides a lower bound for urban/center city homes.

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Notes

[1]Special districts are also referred to as special service districts, special purpose districts, limited purpose districts, municipal development districts and municipal utility districts.

[2]For more information on special districts, see Galvan (2007) and Griffith (2007).

[3]One of the authors had numerous conversations with residential developers and special district bond underwriters in Colorado. These individuals unamimously concluded that no residential infrastructure development since TABOR was financed with municipal bonds.

[4]See Billings and Thibodeau (2011) for more discussion on measuring property tax capitalization for net benefits.

[5] See Evans-Cowley and Lawhon (2003) for a more complete review of this literature.

[6]See Brueckner (1979), Starrett (1981), Yinger (1982), Yinger et al. (1988), Zodrow (2006) and Bradley (2011) for analysis and additional references on property tax capitalization.

[7]As of 2005, twenty nine states had Tax and Expenditure Limits (TELs) like TABOR that provide limits on local government finances (NCSL (2008)). A few scholars (e.g. Nelson (1990) and Carr (2006)) directly link TELs to the creation of special district governments.

[8]There were five special/metropolitan districts that were classified as development districts but were excluded from Table 2 because they did not issue any bonds as of 2004.

[9]The CUSIP (Committee on Uniform Security Identification Procedures) identifier provides an unique code to allow identification of the issuer of any North American security.

[10]Yinger et al. (1988) and Palmon and Smith (1998) incorporate a non-linear specification for estimating property tax capitalization. While this specification is well motivated, it requires assumptions or estimates of annual user costs/rental value for a property. The lack of rental data for a comparable stock of new homes precludes this technique.

[11]The hedonic specification excludes dwelling age since all of the homes are new (e.g less than three years old).

[12]As shown by Thibodeau (2003), segmenting single-family home markets into smaller geographic areas controls for spatial autocorrelation.

[13]Denver and Broomfield are both cities and counties, integrated into a single government institution and treated as a county in this dataset. The Denver-Boulder-Greeley CMSA consists of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, and Weld counties.

[14]All Geographical Information Systems datawork is implemented using the Colorado Central Zone State Plane NAD83 Projection.

[15]See Klotz (2004) for a discussion of the implications of spatial dependence in regression models.

[16]Conceptually, this third subsample involves matching neighboring developments that are similar in size, but vary in their implementation of development districts.

[17]The complete data sample generated a p-value of 0.022; the middle sample p-value is 0.266 and the most restrictive

sample p-value is 0.382.

[18]A Breusch-Pagan test confirms the presence of heteroskedasticity in our model. These results are available upon request.

[19]See Baum et al. (2003) for a articulate discussion of GMM-IV estimation in Stata.

[20]See Cameron and Trivedi (2005), Wooldridge (2002), or Section 5 of Baum et al. (2003) for a description of the Hausman-Wu-Durbin test.

[21]A total of 28 school districts in Model 2, 11 school districts in Model 3 and 6 school districts in Model 4 contain a boundary that falls within a CBG.

[22] Correspondingly, properties not located in a development district contain a development district property tax rate equal to 0 mills. Controls for other types of governments address any underlying property tax differences between development district and non-development district properties.

[23]See de Bartolome and Rosenthal (1999) for a good discussion of property tax capitalization under different assumptions regarding tax and mortgage interest deductions.

[24]Distance to downtown and distance to downtown squared variables are no longer necessary when CBG fixed effects are included in the specification.

[25]We attempted to disentangle the capitalization of special district tax liability from being in a development district versus the magnitude of the tax rate by incorporating a dummy variable into Model 4. Unfortunately, the inclusion of the development district indicator made our instrumentation of the tax rate invalid according to a Hansen's J Statistic p-value of 0.00.

[26]Under our assumptions about how homeowners discount future expected tax liabilities, the test of 100% capitalization is equivalent to a test of whether the estimated coefficient for the tax rate variable is statistically different from -0.0010139. The estimated coefficient for the tax rate variable in Model 4 is statistically different from -0.0010139 at the 0.01 level (as the estimated coefficient of -0.000497 is 3.4 standard errors away from -0.0010139).

[27]If homeowners were unable to take advantage of the property tax deduction and discounted future development district tax liabilities at 6.07% instead of 4.37%, then present values of future tax liabilities decrease and estimates of property tax capitalization increase to **45**% in Model 3 and **58**% in Model 4.

[28]In Models 2 through 4, government variables provide controls for the case when special districts contain boundaries that fall within both a development district and a CBG. This only occurs within a few CBGs.

[29]Across the different assumptions in Table 9, instruments were valid with J test p-values between 0.13 and 0.31. Less restrictive sub-sampling produced invalid instruments.

[30]The remaining 17 development districts used in estimation contained incomplete bond data to compute capitalization rates for individual development districts.

[31]Estimation of tax coefficients by variation in years remaining on special district bonds would provide interesting insight into a taxpayer's response to the length of finite tax liabilities. Unfortunately, the limited number of development districts with information on special district bonds prevents us from estimating tax capitalization for different

remaining bond maturities.

[32]One can calculate the number of years (N) required to equate the present value of future tax liability to equal the property value capitalization based on $N = ln(\frac{AR}{(AR+1000\beta d)})/[ln(1+d)]$, where AR = assessment rate, which is 0.0796 in Colorado, β is the estimated tax coefficient, and d is the homeowner's discount rate.

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Table 1: **Growth in Special/Development Districts, by State: 1992-2002**

	Special Districts				**Development Districts**			
	Total		1992-2002 Change		Total		1992-2002 Change	
	1992	2002	Number	Percent	1992	2002	Number	Percent
New Mexico	116	628	512	441%	94	604	510	543%
Wisconsin	377	684	307	81%	192	511	319	166%
Illinois	2,920	3,145	225	8%	1,185	1,263	78	7%
Indiana	939	1,125	186	20%	247	319	72	29%
Wyoming	373	546	173	46%	213	301	88	41%
Florida	462	626	164	35%	200	350	150	75%
Colorado	1,252	1,414	162	13%	632	708	76	12%
Georgia	421	581	160	38%	84	177	93	111%
New York	980	1,135	155	16%	13	19	6	46%
Iowa	388	542	154	40%	289	333	44	15%

Table 2: **Metropolitan Denver Development Districts**

Development District Name	**County**	**Nearest/in City/Town**	**Area (SqMi)**	**Date District Created**	**2003 Property Mill Levy**
Aurora Single Tree Metropolitan District	Adams	Aurora	4.21	1998	42.6
Belle Creek Metropolitan District	Adams	Commerce City	2.30	2000	47.9
Brighton Crossing Metropolitan District No. 4	Adams	Brighton	7.78	1985	38.0
Broadlands Metropolitan District No. 1	Adams	Broomfield	0.39	1997	20.0
Bromley Park Metropolitan District No. 2	Adams	Brighton	6.90	1985	38.0
Buffalo Ridge Metropolitan District	Adams	Commerce City	2.30	1996	37.3
Buffalo Run Mesa Metropolitan District	Adams	Commerce City	2.30	2002	42.0
Canterberry Crossing Metropolitan District	Douglas	Parker	1.39	1996	39.5
Canterberry Crossing Metropolitan District II	Douglas	Parker	0.64	2000	37.3
Cherry Creek South Metropolitan District No. 1	Douglas	Parker	2.57	1985	39.8
Compark Business Campus Metropolitan District	Douglas	Parker	0.35	1998	45.2
Eagle Bend Metropolitan District No. 2	Arapahoe	Aurora	0.76	1998	45.3
Eagle Creek Metropolitan District	Adams	Commerce City	2.30	1996	50.0
East Smoky Hill Metropolitan District No. 2	Arapahoe	Aurora	0.49	1994	17.0
Ebert Metropolitan District	Denver	Denver	0.47	1982	39.0
Gateway Regional Metropolitan District	Adams	Aurora	9.10	1998	10.0
Goodman Metropolitan District	Arapahoe	Foxfield	0.80	1994	26.5
GVR Metropolitan District	Denver	Denver	5.36	1983	30.3
Highlands Ranch Metropolitan District No. 1	Douglas	Littleton	4.40	1980	20.3
Highlands Ranch Metropolitan District No. 3	Douglas	Lone Tree	4.54	1980	20.3
Highlands Ranch Metropolitan District No. 4	Douglas	Littleton	4.37	1980	20.3
Interlocken Consolidated Metropolitan District	Boulder	Broomfield	1.16	1994	27.2
Lincoln Park Metropolitan District	Douglas	Parker	0.59	1983	45.0
Maher Ranch Metropolitan District No. 4	Douglas	Castle Rock	2.81	1987	40.0
Meadows Metropolitan District No. 1	Douglas	Castle Rock	0.79	1985	35.0
Meadows Metropolitan District No. 2	Douglas	Castle Rock	1.73	1985	35.0
Meadows Metropolitan District No. 6	Douglas	Castle Rock	0.73	1985	35.0
Meadows Metropolitan District No. 7	Douglas	Castle Rock	1.73	1985	35.0
North Range Village Metropolitan District	Adams	Commerce City	2.30	1999	38.5
Parker Properties Metropolitan District No. 1	Douglas	Parker	1.47	1985	24.0
Pinery West Metropolitan District No. 2	Douglas	Castle Rock	3.37	1998	45.0
Potomac Farms Metropolitan District	Adams	Commerce City	2.30	2001	38.0
Riverdale Dunes Metropolitan District No. 1	Adams	Commerce City	2.30	1996	45.0
Roxborough Village Metropolitan District	Douglas	Littleton	1.84	1985	70.1
Second Creek Ranch Metropolitan District	Denver	Aurora	4.72	1985	90.0
Sterling Hills Metropolitan District	Arapahoe	Aurora	0.60	1994	30.0
Stonegate Village Metropolitan District	Douglas	Parker	0.77	1983	27.4
Superior Metropolitan District No. 2	Boulder	Louisville	1.79	1988	22.0
Tallyn's Reach Metropolitan District No. 2	Arapahoe	Aurora	9.33	1998	49.0
Tallyn's Reach Metropolitan District No. 3	Arapahoe	Aurora	9.33	1998	49.0
Todd Creek Farms Metropolitan District No. 1	Adams	Thornton	1.95	1994	16.5
Todd Creek Farms Metropolitan District No. 2	Adams	Thornton	1.95	1996	18.0
Town Center Metropolitan District	Denver	Denver	0.88	1983	39.0
Upper Cherry Creek Metropolitan District	Douglas	Parker	0.70	1985	6.0
Villages At Castle Rock Metropolitan District	Douglas	Castle Rock	3.37	1984	40.0
Average			2.65	1994	35.7

Table 3: **Development District Bonds**

Development District Name	Bond CUSIP	Issue Date	Maturity	Term (Years)	Rate Fixed/ Amount	Interest Variable	Rate
Aurora Single Tree Metropolitan District	05206NAA8	10/5/2000	11/15/2025	25	$1,575,000	Fixed	8.000%
Belle Creek Metropolitan District	078341AA2	10/1/2000	12/1/2020	20	$5,215,000	Fixed	8.000%
Brighton Crossing Metropolitan District No. 4	109330AA8	12/17/2004	12/1/2034	30	$13,800,000	Variable	
Broadlands Metropolitan District No. 1	11132NAA5	8/6/1998	8/1/2018	20	$4,925,000	Variable	
Buffalo Ridge Metropolitan District	119802AA4	12/1/2003	12/1/2033	30	$10,130,000	Fixed	7.500%
Canterberry Crossing Metropolitan District	138100AE2	12/27/2001	12/1/2031	30	$10,430,000	Fixed	6.700%
Canterberry Crossing Metropolitan District II	138101AB6	12/1/2002	12/1/2032	30	$7,500,000(a)	Fixed	(a)
Cherry Creek South Metropolitan District No. 1	164561AC6	5/15/2003	12/15/2033	30	$10,060,000(b)	Fixed	(b)
Eagle Bend Metropolitan District No. 2	269422AA9	10/1/1999	12/1/2018	19	$7,500,000	Fixed	6.875%
Eagle Creek Metropolitan District	269492AA2	11/1/2001	6/1/2021	20	$2,000,000	Fixed	6.750%
East Smoky Hill Metropolitan District No. 2	275292AD2	8/31/2000	12/1/2030	30	$9,600,000(c)	Fixed	(c)
Gateway Regional Metropolitan District	36779TAA7	5/15/2000	12/1/2010	10	$1,235,000	Fixed	6.500%
Goodman Metropolitan District	38238EAA1	6/1/1999	12/1/2019	20	$5,000,000	Fixed	5.000%
GVR Metropolitan District	362374CL2	12/15/1999	12/1/2019	20	$13,165,000(d)	Fixed	(d)
Highlands Ranch Metropolitan District No. 1	431096EW2	6/1/1997	9/1/2012	15	$19,415,000(e)	Fixed	(e)
Highlands Ranch Metropolitan District No. 3	430905BY4	6/1/1999	12/1/2019	20	$13,075,000(f)	Fixed	(f)
Highlands Ranch Metropolitan District No. 4	430903BB9	4/1/1997	12/1/2017	20	$5,390,000(g)	Fixed	(g)
Interlocken Consolidated Metropolitan District	458761BE2	11/15/1999	12/15/2019	20	$72,215,869(h)	Fixed	(h)
Lincoln Park Metropolitan District	534550AB4	6/29/2001	12/1/2026	25	$16,610,000	Fixed	7.750%
Maher Ranch Metropolitan District No. 4	559827AB6	6/1/2003	12/1/2027	25	$13,100,000(i)	Fixed	(i)
Meadows Metropolitan District No. 1	582903BU3	9/1/1989	6/1/2029	40	$30,730,000	Fixed	7.990%
Meadows Metropolitan District No. 2	582903BW9	9/1/1989	6/1/2029	40	$15,440,000	Fixed	7.990%
North Range Village Metropolitan District	661766AA3	8/1/2000	12/1/2020	20	$2,800,000	Fixed	8.000%
Pinery West Metropolitan District No. 2	723295AA9	12/30/2002	11/1/2032	30	$21,815,000	Fixed	3.700%
Potomac Farms Metropolitan District	73768TAA3	3/1/2002	12/1/2032	30	$4,315,000	Fixed	6.850%
Riverdale Dunes Metropolitan District No. 1	768643AA6	1/1/2002	12/1/2032	30	$3,800,000	Fixed	6.500%
Roxborough Village Metropolitan District	779814BG6	9/1/1993	12/31/2021	28	$6,247,629	Not Reported	Not Reported
Sterling Hills Metropolitan District	85933LAB2	11/1/1998	6/1/2018	20	$2,000,000	Fixed	7.750%
Stonegate Village Metropolitan District	861819BJ8	11/1/1996	12/1/2025	29	$42,330,000(j)	Fixed	(j)
Superior Metropolitan District No. 2	86820PAK7	6/18/1998	12/1/2013	15	$9,190,000	Fixed	4.625%
Todd Creek Farms Metropolitan District No. 1	88901POA2	11/16/2001	12/1/2021	20	$12,500,000	Fixed	5.000%
Todd Creek Farms Metropolitan District No. 2	889013AS7	6/1/2003	12/1/2018	15	$2,755,000(k)	Fixed	(k)
Upper Cherry Creek Metropolitan District	915618CC4	5/15/1996	12/1/2011	15	$1,705,000(l)	Fixed	(l)
Average				24			

Notes for District Bonds Table:

a. This amount is the result of two bonds [$2,500,000 at 7.00% and $5,000,000 at 7.375%]

b. This amount is the result of two bonds [$3,511,000 at 1.4% and $6,549,000 at 1.4%]

c. This amount is the result of three bonds [$1,430,000 at 3.8%, $3,390,000 at 4.90%, and $4,780,000 at 5.00%]

d. This amount is the result of 15 bonds ranging from $420,000 to $4,630,000 with interest rates ranging from 4.05% to 5.75%

e. This amount is the result of 15 bonds ranging from $470,000 to $5,005,000 with interest rates ranging from 4.5% to 5.75%

f. This amount is the result of 11 bonds ranging from $465,000 to $4,890,000 with interest rates ranging from 4.25% to 5.3%

g. This amount is the result of 14 bonds ranging from $155,000 to $2,310,000 with interest rates ranging from 4.2% to 6.3%

h. This amount is the result of 11 bonds ranging from $205,000 to $46,469,778 with interest rates ranging from 5.0% to 5.75%

i. This amount is the result of 3 bonds ranging from $820,000 to $6,245,000 with interest rates ranging from 7.7% to 7.875%

j. This amount is the result of 16 bonds ranging from $400,000 to $10,660,000 with interest rates ranging from 4.35% to 5.6%

k. This amount is the result of 16 bonds ranging from $120,000 to $250,000 with interest rates ranging from 2.0% to 3.75%

l. This amount is the result of 5 bonds ranging from $10,000 to $1,005,000 with interest rates ranging from 5.375% to 6.75%

Table 4: **Census Block Group Summary Statistics**

All Census 2000 Block Groups

	Mean	Std Dev	Min	Max
Number Sold 02-04	52.1	181.4	1	2,711
Sold in Development District	20.8	107.0	0	1,177
Sold outside a Development District	31.3	109.1	0	1,715
Total Existing SF Homes	448.3	267.0	0	2,140
Population	1,478	842	0	6,775
Population Density (per square mile)	3,294	2,940	0	14,183

N=654

CBGs with $>$ 20 **sales; sales** $>$ 20% **of 2000 Census housing stock**

	Mean	Std Dev	Min	Max
Number Sold 02-04	344.1	408.7	37	2,711
Sold in Development District	151.6	263.5	0	1,177
Sold outside a Development District	192.5	255.4	0	1,715
Total Existing SF Homes	362.8	306.3	0	1,912
Population	1,159	954	0	6,442
Population Density (per square mile)	1,109	1,423	0	6,545

N=81

Many sales located both in and out of development districts

	Mean	Std Dev	Min	Max
Number Sold 02-04	722.2	564.2	88	2,711
Sold in Development District	403.9	361.7	20	1,177
Sold outside a Development District	318.2	366.8	34	1,715
Total Existing SF Homes	550.5	412.6	47	1,912
Population	1,677	1,335	125	6,442
Population Density (per square mile)	552	598	5	1,635

N=23

Table 5: **Variable Definitions**

Variable	**Description**
Sales Price	Transaction price in 2002-2004
ln(Sales Price)	The natural log of transaction price in 2002-2004
Price per Sqft	The per square foot transaction price in 2002-2004
Acres	Lot size in acres
Bath	Number of bathrooms
Sqft	Total square footage of living area
$Sqft^2(000s)$	Total square footage of living area squared (thousands)
Garage	Indicator variable for a property with a garage
Basement	Indicator variable for a property with a basement
ForcedAirHeat	Indicator variable for a property with forced air heating
Fireplace	Indicator variable for a property with a fireplace
Sale Year-Quarter	Indicator variable for each year and quarter of sale, total = 12 variables
DevDistMillLevy	Development district mill levy. Equal to zero for properties not in development districts
NumberJuris	The number of local governments serving a property
Anntax	Annual property taxes
DevDistAnnTax	Annual property taxes paid to the development district

Table 6: **Summary Statistics - single-family homes sold between 2002 and 2004, 3 yrs old or newer**

	In Development District		**Not in Development District**	
Variable	Mean	Std Dev	Mean	Std Dev
Sales Price	318,622	133,893	322,347	134,436
Price per Sqft	135.46	30.13	143.54	35.05
Acres	0.196	0.165	0.267	0.339
Bath	2.877	0.681	2.730	0.650
Sqft	2,362	727	2,249	680
Garage	0.993	0.084	0.958	0.200
Basement	0.826	0.379	0.881	0.323
ForcedAirHeat	0.998	0.049	0.894	0.308
Fireplace	0.808	0.394	0.621	0.485
Sale02qt1	0.069	0.253	0.072	0.258
Sale02qt2	0.080	0.272	0.076	0.265
Sale02qt3	0.088	0.282	0.077	0.268
Sale02qt4	0.093	0.291	0.079	0.270
Sale03qt1	0.071	0.257	0.069	0.253
Sale03qt2	0.087	0.282	0.078	0.269
Sale03qt3	0.092	0.289	0.088	0.283
Sale03qt4	0.090	0.286	0.092	0.289
Sale04qt1	0.064	0.245	0.077	0.267
Sale04qt2	0.079	0.269	0.097	0.296
Sale04qt3	0.094	0.291	0.099	0.298
Sale04qt4	0.094	0.292	0.097	0.296
DevDistMilllevy	36.7	15.6	0	0
NumberJuris	4.40	0.99	3.88	0.96
Anntax	3,056	1,186	2,657	1,143
DevDistAnnTax	1,056	535	0	0
Observations	13,582		20,466	

Table 7: **Hedonic Estimation Results**

Dep Var =	(1)		(2)		(3)		(4)	
ln(Sales Price)	OLS	GMM-IV	OLS	GMM-IV	OLS	GMM-IV	OLS	GMM-IV
DevDistMillLevy	-0.000336***	-0.002112***	-0.000087	-0.000379***	-0.000105	-0.000379***	-0.000192***	-0.000497***
	(-5.4)	(-20.2)	(-1.5)	(-4.3)	(-1.9)	(-5.0)	(-3.5)	(-3.3)
Acres	0.198795***	0.202569***	0.172938***	0.198795***	0.260717***	0.263152***	0.305311***	0.309138***
	(16.0)	(16.0)	(10.4)	(11.9)	(42.4)	(42.8)	(38.9)	(23.5)
Bath	0.037175***	0.044805***	0.019620***	0.018777***	0.015389***	0.015015***	0.016058***	0.015486***
	(14.5)	(17.6)	(9.8)	(9.5)	(8.0)	(7.8)	(6.9)	(5.8)
Sqft	0.000322***	0.000326***	0.000290***	0.000291***	0.000270***	0.000271***	0.000258***	0.000259***
	(38.4)	(38.6)	(40.6)	(41.1)	(41.2)	(41.7)	(31.4)	(31.5)
$Sqft^2$ (000s)	-0.000006***	-0.000007***	-0.000006***	-0.000006***	-0.000003	-0.000003**	-0.000003	-0.000003
	(-3.5)	(-4.0)	(-4.2)	(-4.5)	(-1.9)	(-2.0)	(-1.7)	(-1.7)
Garage	-0.023511***	-0.015491	0.045255***	0.041417***	0.024263***	0.022935***	0.001436	-0.003958
	(-2.6)	(-1.7)	(5.0)	(4.6)	(4.1)	(3.9)	(0.1)	(-0.3)
Basement	0.158679***	0.142328***	0.112150***	0.110779***	0.106936***	0.105490***	0.105930***	0.103844***
	(48.9)	(45.2)	(38.9)	(38.2)	(50.7)	(49.5)	(43.1)	(37.4)
ForcedAirHeat	-0.138983***	-0.133878***	-0.087982***	-0.077568***	-0.018424	-0.019014	-0.042338	-0.043407
	(-8.2)	(-7.9)	(-3.2)	(-2.9)	(-0.7)	(-0.8)	(-1.4)	(-1.4)
Fireplace	0.067831***	0.063337***	0.037888***	0.036351***	0.034053***	0.033786***	0.030568***	0.030118***
	(33.0)	(30.4)	(20.6)	(20.0)	(21.3)	(21.2)	(14.8)	(14.2)
CurrentSale02qt2	0.011596**	0.009994**	0.007795**	0.007857**	0.011427***	0.011418***	0.004115	0.004399
	(2.4)	(2.0)	(2.2)	(2.2)	(3.3)	(3.3)	(0.86)	(0.8)
CurrentSale02qt3	0.014364***	0.015527***	0.013619***	0.014673***	0.012750***	0.012982***	0.003025	0.003469
	(3.1)	(3.3)	(3.9)	(4.2)	(3.9)	(4.0)	(0.7)	(0.6)
CurrentSale02qt4	0.012421***	0.013878***	0.015245***	0.016225***	0.011146***	0.011612***	0.003052	0.003828
	(2.8)	(3.0)	(4.5)	(4.8)	(3.5)	(3.6)	(0.7)	(0.6)

Table 8: **Hedonic Estimation Results cont.**

Dep Var =	(1)		(2)		(3)		(4)	
ln(Sales Price)	OLS	GMM-IV	OLS	GMM-IV	OLS	GMM-IV	OLS	GMM-IV
CurrentSale03qt1	0.020567***	0.021381***	0.016691***	0.017093***	0.011753***	0.012205***	0.007125	0.008102
	(4.3)	(4.4)	(4.6)	(4.8)	(3.3)	(3.5)	(1.6)	(0.7)
CurrentSale03qt2	0.032794***	0.033105***	0.025482***	0.025663***	0.021755***	0.021876***	0.020018***	0.020297***
	(6.9)	(6.9)	(7.0)	(7.1)	(6.3)	(6.4)	(4.3)	(2.9)
CurrentSale03qt3	0.040720***	0.041698***	0.033087***	0.034025***	0.027994***	0.028298***	0.020379***	0.020919***
	(8.9)	(9.0)	(9.5)	(9.8)	(8.5)	(8.6)	(4.6)	(3.2)
CurrentSale03qt4	0.049463***	0.046159***	0.034389***	0.035346***	0.031324***	0.031449***	0.017510***	0.017701***
	(10.8)	(9.9)	(9.7)	(10.1)	(9.4)	(9.4)	(4.0)	(2.7)
CurrentSale04qt1	0.044364***	0.042066***	0.034736***	0.034970***	0.026895***	0.026703***	0.024139***	0.023898***
	(8.6)	(8.0)	(8.8)	(8.9)	(7.2)	(7.2)	(5.1)	(3.6)
CurrentSale04qt2	0.077184***	0.073895***	0.060880***	0.061358***	0.054676***	0.054379***	0.043096***	0.042496***
	(16.4)	(15.4)	(16.8)	(17.1)	(16.4)	(16.3)	(9.8)	(6.8)
CurrentSale04qt3	0.085493***	0.085807***	0.070289***	0.071193***	0.063054***	0.063283***	0.045039***	0.045246***
	(18.3)	(18.1)	(19.3)	(19.7)	(18.7)	(18.9)	(10.4)	(7.4)
CurrentSale04qt4	0.103428***	0.099439***	0.084600***	0.085852***	0.078311***	0.078399***	0.061267***	0.061341***
	(21.7)	(20.6)	(21.7)	(22.2)	(22.0)	(22.0)	(13.7)	(9.0)
Constant	12.118979***	11.874026***	11.877217***	11.879544***	11.765514***	11.771592***	11.863591***	11.767862
	(447.7)	(62.3)	(329.4)	(335.4)	(78.7)	(78.4)	(310.6)	(1.9)
CBG Fixed Effects	No	No	Yes	Yes	Yes	Yes	Yes	Yes
School District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CBG*School District Fixed Effects	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Indicators for Other Govts	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,048	34,048	34,048	34,048	27,869	27,869	16,543	16,543
R^2	0.77	0.76	0.88	0.88	0.88	0.88	0.87	0.87
Hansen's J p-value		0.00		0.00		0.09		0.15
Instrument F-Stat p-value		0.00		0.00		0.00		0.00
First Stage - Shea's Partial R^2		0.42		0.39		0.42		0.44
Hausman-Wu-Durbin p-value	0.00		0.00		0.00		0.00	

T-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.010

The instrument list is the number of homes sold within the development district between 2002 and 2004;

The land area of the development district (in square miles); and the number of years since the development district was created.

Table 9: **Sensitivity Test**

Min Transactions/ % of Existing Homes	**No. Census BGs**	**No. Development Districts**	**No. Observations**	**Estimated Tax Coefficient**
10/10%	26	55	16,767	-0.000495
20/20%	23	50	16,543	-0.000497
30/20%	20	47	16,086	-0.000530
40/20%	18	44	14,928	-0.000544

Table 10: **Estimated Capitalization Effects**

Development Special District Name	Average Sales Price	Property Mill Levy	Estimated Price Discount	Annual Property Tax	Remaining Term as of 2004	Present Value of Future Tax Liability	Percent Capitalization
Aurora Single Tree Metropolitan District	$229,180	42.6	$4,852	$777.14	21	$10,540	46.0%
Belle Creek Metropolitan District	$194,474	47.9	$4,630	$741.50	16	$8,409	55.1%
Brighton Crossing Metropolitan District No. 4	$225,072	38.0	$4,251	$680.80	30	$11,261	37.7%
Buffalo Ridge Metropolitan District	$205,856	37.3	$3,816	$611.20	19	$7,772	49.1%
Canterberry Crossing Metropolitan District	$232,914	39.5	$4,572	$732.33	27	$11,475	39.8%
Canterberry Crossing Metropolitan District II	$255,525	37.3	$4,737	$758.67	28	$12,106	39.1%
Cherry Creek South Metropolitan District No. 1	$256,761	39.8	$5,079	$813.44	29	$13,221	38.4%
Eagle Bend Metropolitan District No. 2	$415,308	45.3	$9,350	$1,497.55	15	$16,224	57.6%
Eagle Creek Metropolitan District	$266,531	50.0	$6,623	$1,060.79	17	$12,543	52.8%
East Smoky Hill Metropolitan District No. 2	$256,817	17.0	$2,170	$347.52	26	$5,337	40.7%
Ebert Metropolitan District	$252,733	39.0	$4,899	$784.58	21	$10,641	46.0%
Gateway Regional Metropolitan District	$248,462	10.0	$1,235	$197.78	6	$1,024	120.5%
Goodman Metropolitan District	$245,067	26.5	$3,228	$516.94	15	$5,610	57.5%
GVR Metropolitan District	$255,983	30.3	$3,855	$617.40	15	$6,684	57.7%
Highlands Ranch Metropolitan District No. 1	$369,769	20.3	$3,731	$597.50	8	$3,959	94.2%
Highlands Ranch Metropolitan District No. 3	$367,252	20.3	$3,705	$593.44	15	$6,425	57.7%
Highlands Ranch Metropolitan District No. 4	$306,667	20.3	$3,094	$495.54	13	$4,832	64.0%
Interlocken Consolidated Metropolitan District	$399,530	27.2	$5,401	$865.03	15	$9,387	57.5%
Lincoln Park Metropolitan District	$430,028	45.0	$9,618	$1,540.36	22	$21,493	44.7%
Maher Ranch Metropolitan District No. 4	$227,679	40.0	$4,526	$724.93	24	$10,646	42.5%
Meadows Metropolitan District No. 1	$302,879	35.0	$5,269	$843.82	25	$12,678	41.6%
Meadows Metropolitan District No. 2	$335,700	35.0	$5,840	$935.26	25	$14,056	41.5%
North Range Village Metropolitan District	$237,077	38.5	$4,536	$726.55	16	$8,240	55.1%
Pinery West Metropolitan District No. 2	$366,465	45.0	$8,196	$1,312.68	28	$20,969	39.1%
Potomac Farms Metropolitan District	$288,830	38.0	$5,455	$873.65	28	$13,956	39.1%
Riverdale Dunes Metropolitan District No. 1	$240,710	45.0	$5,383	$862.22	28	$13,774	39.1%
Roxborough Village Metropolitan District	$317,903	70.1	$11,076	$1,773.89	17	$20,963	52.8%
Sterling Hills Metropolitan District	$271,744	30.0	$4,052	$648.92	14	$6,690	60.6%
Stonegate Village Metropolitan District	$387,839	27.4	$5,282	$845.89	22	$11,815	44.7%
Superior Metropolitan District No. 2	$395,456	22.0	$4,324	$692.52	9	$5,063	85.4%
Todd Creek Farms Metropolitan District No. 1	$311,550	16.5	$2,555	$409.19	17	$4,838	52.8%
Todd Creek Farms Metropolitan District No. 2	$271,846	18.0	$2,432	$389.50	14	$4,016	60.6%
Upper Cherry Creek Metropolitan District	$256,119	6.0	$764	$122.32	7	$724	105.5%