Intrametropolitan Decentralization: Is Government Structure Capitalized in Residential Property Values?

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July 17, 2009

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Abstract

This paper examines the influence that the intrametropolitan growth in special districts has on residential property values. Our empirical approach tests whether the benefits of decentralizing local public good providers increases, decreases or leaves residential property appreciation rates unchanged. Past research in this area has been limited by the lack of variation in government structure within a region and by the self-selection of areas that decentralize governments. This research overcomes these limitations by 1) comparing appreciation rates for single-family homes that were located in areas that added local governments to appreciation rates for properties that were not; and 2) employing an estimation technique that border matches repeat sales to control for the self-selection of government structure. Overall, empirical results indicate that institutional decentralization has no influence on single-family property appreciation rates. It makes no difference whether the new government is the 3rd, 4th, 5th or 6th new jurisdiction–the new government does not influence appreciation rates. Residential property values for homes located in jurisdictions that added security special districts experienced rates of appreciation that were lower than otherwise comparable properties. Recreation, fire, water, sewer and other special districts had no measurable influence on appreciation rates. Empirical results also indicate that more overlap among local governments reduces appreciation rates. New governments created in areas whose residents have greater income heterogeneity increase appreciation rates. The distance separating the new government from existing governments, the land area of the new government and the creation of multiple new governments have no influence on appreciation rates. Finally, these results depend on the border matching repeat sales estimation technique employed here.

JEL Classification: H1, H21, R50

Keywords: government structure, capitalization, border matched repeat sales

1   Introduction

During the past twenty years, some parts of the United States have significantly increased the number of local governments serving residents. The State of Colorado, for example, added 335 county, municipal and special district governments between 1987 and 2002 (Table 1). The most common of these new governments are special districts, created to provide specific services and varying in size from less than a square mile to multiple counties. In addition, the number and types of these governments exhibit substantial spatial variation. This variation allows us to empirically examine the impact that institutional decentralization has on residential property values.[1]

State	Number of Local Governments in 1987	Growth in the Number of Governments 1987-2002	Percent Growth in Governments 1987-2002
New Mexico	332	527	158.7%
Wyoming	425	298	70.1%
Connecticut	479	103	21.5%
Colorado	1,595	335	21.0%
Delaware	282	58	20.6%
Mississippi	855	147	17.2%
Arkansas	1,401	192	13.7%
Georgia	1,285	162	12.6%
Wisconsin	2,719	329	12.1%
Kentucky	1,307	136	10.4%

Source: 2002 Census of Governments
Note: Approximately 90% of the new governments in these states are
      special districts and the remaining are primarily cities and towns.

Table 1: Top 10 States for Percent Growth in Governments between 1987 and 2002

The federalism literature debates whether decentralization influences the efficiency of local public good provision. Olson (1969) argues for a highly decentralized local government structure:

> "There is a need for a separate government institution for every collective good within a unique boundary, so that there can be a match between those who receive the benefits of

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[1]Formally, this is termed, institutional decentralization, which is the shifting of governmental responsibilities to an additional government with associated taxing and spending powers. There is some debate over this terminology. We think about institutional decentralization as the creation of additional layers of government and use institutional decentralization and structural decentralization interchangeably.

a collective good and those who pay for it. This match we define as *'fiscal equivalence'.*" (p. 483).

This is contrasted with theoretical results from Hochman et al. (1995) who advocate a centralized institutional structure:

"...full decentralization requires an institutional system in which each local government supplies the whole range of LPG's [Local Public Goods] to the individuals residing in the territory under its control;..." (p. 1225)

The existing literature has examined the relationship between government structure, the size of the public sector and the provision of local pubic goods using a variety of different approaches. Brennan and Buchanan (1980)'s Leviathan model argues that decentralization encourages competition and forces local governments to be efficient producers of local public goods. Empirical tests of the Leviathan model (e.g. Oates (1985), Nelson (1987), Zax (1989) and Baqir (2002)) have yielded mixed results. The empirical literature on subnational decentralization (e.g. Nelson (1990), Foster (1997), Deller (1990), Fisher and Wassmer (1998), and Stansel (2005)) examines the structure of local governments in the U.S. and how government structure impacts economic growth. A related literature examines the horizontal and vertical relationships among local governments (e.g. Turnbull and Djoundourian (1993) and Campbell (2004)) to determine whether services provided by overlapping governments are complementary or unrelated. The capitalization literature (e.g. Oates (1969), Brueckner (1979), Brasington (2001) and Bates and Santerre (2006))) examines whether property tax rates are capitalized in house prices and whether any efficiency gains associated with decentralization are reflected in house prices. It should be noted that the impact of government structure on property values measures the entire bundle of LPGs and taxes associated with governmental units in a given structure of local government. Therefore, the impacts due specifically to changes in taxes or LPGs are not identifiable unless the associated change in government structure involves either no change in LPGs or no change in taxes.

Most of this literature assumes that government structure is exogenous. This assumption is problematic if unobservable characteristics or government interdependence are correlated with government structure. Unobservable characteristics potentially include a variety of neighborhood attributes such as proximity to open space and neighborhood crime rates. These characteristics

4

may be positively correlated with a higher demand for supplemental LPGs and with a greater decentralization of local governments.

This research overcomes three shortcomings in the literature. First, property specific observations enable an accurate representation of the spatial distribution of local governments. Second, variation in institutional structure within a metropolitan area and observing the addition of new governments allows an empirical examination of the influence that decentralization has on residential property values. Third, border matching repeat sales controls for neighborhood characteristics that influence government structure.

This research empirically examines whether variation in government structure is capitalized in house prices by computing appreciation rates for single-family homes sold in the Denver-Boulder-Greeley CMSA (Consolidated Metropolitan Statistical Area) between 1987 and 2004. To assign properties to their corresponding governments, we employ a unique dataset of digitally encoded Colorado government maps. This assures an accurate representation of the number and types of governments serving each property and of the spatial relationships among governments. In addition, this data allow us to identify properties located in areas that added new governments over the 1987-2004 period. The repeat sales specification controls for the number of new governments, for the types of services provided by the new governments (e.g. recreation, fire protection, security protection, water/sewer, metropolitan and other[2]), and for variation in new governments' expenditures. The specification also includes four variables that estimate the influence that the spatial distribution of governments has on appreciation rates: (1) the spatial overlap of local governments; (2) the distance separating the new government from existing governments; (3) the heterogeneity of residents' incomes; and (4) the geographic size of the new government.

To control for neighborhood characteristics that influence government structure, property appreciation rates are computed using border matched repeat sales. Appreciation rates are computed using repeat sales of properties located within new jurisdictions formed at least two years after the first sale and at least one year prior to the second sale. Properties located within a new jurisdiction are matched with repeat sales located just outside the new jurisdiction's boundary. If homeowners

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[2]Other special district services include ambulance services, flood control, irrigation, medical, mosquito control, pest control, storm drainage, street, television, transportation, and weed control.

in the new jurisdiction value the services provided by the new government by an amount that exceeds the additional property taxes paid, the net benefit will be capitalized in the new jurisdiction's house prices. This increase in house prices will result in higher appreciation rates relative to otherwise similar properties located just outside the new jurisdiction. This estimation strategy controls for time varying unobservables by matching observations in close proximity, but on opposite sides, of a new jurisdiction's border.[3] Computing appreciation rates for the same properties removes pre-existing differences among border matched observations.

We report parameter estimates obtained from three repeat sales specifications: one that employs all repeat sales of single-family properties in the Denver metropolitan area over the 1987-2004 period; a second specification that limits the data to border matched repeat sales but excludes neighborhood fixed effects; and a third border matched repeat sales specification that includes controls for neighborhood fixed effects. The empirical results illustrate the importance of controlling for neighborhood fixed effects: both the number and types of new governments have significant influences on property appreciation rates for the first two repeat sales specifications. Most of the estimated effects vanish when controls for neighborhood fixed effects are added to the border matched repeat sales specification.

Overall results obtained from the border matched repeat sales specification that controls for neighborhood fixed effects indicate that institutional decentralization has no measurable influence on appreciation rates. Functionally, decentralizing governments that provide security reduce appreciation rates while decentralizing governments that provide recreation, fire, water/sewer or other services have no influence on appreciation rates. Measures of jurisdictional characteristics indicate that more overlap between local governments reduces appreciation rates. New governments created in areas whose residents have greater income heterogeneity increase appreciation rates. The distance separating the new government from existing governments, the land area of the new government and multiple new governments have no measurable influence on appreciation rates. Finally, these inferences rely on the empirical methodology employed here.

This paper begins by discussing the conceptual framework of institutional decentralization and

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[3]Government refers to the public institution which has taxing and spending powers. Jurisdiction refers to the physical area served by a government.

by summarizing the relevant literature. Section 3 provides the empirical methodology for using a repeat sales house price specification to estimate the impacts of institutional decentralization and discusses various government structure metrics. Section 4 compares empirical results obtained using all repeat sales; using border matched repeat sales without controlling for neighborhood fixed effects; and using a repeat sales specification that controls for neighborhood fixed effects with the border matched sample. Finally, Section 5 contains concluding remarks.

2   Conceptual Framework

The spatial distribution of local governments influences the scale and scope of local public good (LPG) provision, and depends on two fundamental tradeoffs: (1) the benefits of institutional decentralization are due to the flexibility of grouping residents by preferences for LPGs; and (2) the costs of institutional decentralization are associated with the creation and administration of more governments. These costs include the loss of economies of scope from providing multiple LPGs within a single jurisdiction.

Brennan and Buchanan (1980)'s Leviathan model of government assumes that governments are revenue maximizers and that increasing the number of local governments reduces government's monopoly power, increases competition among public good providers, and forces governments to produce LPGs more efficiently. Epple and Zelenitz (1981)'s formalization of Brennan's and Buchanan's model concludes that the relationship between the number of governments and government expenditures is theoretically indeterminant:

> "competition among many local jurisdictions is not sufficient to prevent local governments from exercising monopoly power....Mobility of residents across a large number of jurisdictions can prevent individual governments from exploiting the elasticity of housing demand but not the elasticity of housing supply." (p. 1216).

One implication of this result is that the relationship between government structure and the efficiency of LPG provision is ultimately an empirical question.

Oates (1985), Nelson (1987), Zax (1989) and Baqir (2002) empirically examine the relationship between government structure and the size of the public sector. Oates (1985) examines the deter-

7

minants of interstate variation in the size of the public sector. He measures public sector size using total state and local tax receipts as a percent of personal income. He examines three alternative measures of government structure: (1) the state's share of total tax revenues; (2) the state's share of total expenditures; and (3) the number of governments in the state. His empirical specification controls for other determinants of government size (e.g. per capita income, population, extent of urbanization, and intergovernmental grants as a percent of total revenues). He reports that none of these three measures of government structure have an influence on government size. Oates (1972)'s Decentralization Hypothesis claims that local governments are better able

> "to provide the Pareto-efficient levels of output for their respective jurisdictions than for the central government to provide any specified and uniform level of output across all jurisdictions." (p. 35).

Nelson (1987) argues that the decentralization hypothesis is primarily relevant for general purpose governments (e.g. counties and municipalities) but is inappropriate for single-function governments (e.g. school districts, recreation districts, water districts, etc.). His empirical analysis examines whether the type of local government (single-function vs. general purpose) influences the size of the public sector. He reports a statistically significant relationship between government structure and the size of the public sector for general purpose local governments but that special districts have little influence on government size. Zax (1989) argues that decentralization can either increase or decrease the size of the public sector:

> "Decentralization which encourages competition reduces the size of the local public sector. Decentralization which discourages scale economies increases it." (p. 560).

His model explains across county variation in government revenue (for all governments in the county) as a function of preferences for public goods (measured using a variety of socioeconomic and demographic characteristics) and household mobility. He concludes that the densities and functions of local government significantly influence how effectively governments provide public goods. Baqir (2002) employs instrumental variables to control for the endogeneity of local government structure and finds that more districts within a political jurisdiction positively impact government spending. One concern with using government expenditures to measure the impacts of institutional

decentralization is that highly decentralized areas typically contain higher LPG demand. Disentangling demand-based government expenditures from expenditures due to institutional structure is difficult.

The empirical literature on subnational decentralization in the U.S. typically bundles institutional and fiscal decentralization in measuring the impacts of decentralization.[4] Nelson (1990) and Fisher and Wassmer (1998) examine the determinants of local government structure by regressing the number of governments per Metropolitan Statistical Area (MSA) on population heterogeneity and on state laws regulating government structure. Both report positive effects for heterogeneity and negative effects for stricter laws regarding new jurisdiction formation. Foster (1997) finds a negative relationship between the number of special districts and income growth at the MSA level. Deller (1990) reports that the number of local jurisdictions is positively related to aggregate property values. Finally, Stansel (2005) finds a positive relationship between the number of cities and counties and metropolitan area growth.

Typically, decentralization involves the spreading of government functions and expenditures to successively smaller units of government. This results in a nested spatial distribution of jurisdictions among levels of government. In the U.S., the nesting of cities within counties and counties within states provides a clear example. A more complicated spatial structure occurs with the decentralization of governments within a metropolitan area. In this structure, the overlapping of special districts, school districts, cities and counties allows households to reside in different numbers and types of governments.

Figure 1 illustrates the difference between nested and overlapping jurisdictions. Both government structures have four subcounty jurisdictions (J_1, J_2, J_3, J_4) overlapping one county government. In the Nested Government Structure, properties A, B and C are each served by two governments: the county government and just one subcounty jurisdiction. In the Overlapping Government Structure, J_1, J_2, and the county government serve property A; J_4 and the county serve property B; and only the county government serves property C. These two spatial distributions contain the same number of governments per county, yet the number of governments serving a

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[4]Fiscal decentralization is the spreading of tax and expenditure responsibilities to lower tiers of government.
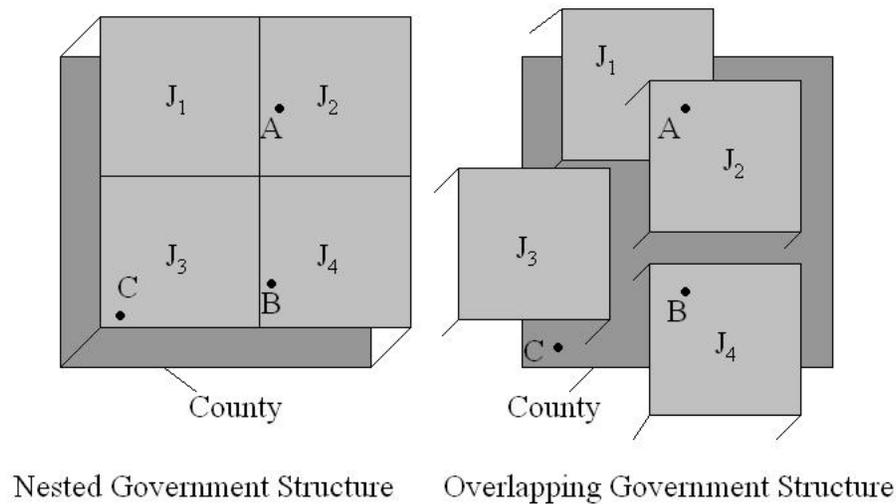
Figure 1: Two Government Structures

home and the relationships between overlapping governments differs significantly.[5]

The growth of noncontiguous cities and special districts makes the Overlapping Government Structure more appropriate for modeling local government. An underlying assumption in thinking about overlapping governments is that every property receives basic local public goods (e.g. schools, fire protection, security, infrastructure, etc.). Therefore, overlapping governments should provide services that are either complementary or unrelated.[6] This assumption is confirmed by Turnbull and Djoundourian (1993), who find that overlapping cities and counties contain complementary general service expenditures and unrelated police and roads services. Campbell (2004) incorporates overlapping jurisdictions in a median voter model of local governments. She reports that municipal

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[5]Empirical papers using Census of Government data cannot distinguish between these two government structures within a metropolitan area. In 2002, the Census of Governments added spatial information. This data distinguishes whether a jurisdiction overlaps multiple counties, overlaps a city, and if a jurisdiction is contained within a county. This information describes the general distribution of governments, but does not distinguish the amount of overlap between governments.

[6]In some cases, overlapping governments provide the same category of functions, but they are qualitatively different. An example is the county provision of highway police and an overlapping city's provision of urban police services.

10

and county per capita expenditures are complementary.

Using residential property values to examine the implications of institutional decentralization relates to Oates (1969)'s, Brueckner (1979)'s, Brasington (2001)'s and Bates and Santerre (2006)'s tests for the allocative efficiency of local governments. In what was purported to be an empirical test of the Tiebout (1956) Hypothesis, Oates (1969) examined whether property tax rates are capitalized in house prices. He concluded that an increase in property tax rates, without a corresponding increase in the level of public services, reduces residential property values. Brueckner (1979) developed and estimated the parameters of a model that related the efficiency of public good provision to residential property values. The basic prediction of this model is that if public goods are inefficiently provided, then aggregate property values will be lower than they would be if public goods were produced efficiently. Brasington (2001) uses a hedonic house price model to show that the rate of property tax capitalization depends on the jurisdiction's size. Bates and Santerre (2006) empirically examine whether the market power of local government influences the production of public goods. Market power is measured using the Herfindahl-Hirschmann Index (HHI) of market concentration and the degree of efficiency is measured using aggregate property values. Their empirical results indicate that aggregate property values are lower in areas where local governments have more monopoly power, providing some empirical support for the Leviathan model.

The influence that government structure has on residential property values can be positive, negative or zero. Government expenditures will increase (decrease) residential property values if residents value the services provided by local governments by an amount that exceeds (is less than) the taxes residents pay for those services. Government expenditures will have no effect on house prices if residents value the benefits generated by those services at cost.

3   Empirical Methodology

The benefits provided by a new government depend on the residents' valuation of the public goods produced and consequently is a latent variable. Examining whether the net costs or benefits are capitalized in residential property values is an indirect way to measure the net value of those

unobserved net benefits. The existing literature has not examined the marginal impact that adding a local government has on residential property values (or on appreciation rates). We examine the influence that new governments have on appreciation rates using border matched repeat sales.

Using appreciation rates to measure the impacts of institutional decentralization raises two issues. First, residents may have limited information about the structure of local governments serving a property. This research assumes that the structure of local government may influence the net benefits generated by a property's bundle of taxes and LPGs and that those net benefits will be capitalized in residential property values.[7] The impact of government structure on taxes and LPGs will hold even if residents have limited information about how local governments are structured.

Second, decentralizing local governments entails two simultaneous effects: (1) a change in LPG expenditures and functions attributable to the additional government; and (2) a change in the number and spatial distribution of local governments. Estimation needs to account for both effects to determine if institutional decentralization is just a mechanism to change LPG levels or if the actual government structure for providing LPGs influences efficiency.

3.1 The Repeat Sales Specification

The repeat sales house price index is derived by computing appreciation rates for properties that have sold (at least) twice. Let the natural log of the price for house i in period t be represented by:

$$ln(P_{i,t}) = \alpha_t + \beta_t X_{i,t} + \eta_t N_{i,t} + \gamma_t G_{i,t} + \Sigma_{j=1}^{n_j} \delta_j D_{i,j} + \varepsilon_{i,t} \tag{1}$$

where

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

$X_{i,t}$ = a vector of structural characteristics for property i in period t;

$N_{i,t}$ = a vector of neighborhood characteristics for property i in period t;

$G_{i,t}$ = a vector of government structure characteristics for property i in period t;

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[7]As noted by an anonymous referee, the efficiency gains of a new special district (SD) may be long-run in nature. The longer term unanticipated public services/taxes at formation are not a large concern given that the average time between the formation of a SD and the second sale is 4.91 years in our data. This is sufficient time for the SD to establish itself and provide regular services and taxation.

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

α_t = the hedonic equation intercept for period t;

β_t = a vector of structural characteristic hedonic coefficients in time period t;

η_t = a vector of neighborhood characteristic hedonic coefficients in time period t;

γ_t = the vector of government structure hedonic coefficients in time period t;

δ_j = hedonic coefficients for sale period j binary variable (j = 1, 2,..., n_j); and

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

Assuming there were no changes in the structural or neighborhood characteristics of properties between sales[8] (e.g. $X_{i,t} = X_{i,t-1} = X_i$ and $N_{i,t} = N_{i,t-1} = N_i$) and no changes in the structure of governments serving properties between sales (e.g. $G_{i,t} = G_{i,t-1} = G_i$), the repeat sales specification becomes:

$$ln(P_{i,t}) - ln(P_{i,t-1}) = \alpha_t - \alpha_{t-1} + (\beta_t - \beta_{t-1})X_i + (\eta_t - \eta_{t-1})N_i + (\gamma_t - \gamma_{t-1})G_i + \Sigma_{j=1}^{n_j} \delta_j D^*_{i,j} + \varepsilon_{i,t} - \varepsilon_{i,t-1}$$

$$(2)$$

where $D^*_{i,j}$ = -1 if property i sold for the first time in period j (j = 1, 2,..., n_j); equals +1 if property i sold for the second time in period j; and equals zero otherwise.

The standard repeat sales house price index (e.g. Bailey et al. (1963), Case and Shiller (1987, 1989), Calhoun (1996)) requires the additional assumption that the hedonic coefficients for the structural, neighborhood and government structure characteristics are temporally invariant (e.g. $\alpha_t = \alpha_{t-1}$, $\beta_t = \beta_{t-1}$, $\eta_t - \eta_{t-1}$ and $\gamma_t = \gamma_{t-1}$). These additional assumptions yield:

$$ln(P_{i,t}) - ln(P_{i,t-1}) = \Sigma_{j=1}^{n_j} \delta_j D^*_{i,j} + \varepsilon_{i,t} - \varepsilon_{i,t-1} \qquad (3)$$

Case and Shiller (1987, 1989) show that $\varepsilon_{i,t}$ - $\varepsilon_{i,t-1}$ is correlated with the length of the holding period and estimate the parameters of Equation 3 using weighted least squares where the weights are inversely proportional to the length of time between sales. Goodman and Thibodeau (1998) demonstrate that $\varepsilon_{i,t}$ - $\varepsilon_{i,t-1}$ is also correlated with dwelling age (e.g. properties must be older

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[8]For other papers that develop the relationship between the hedonic house price equation and the repeat sales equation, see Case and Quigley (1991), Quigley (1995), Hill et al. (1997), and Clapp and Giaccotto (1998).

to be held longer) and estimate the parameters of Equation 3 using iterative Generalized Least Squares. They model the residual variance using polynomials in holding period and dwelling age.

Goetzmann and Spiegel (1995) separate capital appreciation for residential properties into temporal and fixed components and demonstrate that repeat sales equations that omit the intercept will usually generate biased estimates of appreciation rates. They attribute the fixed, temporally invariant, component of housing return to the repairs that typically take place when a house is bought or sold. In our model, this is equivalent to assuming α_t - $\alpha_{t-1} = \alpha$ for all t.

To examine the influence that changes in government structure have on appreciation rates, we initially retain the assumptions of temporally unchanged structural and neighborhood characteristics but allow government structure to change as new governments are added between sales. If γ_t = $\gamma_{t-1} = \gamma$[9], then the repeat sales specification incorporating the Goetzmann and Spiegel (1995) correction is:

$$ln(P_{i,t}) - ln(P_{i,t-1}) = \alpha + \gamma(G_{i,t} - G_{i,t-1}) + \Sigma_{j=1}^{n_j}\delta_j D^*_{i,j} + \varepsilon_{i,t} - \varepsilon_{i,t-1} \qquad (4)$$

3.2 Border Matching Repeat Sales

One of the concerns with the estimated impact of γ is that neighborhood characteristics may change over time. Furthermore, these neighborhood changes may be correlated with the decision to form a new government.[10] This endogeneity results from the self-selection of neighborhoods that influence government formation. One example is that neighborhoods experiencing increasing crime rates may create a special district to provide additional security. The standard repeat sales specification differences out temporally invariant neighborhood characteristics; it does not adequately control for neighborhood characteristics that change over time. This is particularly problematic when changes in neighborhood characteristics are correlated with changes in G_i.

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[9]We test the validity of this assumption.

[10]A-priori, there is no reason to expect changes in structural characteristics to be related to changes in government structure. Allen Goodman observed that homeowners can implement changes in structural characteristics themselves but need governments to provide local public goods and to deal with externalities. An alternative to public sector controls for land use externalities and the provision of LPGs are land use covenants and homeowners' associations. As noted by Hughes and Turnbull (1996), land use covenants provide a Coasian mechanism to deal with land use externalities and increase property values. As discussed in McKenie (1994), homeowners' associations provide a similar role in LPG provision.

Border matching properties can control for time varying neighborhood characteristics. This methodology relies on the idea that locations close together are more alike.[11] This idea is easily applied to examining appreciation rates for properties located near the borders of new governments because neighborhood factors that vary over time such as crime and school quality are likely to be the same within geographically small areas. House prices before the formation of a new government capitalize differences between properties that influence the location of the new government's borders. Therefore, a new government border allows the assignment of properties to control and treatment groups. The control group is represented by the area just outside the new government's border and the treatment group is the area just inside the new government's border. In the end, identification results from comparing the appreciation rates for homes on opposite sides of the new boundary. Resulting estimated coefficients for government structure variables compare properties in close geographical proximity, but on opposite sides, of the boundaries. Modifying Equation 4 to permit time varying neighborhood characteristics (and assuming $\eta_t = \eta_{t-1} = \eta$) yields:

$$ ln(P_{i,t}) - ln(P_{i,t-1}) = \alpha + \gamma(G_{i,t} - G_{i,t-1}) + \eta(N_{i,t} - N_{i,t-1}) + \Sigma_{j=1}^{n_j}\delta_j D^*_{i,j} + \varepsilon_{i,t} - \varepsilon_{i,t-1} \qquad (5) $$

Border matching requires identifying properties within the same neighborhood, but varying in G_i. To derive the final estimating equation requires a modification of equation 5. Since some variables in $(N_{i,t} - N_{i,t-1})$ cannot be measured directly, fixed effects are created to control for neighborhood characteristics that change over time. This modification allows neighborhood characteristics to change uniquely by neighborhood. Fixed effects are defined as $\Sigma_{k=1}^{n_k}\theta_k Z_{i,k}$ for all n_k neighborhoods that are defined spatially as one mile square areas covering Denver. These one mile square areas are generated by connecting a lattice of points to form one mile squares over the entire Denver metropolitan area. Overlaying these squares on geographically coded property data assigns repeat sales to one square mile neighborhoods. The use of one square mile areas is preferable to Census geographies or to zip codes because it partitions the data into more geographical areas with repeat

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[11]Holmes (1998) uses border matching to examine the impact that right-to-work laws have on firm location; Black (1999) border matches single-family homes to estimate how school quality is capitalized in house prices; and Billings (2009) border matches employers to examine the impact that enterprise zones have on the location of jobs. Ries and Somerville (2004) examine whether school quality is capitalized in Vancouver house prices by border matching repeat sales after the local school district changed elementary and secondary school attendance zone boundaries.

sales located on both sides on the new government's border.

The resulting equation using border matched repeat sales that includes controls for neighborhood fixed effects becomes:

$$ln(P_{i,t}) - ln(P_{i,t-1}) = \alpha + \gamma(G_{i,t} - G_{i,t-1}) + \Sigma_{k=1}^{n_k}\theta_k Z_{i,k} + \Sigma_{j=1}^{n_j}\delta_j D^*_{i,j} + \varepsilon_{i,t} - \varepsilon_{i,t-1} \qquad (6)$$

3.3 Measuring Government Structure

Our empirical analysis requires metrics that characterize the structure of local governments, that quantify institutional decentralization and that summarize the spatial distribution of governments within Denver. Governments in the Denver-Boulder-Greeley CMSA consist of counties, cities, school districts, and six classifications of special districts. While a county government and a school district serve all residential properties, a property may be served by up to eight local governments (a county, a city, a school district, and up to five types of special districts). In this context, full institutional decentralization would have eight governments serving a property and a fully centralized government structure would have only two (the county and the school district).

The functional classifications of special districts (SDs) are recreation, fire, water, sewer, water-sewer, or metropolitan.[12] Metropolitan special districts perform multiple functions and commonly provide security[13], recreation, water, sewer, and other services.[14] Special districts may be formed by residents, by developers, or by county governments and require fifty-percent approval of affected land owners.

The vector of G variables in the repeat sales specification includes three variables that measure the influence of institutional decentralization, four variables that control for the spatial configuration of local governments and a variable controlling for the new governments' expenditures. The first institutional decentralization variable is a dummy variable indicating whether the property is located in an area that added a new government between transactions. The second is a set of

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[12]Only five of the six types of special districts will serve a property given the redundancy of water, sewer, and water-sewer special districts.

[13]Security can include security gates, lighting, security guards, signage (e.g. traffic calming as well as neighborhood watches).

[14]Other services for Metropolitan SDs include ambulance services, flood control, irrigation, medical, mosquito control, pest control, storm drainage, street, television, transportation, and weed control.

dummy variables indicating whether the new government is the 3rd, 4th, 5th, 6th or 7th-8th local government serving the property. These indicators for number of governments provide a measure of institutional structure present upon the formation of a new government. The third is a collection of dummy variables identifying the type of government service provided (e.g. recreation, fire protection, etc.)

The repeat sales specification also includes four variables that control for the spatial distribution of governments and for the heterogeneity of residents' preferences for LPGs among overlapping governments. These variables measure the physical overlap between jurisdictions, the average Euclidean distance between governments of the same type, the heterogeneity of household income within overlapping jurisdictions and the size of governments.[15] The overlap measure is the percent of land shared by overlapping governments. This measure is illustrated in Figure 2 by the ratio of the overlap land area C to the total land area $(A + B - C)$.[16] The spatial overlap indicates how similar the boundaries of a new SD are to existing governments. This represents a measure of Olson (1969)'s fiscal equivalence and that each LPG should have an unique boundary. Therefore, lower overlap indicates unique LPG boundaries and is hypothesized to increase the efficiency of LPG provision and increase property values. The average distance to the nearest five governments of the same functional classification represents a measure of proximity to similar governments. This metric involves distance calculations between the centroid of each jurisdiction and its nearest five neighbors. This is shown in Figure 2 by the average length of the five segments (a, b, c, d, e). The Leviathan literature (Oates (1985) and Zax (1989)) finds that horizontal competition between similar governments decreases government spending. The distance to similar jurisdictions measures this horizontal competition. The Leviathan literature hypothesizes that more governments in a geographic area increases the efficiency of LPG provision. More efficient LPG provision should increase property values.

The income deviation is computed as the absolute value of the difference between the median income for the households located in the jurisdiction that includes the new government and the

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[15]These variables are all constructed in ArcGIS 9.0 based on spatially encoded local governments maps from the State of Colorado.

[16]In cases where a new government overlaps more than one government, this metric becomes the average overlap for all pairwise combinations of overlapping governments.

Overlap Measure

Distance to Other Governments

A   C   B
• i

i •
a   e
c   d
b

$Overlap_i = C/(A+B-C)$

$DistanceOtherGovts_i$
$= (a + b + c + d + e)/5$
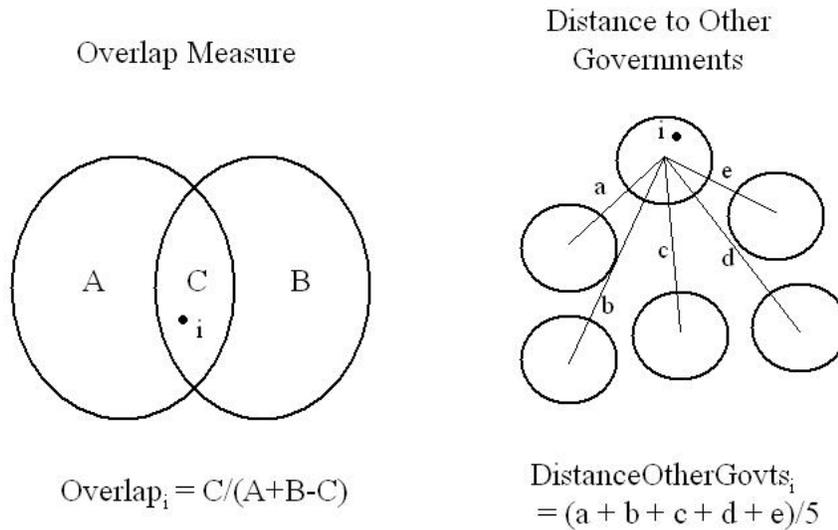
Figure 2: Two measures of jurisdictional spatial characteristics

corresponding county's median household income.[17] Larger differences in household incomes indicate a greater potential for the new government to serve residents that demand different levels of LPGs. If the residents were homogenous in their demand for LPGs, then the residents would simply change the existing governments' provision of LPGs rather than form a new government. Income deviation between overlapping governments measures heterogeneity and, as discussed in Alesina et al. (2004), greater heterogeneity decreases the match between the median voters' preferences for LPGs and the actual LPG provided. A new government that contains greater deviation in income from existing government decreases heterogeneity and improves the efficiency of LPG provision. The final spatial variable is the geographic area of the new government measured in square miles. The geographic size of government measures economies of scale and larger jurisdictions should lower the costs of LPG provision and increase property values.[18] The combination of metrics for distance

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[17]The median household income for residents located in the jurisdiction served by the new government is computed by aggregating all Census block groups within the new jurisdiction. The inclusion of partial block groups is based on proportion of shared land area between a given block group and the new government.

[18]Brasington (2001) also finds that the amount of capitalization is negatively related to the size of a jurisdiction. This measure controls for any capitalization differences due to the size of a jurisdiction.

to nearest neighbor and land area of a new government's jurisdiction provide an overall measure of the spatial distribution of governments.

One concern that arises when testing for the capitalization of government structure is the spillover in benefits from a government's service provision to neighboring properties outside the jurisdiction.[19] Since properties outside of a jurisdiction do not pay for these services, spillovers are likely to be non-negative. A strong positive spillover under a border matching methodology would result in a negative impact on property value appreciation for those just inside a new government's jurisdiction relative to those just outside the new government. Since spillovers likely vary by functions provided, indicator variables for specific functions should highlight the role of spillovers in subsequent results. For the functions provided by special districts, three are hypothesized to have low spillovers and one to have high spillovers. Security, fire and water/sewer services are localized to a service area and typically do not provide services outside the government's jurisdictional boundaries. Recreation may have higher spillovers because it provides services such as open space management and recreation trail construction. These services are usually open to non-jurisdictional residents for direct usage and the provision of open space is an amenity to neighboring properties.

3.4 Data

Estimating the impacts of institutional decentralization requires incorporating all local governments with legitimate residential property taxing power in the analysis.[20] The use of local government Geographical Information Systems (GIS) maps allows assignment of properties to governments and the incorporation of the spatial relationship between governments.[21] The accuracy of these maps is insured by Colorado State Statute 32-1-202, which requires all local governments to file updated maps of jurisdictional boundaries annually.

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[19]As discussed by Olson (1969), one expects residents to set jurisdictional boundaries in a way to internalize most of the benefits of a new government. Therefore, spillovers would be small in magnitude.

[20]Private governments (e.g. homeowner's associations and gated communities) are not included in this data. Border matching repeat sales will remove the influence of private governments because they are typically created in conjunction with a new development. Also, since private governments represent direct substitutes for special districts, there are limited benefits from forming special districts that have coterminous boundaries with private governments. In the end, any pre-existing private governments will be capitalized in sales prices transacted before the formation of a special district.

[21]These files exclude special districts considered nonactive by the state of Colorado and those with inaccurate jurisdictional maps.

The Denver-Boulder-Greeley Consolidated Metropolitan Statistical Area (CMSA) is a metropolitan area that consists of the City/County of Denver, its bedroom communities, and nearby employment centers.[22] We begin our empirical analysis by identifying all single-family properties sold in the Denver metropolitan area during the 2002-2004 period. There were about 128,000 single-family homes sold in the Denver metropolitan area during this period. Of these, 14.4% were served by two governments; 38.9% by three; 18.3% by four; 23.1% by five; 4.7% by six; and 0.6% by seven or eight governments. Digitized maps identified 467 special districts (SD), 34 school districts, 69 cities, and 8 counties in the Denver-Boulder-Greeley CMSA in 2002.[23]

Appendix Figure 3 illustrates a dichotomy in Denver metropolitan area governance. Central Denver and outer suburbs contain relatively few governments, while inner suburban communities to the north, west, and south of Denver contain many governments. The fact that certain areas contain clusters of more centralized or more decentralized government structures indicates heterogeneity in benefits from decentralization. Inner suburban residents likely benefit from a highly decentralized structure while central city and outer suburban residents benefit from a more centralized structure.

The property data are from each of the eight Denver-Boulder-Greeley CMSA county assessors' offices and are compiled by a private company, Property Database Center.[24] Single-family properties located on more than 5 acres are excluded as ranch or agricultural properties. All transactions that were not arms length transfers (e.g. foreclosures) and properties that traded for prices below $10,000 are excluded. This research also removes properties with transaction prices exceeding $1,000,000 and those single-family residences containing no bathrooms. Census (2000a) geospatial data provides information about parks and Census block group boundaries. Denver, Boulder, the Denver Tech Center, and Golden are designated commercial centers and property characteristics

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[22]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.

[23]Of these 467 special districts, 203 are classified as metropolitan districts (special districts providing two or more services), 83 as water-sewer only, 80 as fire only, 42 as water, 33 as sewer, and 26 as recreation. Among the 203 metropolitan districts, 133 provided security, 175 water/sewer, 149 recreation, 21 fire, and 183 provided other services. This total number of special districts excludes some special districts with missing or limited data. In some case, paper maps were used to update or supplement jurisdictional information. Our analysis requires transactions two years prior to the formation of the new government. Consequently, special districts created to just finance infrastructure for new residential developments are excluded.

[24]This data was accessed from the Property Database Center website, http: www.myPDC.com, beginning 2/15/07.

include distance to the closest commercial center. The county assessors record previous transaction prices consistently back to 1987. Table 2 provides a detailed explanation of all variables and their sources. We include descriptive statistics for structural characteristics to facilitate comparison of the border-matched samples.

To estimate the impacts of government structure while controlling for changes in neighborhood characteristics requires restricting the data to those properties within 1/2 mile of a new government border.[25] This restriction yielded properties in 241 one square mile neighborhoods, with each neighborhood containing an average of 47.4 properties. An average of 22.7 properties per neighborhood are located within new government boundaries. 76 neighborhoods contain no properties within a new government and 24 neighborhoods contain no properties located outside new governments.

For single-family properties that sold during the 2002-2004 period, we then identify those properties that also sold previously during the 1987-2001 period. This yielded 95,646 repeat sales. Table 3 provides summary statistics for these properties. Columns (1)-(4) provide descriptive statistics for all repeat sales while columns (5)-(8) provide descriptive statistics for repeat sales located within 1/2 mile of a new government's boundary. About 8% of all repeat sales were located in areas that added a new government between 1987 and 2004. About 72% of those were located within one-half mile of a new government boundary. For all repeat sales, properties located in areas that added governments had just over 200 square feet more living space than properties located outside these areas. These larger properties commanded higher transaction prices. Otherwise, the property characteristics for the repeat sales located in areas that added governments over the 1987-2004 period were similar to the repeat sales for properties in areas that did not.

Table 3 also provides summary data for new government expenditures, for new government functions and for government structure variables.[26] About 26% of the properties that added a

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[25]The average land area of new governments was about 4.6 square miles. This research adopts 1/2 mile distances to new government boundaries and one square mile neighborhoods (just under 20% of the average new government area) over smaller geographies for two reasons. First, restricting the data to smaller distances reduces both the number of observations and the number of new governments used to estimate parameters. Second, smaller neighborhoods (e.g. 1/2, 1/4 square mile) assume that changes in neighborhood characteristics are localized in impacts, when in fact, factors such as crime and school quality likely influence larger geographic areas. As a sensitivity test, we examined 1/2 square mile neighborhoods and 1/4 mile buffers. This yielded 6,888 observations and produced results that are broadly similar to those reported here.

[26]One limitation of this data is the lack of detailed expenditure categories within multiple function special districts. This shortcoming is mitigated with the availability of the functions provided within these special districts and measures

Variables	Description
Dependent Variables	*Source: County Assessor*
Recent Sales Price	Reported sales price for single-family detached homes sold between 2002 and 2004.
Previous Sales Price	Any previous sales price between 1987 and 2001.
Independent Variables	
Property Variables X_i	*Source: County Assessor's Data and and authors' calculations.*
Lot Size (acres)	The property's land area.
Bathrooms	Number of bathrooms (0.5 increments).
Bedrooms	Number of bedrooms.
Living Area	Square feet of a property's living space.
Age	Age of structure (years).
Garage Dummy	0,1 for having a garage relative to no garage.
Forced Air Heating Dummy	0,1 for forced air heating relative to other heating types.
Fireplace Dummy	0,1 for having a fireplace relative to no fireplace.
Distance to Commercial Center (miles)	Distance to the nearest commercial center (i.e. Downtown Denver, Boulder, Golden, or Denver Tech Center).
Distance to Park (miles)	Distance to the closest park.
Government Variables	*Source: Dept. of Local Affairs, Colorado, Census 2000 Block Group data, Tigerline files, and author's calculations.*
In New Government	Indicator if a new government formed between repeat sales with the first sale occurring at least two years prior to the formation of the new government.
Number of Governments	Indicators for each of the 3 through 8 governments that may serve a property.
Government Function	Indicator for a special district providing one of six specific functions (recreation, fire, water, sewer, security, other).
New Govt Overlap	Average (%) overlap between the new government and all special districts and cities serving a property [0,1].
New Govt Distance to Other Govts	Average Euclidean distance (miles) to five nearest jurisdictions with the same function as the new government.
New Govt Income Deviation	The absolute value of the difference between the 2000 median household income for census block groups in the new government and the overlapping county's 2000 median household income.
New Govt Size	The new government's land area in square miles.
More Than One Government	Indicator if more than one government formed between a property's repeat sales.
New Government Expenditure	The new government's total 2004 expenditure divided by the number of housing units in the jurisdiction.

Table 2: Data Information

government were recreation special districts (column (1)); 59% were fire districts; 20% security districts; 59% water and sewer districts; 24% other and 41% were located in areas that added multi-function special districts.

Columns (5)-(8) of Table 3 provide descriptive statistics for the 11,422 repeat sales located within 1/2 mile of a new govenment boundary. After border matching repeat sales, properties located within 1/2 mile of a new government boundary had about 300 square feet of additional living space compared to properties located outside any new government. Repeat sales located within a new government's borders were situated on slightly larger lots (0.34 acres vs. 0.22 acres). Otherwise, the characteristics of border matched properties located in areas that added a new government were similar to the characteristics of border matched properties that were not.

Between 1987 and 2004, the Denver-Boulder-Greeley CMSA experienced the creation of two hundred and forty-seven special districts, three cities and one county. Of these new governments, 96 contained properties with transactions both two years before and after their formation.[27] This number decreases to 87 governments with observations within 1/2 mile of the jurisdiction's border. In the end, all the new governments used in this analysis are special districts. Table 4 lists the number of new governments formed in the Denver metropolitan area over the 1987-2004 period by type of service and the number of repeat sales observations located in each new jurisdiction.[28]

4   Estimation Results

Using repeat sales to measure the impacts of institutional decentralization raises several concerns. First, the use of repeat sales data allows for property improvement. For our purpose, this is only an issue if property improvements are correlated with the structure of local government. A-priori there is no reason to expect that the formation of a new government is correlated with the likelihood of property improvements. But to mitigate this possible influence, any house with an average

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of total expenditures. Variation in functions and expenditures allow identification of functional and expenditure impacts within a multiple purpose special district.

[27]Most of the 151 excluded special districts were created to finance infrastructure for new residential developments.

[28]State laws regarding formation of SDs and governance structure vary among states.

single-family Homes Sold 2002-2004	All Properties with Repeat Sales				Repeat Sales within 1/2 of New Govt border			
	New Government		No New Government		New Government		No New Government	
	(1) Mean	(2) Std Dev	(3) Mean	(4) Std Dev	(5) Mean	(6) Std Dev	(7) Mean	(8) Std Dev
Recent Sales Price	317,347	140,801	273,971	122,743	326,852	143,590	249,587	91,685
Year of Recent Sales	2003.0	0.86	2003.1	0.81	2002.9	0.88	2002.9	0.89
Previous Sales Price	190,136	113,832	215,762	139,922	203,143	114,276	158,710	81,470
Year of Previous Sales	1994.5	3.7	1997.8	3.2	1994.8	3.7	1995.3	3.4
Lot Size (acres)	0.33	0.38	0.27	0.34	0.34	0.36	0.22	0.29
Bathrooms	2.35	0.74	2.33	0.83	2.41	0.73	2.35	0.74
Bedrooms	3.39	0.89	3.12	0.82	3.54	0.91	3.16	0.74
Living Area (sqft)	1,943	723	1,739	726	2,009	719	1,700	576
Age (years)	27.0	18.6	28.8	25.8	24.0	18.1	22.3	19.4
Garage Dummy	0.88	0.32	0.79	0.40	0.92	0.28	0.92	0.27
Basement Dummy	0.80	0.40	0.80	0.40	0.82	0.38	0.81	0.39
Forced Air Heat Dummy	0.80	0.40	0.86	0.35	0.78	0.41	0.90	0.30
Fireplace Dummy	0.75	0.57	0.60	0.50	0.79	0.61	0.69	0.51
Distance to Commercial Center (miles)	7.32	3.78	7.37	4.14	7.74	3.86	8.01	3.46
Distance to Park (miles)	0.59	0.68	0.70	1.27	0.67	0.71	0.54	0.48
Number of Governments before New Government	3.79	0.89	3.68	1.20	3.79	0.91	3.54	1.15
New Government Variables								
New SD Expenditures per Housing Unit	631	1,600			845	1,905		
New Government provides Recreation	0.26	0.44			0.33	0.47		
New Government provides Fire	0.59	0.49			0.52	0.50		
New Government provides Security	0.20	0.40			0.28	0.45		
New Government provides Water/Sewer	0.59	0.49			0.61	0.49		
New Government provides Other	0.24	0.42			0.29	0.45		
Formation of More than One New Government	0.11	0.31			0.11	0.31		
New Government Overlap with Existing Cities, SDs	0.38	0.18			0.35	0.18		
New Government Distance to other Govts (miles)	5.3	2.5			4.9	2.6		
New Government Income Deviation	16,434	17,694			15,953	17,738		
New Government Land Area (SqMiles)	4.6	4.6			4.1	4.1		
N	7,650		87,996		5,472		5,950	

SD = Special District.

Table 3: Summary Statistics

Special District Function	Number of Governments Formed Between 1987 and 2004	Number of Repeat Sales Transactions in Areas with New Governments
Fire	11	2,859
Recreation	41	1,821
Water/Sewer	58	3,335
Security	29	1,519
Other	41	1,575
Total (1)	87	5,472

Note: This table only includes properties that: 1) are located in areas that added a new government between sales; and 2) are located within 1/2 mile of the new government's border. (1) The total is more than the sum of the rows because some governments provide more than one function.

Table 4: Border matched repeat sales by type of special district

annual appreciation rate exceeding 40% is removed from the estimation sample.[29] Another issue, highlighted in Table 3, is the higher average previous sales price for properties located in areas that added a government. This could bias estimates if the prior house price influences either the subsequent appreciation rate or the likelihood of property improvement. To mitigate this problem, the explanatory variables in the repeat sales equations include a measure of previous price. This measure consists of dummy variables that categorize the previous price into price deciles.[30]

A second concern with border matching is that households may anticipate the new government's formation. If households' expectations incorporate the influence that a new government will have on house price, then the previous price may fully capitalize the net benefits of the new government. To control for this possibility, border matching is limited to properties with previous sales that occurred at least two years prior to the formation of the new government.[31]

A final concern with border matching is the potential to match properties within 1/2 mile of

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[29]This value is chosen because the average annual appreciation rate for all repeat sales in this data was 5.8% with a standard deviation of 8.8%. Therefore, annual appreciation rates exceeding 40% are about 3.9 standard deviations away from the mean. The border matched repeat sales have a 6.8% mean rate of appreciation and a standard deviation of 4.3%. The Office of Federal Housing Enterprise Oversight, $http://www.ofheo.gov/hpi_download.aspx$, reports annual average rates of house price appreciation over the 1987 through 2004 period of 5.3% for Denver; 6.3% for Boulder; and 5.1% for Greeley. The Case-Shiller Home Price Index for Denver reports a 5.39% annual rate of appreciation over the 1987-2004 period, $http://www2.standardandpoors.com/spf/pdf/index/CSHomePrice\_History\_072943.xls$.

[30]Goetzmann and Spiegel (1995) used house price quartiles.

[31]A home buyer is unlikely to have information about a new government that will be formed more than two years into the future. Given the state statute for Special Districts dictates the approval timeline, two years is sufficient time to ensure that the anticipation of special district formation is unlikely.

the border, but in different parts of a jurisdiction or even in different jurisdictions.[32] This issue is addressed by the one square mile neighborhood fixed effects included in Equation 6.

4.1 All Repeat Sales Results

The initial results assume that changes in neighborhood characteristics are uncorrelated with changes in government structure and report estimated coefficients for Equation 4. To accommodate heteroskedasticity in the residuals, we estimate the parameters of Equation 4 twice: once using the White (1980) correction and a second time using Generalized Least Squares with the Goodman and Thibodeau (1998) residual variance model. Table 5 provides regression statistics for four repeat sales specifications: columns (1) and (2) report the estimated influence that new governments have on appreciation rates; columns (3) and (4) identify whether the additional government is the 3rd, 4th, etc. government; columns (5) and (6) report the influence of the new government by function; and columns (7) and (8) add controls for government structure. The first column in each pair provides results generated by White (1980)'s procedure and the second column reports estimates produced using GLS. The estimates in Table 5 are computed using all 95,646 repeat sales–without border matching.

Columns (1) and (2) of Table 5 indicate that single-family appreciation rates are higher for properties located in areas that added governments. Using the Halvorsen and Palmquist (1980) correction to properly interpret the influence that a new government has on appreciation rates, the White estimated coefficient for new government indicates that properties located in areas that added a new government experience a 7.25% higher appreciation rate compared to properties located in areas that did not. These estimates are highly statistically significant with estimated coefficients over twenty (estimated) standard errors away from zero. The estimates in columns (3) and (4) indicate that each additional government generated higher appreciation rates, although the magnitude of the impacts vary significantly and are highly nonlinear. Columns (5) and (6) illustrate that the new government's influence varies considerably across type of service. Governments that

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[32]An example is matching a property just inside the western border of a jurisdiction with another property just outside the eastern border of the same jurisdiction. For large jurisdictions, this would involve border matching over a much larger distance than 1/2 of a mile.

provide recreation, fire protection, and water/sewer all generate higher appreciation rates. New governments that provide security reduce appreciation rates. Governments that provide other services have no influence on appreciation rates. According to these results, Denver metropolitan area residents value the services provided by recreation, fire and water/sewer special districts more than they pay in higher property taxes. Residents value services provided by security districts less than they pay in additional taxes. Controlling for government structure and expenditures (columns (7) and (8)) reduces the statistical and economic significance of the type of government service effects. The effects that recreation, water/sewer and security special districts have on property appreciation rates are reduced by more than half while the influence that fire protection special districts have on appreciation rates are no longer statistically different from zero. The estimated coefficients for all but the new government overlap variables are statistically significant at conventional levels. These results indicate greater distances between governments generate higher appreciation rates; higher disparity in household incomes generates higher appreciation rates; geographically larger new governments reduce appreciation rates; multiple new governments increase appreciation rates; and higher new government expenditures increase appreciation rates.

Table 6 lists the regression statistics for the previous price decile variables in the all repeat sales equations. These results illustrate two things. First, the price decile for the initial transaction price has a significant influence on estimated appreciation rates. Second, the magnitude of the effect varies considerably by price decile.

Table 7 provides the regression statistics for the Goodman-Thibodeau residual variance model. The estimates indicate that the variance in the repeat sales residuals is a function of both holding period and dwelling age. Estimating parameters using GLS with this model of the residual variance reduces the estimated standard errors for the previous price decile coefficients by half compared to the White (1980) estimates (see Table 6). Consequently, subsequent results will only be reported for the Goodman-Thibodeau estimation procedure.

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Dep Var: ln(Sales Price) - ln(Previous Sales Price)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
In New Govt	0.070***	0.0658***						
	(0.0030)	(0.0032)						
New Govt is 7th or 8th Govt			0.1041***	0.0992***				
			(0.0122)	(0.0145)				
New Govt is 6th Govt			0.0330***	0.0357***				
			(0.0066)	(0.0079)				
New Govt is 5th Govt			0.0870***	0.0786***				
			(0.0037)	(0.0040)				
New Govt is 4th Govt			0.0385***	0.0406***				
			(0.0050)	(0.0057)				
New Govt is 3rd Govt			0.1445***	0.1365***				
			(0.0229)	(0.0161)				
New Govt provides Recreation					0.0727***	0.0651***	0.0297***	0.0261***
					(0.0069)	(0.0076)	(0.0077)	(0.0090)
New Govt provides Fire					0.0134***	0.0194***	-0.0179*	-0.0093
					(0.0043)	(0.0043)	(0.0094)	(0.0082)
New Govt provides Water or Sewer					0.0738***	0.0620***	0.0299***	0.0222***
					(0.0051)	(0.0050)	(0.0062)	(0.0065)
New Govt provides Security					-0.0672***	-0.0561***	-0.0285***	-0.0215*
					(0.0203)	(0.0115)	(0.0105)	(0.0118)
New Govt provides Other Functions					0.0029	0.0067	-0.0058	-0.0011
					(0.0074)	(0.0083)	(0.0091)	(0.0096)
New Govt Overlap							-0.0028	-0.0054
							(0.0169)	(0.0165)
New Govt Distance to Other Govts (miles)							0.0015**	0.0015**
							(0.0007)	(0.0007)
New Govt Income Deviation ($000s)							0.0024***	0.0022***
							(0.0002)	(0.0002)
New Govt Size (10 square miles)							-0.0031***	-0.0026***
							(0.0010)	(0.0008)
More Than One Govt Formed							0.0472***	0.0409***
							(0.0101)	(0.0106)
New Govt Expend ($000s)							0.0011***	0.0010***
							(0.0001)	(0.0002)

Table 5: Repeat Sales Results

Dep Var: ln(Sales Price) − ln(Previous Sales Price)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln 9th Previous Price Decile	-0.4312***	-0.4299***	-0.4310***	-0.4298***	-0.4305***	-0.4290***	-0.4283***	-0.4270***
	(0.0095)	(0.0048)	(0.0095)	(0.0048)	(0.0095)	(0.0048)	(0.0095)	(0.0048)
ln 8th Previous Price Decile	-0.5993***	-0.5874***	-0.5995***	-0.5877***	-0.5984***	-0.5864***	-0.5971***	-0.5850***
	(0.0092)	(0.0047)	(0.0092)	(0.0047)	(0.0092)	(0.0047)	(0.0092)	(0.0047)
ln 7th Previous Price Decile	-0.7034***	-0.6811***	-0.7035***	-0.6813***	-0.7027***	-0.6803***	-0.7025***	-0.6797***
	(0.0092)	(0.0047)	(0.0092)	(0.0047)	(0.0092)	(0.0047)	(0.0092)	(0.0047)
ln 6th Previous Price Decile	-0.7547***	-0.7293***	-0.7549***	-0.7296***	-0.7542***	-0.7286***	-0.7553***	-0.7291***
	(0.0093)	(0.0047)	(0.0093)	(0.0047)	(0.0093)	(0.0047)	(0.0093)	(0.0047)
ln 5th Previous Price Decile	-0.7972***	-0.7700***	-0.7974***	-0.7700***	-0.7970***	-0.7695***	-0.7987***	-0.7704***
	(0.0094)	(0.0047)	(0.0094)	(0.0047)	(0.0094)	(0.0047)	(0.0094)	(0.0047)
ln 4th Previous Price Decile	-0.8266***	-0.7961***	-0.8271***	-0.7966***	-0.8267***	-0.7958***	-0.8290***	-0.7971***
	(0.0095)	(0.0047)	(0.0095)	(0.0047)	(0.0095)	(0.0047)	(0.0095)	(0.0047)
ln 3rd Previous Price Decile	-0.8497***	-0.8131***	-0.8505***	-0.8138***	-0.8498***	-0.8127***	-0.8526***	-0.8145***
	(0.0095)	(0.0048)	(0.0095)	(0.0047)	(0.0095)	(0.0047)	(0.0095)	(0.0047)
ln 2nd Previous Price Decile	-0.8746***	-0.8328***	-0.8753***	-0.8335***	-0.8748***	-0.8324***	-0.8786***	-0.8353***
	(0.0096)	(0.0048)	(0.0096)	(0.0048)	(0.0096)	(0.0048)	(0.0096)	(0.0048)
ln 1st Previous Price Decile	-1.0887***	-1.0222***	-1.0899***	-1.0235***	-1.0890***	-1.0217***	-1.0945***	-1.0266***
	(0.0106)	(0.0050)	(0.0104)	(0.0050)	(0.0104)	(0.0050)	(0.0105)	(0.0050)
Intercept	0.8851***	0.8439***	0.8858***	0.8447***	0.8883***	0.8461***	0.8882***	0.8456***
	(0.0106)	(0.0063)	(0.0106)	(0.0063)	(0.0106)	(0.0063)	(0.0106)	(0.0063)
Property Sale Year/Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1 mile square fixed effects	No	No	No	No	No	No	No	No
Heteroscedasticity Correction	White	GT	White	GT	White	GT	White	GT
F Statistic	2,179.4	2,191.3	2,089.2	2,095.9	2,085.4	2,091.9	1,971.8	1,971.8
Adjusted R-squared	0.65	0.66	0.65	0.66	0.65	0.66	0.65	0.66
N	95,646	95,646	95,646	95,646	95,646	95,646	95,646	95,646

ln New Govt indicates that the property is served by a newly formed special district.
Number of government indicators are relative to no new government serving a property.
Previous Price Decile fixed effects categorizes the previous sales prices into deciles relative to each other,
and regressions exclude the lowest priced or 10th previous price decile.
Note: GT represents a heteroscedasticity correction based on Goodman and Thibodeau (1998).
* significant at 10%; ** significant at 5% ***significant at 1%

Table 6: Regression Statistics for Previous Price Deciles in All Repeat Sales Regressions

Dep Var: absolute value of residual	(2)	(4)	(6)	(8)
Age	-0.0075***	-0.0075***	-0.0075***	-0.0074***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Age Squared	0.1347***	0.1344***	0.1335***	0.1335***
	(0.0028)	(0.0028)	(0.0028)	(0.0028)
Age Cubed	-0.0006***	-0.0006***	-0.0006***	-0.0006***
	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Holding Time	0.0024***	0.0024***	0.0025***	0.0024***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
R-squared	0.035	0.035	0.035	0.035
N	95,646	95,646	95,646	95,646

Table 7: Estimated Parameters for Goodman-Thibodeau Residual Variance Model

4.2 Border Matched Repeat Sales Results

Table 8 provides border matched repeat sales estimation results. These results are reported in eight columns. The first pair of columns report the influence that a new government has on appreciation rates. The second pair provides the impacts that the number of governments have on appreciation rates. The third pair reports the influence that government functions have on appreciation rates. The fourth pair adds controls for government structure. All of the estimates in Table 8 are based on the 11,422 border matched repeat sales. The difference between the estimates is that the first column in each pair lists estimates *without controlling for neighborhood fixed effects*. The estimates in the second column are computed using a repeat sales specification that includes dummy variables for neighborhood fixed effects. The differences in these estimates illustrates the importance of including neighborhood fixed effects in the border matched sample. All regressions include the Goodman-Thibodeau Residual Variance Model and Previous Price Deciles.

The estimated coefficient for *In New Govt* in column (1) of Table 8 suggests that new governments have a significant positive influence on property appreciation rates. This influence vanishes when neighborhood fixed effects are included in the specification. The estimated coefficients for each of the number of government variables are statistically significant in the specification that excludes neighborhood fixed effects (column (3)). The statistical significance vanishes for all but the 7th or 8th government when neighborhood fixed effects are included (column (4)). While the estimated coefficient for the 7th or 8th government is statistically significant, only 0.6% of the

border matched repeat sales sample were located in areas where the government was the 7th or 8th government; and only 1.8% of the border matched repeat sales were located in areas where the new government was the 7th or 8th government. New recreation and fire special districts increase appreciation rates while new security districts reduce appreciation rates in both models (columns (5) and (6)). Adding controls for government structure and expenditures yields estimated coefficients for all but the security district coefficients that are not distinguishable from zero. Denver-Boulder-Greeley CMSA residents apparently think they overpay for security in the new security districts. These insignificant results for most functions indicate that spillovers are not driving results. In fact, the significant impact of only security services runs contrary to the presence of spillovers given that security services are limited to the jurisdiction's service area.[33] The estimated coefficients for the government structure variables indicate greater overlap reduces property appreciation rates while greater disparity in household income increases appreciation rates. Distance to other governments, government size and multiple governments do not influence appreciation rates. Higher government expenditures increase appreciation rates.

The empirical results obtained using the border matched sample with the repeat sales specification that included neighborhood fixed effects suggests that properties located in newly formed security districts experienced a 6.25% lower rate of house price appreciation between sales relative to similar properties located outside newly formed security districts. The (geometric) mean rate of house price appreciation over the 1987-2004 period for the border matched sample was 6.8% annually. The average length of time between border matched sales was about 7 years and 10 months. So over the average holding period, properties located in areas that added security districts experienced a cumulative appreciation rate of 63% while similar properties located outside newly formed security districts appreciated 69.2%. Being located in a newly formed security district cost homeowners about one year's worth of house price appreciation. Properties located in areas that had a one standard deviation greater difference in household income experienced a 1.8% higher rate of appreciation between sales while properties located in areas where government expenditures were one standard deviation higher than average experienced a 1.4% higher rate of appreciation between

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[33]Security services may push crime to neighboring areas, but this would generate a negative spillover and only reinforces the negative estimated impact of security services.

sales.

4.3 Testing the Temporal Equivalence of the Government Structure Variables

Table 9 reports the results of statistical tests that examine whether the estimated coefficients for the number of government variables and the government function variables are constant over time.[34] Using all repeat sales, the null hypothesis of temporally equivalent coefficients is rejected for all number of government variables and for all government function variables. Using the border matched sample that controls for neighborhood effects, the statistical significance vanishes for all but the estimated coefficient for fire districts. The estimated coefficient for new fire districts in the border matched specification that included neighborhood fixed effects was not statistically different from zero. One possible explanation for this inconsistent result is that the binary variable does not adequately measure the level of services provided by the special district. This is likely the case for fire special districts, which traditionally were used as reorganizing urban fire services, but more recently have been used for outer suburban wildfire mitigation/protection.

5 Conclusions

Adding local governments within a metropolitan area enables an unique examination of institutional decentralization. We empirically examine whether adding local governments influences residential property appreciation rates. Our econometric method controls for neighborhood characteristics that influence government structure. Overall results find that institutional decentralization has no influence on single-family property appreciation rates. It makes no difference whether the new government is the 3rd, 4th, 5th or 6th new jurisdiction–the new government does not influence appreciation rates (in the border matched repeat sales specification that includes government structure variables and neighborhood fixed effects). We also find that residential property values for homes

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[34]This required a slightly different repeat sales specification. For example, to test whether the hedonic coefficients for properties located in recreation special districts were constant over time, the repeat sales equation included two dummy variables: one that equaled one if the property was located in a recreation special district at the first sale (and was zero otherwise); and a second dummy variable that equaled one if the property was located in a recreation special district at the time of the second sale (and was zero otherwise). The F-test statistics reported in Table 9 test the equivalence of these two estimated coefficients.

Dep Var: ln(Sales Price) - ln(Previous Sales Price)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
in New Govt	0.0495***	0.0031						
	(0.0036)	(0.0059)						
New Govt is 7th or 8th Govt			0.0309**	0.0739***				
			(0.0132)	(0.0147)				
New Govt is 6th Govt			0.0296***	-0.0225*				
			(0.0079)	(0.0125)				
New Govt is 5th Govt			0.0690***	-0.0081				
			(0.0043)	(0.0087)				
New Govt is 4th Govt			0.0213***	-0.0091				
			(0.0053)	(0.0079)				
New Govt is 3rd Govt			0.1335***	0.0285				
			(0.0195)	(0.0260)				
New Govt provides Recreation					0.0350***	0.0427***	0.0043	0.0159
					(0.0065)	(0.0103)	(0.0081)	(0.0138)
New Govt provides Fire					0.0378***	0.0401***	0.0213**	0.0192
					(0.0048)	(0.0080)	(0.0085)	(0.0128)
New Govt provides Water or Sewer					0.0282***	0.0065	0.0088	-0.0035
					(0.0056)	(0.0109)	(0.0064)	(0.0149)
New Govt provides Security					-0.0334***	-0.0826***	-0.0274***	-0.0645***
					(0.0091)	(0.0225)	(0.0095)	(0.0252)
New Govt provides Other Functions					0.0001	-0.0167	0.0184*	0.0039
					(0.0074)	(0.0171)	(0.0109)	(0.0233)
New Govt Overlap							-0.0249	-0.0577**
							(0.0181)	(0.0260)
New Govt Distance to Other Govts (miles)							0.0035***	0.0003
							(0.0007)	(0.0009)
New Govt Income Deviation ($000s)							0.0013***	0.0010***
							(0.0002)	(0.0002)
New Govt Size (10 square miles)							-0.0068***	0.0031*
							(0.0009)	(0.0016)
More Than One Govt Formed							0.0206**	-0.0164
							(0.0099)	(0.0127)
New Govt Expend ($000s)							0.0052***	0.0072***
							(0.0014)	(0.0026)
1 mile square fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
F Statistic	323.5	238.7	312.3	228.9	308.5	230.6	294.2	217.5
Adjusted R-squared	0.71	0.76	0.71	0.76	0.71	0.76	0.71	0.76
N	11,422	11,422	11,422	11,422	11,422	11,422	11,422	11,422

In New Govt indicates that the property is served by a newly formed special district.

Number of government indicators are relative to no new government serving a property.

* significant at 10%; ** significant at 5% ***significant at 1%

Table 8: Border Matched Repeat Sales Results

	All Repeat Sales		Repeat Sales w/ Border Matching	
$H_0 : \gamma_t = \gamma_{t-1}$	F test	p value	F test	p value
No. of Governments				
Governments = 3	58.85	0.00	0.19	0.66
Governments = 4	64.83	0.00	0.09	0.77
Governments = 5	67.82	0.00	0.06	0.81
Governments = 6	64.96	0.00	0.02	0.88
Governments = 7	122.63	0.00	0.68	0.41
Govt Functions				
Fire	216.78	0.00	78.73	0.00
Recreation	43.83	0.00	0.06	0.81
Water/Sewer	58.51	0.00	2.19	0.14
Security	12.87	0.00	0.04	0.85
Other	4.30	0.04	1.61	0.20

p value ≤ 0.05 indicates a rejection of the null hypothesis at a 95% confidence interval
and acceptance of the alternative hypothesis $\gamma_t \neq \gamma_{t-1}$.

Table 9: Testing for Time Invariant Government Variable Coefficients

located in areas that added security districts experienced rates of appreciation that were lower than appreciation rates for otherwise comparable properties. Recreation, fire, water/sewer and other special districts had no influence on appreciation rates. The analysis of the spatial characteristics of governments shows that greater overlap among governments reduces appreciation rates; that house prices appreciate more rapidly in areas with greater heterogeneity in household income; and that new government expenditures are positively correlated with appreciation rates. So the number of local jurisdictions does not influence residential property values (or appreciation rates), but the amount of overlap in government services does.

The formation of a SD with overall insignificant net impacts on property value appreciation indicates that residents value the SD benefit at SD taxation. This is not surprising given the relative ease of SD formation in Colorado. In essence, no impact indicates a dynamic government structure that is serving residents in an efficient manner. The negative effect of security SDs could be a result of intergovernmental externalities in service provision. Anecdotally, residents state that county police patrolling is scaled down in SDs that added security. Since residents still pay county taxes, this decrease in county services could generate negative impacts on property values.

We also demonstrate that these inferences depend critically on our border matching repeat

sales estimation procedure. An analysis of 95,646 repeat sales using the standard specification would conclude that adding governments positively influences appreciation rates; that 3rd, 4th, 5th, 6th, or 7th/8th additional government positively influences appreciation rates; that additional recreation and water/sewer special districts positively influences appreciation rates; and that, in addition to heterogeneity in household income, government size and multiple new governments all positively influence appreciation rates. Restricting the data to border matched repeat sales but excluding controls for neighborhood fixed effects would lead to similar incorrect inferences.

Finally, the location of governments within the Denver-Boulder-Greeley CMSA highlight a dichotomy in urban governance between the highly decentralized inner suburban areas and the centralized central city and outer suburban areas. This pattern highlights that flexibility in altering local government structure may be beneficial for serving diverse residents and meeting LPG demand conditions within an urban area. These results suggest that neither the full decentralization quoted by Olson (1969) nor the centralization quoted by Hochman et al. (1995) should always be adopted by local governments. Rather, results advocate for limited decentralization and the ability of residents to structure government to better serve diverse LPG demands and minimize government overlap.

Results are generalizable in two ways. First, new government formation is not unequivocally beneficial even with the majority approval of included residents. Second, heterogeneity in benefits due to the function and spatial characteristics of governments show that the types of LPGs provided and the structure of existing governments influence the impacts of institutional decentralization.

References

Alesina, A., Baquir, R. and Carolyn, H.: 2004, Political jurisdictions in heterogenous communities, *Journal of Political Economy* **112**, 348–396.

Bailey, M. J., Muth, R. F. and Nourse, H. O.: 1963, A regression method for real estate price index construction, *Journal of the American Statistical Association* **58**(304), 933–942.

Baqir, R.: 2002, Districting and government overspending, *Journal of Political Economy* **110**(6), 1318–1354.

Bates, L. J. and Santerre, R. E.: 2006, Leviathan in the crosshairs, *Public Choice* **127**(1-2), 133–145.

Billings, S.: 2009, Do enterprise zones work? an analysis at the borders, *Public Finance Review* **37**(1), 68–93.

Black, S. E.: 1999, Do better schools matter? parental valuation of elementary education, *Quarterly Journal of Economics* **114**(2), 577–599.

Brasington, D. M.: 2001, Capitalization and community size, *Journal of Urban Economics* **50**(3), 385–395.

Brennan, G. and Buchanan, J.: 1980, *The Power to Tax: Analytical Foundations of a Fiscal Constitution*, Cambridge University Press, New York.

Brueckner, J. K.: 1979, Property values, local public expenditure and economic efficiency, *Journal of Public Economics* **11**(2), 223–245.

Calhoun, C. A.: 1996, OFHEO house price indexes: HPI technical description. Office of Federal Housing Enterprise Oversight Technical Report.

Campbell, R. J.: 2004, Leviathan and fiscal illusion in local government overlapping jurisdictions, *Public Choice* **120**(3-4), 301–329.

Case, B. and Quigley, J. M.: 1991, The dynamics of real estate prices, *The Review of Economics and Statistics* **73**(1), 50–58.

Case, K. E. and Shiller, R. J.: 1987, Prices of single-family homes since 1970: New indexes for four cities, *New England Economic Review* **September/October**, 45–56.

Case, K. E. and Shiller, R. J.: 1989, The efficiency of the market for single-family homes, *The American Economic Review* **79**(1), 125–137.

Census: 2000a. Tiger/Line Files. http://www.census.gov/geo/www/tiger.

Census: 2000b. American FactFinder Summary File 3. http://www.census.gov.

Clapp, J. M. and Giaccotto, C.: 1998, Price indices based on the hedonic repeat-sales method: Application to the housing market, *Journal of Real Estate Finance and Economics* **16**(1), 5–26.

Deller, S. C.: 1990, An application of a test for allocative efficiency in the local public sector, *Regional Science and Urban Economics* **20**(3), 395–406.

Epple, D. and Zelenitz, A.: 1981, The implications of competition among jurisdictions: Does Tiebout need politics?, *The Journal of Political Economy* **89**(6), 1197–1217.

Fisher, R. C. and Wassmer, R. W.: 1998, Economic influences on the structure of local government in U.S. metropolitan areas, *Journal of Urban Economics* **43**(3), 444–471.

Foster, K.: 1997, *The Political Economy of Special-Purpose Government*, Georgetown University Press.

Goetzmann, W. N. and Spiegel, M.: 1995, Non-temporal components of residential real estate appreciation, *Review of Economics and Statistics* **77**(1), 199–206.

Goodman, A. C. and Thibodeau, T. G.: 1998, Dwelling age heteroskedasticity in repeat sales house price equations, *Real Estate Economics* **26**(1), 149–169.

Halvorsen, R. and Palmquist, R.: 1980, The interpretation of dummy variables in semilogarithmic equations, *American Economic Review* **70**(3), 474–475.

Hill, R. C., Knight, J. K. and Sirmans, C. F.: 1997, Estimating capital asset price indexes, *The Review of Economics and Statistics* **79**(2), 226–233.

Hochman, O., Pines, D. and Thisse, J.-F.: 1995, On the optimal structure of local governments, *American Economic Review* **85**(5), 1224–1240.

Holmes, T. J.: 1998, The effect of state policies on the location of manufacturing: Evidence from state borders, *Journal of Political Economy* **106**, 667–704.

Hughes, W. and Turnbull, G.: 1996, Uncertain neighborhood effects and restrictive covenants, *Journal of Urban Economics* **39**, 160–172.

McKenie, E.: 1994, *Privatopia: Homeowner Associations and the Rise of Residential Private Government*, New Haven:Yale University Press.

Nelson, M. A.: 1987, Searching for Leviathan: Comment and extension, *American Economic Review* **77**, 198–204.

Nelson, M. A.: 1990, Decentralization of the subnational public sector: An empirical analysis of the determinants of local government structure in metropolitan areas in the U.S, *Southern Economic Journal* **57**(2), 443–457.

Oates, W. E.: 1969, The effects of property taxes and local public spending on property values: An empirical study of tax capitalization and the Tiebout hypothesis, *Journal of Political Economy* **77**(6), 957–971.

Oates, W. E.: 1972, *Fiscal Federalism*, Harcourt, Brace and Javonvich, New York.

Oates, W. E.: 1985, Searching for Leviathan: An empirical study, *American Economic Review* **75**(4), 748–757.

Olson, M.: 1969, The principle of "fiscal equivalence": The division of responsibilities among different levels of government, *American Economic Review* **59**(2), 479–487.

Quigley, J. M.: 1995, A simple hybrid model for estimating real estate price indexes, *Journal of Housing Economics* **4**(1), 1–12.

Ries, J. and Somerville, T.: 2004, School quality and residential values: Evidence from vancouver zoning, *University of British Columbia: Centre for Urban Economics and Real Estate Working Paper* **04-01**.

Stansel, D.: 2005, Local decentralization and local economic growth: A cross-sectional examination of US metropolitan areas, *Journal of Urban Economics* **57**(1), 55–72.

Tiebout, C. M.: 1956, A pure theory of local expenditures, *Journal of Political Economy* **64**, 416–424.

Turnbull, G. K. and Djoundourian, S. S.: 1993, Overlapping jurisdictions: Substitutes or comple-
ments?, *Public Choice* **75**(3), 231–245.

White, H.: 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for
heteroskedasticity, *Econometrica* **48**, 817–830.

Zax, J. S.: 1989, Is there a Leviathan in your neighborhood?, *American Economic Review*
79(3), 560–567.

Denver-Boulder-Greeley CMSA
Number of Governments

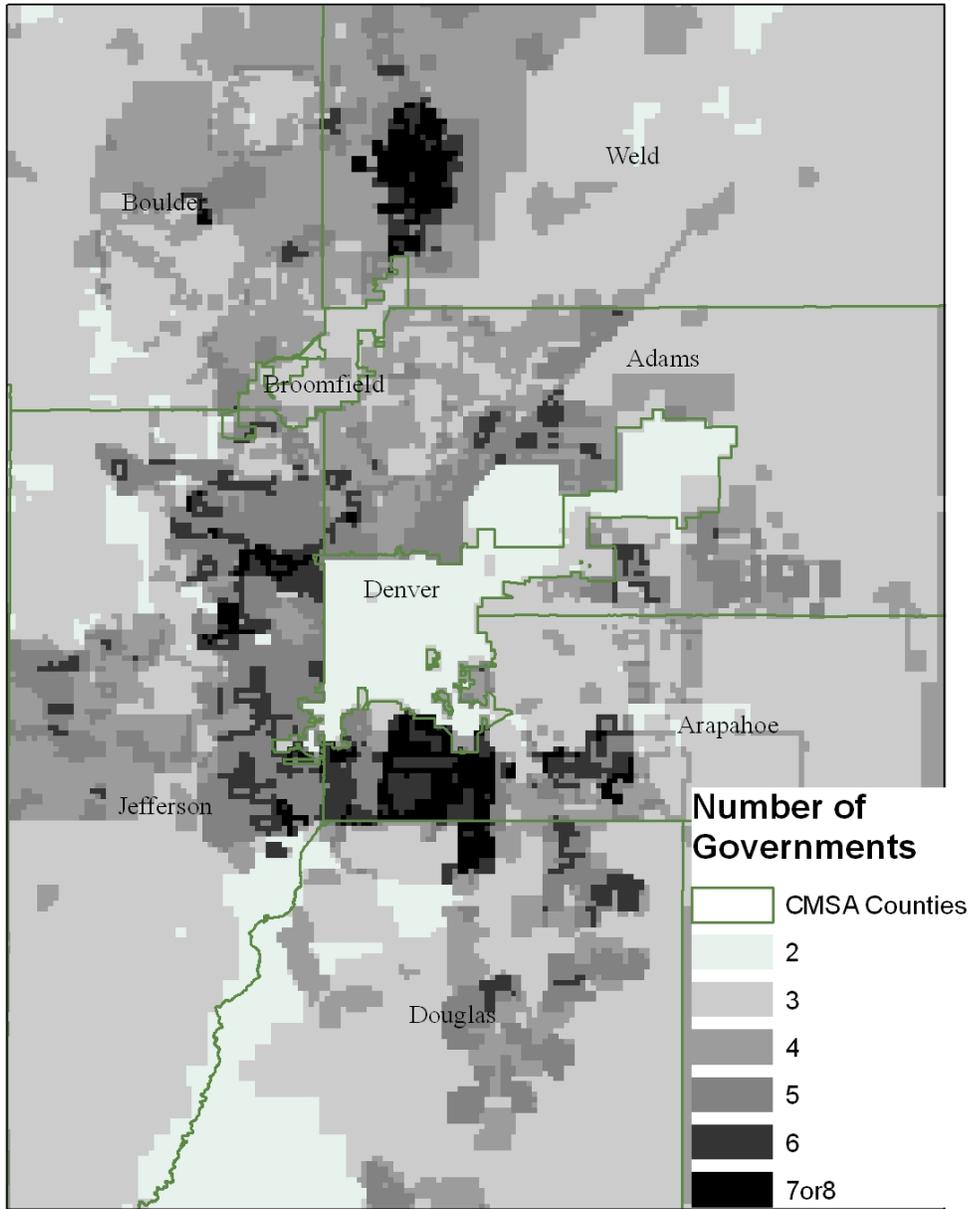**Number of Governments**

- CMSA Counties
- 2
- 3
- 4
- 5
- 6
- 7or8

Figure 3: Denver-Boulder-Greeley CMSA: Number of Governments