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THREE ESSAYS ON LOCAL PUBLIC FINANCE

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THREE ESSAYS ON LOCAL PUBLIC FINANCE

DISSERTATION

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ABSTRACT OF DISSERTATION

THREE ESSAYS ON LOCAL PUBLIC FINANCE

This dissertation seeks to develop the subject of local public finance in a manner consistent with the political economy of local governments. For ease of description, each essay will be discussed briefly.

The first essay is titled "The Provision of Generalized Local Public Goods Financed by Distortionary Taxation." This essay models the provision of a local public good that is simultaneously utilized as a public consumption good and a public intermediate good. Since the public good can simultaneously enter both utility and production functions, it is considered a "generalized public good." This is done to model the provision of infrastructure by sub-federal governments, which is financed with taxes on local residents. A theoretical analysis provides a cost-benefit rule for public good provision by a rent-maximizing local government facing mobile households. Illustrative calculations of the marginal cost of public funds are provided. Calibrated to U.S. data, the role of intergovernmental transfers on the provision of infrastructure by rent-maximizing local governments is analyzed. Theoretical evidence of the higher responsiveness of local governments to matching grants relative to lump-sum grants is provided.

The second essay is titled "The Impact of Local Households' Housing Tenure on Local Public Debt Levels." This essay investigates the relation between local housing tenure and local public debt. It does this by establishing housing tenure as a theoretical basis for the potential differences in how households view public debt. Homeowners capitalize the burden of local public debt into their home value, while renters do not. A hypothesis is generated that an increase in the renter share of households in a locality leads to higher levels of local public debt, all else equal. Using an instrumental variable approach, the empirical evaluation shows an increase in the proportion of renters leads to higher levels of public debt in a panel data set of U.S. local governments. Specifically, a one percentage point increase in the percent of renters increases unfunded public debt per household by $400, or about 7% of the average local debt level, and 24% of the county with the median debt level. This relationship is robust across multiple specifications.

The third essay is titled "A Spatial Econometric Analysis of Local Households' Housing Tenure on Local Public Debt Levels: Implications for Federalism." This essay extends the model of the second essay by measuring the spatial spillovers using a spatial autoregressive model with autoregressive disturbances. The existence and magnitude of local government spillovers related to local public debt levels are used to inform policy makers at higher levels of government. The analysis identifies possible geographic segmentation of the municipal bond markets and the role of special district debt as a key component of the spatial distribution of local public debt. Additionally, a positive spatial disturbance is found.

KEYWORDS: public finance, political economy, fiscal federalism, housing tenure, capitalization

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Dedicated to my loving wife, Kristen

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Chapter 1 Introduction

This dissertation on local public finance contains three essays. These essays make up the subsequent chapters. Chapters two and three are completely self-contained and do not reference any other work within this dissertation. The fourth chapter uses the same dataset and similar econometric methodology as the third chapter. For this reason, chapter four refers to the empirical design of chapter three. Summaries of each individual chapter follow.

1.1 The Provision of Generalized Local Public Goods Financed by Distortionary Taxation

The second chapter of this dissertation develops a theoretical model of the provision of a local public good. The model is a stylized description of the provision of infrastructure in the United States, using observations of actual infrastructure provision to motivate and provide a basis for the assumptions used in the model. A key feature is that the local public good simultaneously provides direct benefits to households through its consumption, and it provides benefits to the owners of the factors of production through its role as an unpaid input in the production process. This dual nature of the public good is what I term a "generalized public good."

Recognizing that a great deal of infrastructure is provided by state and local governments, this model takes on many characteristics familiar to the urban economics literature. As the model is a stylized sub-federal government, it is assumed that labor-providing households are freely mobile and that the local government is small and open with respect to the location of households. Households make locational decisions to maximize their utility. Households provide labor, receive wages, pay taxes, consume a private composite good, and consume the public good in the locality. The locality takes utility of mobile households as given, implementing tax and expenditure policies that maximize the payouts to the owners of the fixed factors. The role of the fixed factor and its owners are vital to the model, as the fixed factor captures the rents that are not paid as wages. Of course, it need not be the case that mobile households are not also owners of the fixed factor.

In order to establish a first-best benchmark for provision, I postulate that a tax on the return to the fixed factor is available to the locality for funding the generalized public good. This tax acts as a lump-sum tax instrument resulting in a combination of the Samuelson condition and the Kaizuka/Sandmo rule for public inputs. Replacing this tax instrument with a head tax on households results in a rule of provision that is second-best, since a head tax on mobile households is distortionary.

The second-best rule provides some insights into the provision of generalized public goods. First, the resulting rule defines the marginal cost of public funds (MCPF). The MCPF includes the marginal dead-weight loss of taxation. The MCPF is partly determined by the complementarity or substitutability in production between the public factor and labor. If labor is a complement in production to the public factor, then households are attracted to the jurisdiction by the increase in their marginal product and the MCPF decreases. However, if labor and the public factor are substitutes, then the provision of the public factor increases the MCPF.

After deriving a rule for provision, I use estimates of the parameters that appear in the MCPF to provide illustrative calculations of the magnitude of the distortions. The resulting magnitudes of the MCPF are consistent with empirical estimates.

The final feature of this chapter is that the model of local government behavior includes the responses to intergovernmental grant policy from a central government. The central government may provide lump-sum as well as matching grants. With the locality taking the grant policy as given, an experiment is postulated, which type of grants are more effective at increasing provision of the public good by the locality. The behavioral responses by the locality are in line with findings in previous literature that use alternate objective functions and agents.

1.2 The Impact of Local Households' Housing Tenure on Local Public Debt Levels

The third chapter of this dissertation is an empirical exercise designed to analyze an aspect of Buchanan's Public Principles of Public Debt (1958). Buchanan (1958) critiques Ricardian equivalence, which suggests that public debt and current taxes have equivalent effects on economic outcomes because future taxes are accounted for by current agents. Buchanan postulates an imperfect equivalence exists because not all agents account for future taxes. Agents without ties to the taxing jurisdiction may not be concerned with future tax payments. Generally, Ricardian equivalence operates through intergenerational relations and transfers to descendants subject to the taxing jurisdiction. However, in a local setting where descendants can easily leave the jurisdiction, equivalence is driven by permanent ties through real property ownership. Specifically, in order for homeowners to leave a jurisdiction and the future taxes behind, they must divest their real property holdings. Since future policies are capitalized into the real property values, the homeowner internalizes future tax payments. Renters do not have this type of connection to the jurisdiction and may not internalize the burden of future tax payments. The different incentives between homeowners and renters may result in different preferences for local public debt utilization. I hypothesize that renters prefer higher levels of public debt to current taxes, all else equal. This is tested through regressing the aggregate local public debt outcomes on the renter share of households in the jurisdiction.

I use a panel dataset of American local governments to evaluate the relationship between local public debt levels and housing tenure. Most of the data is from the census of governments and the decennial census. I only use years of the census of governments in which the entire population of local governments exists, so quinquennial years that end with "2" or "7" from 1980-2010 are used. I aggregate variables up to the county level to limit the variation in local government functions, particularly between special district and general purpose. This results in a balanced panel of 3,106 counties over 6 periods. I collect a number of variables common to the local public debt literature. These controls are categorized as public preferences and institutional constraints.

I use two-stage least squares estimation methods to correct for potential endogeneity operating through capitalization of the local public debts into home values and a control function to control for potential endogeneity of the rent/own decision. I find that an increase in the renter share of households in the county predicts an increase in the level of local public debt. Furthermore, I argue the magnitude is substantial, with a one percentage point increase in the renter share leading to a $400 increase in local public debt per household, around 5% of the debt per household in Fayette County, KY.

1.3 A Spatial Econometric Analysis of Local Households' Housing Tenure on Local Public Debt Levels: Implications for Federalism

This chapter extends the empirical model of local public debt in the previous chapter by considering spatial dependence among counties. I assume the spatial dependence follows a simple geographic structure, where Tobler's first law of geography is in effect: "everything is related to everything else, but near things are more related than distant things." Spatial models of fiscal outcomes frequently contain spatial dependence at the local level since the governing institutions and processes of fiscal policy determination are correlated across space. Furthermore, at lower levels of the federal system, mobility becomes easier for households to utilize and is more impactful on fiscal policies. With the results of the previous chapter that renting households prefer higher levels of public debt, the presence of spillovers in local public debt could be one way to justify federal or state level housing policy aimed at homeownership rates.

The spatial model I estimate is known as a Cliff-Ord model, or a spatial autoregressive model with autoregressive disturbances. This model allows for spatial dependence through other counties' public debt outcomes and through the error process. I use generalized methods of moments to overcome the auto-correlation from the spatial parameters. First, I use two-stage IV estimators with the renter share of households treated as endogenous. Under this procedure, the renter share still positively predicts local public debts levels. A negative spatial lag is found, and the spatial errors are spatially clustered.

I then estimate models treating the renter share as exogenous to perform simulations on the impact of the spillovers. I also use various spatial weight matrices to investigate the possible drivers of spatial dependence. Each model's spatial lag parameter is negative. This is associated with negative spillovers, i.e., one county's relatively high debt level is adjacent to counties with relatively low debt levels. In specific terms, this is interpretable as a one percentage point increase in renter share leads to a $297 global average increase in net debt per household. I find that the spatial parameters have stronger within-state effects and that state borders dampen the effect of the spillovers.

The magnitude of the spillover is not large relative to the impact of the coefficient on renter share, which suggests a $320 direct increase in net debt per household for a one percentage point increase in renter share. The spillover has an indirect effect on local public debt levels of about $23 per household. However, the confirmed presence of a spillover suggests that higher levels of government can adopt policies that allow for the internalization of these externalities. Currently, states are autonomous in their control over local public debt, and this appears to be the appropriate level. Additionally, the flexible jurisdictional area of special districts is useful for handling potential policy spillovers within and among states. The initial analysis of the role of special district debt suggests that special districts may be driving the empirical detection of spillovers. Future research in this area ought to continue focusing on the role of special districts in determining the spatial distribution of local public debt.

Chapter 2 The Provision of Generalized Local Public Goods Financed by Distortionary Taxation

2.1 Introduction

Local governments frequently provide public goods and services that, to varying degrees, directly benefit their residents and simultaneously enhance the productivity of local businesses. Some examples of these public goods are readily apparent, including public utilities, legal institutions, public safety measures, and transportation infrastructure. Expenditures on local public goods are chosen by local decision makers, who must simultaneously consider the funding source(s). While user fees may be used to offset operational expenses, oftentimes the funding source of marginal capital outlays (and potential accompanying debt) of a project is local tax revenues. Local taxes may affect household locational choices by making a locality less attractive to residents. At the same time, public goods make a locality more attractive to residents, either because they directly benefit residents or because, through their impacts on local business activity, they increase (or, through potential substitution effects, decrease) the demand for labor.

Within this backdrop of local public expenditures, this chapter develops a positive theoretical model to determine the cost-benefit rule for provision of a local public good. Typical theoretical models of public good provision assume that a public good enters either the utility function or the production function, but not both. That restriction is not imposed here. The model here follows the flexibility sometimes utilized in applied economic analyses of the provision of public goods that recognize the multi-use aspect of public goods as final consumption goods and as productive inputs (Brueckner & Wingler 1984, Haughwout 2002). The integrated treatment of these goods—which encompass, as polar cases, public goods that only benefit households and public goods that only affect production—facilitates a unified analysis of the impacts of public expenditure and tax policies that have generally been examined in more fragmentary settings in previous literature.

By simply allowing a single public good to enter into both utility and production functions this chapter models a more general public good. Thus, a public good which directly enters both utility and production functions is henceforth called a "generalized public good." This nomenclature is partially attributed to Brueckner & Wingler (1984), which uses this type of public good for the derivation of a "generalized Samuelson condition." This approach is distinct from theoretical models that posit two public goods where each public good is treated dichotomously, i.e., one public good enters the utility function and the other enters the production function. For example, Richter & Wellisch (1996) models the provision of two local public goods under conditions of factor mobility to analyze the efficiency of the provision of each public good. In the tax competition literature, the use of multiple public goods is used to model the composition of public consumption goods and public intermediate goods under various tax regimes (Keen & Marchand 1997, Matsumoto 2000).

Given the local nature of the problem, a mobile tax base is assumed. In this model, the tax imposed on the mobile tax base is distortionary, so the rule of marginal provision of a generalized public good financed results in a marginal cost of public funds (MCPF) formula. This formula reveals some of the factors that influence the cost-benefit calculus, especially the productive complementarity (or substitutability) of the generalized public good with local private inputs. The MCPF is parameterized to facilitate the interpretation using empirical counterparts. A key parameter is the elasticity of complementarity, the variation of which drives significant swings in the MCPF. It is shown that the polar cases of public intermediate and public consumption goods have different MCPFs and the generalized formulation is a weighted combination. Since this model is intended to provide a stylized reflection of the provision of infrastructure in the United States, an intergovernmental matching grant adjusted MCPF is also provided and reveals significant impacts to the decision rule.

Section 2 begins by setting up the assumptions of the model and the necessary conditions for the optimization. Section 3 looks at the resulting cost-benefit rule for provision of a generalized public good by providing a measure of MCPF. Illustrative calculations regarding the MCPF are provided. Then the results look specifically at the role intergovernmental transfers have on the provision of infrastructure by providing illustrative calculations. Finally, a theoretical grant policy experiment is evaluated through the use of compensated changes in grant policies. Section 4 concludes.

2.2 Method

Observation based Assumptions

The theoretical model presented in this chapter is motivated by six crucial observations about infrastructure policy in the U.S. Many of these assumptions are typical of theoretical urban public finance models; although the model can potentially be adapted to many policy contexts and countries.

First, publicly provided infrastructure has both commercial and domestic uses. In the U.S., single unit trucks and semi-trailer trucks account for about 10% of total miles driven on public roads, and over 15% of all interstate miles. This sets a lower bound for the share of commercial miles driven.[1] Furthermore, about 55% of publicly supplied water use in the U.S. is household usage, with most of the remainder used directly for commercial and industrial uses (Maupin et al. 2014). Therefore, the public good is modelled as both a public intermediate good[2] and as a public consumption good simultaneously, a generalized public good as defined above.

Second, the marginal dollar spent on public goods is determined by local governments and is financed by local tax revenues. The majority of direct transportation and water infrastructure spending and funding is done by American state and local

[1]See the Federal Highway Administration, Annual Vehicle Distance Traveled in Miles and Related Data - 2014 by Highway Category and Vehicle Type, Table VM-1.

[2]Duranton & Deo (1999) provides additional background and rationalization for how public goods are productive and affect local industry.

entities. State and local governments' share of infrastructure spending is typically around 90%. Their share of funding, after intergovernmental transfers, is about 75% of total funding.[3] The model developed here accordingly focuses on infrastructure provided by a local government within a federation.

Third, household mobility between regions is an important feature of subnational governments in the U.S. and elsewhere. In fact, membership within many federations oftentimes requires the regions (states or provinces) to allow households free mobility within the entire federation.[4] Therefore, it is assumed that households are mobile within the federation, and there are many localities to live in. Assuming, as an idealization, that households have costless mobility, no locality's policies can have an appreciable effect on the utility in equilibrium, i.e., localities are utility takers.

Fourth, U.S. state and local governments use "territorial" taxes (personal income, sales, property) as primary sources of revenue, so households that locate within the state and local jurisdictions subject themselves to these tax assessments. While there is some variation across states in composition, the share of state and local revenue from personal income, sales and property taxes average around 90% of own-source tax revenue. Large variation in the share collected from these taxes is observed only in the few states that generate significant revenue from severance taxes on natural resources. Therefore, a stylized location contingent tax is used as the primary source of revenue by the locality.

Fifth, the local political process is dominated by "landed interests."[5] This is possible since homeowners are much more likely to vote in local elections relative to renters, 65% to 54% respectively, and homeowners make up around 70% of the electorate (McCabe 2013).[6] Landed interests are also dominant in the realm of local campaign finance.[7] With both the electorate and the campaign finance dominated by landed interests, local decisions may reflect these interests in setting policy; therefore, the local government in the model maximizes aggregate land value.

And sixth, the Federal government provides between 15-20% of total state and local revenue through intergovernmental transfers. These transfers consist of matching and non-matching grants. Matching grants vary by rates and form depending on the

[3]Most of the spending on transportation infrastructure is maintenance of existing infrastructure. Also, within all infrastructure spending, around 65% is spent on transportation. These figures are gathered from data releases from the Congressional Budget Office.

[4]Examples include: Privileges and Immunities Clause, found in the US Constitution, Article IV, Section 2, Clause 1; Russian Constitution, Rights and Freedoms of Man and Citizen, Chapter 2, Article 27, Clause 1; Constitution of Canada, Canadian Charter of Rights and Freedoms, Mobility Rights, Section 6. Even the European Union shares this aspect of federations through the Treaty on the Functioning of the European Union, Free movement of workers, services and capital, Part 3, Title IV, Chapter 1, Article 45. As a counterexample to free mobility, China uses the Hukou system severely hinders internal migration of households.

[5]Landed interests are the interests of individuals that own land within the local political jurisdiction.

[6]These facts have contributed to the development of the so-called "homevoter hypothesis" (Fischel 2001*a*).

[7]Oftentimes the single largest identifiable local campaign contributor category is the land development interest. This fact has contributed to the development of the so-called "growth machine theory" (Logan & Molotch 2007, Fleischmann & Stein 1998).

project. For example, the U.S. federal government typically matches 80% of eligible highway projects, but can match up to 90%, of total spending on a project. Federal grants can match local funds to repair damaged water infrastructure after a disaster at a rate of 75%. States can receive matching grants to capitalize a revolving loan fund for financing eligible clean and drinking water infrastructure projects at an 80% matching rate. Therefore, the model includes non-own source revenue for the local government from federal lump-sum and matching grants.

Under the modelling assumptions that reflect these observations, a second-best decision making rule for infrastructure provision of a local government is found and reported.

Theoretical Model

Household

Many households exist within the model. Each household is freely mobile between localities and moves in order to maximize their own utility.[8] Utility is a function, U, of private consumption, c, and a generalized public good, z.[9] From the viewpoint of a single locality, for any household to locate within its jurisdiction, the attainable utility within the locality must be at least as high as any other locality in which the household may locate. Since household movement is costless and there are many localities to choose from, the locality cannot appreciably affect the utility available to a household. Thus a locality can be considered small and open, and thereby is a utility taker. In equilibrium, equation 2.1 describes the migration equilibrium condition that the local government must satisfy as:

$$U(c, z) = \bar{U}. \tag{2.1}$$

Since the analysis focuses on a single locality, $\bar{U}$ is treated as exogenous and it therefore does not appear explicitly, henceforth. For simplicity, the implicit function theorem is applied to define consumption as a function of the public good, and its first derivative is taken as well. This first order condition is crucial to the results of the optimization problem, thus it is noted that the negative of the first order condition is the marginal rate of substitution (MRS) between the generalized public good and the consumption good. Furthermore, choosing the consumption good as numeraire means the condition can also be considered the marginal benefit of the public good to the household, or the marginal willingness to pay for the generalized public good. These results, as well as the other results from application of the implicit function theorem and associated first order conditions, are included in the proofs section 2.5.

[8]For simplicity in developing the insights of the model, identical mobile households are considered. Of course, it is possible to assume multiple classes of households with differing utility functions and mobility, but that would provide an inessential complexity to the analysis. However, one important aspect in which households can be considered heterogeneous is in wealth, provided that preference for wealth is separable.

[9]Each of these variables can be thought of as a vector of consumption goods and public goods, respectively.

For now, it is helpful to state the notation convention in use, which is that each lower case letter represents a variable and the upper case letter represents the corresponding function. For example, c is consumption and C is the function of how consumption is determined by the generalized public good, z. Additionally, prime is used to denote derivatives of univariate functions and a subscript on a function is used to denote partial derivatives of multivariate functions.

Each household is endowed with one unit of labor, which it provides within the locality where it chooses to locate.[10] Labor is homogeneous and the market in which this labor is employed is competitive so the household receives the marginal product for its labor, denoted F_l. Out of this income the household pays a "head" tax, t, to the jurisdiction in which it locates and consumes its post-tax income. Thus, each household uses equation 2.2 as a budget constraint.

$$F_l - t = C \tag{2.2}$$

Production

Production takes place at the local level and utilizes three factors of production: the generalized public good as a public input, z, and two private inputs, labor and a fixed factor, which are denoted as l and $\bar{k}$, respectively. Given that labor is supplied by households that locate within the locality, l reflects the number of households that are present within the jurisdiction. The locality is endowed with some of the fixed factor, though not necessarily the same amount as other localities.

An aggregate production function, denoted $F(z, l, \bar{k})$, is assumed for the locality. The private factors in production are assumed to have positive, but diminishing marginal products. However, no such assumption is necessary for the sign of the marginal product of the public input. Also, no assumptions are made for the signs of each of the cross products between inputs. This is to say that any of the pairs of inputs may be complements or substitutes within the production process.

Each factor of production has a different basis for compensation. The public input is unpaid, labor receives its marginal product, and the fixed factor receives the remainder of production as rents. This exhausts all revenue from output. Furthermore, with rents accruing to the fixed factor, no assumptions need to be made with respect to the type of public (unpaid) factor in use.[11] The output is costlessly converted to the consumption good, which serves as numeraire, and the cost function for the generalized public good is $H(z)$. Formally, this statement implies that H' is the marginal rate of transformation (MRT). Of course in a market setting, this is the direct cost of

[10] With labor provided within the locality, this model is a "regional" and not a "metropolitan" Tiebout-type model (Mieszkowski & Zodrow 1989). Regional models generally require three assumptions: 1. the households work within the jurisdiction they reside in, 2. regional governments do not have absolute control of community size, and 3. land is fixed within regions.

[11] There is an expansive literature on the impact of the assumption to whom the benefits accrue, see Feehan (1989) for a review of this literature. In particular it depends on whether the production function exhibits constant returns to scale in all inputs or just in the private inputs, i.e., the public good may be congestible in its use by firms that make up the aggregate production function.

the generalized public good in terms of consumption good, is constant, and is equal to one, such that the marginal cost of z, MC_z, is one.

Local Government

In this model, the local government makes the decision of how much of the generalized public good to provide in the locality. The public good is financed from three sources of revenue; only one of which is a choice variable to the local government—the tax on households. This tax is contingent on a household locating within the local government's jurisdiction, and the burden is uniformly distributed to those households. This is an abstraction used to simplify the distortionary margins of a local tax. For example, it abstracts away from labor-leisure or consumption margins. Thus, the only margin is the migration margin allowing for all the focus to be on the location contingent aspect of local taxation. The locality also receives grants from a federal government. The two types of grants it receives are a lump-sum grant and a matching grant. The lump-sum grant amount is denoted $\bar{g}$. The matching grant matches the level of public expenditure at some rate, with the matching rate denoted $\bar{m}$. The grant policies are taken as given by the local government. To denote that grants are exogenous to the local government, over bars are used in the government budget constraint in equation 2.3:

$$L(z,t)t + \bar{g} + H(z)\bar{m} = H(z) \tag{2.3}$$

The local government is postulated to choose its policies so as to maximize the value of the fixed factor, which is $\bar{k}$ in this model. This is a typical objective function for models of local public good provision with mobile households (Negishi 1972, Wildasin 1986, 1987). One might alternatively consider the possibility that the government tries to maximize utility, but this approach cannot be meaningful in a model with utility-taking localities. In such a model, the only agents whose utility is appreciably affected by local policies are the owners of the fixed factor, and their sole interest is to maximize its value (Fischel 2001*a*).[12] The objective function is to maximize rents, denoted R.

$$R = F(z,l,\bar{k}) - F_l(z,l,\bar{k})l \tag{2.4}$$

After substitution of variables with their associated functions, a more complete objective function is specified as follows:

$$R = F(z, L(z, T(z,\bar{g},\bar{m}))) - F_l(z, L(z, T(z,\bar{g},\bar{m})))L(z, T(z,\bar{g},\bar{m})) \tag{2.5}$$

[12] Wilson (1995) points out that since there are many regions that are small and open, an Arrow-Debreu like separation may be applied, thus households may own the fixed factor but the decision is unattached to their locational choice of maximizing utility, i.e., they allow market conditions to dictate the optimal mix in their locational decision as a consumers of private and public goods. Therefore, households that locate in this locality and own a portion of the fixed factor also prefer this objective to the extent they also own some of the fixed factor, or a non-traded good (e.g., houses), within the region (Sonstelie & Portney 1978, Wildasin 1979).

Optimization of this objective function results in z^*, the argmax of R, which must meet the following two conditions:[13]

$$\Phi(z^*, \bar{g}, \bar{m}) \equiv \frac{dR(z^*, \bar{g}, \bar{m})}{dz} = 0, \tag{2.6}$$

$$\Phi_{z^*} = \frac{d^2R(z^*, \bar{g}, \bar{m})}{dz^2} < 0. \tag{2.7}$$

2.3 Results

In order to facilitate economic meaning and practical relevance of the results of the optimization, some observable or empirically estimable parameters are introduced here. Five parameters are introduced that are used to demonstrate the effect of the the tax distortion on the MCPF. The first parameter is the demand elasticity of labor, defined as $\epsilon_l = \frac{F_l}{LF_{ll}} < 0$. The second parameter is the tax rate, defined: $\tau = \frac{t}{F_l} > 0$. Third is the factor share of labor: $\theta_l = \frac{LF_l}{F} > 0$. The fourth parameter is used for convenience in balancing the generalized public good between its utilization as a public input and as a public consumption good. The parameter λ defines the share of marginal benefits that accrue through the role of the public good as a public input. So, if $\lambda = 1$ then the entire benefit of the public good is due to its impact on production, and $\lambda = 0$ means that it has no benefits as a public input.

The final parameter requires more discussion than the previous parameters given its potential impact on the MCPF through its possible sign and magnitude. The parameter is the Hicks elasticity of complementarity (Hicks 1970, Hamermesh 1996). Formalized as:

$$\sigma_{lz} = \frac{F_{lz}F}{F_lF_z} \begin{cases} < 0 & \text{q-complements} \\ > 0 & \text{q-substitutes} \end{cases}.$$

This elasticity describes how a change in the amount of public good employed affects the relative marginal product of labor holding other inputs and the price of the output

[13] A useful benchmark for the model would be one with lump-sum taxes and the first-best provision of public goods. Given the established framework, a simple alteration of the tax available provides the necessary conditions. Thus, supposing that instead of a tax on labor the public good is solely financed with a tax on rents—such as Henry George's single tax, a well known lump-sum tax—the rule for first-provision should result. This specification would be

$$Q = F(L(z), z) - C(z)L(z) - H(z).$$

After optimization following 2.6 and cancellations, the result is $F_z - C'L = (1 - \bar{m})H'$. This result is the rule for the first-best provision of public expenditure. The first term is the value marginal product of the public expenditure. This follows the Kaizuka/Sandmo rule for an aggregate production function (Kaizuka 1965, Sandmo 1972). The second term is the marginal rate of substitution of the public expenditure to the private good multiplied by the number of households, which follows Samuelson (1954). The right side is the local price adjustment for the matching grant times the first derivative of the cost function with respect to the numeraire, or the marginal rate of transformation. By setting the matching rate to zero, and simplified to familiar terms this is equivalent to a "generalized Samuelson condition" for first-best provision: $VMP_z + \sum MRS = MRT$ (Brueckner & Wingler 1984).

constant. Thus, it reflects the degree to which an isoquant shifts with a change in the level of public inputs (Kim 2000, Stern 2011). This is roughly the dual to more commonly estimated Allen-Uzawa elasticity of substitution, which describes the curvature along an isoquant as one factor level is adjusted.[14] For theoretically possible directions and magnitudes, potential production functions may be considered. One theoretical example is a Leontief production function. The magnitude of the elasticity of complementarity, in this case, goes to positive infinity for q-complements as a new unit of one input infinitely increases the relative marginal product of the other input. Another theoretically relevant example is the Cobb-Douglas production function, which has an elasticity of complementarity of one by construction.

Rent-maximizing Solution

Proposition 1. *When a small open jurisdiction uses a tax on mobile labor to finance its expenditures for a generalized pure public good, the rent-maximizing level of expenditure must satisfy:*

$$F_z + L \cdot MRS = \frac{[(1-\bar{m})MRT - tL_z]}{tL_t + L}L. \tag{2.8}$$

Note that $L \cdot MRS$ is simply the marginal willingness to pay for the public good aggregated across L households, otherwise written as $\sum MRS$, and F_z is the value marginal product of z, written as VMP_z. This entire condition can be restated in empirically meaningful terms that is useful to highlight two special cases:

$$VMP_z + \sum MRS = \frac{(1-\bar{m})MRT}{1+\epsilon_l\tau} + VMP_z\frac{\epsilon_l\tau\sigma_{lz}\theta_l}{1+\epsilon_l\tau} + \sum MRS\frac{\epsilon_l\tau}{1+\epsilon_l\tau}. \tag{2.9}$$

(a) In the special case of sole public consumption goods (i.e., $VMP_z = 0$), this reduces to,

$$\sum MRS = (1-\bar{m})MRT, \tag{2.10}$$

that is, when $\bar{m} = 0$, this reduces to the Samuelson condition.

(b) In the special case of sole public intermediate goods (i.e., $\sum MRS = 0$) this condition becomes,

$$VMP_z = \frac{(1-\bar{m})MRT}{1+\epsilon_l\tau - \epsilon_l\tau\sigma_{lz}\theta_l}, \tag{2.11}$$

that is, a modified Kaizuka/Sandmo rule, since the rent maximizing level of public inputs depends on the behavioral responses of households.

[14] The Allen-Uzawa elasticity of substitution shows how the change in the price of the public good changes the level of labor, holding the input prices and the output quantity constant. The relation between the two elasticities is reciprocal under constant returns to scale production functions (Sato & Koizumi 1973, Syrquin & Hollender 1982). Syrquin & Hollender (1982) shows that in the non-constant returns to scale production function the reciprocity rule of the two elasticities does not hold, but is altered by a scale effect on the marginal cost. Given that estimates for public inputs are only available for the Allen-Uzawa elasticity of substitution, these are roughly converted to elasticity of complementarity using the reciprocity rule to give a loose sense of sign and magnitude.

Proof. See proof 2.5. □

The results stated in equation 2.8 reflect a new formulation that combines some classic results. The left hand side can be interpreted as the marginal benefits of a generalized public good that was obtained in Brueckner & Wingler (1984). The right hand side is the marginal cost of public funds, a result in the spirit of Stiglitz & Dasgupta (1971) from the use of a distortionary tax to finance a public good.[15] Simply put, the provision of a generalized public good with a distortionary tax must follow a modified generalized Samuelson condition.

The first term in the bracketed expression of equation 2.8 is the matching grant adjusted MRT. The last term in the brackets is the effect of the public spending on tax revenue, via the size of the tax base. The impact of public spending on the tax base is theoretically ambiguous, public spending may enlarge, shrink, or have no effect on the tax base. The denominator describes how the tax revenue changes with respect to the tax level, again through the size of the base. The dual effects on the tax base are a product of the general equilibrium nature of the problem. Whether these effects operate in the same direction or in opposite directions is not assumed and theoretically ambiguous, thus whether they are individually or jointly relevant is an empirical question.

With respect to the special case in proposition 1.(a), it is necessary to note that there is no MCPF rule. However, this is not necessarily a first-best allocation since the efficient rule for provision does not ensure that the efficient level is achieved. In this case, it is possible that locational distortions stemming from the non-congestible (pure) public goods and a non-uniform distribution of the fixed factor between local jurisdictions cause locational inefficiencies. These distortions are not apparent in this model, since this model is not equipped to analyze locational distortions.

Proposition 1.(b) has two important components to the MCPF rule given.[16] First, the middle term in the denominator of equation 2.11 unambiguously raises the MCPF, as it reflects the impact of the collection of tax revenue on the tax base. Second, the final term in the denominator reflects the impact of the public expenditure on the tax base, and the sign is theoretically ambiguous. The expenditure operates specifically on the productivity of the households' private factor of production. Through σ_{lz}, and thereby F_{lz}, the sign of the entire term is positive (negative) if the public expenditure is a substitute (complement) to labor in the production function. Thus, substitutable (complementary) factors exacerbate (mitigate) the outflow of households from the jurisdiction from the effect of taxation. Of course, σ_{lz} can also take on a null value, where the public expenditure has no impact whatsoever on the marginal product of labor and the subsequent flow of households in the jurisdiction.

[15] Stiglitz & Dasgupta (1971) is among the first that showed how the MCPF with uncompensated demand curves take the effect of public expenditure into account. This contrasts with simply adding the marginal excess burden to the amount of tax collected under a "Harberger/Browning" approach. For a more thorough discussion on MCPF and the differences in approaches see Wildasin (1984), Ballard & Fullerton (1992), Dahlby (2008).

[16] These results are similar to those found in Feehan & Matsumoto (2002).

More generally, we can derive a MCPF rule for public goods that serve both as public consumption and as public intermediate goods. As we see from equation 2.12, the parameter λ in the generalized formula reflects the relative weights of these two uses. The generalized MCPF is therefore defined as,

$$VMP_z + \sum MRS = \frac{(1-\bar{m})MC_z}{1+\lambda(\epsilon_l \tau - \epsilon_l \tau \sigma_{lz} \theta_l)}. \tag{2.12}$$

Illustrative Calculations

The right hand side of equation 2.12 is used in the illustrative calculation to give potential values of a MCPF, while the left hand side is the unaltered marginal benefits. In all cases, the optimal rule for provision of a public good is that "marginal benefits" should be equated to "marginal cost", where, however, these concepts are appropriately defined. It should be noted that the practical use of this rule requires the parameters to take on values that are reflective of each potential marginal expenditure decision, thus these calculations should be considered relevant for specific public projects (Ballard & Fullerton 1992). Parameter values are also jurisdiction specific as localities vary on a number of important dimensions that affect parameter values, including the physical, demographic, and industrial characteristics.

As any stylized model must, this model is based on simplifying assumptions which may have implications to the interpretation of the results. One of the primary simplifying assumptions in this model is that of perfect household mobility. Household mobility clearly deals within a spatial dimension; however, household mobility (or the degree of "free" mobility) also is part of a temporal dimension. Up to this point, nothing has been said about the appropriate unit of time in which the analysis takes place, which may have implications on the degree of simplification that "free" mobility has, since the model is static and adjustments occur instantaneously. One natural length of time for the analysis in this chapter is the lifetime of the public project, time that could likely be measured in decades. Thus, in asking about the degree of mobility of a household, how free is its mobility over a three or four decade period? Likely almost all households can freely move over such a period. Also, the time period can impact the estimated elasticity of labor demand to the extent the estimates are "short-run" elasticities, since short-run elasticities are more inelastic than the long-run counterparts.

Another crucial assumption by construction in the model is the complete absence of mobile capital. The model as constructed can have two implications on capital. The first is that all capital is fixed and thus, considered part of the fixed factor. Over a four decade period, it is doubtful that much of the capital stock is completely fixed. The other implication, and more likely, is that labor and capital are used in fixed proportion in production. Surely, residential capital stock (housing) has very high correlation with population size. This is also likely true for non-residential capital stock (commercial) in regions that encompass commercial centers as well as surrounding commuter towns. Of course, this type of regional view requires that the region has authority to tax and authorize public expenditure. These are just two

Table 2.1: Marginal Cost of Public Funds for Generalized Public Goods

		$\sigma_{lz} = 5$	$\sigma_{lz} = 2$	$\sigma_{lz} = 0.5$	$\sigma_{lz} = -0.5$	$\sigma_{lz} = -2$	$\sigma_{lz} = -5$
$\epsilon_l = -0.15$	$\tau = 0.15$	0.97	0.99	1.01	1.02	1.03	1.06
	$\tau = 0.25$	0.95	0.99	1.01	1.03	1.05	1.10
	$\tau = 0.35$	0.93	0.99	1.02	1.04	1.07	1.14
	$\tau = 0.45$	0.92	0.98	1.02	1.05	1.09	1.19
$\epsilon_l = -0.45$	$\tau = 0.15$	0.92	0.98	1.02	1.05	1.09	1.19
	$\tau = 0.25$	0.87	0.97	1.04	1.08	1.16	1.36
	$\tau = 0.35$	0.82	0.96	1.05	1.12	1.25	1.60
	$\tau = 0.45$	0.78	0.95	1.07	1.16	1.34	1.93

$\lambda = 0.5$
$\theta_l = 0.75$
$\bar{m} = 0$

implications of the assumptions within this model. It suffices to say that there are more, and the implications require careful consideration when applying the results to real world scenarios.

In order to proceed to the illustrative calculations, actual empirically estimated values for the parameters set forth in equation 2.12 are used.[17] The estimated values the calculations are encouraging. First of all, for the central estimated parameters, the MCPF is around one. This is consistent for empirical findings of own-source revenue sources. Next, it is seen that higher elasticity of labor demand increases the distortion on the MCPF. Also, the distortion is increasing in tax rates. Each are results that are consistent with the literature (Dahlby 2008). Finally, the elasticity of complementarity reveals some interesting effects on the MCPF. For highly complementary public inputs, the MCPF can go below one, which is not a result without precedent (Noiset 1995, Gahvari 2006). Conversely, as private inputs and public input substitutability increases, so does the MCPF.

Grant Policy

The model includes grant policies, which are exogenous to the local government problem under which the optimization takes place. And so far, their operation is secondary to the analysis. This section puts the impact of these parameters in the forefront. Initially, it is shown how the matching rate affects the MCPF. Then, given two types of grants, the analysis is shifted to the federal government where the relative impact on local public spending per dollar of the grant types is evaluated.

[17]The values of these parameters can be found in a number of papers and studies. For the purposes here, Krol (1998) provides an incredibly valuable review and collection of papers, including the crucial specification of production and cost function estimates. The various levels of elasticity of complementarity are chosen to demonstrate the operation of both the potential sign and magnitude. The upper and lower extremes of the parameter values seem plausible given the results in Nadiri & Mamuneas (1994). Additionally this parameter is also shown to lie between 0.5 and 1 given the results of Canning & Bennathan (2000), after adjustments following Kim (2000).

Table 2.2: Marginal Cost of Public Funds for Generalized Public Goods with Matching Grants

		$\sigma_{lz} = 5$	$\sigma_{lz} = 2$	$\sigma_{lz} = 0.5$	$\sigma_{lz} = -0.5$	$\sigma_{lz} = -2$	$\sigma_{lz} = -5$
$\epsilon_l = -0.15$	$\tau = 0.15$	0.19	0.20	0.20	0.20	0.21	0.21
	$\tau = 0.25$	0.19	0.20	0.20	0.21	0.21	0.22
	$\tau = 0.35$	0.19	0.20	0.20	0.21	0.21	0.23
	$\tau = 0.45$	0.18	0.20	0.20	0.21	0.22	0.24
$\epsilon_l = -0.45$	$\tau = 0.15$	0.18	0.20	0.20	0.21	0.22	0.24
	$\tau = 0.25$	0.17	0.19	0.21	0.22	0.23	0.27
	$\tau = 0.35$	0.16	0.19	0.21	0.22	0.25	0.32
	$\tau = 0.45$	0.16	0.19	0.21	0.23	0.27	0.39

$\lambda = 0.5$
$\theta_l = 0.75$
$\bar{m} = 0.8$

Illustrative Calculations with Non-zero Matching Grants

The illustrative calculations of table 2.1 assume that there are no matching grants available. This is true of a vast majority of infrastructure spending. However, a portion of infrastructure projects are undertaken with matching rates around 80%. When a local government has access to matching grants for a specific project, how does that affect the MCPF faced by the local government? Table 2.2 uses the exact parameters in table 2.1 with the exception of an 80% federal matching rate.

It is seen that the matching grant policy dramatically lowers the MCPF in all cases, with the relative differences from other parameter variation remaining consistent. The marginal decision criteria implies that projects with marginal benefits that equal or exceed the MCPF are undertaken. The magnitudes of the MCPF, in table 2.2, imply that local governments fund projects that have limited local marginal benefits.[18] Although the estimation of the marginal product of public infrastructure is rife with complications, the magnitude of estimated parameters of highway spending on marginal output are possible given the magnitudes in table 2.2 (Gramlich 1994, Krol 1998).

Local Government Responsiveness to Grant Policy

In standard analyses of lump-sum and matching grants, a standard finding is that matching grants stimulate provision of public goods to a greater extent than lump-sum grants (Wilde 1968). Such analyses generally abstract from household mobility, and hinge on the difference of income and substitution effects stemming from a locationally fixed household's indifference curve and budget constraint. That line of analysis cannot be applied where households are perfectly mobile and utility is fixed. Thus, a theoretical experiment is postulated, wherein the federal government alters

[18] This finding is in line with the results in Haughwout (2002).

its grant policies to evaluate the impact of the local public good provision under a rent-maximizing objective function to see if the classic result persists.

In order to compare the two types of grants, equivalent amounts of grant funds must be compared. Since this model uses the matching *rate* and lump-sum *amount*, the comparisons in grants must be federal government expenditure neutral, i.e., an additional dollar spending on matching grants from a change in the matching rate is offset by a one dollar reduction of lump-sum grants. In order to do this, it is assumed that the federal government has a fixed budget of grant dollars to allocate, and that this entire budget goes into one of the two grant programs. Effectively, this reduces the federal government to one policy choice. Thus, in this experiment, it is posited that total grant funds received by the recipient government does not change, but that the composition of the funds change. This results in a compensated change of the matching rate. However, it is important to note, the local government does not know that it receives the same amount of grants regardless of its spending, so in this respect, it does not behave strategically. Simply put, the local government takes the federal grant policies as given. Given this setup, it is possible to assess the difference between the effects of grant policies on the provision of the generalized local public good, z^*.

Proposition 2. *Public expenditure matching grants result in more local public expenditures than lump-sum grants of the same amount.*

Proof. See proof 2.5. □

This result is consistent with the literature on intergovernmental transfers, maintaining the theoretical prediction that matching grants stimulate higher spending on the public good than lump-sum grants of the same amount. The economic reasoning is straight forward. Matching grants have price effects, even under distortionary taxes, as observed in the differences of the MCPFs in tables 2.1 and 2.2. This change in relative prices induces a substitution-like effect, even when generalized public good spending is chosen to maximize rents given a fixed utility level of mobile households. Therefore, the policy prescriptions that utilize matching grants in lieu of lump-sum grants to increase the provision of public goods are still sound.

2.4 Conclusion

This chapter builds a model for public good provision based on the institutional structure of infrastructure provision in the U.S. The resulting rule for second-best provision is provided as a MCPF that neatly parallels previous findings in the literature. Specifically, there are two contributions to the literature. First, by treating the benefits of public goods as simultaneously impacting both household consumption and the production process directly a more general MCPF is generated. This MCPF shows that a locality optimally provides a generalized public good under distortionary taxes with the impact of the expenditures on the tax base in mind. The illustrative calculations show that there is a wide range of potential impacts on the local labor market by public good expenditures.

Second, this chapter shows that a model of local spending by a rent-maximizing locality follows typical theories on intergovernmental grant impacts. Two types of transfers are considered and, under a given amount of grant funds, matching grants increase local provision more than lump-sum grants. Matching grant adjusted illustrative calculations of the MCPF are provided and appear to corroborate empirical findings regarding the marginal productivity of infrastructure spending.

Following these results, there are some clear paths to improvements of the model. The model here assumes only a single distortionary margin, the household migration margin. Of course, there are many more potential margins for distortion by local taxation. A model with richer contours of local taxation and household decisions likely does not change the conclusions here but provides additional marginal impacts to consider. In particular, expanding this model to include a distortionary tax on local capital likely introduces additional impacts on the MCPF, similar to those of local labor. Specifically, the inclusion of capital would likely create a decision rule that includes the elasticity of complementarity between the public input and capital, and capital and labor. It is not clear ex ante how the inclusion of these parameters would affect the MCPF. Additionally, this research suggests that empirical research on the elasticity of complementarity between public and private inputs at the local level is important. A clearer empirical understanding of this relationship can bring more insight to the provision of infrastructure within the U.S.

2.5 Proofs

Proof: Rent-maximizing Solution

Proof. Applying the implicit function theorem to equation 2.1 defines consumption as

$$c = C(z). \tag{2.13}$$

With the first derivative:

$$C' = \frac{-U_z}{U_c} \tag{2.14}$$

or

$$-C' = MRS. \tag{2.15}$$

Next, using the implicit function theorem on the household budget constraint, equation 2.2, defines the number of households in the jurisdiction as a migration response function:

$$l = L(z, t) \tag{2.16}$$

The first derivatives are thus:

$$L_t = \frac{1}{F_{ll}} < 0 \tag{2.17}$$

and

$$L_z = \frac{-(F_{lz} - C')}{F_{ll}} \gtrless 0. \tag{2.18}$$

The sign of L_t follows from concavity of the production function in L, higher tax rates cause households to leave a jurisdiction, ceteris paribus. The sign of L_z is indeterminate because no assumptions have been made on the complementarity of inputs; the marginal cross product of production may be positive, if labor and the public good are complements in the production process, or it may be negative, if they are substitutes.

Let the local government own source revenue function be defined:

$$P(z,t) \equiv L(z,t)t. \tag{2.19}$$

With a first order condition:

$$P_t = tL_t + L > 0. \tag{2.20}$$

The sign is positive provided tax levels are assumed to be on the upward side of the Laffer curve.

Applying the implicit function theorem to the government budget constraint, equation 2.3, gives the function of the tax rate:

$$t = T(z, \bar{g}, \bar{m}). \tag{2.21}$$

With first derivatives:

$$T_z = \frac{-(L_z t + H'\bar{m} - H')}{P_t} > 0, \tag{2.22}$$

$$T_{\bar{g}} = \frac{-1}{P_t} < 0, \tag{2.23}$$

and

$$T_{\bar{m}} = \frac{-H(z)}{P_t} < 0. \tag{2.24}$$

It should be noted that T_z is positive; this sign is also a result of assuming the tax level is on the upward side of the Laffer curve. T_z describes the change in the tax level for a given change in public expenditure, so that, with $\bar{g}$ held constant, an increase in public spending must come from an increase in the tax level where the spending exhausts all the tax revenue. This assures that expenditure on public goods is not self-financing, i.e., it is not possible that public services attract so many migrants that more spending produces a net revenue surplus. $T_{\bar{g}}$ and $T_{\bar{m}}$describe how the tax level changes with intergovernmental transfers to the local government. As expected, both derivatives are negative, and transfers are a substitute for tax revenue.

Optimization of equation 2.5, results in:

$$R_z = \Phi = 0 = F_l L_z + F_z - (F_l L_z + L[T_z + C']). \tag{2.25}$$

Which after cancellations simplifies to,

$$F_z - C'L = LT_z. \tag{2.26}$$

Substitutions define the right hand side of equation 2.26:

$$LT_z = \frac{-[\frac{-(F_{lz}-C')}{F_{ll}}t + H'\bar{m} - H']}{P_t}L, \tag{2.27}$$

followed by the substitution of these empirical parameters:

$$\epsilon_l = \frac{F_l}{LF_{ll}} < 0, \tag{2.28}$$

$$\sigma_{lz} = \frac{F_{lz}F}{F_l F_z} \begin{cases} < 0 & \text{q-complements} \\ > 0 & \text{q-substitutes} \end{cases}, \tag{2.29}$$

$$\tau = \frac{t}{F_l}, \tag{2.30}$$

$$\theta_l = \frac{LF_l}{F}. \tag{2.31}$$

Eventually results in:

$$LT_z = \frac{H' - H'\bar{m} + \epsilon_l \tau (F_z \sigma_{lz} \theta_l - C'L)}{1 + \epsilon_l \tau}. \tag{2.32}$$

This is further simplified to:

$$F_z - C'L = \frac{H' - H'\bar{m}}{1 + \epsilon_l \tau} + F_z \frac{\epsilon_l \tau \sigma_{lz} \beta}{1 + \epsilon_l \tau} - C'L \frac{\epsilon_l \tau}{1 + \epsilon_l \tau}. \tag{2.33}$$

The final parameter that is used for convenience is formally divides the marginal benefits of the left hand side of equation 2.33 is defined:

$$\lambda MB + (1 - \lambda)MB = MB. \tag{2.34}$$

Where the parts of the marginal benefit are defined:

$$VMP_z = \lambda MB \tag{2.35}$$

and

$$\sum MRS = (1 - \lambda)MB. \tag{2.36}$$

□

Proof: Local Government Responsiveness to Grant Policy

Proof. This model allows for the comparison between matching and lump-sum grants on how they alter the choice of generalized public good provision at the local level.

To compare the grant policy, the federal government can alter $\bar{m}$ and $\bar{g}$. Since these are now choice variables, to the federal government, the bars are dropped for this section. Total federal budget is given as exogenously fixed amount $\bar{b}$. Additionally, the cost function of the public good is simplified to an identity function in this section, without loss of generality.

$$g + mz^*(m, g) = \bar{b} \tag{2.37}$$

Federal grant comparison for equal transfer amount must make the following comparison, where the change in grant policy leaves total federal government transfers fixed:

$$\left.\frac{dz^*}{dm}\right|_{d\bar{b}=0} = \frac{\partial z^*}{\partial m} + \frac{\partial z^*}{\partial g}\frac{dg}{dm} \tag{2.38}$$

$$\frac{\partial z^*}{\partial m} + \frac{\partial z^*}{\partial g}\frac{dg}{dm} > 0 \tag{2.39}$$

$$\frac{\partial z^*}{\partial m} > -\frac{\partial z^*}{\partial g}\frac{dg}{dm} \tag{2.40}$$

If equation 2.40 holds, then changes in the matching grant is more stimulative than lump-sum grants, for equivalent changes.

It is possible to derive the final term of equation 2.40 above from 2.37. The federal budget is fixed at $\bar{b}$ and requires that funds shift between grant types at 1 to 1.

$$(1 + m\frac{\partial z^*}{\partial g})dg + (z^* + m\frac{\partial z^*}{\partial m})dm = 0 \tag{2.41}$$

$$\frac{dg}{dm} = \frac{-(z^* + m\frac{\partial z^*}{\partial m})}{(1 + m\frac{\partial z^*}{\partial g})} \tag{2.42}$$

Using 2.38 and 2.41 results in:

$$\frac{\partial z^*}{\partial m}(1 + m\frac{\partial z^*}{\partial g}) > \frac{\partial z^*}{\partial g}(z^* + m\frac{\partial z^*}{\partial m}) \tag{2.43}$$

For assistance in solving the partial derivatives of 2.43, the optimization results for establishing z^* is defined Φ.

$$\Phi = 0 = F_z - C'L - T_zL \tag{2.44}$$

$$\frac{\partial z^*}{\partial m} = \frac{-\Phi_m}{\Phi_{z^*}} = \frac{-\partial\Phi/\partial m}{\partial\Phi/\partial z^*} \tag{2.45}$$

$$\frac{\partial z^*}{\partial g} = \frac{-\Phi_g}{\Phi_{z^*}} = \frac{-\partial\Phi/\partial g}{\partial\Phi/\partial z^*} \tag{2.46}$$

By equation 2.7 $\Phi_{z^*} < 0$. The derivatives of Φ are as follows:

$$\Phi_m = \frac{\partial \Phi}{\partial m} = L_t T_m (F_{zl} - C' - T_z) - T_{zm} L \tag{2.47}$$

$$\Phi_g = \frac{\partial \Phi}{\partial g} = L_t T_g (F_{zl} - C' - T_z) - T_{zg} L \tag{2.48}$$

It is be useful to note the following for ease in comparing the two equations above.

$$T_g = \frac{-1}{P_t} < 0 \tag{2.49}$$

$$T_m = \frac{-z^*}{P_t} < 0 \tag{2.50}$$

$$T_m = z^* T_g \tag{2.51}$$

Differentiating

$$T_z = \frac{-(L_z t + m - 1)}{P_t} > 0 \tag{2.52}$$

results in:

$$T_{zm} = \frac{[(-1 - (L_{zt} T_m + L_z T_m)) P_t] - [(T_m L_t + t L_{tt} T_m + L_t T_m)(1 - m - L_z t)]}{[P_t]^2} \tag{2.53}$$

and

$$T_{zg} = \frac{[-(L_{zt} T_g + L_z T_g) P_t] - [(T_g L_t + t L_{tt} T_g + L_t T_g)(1 - m - L_z t)]}{[P_t]^2}. \tag{2.54}$$

Using equation 2.51 to simplify leads to:

$$T_{zm} = z^* T_{zg} - \frac{1}{P_t}. \tag{2.55}$$

Finally, the following relationship holds between Φ_m & Φ_g using equations 2.47, 2.48, and 2.55:

$$\Phi_m = z^* \Phi_g + \frac{L}{P_t} \tag{2.56}$$

From here, 2.56 can be used to sub into 2.43. Suppose that a dollar matching grants have a larger impact on z^* than a dollar of lump-sum grants.

$$\frac{-\Phi_m}{\Phi_{z^*}}(1 + m\frac{-\Phi_g}{\Phi_{z^*}}) > \frac{-\Phi_g}{\Phi_{z^*}}(z^* + m\frac{-\Phi_m}{\Phi_{z^*}}) \tag{2.57}$$

$$\Phi_m > \Phi_g z^* \tag{2.58}$$

$$z^* \Phi_g + \frac{L}{P_t} > \Phi_g z^* \tag{2.59}$$

$$\frac{L}{P_t} > 0 \tag{2.60}$$

Therefore, a dollar of matching grants increases z^* by more than a dollar of lump-sum grants. This holds for the assumption that the tax rate is on the positive side of the Laffer curve. □

Chapter 3 The Impact of Local Households' Housing Tenure on Local Public Debt Levels

3.1 Introduction

This chapter predicts and evaluates the association between local housing tenure and local public debt for U.S. localities. The form of housing tenure determines how future policies affect households since homeowners, through their house, are linked to a local jurisdiction in perpetuity whereas renters are not. This linkage provides a mechanism for housing tenure to affect households' attitudes regarding intertemporal policies like public debt usage. Among fiscal policy tools, local public debt plays a unique role. While debt finances present expenditures, it merely shifts the timing of tax collection to future periods. The essential intertemporal attribute of public debt means that individuals should take their future within the taxing jurisdiction into consideration when forming preferences. Thus, the burden of public debt will affect households differently through their housing tenure. This results in different preferences for local public debt between homeowners and renters.

Although renters are not tied to the future jurisdiction, as current residents their preferences may be represented through local political processes. The policies enacted at any point in time likely reflect the incumbent residents' interests which makes intertemporal policies likely to exhibit observable differences in utilization based on the residents' housing tenure type. To the extent household preferences differ based on housing tenure and are all represented through policy outcomes, then local debt policy is dependent on the composition of households' tenure in localities.

This chapter proceeds by establishing the theoretical basis for the potential differences in how households view public debt in order to establish a testable hypothesis. The hypothesis in this chapter develops from observations of a specific class of Ricardian equivalence generating assumptions used in economic theory. This is not the only reason for differences in public debt preferences across households, but is a feasible one. Under specific assumptions necessary for capitalization, Ricardian equivalence regards public debt as equivalent to current taxation. However, the capitalization assumptions may only hold for some households in a local setting, specifically homeowners. Thus, the hypothesis states that higher shares of renting households leads to higher public debt levels.

Once the hypothesis is established, an empirical evaluation of the relationship between the renter share of households and local public debt levels shows the expected relationship. An increase in the renter share leads to higher levels of public debt. This relationship is robust across various specifications and estimation methods. Not only is the relation significant, but it also shows a meaningful impact. Specifically, a one percentage point increase in the renter share increases unfunded public debt per household by \$400. The mean value for unfunded debt per household is \$5,500, so a one percentage point rise in renter share increases the average unfunded debt level by 7%. The median value for unfunded debt per household is \$1,700, so the one percentage point increase raises the debt level by 24%.

The next section presents the theoretical foundation of the hypothesis first by establishing the different incentives operating on households' preferences, and then by examining one possible avenue for preference communication. In section 3, the hypothesis is tested empirically using U.S. local government data. The final section concludes.

3.2 Theory

As developed, Ricardian equivalence provides one view of the burden of public debt where current taxes are equivalent to public debt. While there are many conclusions stemming from Ricardian equivalence related to the real macro-economy, namely capital formation and consumption, only the debt burden is discussed here in order to simplify the analysis. Ricardian equivalence,[1] a type of debt neutrality,[2] is a theoretical modeling phenomenon where the fiscal burden of public debt does not shift across generations. Models that lack Ricardian equivalence show the potential for current generations to gain the benefits of public expenditures while placing the burden on future generations. This extreme divergence in results related to the public debt burden calls attention to the assumptions that Ricardian equivalence relies on. These assumptions are crucial in identifying differences across household types.

Ricardian Equivalence through Capitalization

Models for analyzing Ricardian equivalence typically make one of the following three assumptions that effectively incentivizes agents to be mindful of the future:[3] (1) agents are infinitely lived; (2) the utility of agents' posterity is in the agents' utility

[1]Ricardian equivalence gets its name from the observation by David Ricardo that taxpayers are aware of and plan for future tax liabilities emanating from public debts. The economic implications of Ricardian equivalence are described in The New Palgrave Dictionary of Economics (Abel 1991):

> The Ricardian Equivalence Theorem is the proposition that the method of financing any particular path of government expenditure is irrelevant. More precisely, the choice between levying lump-sum taxes and issuing government bonds to finance government spending does not affect the consumption of any household nor does it affect capital formation.

[2]According to Buiter (1986), debt neutrality is defined:

> Debt neutrality is said to occur if, given a program for public spending on current goods and services over time, the real equilibrium of the economy (private consumption, investment, relative prices, etc.) is independent of the pattern of government borrowing and lump-sum taxation over time.

Debt neutrality includes Ricardian equivalence. Barro (1974) formally extends Ricardian equivalence, under additional assumptions, to Barrovian neutrality (Buchanan 1976). Barro's version of debt neutrality includes similar assumptions and subsequently criticisms for actual application as Ricardian equivalence (Buchanan & Roback 1987).

[3]Other necessary assumptions include perfect financial markets, lump-sum taxes, no liquidity constraints, and rational forward-looking agents.

function; (3) agents value their durable, taxable assets. The first two assumptions are shown to be equivalent in Barro (1974) which uses a Samuelson-Diamond overlapping generations model to show that the utility of a successive generation in the utility function leads households "to act as though they were infinitely lived." The rationale for this assumption is based on familial relationships and intergenerational bequests. This results in "families" being treated theoretically as fixed within the jurisdiction. Conversely, the third assumption establishes assets as fixed within the jurisdiction, allowing for individual mobility—an assumption much more appropriate in a local government setting (Daly 1969, Oates 1972).

The preferences of agents who make decisions about public debt depend on whether they can or cannot escape the future tax burdens arising from public borrowing. If one assumes that resident households and their descendants are tied in perpetuity to a locality that incurs new debt obligations, and that today's households are concerned with the well-being of their descendants, the burden of future debt service effectively falls on today's residents. Similar considerations apply in the context of long-lived assets, notably including land and other very durable and immobile forms of property. In this case, the burden of future taxes on property falls on today's property owners, directly, if they continue to hold the property, or indirectly, if they sell the property at a discounted price to new owners. These factors, operating separately or in combination, imply that there are agents who take future debt service obligations into account, and who therefore do not see current borrowing as an opportunity to escape the burden of financing current public expenditures by passing it to others.

Buchanan (1958) points out that while Ricardian equivalence may hold for some households that meet the assumptions, the assumptions may not hold for every household. This allusion to the "micro-foundations" of Ricardian equivalence brings attention to the potential heterogeneity of households within generations. While Ricardian equivalence typically focuses on the *intergenerational* distribution of public debt burdens, the distribution of the *intragenerational* burden has its own insights.[4] The possibility that local public debt is equivalent to current taxes for some households but not to others provides the opportunity for fiscal burdens to be shifted within the current generation.

Whether household heterogeneity affects the usage of public debt is the primary motivation for this chapter. In order to investigate this claim, I will focus on household heterogeneity as determined by ownership of one's home, since local public debts likely capitalize into one's home value.[5] Fiscal burdens capitalize into real property values

[4]Mankiw (2000) provides an inter- and intragenerational analysis of heterogeneous households, savers and spenders, which are differentiated by a bequest motivation. In that analysis where some households are effectively fixed, assets are treated as perfectly elastic.

[5]Fiscal burdens are said to capitalize into real property values when, all else equal, higher burdens lead to lower property values. Through capitalization future benefits and costs impact the current value of property. The value of real property ownership is based on the summation of current and future flows of benefits and costs emanating from the property in perpetuity. If the future is conceptualized into consecutive asynchronous periods, then netting out the costs from the benefits within each period gives a flow value of the real property within each period. However, these values are not simply summed since a flow of value from real property in a near period is worth more than the same flow of value in a later one. The adage "a dollar today is worth more

within a jurisdiction due to the legal spatial boundaries of real property that are immobile and do not depreciate.[6] Public debt is tied—as is real property—to the political jurisdiction in which the debt is incurred. Thus, real property cannot leave the jurisdiction of the taxing authority and the public debt burden behind.[7] Other potential non-fixed tax bases, like capital or households, demonstrate mobility and have the option of 'exit,' and, thus, are not subject to capitalization. Furthermore, the openness of a jurisdiction and the mobility of tax bases impact the distribution of fiscal burdens. Exit allows households without real property to completely leave the burden of public debt behind, while households that own real property cannot put the burden off since it stays with the property. Specifically, households who rent their home may exit and cut ties with a jurisdiction quite easily, leaving a fiscal burden, while homeowners must divest their title to real property to fully exit, both person and property, from a jurisdiction.[8] Hirschman (1978) recognizes that exit from the state involves all forms of personal property evidenced by his discussion of Harrington & Morley (1887), which notes that mobility varies among property types, e.g., land and money.[9]

Consider a simple economic model where the stream of public expenditures is fixed and a shock to the fiscal burden occurs. If the jurisdiction is small and open, and households can relocate freely to other jurisdictions, then rents cannot be raised and fiscal burdens cannot be passed on to renters. Renters would simply find another jurisdiction to live in and escape the additional costs that reap them no benefits. Because of this, renters are not incentivized to care about future policies the same way that homeowners are. Buchanan (1958) does not explicitly mention the differences between homeowners and renters, but the focus on the unequal burdens suggests that individual level differences with respect to capitalization may affect public choice outcomes.

Numerous math-based theoretical models have been put forward to show that

than a dollar tomorrow" asserts this fact, so the future values must be discounted into an equivalent present value. Once the values of each period are discounted, they are summed to equate the net present value of real property, which is simultaneously the price. Where t is time period which goes from zero to infinity, capitalization is written algebraically as, $Value = [t = 0]\infty \sum \frac{Benefits_t - Costs_t}{(1+Discount\ Rate)^t}$.

[6]The benefits and costs that accrue to real property are broad and include many components that motivate estimation of capitalization effects and hedonic equations, including the climate, neighborhood features, community amenities (from both commercial and government sources), disamenities, taxes, debt, etc. (Oates 1969, Blomquist & Worley 1981, Yinger 1982, Hoehn et al. 1987, Blomquist et al. 1988). Since real property cannot be removed and the owner receives these benefits and costs based on the location, these all accrue to the value. To the extent the bundle of all the characteristics of a parcel of real property are more desirous than those of another, the subjective value people place on it will be higher. Then the subjective value is manifest through the bidding that occurs in the buying and selling of property to determine value pragmatically (Ellickson 1971, Oates 1972, Yinger 2015).

[7]The legal definition of real property includes land and all that is of a permanent nature attached to the land, including occupancy rights associated with condominiums (Black 1910).

[8]This discussion of full exit from a jurisdiction is dependent on the household caring about the value of the property, but, of course, the owner could just leave it and receive nothing for it.

[9]These two assets are extreme examples of mobility with the mobility of other assets likely falling somewhere in between.

Ricardian equivalence can hold in a local government setting. Daly (1969) uses capitalization of local assets and residence based taxes to show Ricardian equivalence holds. Buiter (1989) models an important extension of debt neutrality and under certain assumptions shows:

> What matters for debt neutrality to prevail is that agents alive today possess ownership claims to the current and future after-tax income from all land, both that physically present today and any land [exogenously] 'emerging' in the future. In this way, the ownership claims to the land will, if the market for these claims is efficient, fully reflect all current and future land taxes.

This result is assuming a fixed quantity of land, full capitalization, and the use of Henry George's 'single tax' on land. Additionally, Akai (1994) shows Ricardian equivalence holds under fixed land quantity, full capitalization, mobile households, and an income tax. The assumption of a fixed land quantity and full capitalization allows decision makers to take into account the present effects of future taxes, such that the entire burden is priced into the land. However, since some households fall under the equivalence assumptions necessary to generate Ricardian equivalence by owning their home, some do not. Thus, households that do not capitalize future tax burdens may prefer higher levels of public debt since, to some degree, the burden rests on others.

For a difference in public debt burdens between renters and homeowners to exist, some capitalization is necessary. There is not a lot of empirical evidence of public debt capitalization. In a natural experiment of capitalization of local implicit debt, MacKay (2014) finds overcapitalization from news on the state of the San Diego pension system into local housing prices. In a Swiss study of capitalization of explicit debt, Stadelmann & Eichenberger (2014) finds partial capitalization on the order of 40-50%. Although there are few studies on the capitalization of local public debt, there are numerous studies that find at least partial capitalization of the property tax (Oates 1969, Yinger 1982, Palmon & Smith 1998).[10] Partial capitalization is sufficient to drive differences in burdens between renters and homeowners. Consider two forms of a housing transaction. When two distinct parties are involved in a housing transaction, e.g., a landlord and a tenant, the current burden may be split between the parties. When the house is owner-occupied, then one party is on both sides of the transaction. Splitting the party into two agents, an owner and a resident,

[10]The fragile assumptions that theoretical full capitalization models rely on may explain why partial capitalization is commonly observed. Here are three potential reasons. First, real property includes a non-fixed capital component which depreciates over time and requires new investments to maintain. Thus, in practice, real property is not perfectly fixed. Second, land is not effectively fixed in quantity and can be altered endogenously through changes in zoning laws (Hamilton 1978) (A thorough review of this literature is found in Evans (1999)). And third, since the local governments provide public goods or services, these benefits may require the household to live within a local jurisdictional boundary which shifts part of the burden form the owner to the resident household in the housing transaction. Carroll & Yinger (1994) provides evidence that the property tax functions partly as a benefit tax by looking at rental prices and property tax rates, showing that renters bear only 15% of the burden of the property tax.

then the owner-occupier bears some of the burden as the owner and some of the burden as the occupier; therefore, the owner-occupier must bear the entire current burden. So long as the total burden for renters is less than the total burden for homeowners, then the two types of agents will have different preferences related to public debt usage.

Other things the same, renters prefer local fiscal policies that reduce current taxes and therefore result in higher debt levels. Which begs the question, do policies reflect the preferences of all resident households? While no specific collective choice mechanism is postulated in this chapter, it is possible that local policies are determined partly through voting by residents in local democratic processes.

Voting

Voting is one possible way that resident households can effectively communicate their appetite for public debt to policy makers. Clearly, both homeowners and renters can vote, and many political economy theories emphasize the role of voting in policy determination. Households communicate preferences at the polls, and politicians who do not reflect the desires of their electors may find themselves replaced in forthcoming elections. Thus, in a democracy, policy makers may listen to the voice of the electorate, and translate the preferences voiced into policy.

Sometimes voting is necessary for governments to issue public debt. A referendum is a common mechanism that requires citizen approval prior to the imposition of property taxes or the issuance of public debt. Regarding 1840s legislation that imposed a state-wide referendum requirement to issue public debt in the state of New York, the Chairman of the Finance Committee said (McClelland & Magdovitz 1981),

> [W]e will not trust the legislature with the power of creating indefinite mortgages on the people's property . . . . Whenever the people were to have their property mortgaged for a State debt . . . it should be done by their own voice, and with their consent.

At the time, the state property tax in New York only represented 8% of state revenues at an ad valorem rate of only 0.05%, or a 0.5 millage rate (Wallis et al. 2004). The Chairman's justification clearly reflects an understanding real property cannot escape a fiscal burden. However, resident households do not typically require rights to real property in future periods to cast present period ballots. While a referendum requirement for public debt may protect property owners from lawmakers, it does not protect one class of resident voters (homevoters[11]) from another class (leasevoters[12]).

The distinction between homevoters and leasevoters drove some of the discussion of suffrage at the time of the founding of the U.S. Constitution. At that time, debates about the need for a property qualification to grant suffrage were common within the several states. In a letter to Thomas Jefferson, Edmund Pendleton of Virginia wrote (Jefferson 1955),

[11] These are people who vote based on maximizing the value of their home (Fischel 2001*a*).

[12] These are people who vote based on minimizing their fiscal burden (Ahlfeldt & Maennig 2015).

> I think [the right of suffrage] should be confined to those of fixed permanent property, who cannot suddenly remove without injury to that property or substituting another proprietor, and whom alone I consider as having political attachment. The persons who when they have produced burdens on the state, may move away and leave them to be born by others.

Jefferson responded, rather open-endedly, that suffrage should extend to all those with "a permanent intention of living in the country." This debate on the rights of general suffrage is not limited to debt policy but it shows an understanding of the incentives that households may have for using political voice to effectuate policy. This issue of suffrage appears in modern times as some bond offerings and special districts require the payment of property taxes or the ownership of land to participate in referendum required to issue debt. However, the law regarding this practice may not be completely settled. The U.S. Supreme Court has ruled (395 U.S. 701 (1969)), in a decision limited to particular facts so not setting a universal precedent, that limiting suffrage to property owners for issuance of a revenue bond violates the equal protection clause of the 14th amendment (Lewis 1970). While other cases have been filed regarding similar debt rules, it does not appear that this question has been taken up again by the court and, therefore, is allowed to continue as a policy.

Empirical observation of local politics shows that renters do not display the same level of community engagement and democratic participation. The literature demonstrates that homeowners are much more likely to participate in local elections (Rossi & Weber 1996), engage in community activism (McCabe 2013), and invest more in social capital (DiPasquale & Glaeser 1999). Furthermore, there are owners of real property that do not reside in the jurisdiction, and thus may not vote in local elections, but they may have significant interests in affecting public debt policy. They may contribute in other ways, like through financial means (Molotch 1976, Fleischmann & Stein 1998). These factors potentially weaken the prediction that renters' preferences are revealed in policy outcomes. There may be real issues to how impactful renters' votes are on policy outcomes.

Conversely, there is high confidence that homeowners preferences contribute to local policy outcomes (Fischel 2001*a*). Homeowners have substantial incentives to engage in policy determination for policies that can affect house values. Wolff (2014) reports that "[i]n 2013, owner-occupied housing was the most important household asset in the average portfolio breakdown for all households . . ., accounting for 29 percent of total assets." Fischel (2001*b*) cites Tracy et al. (1999) stating, "the typical household in 1995 had 66 percent of its total assets in real estate and *no* portion of its assets in corporate equity (emphasis in original)."[13] With so much net worth tied to the value of real property, the incentives to protect and enhance its value are substantial. These incentives are manifest in various ways, some of which were mentioned previously. In fact, largely debated theories of local politics are based on

[13]Fischel (2001*b*) further notes that mutual funds and defined-contribution retirement funds are counted as equity but the present value of social security benefits is not. Other household assets include automobiles, consumer durables, and bank accounts.

the notion of incentives stemming from property ownership (Molotch 1976, Fischel 2001*a*). Homevoters (and absentee landlords) have significant monetary interests in local policy that improves the value of their property.

While significant incentives to exercise control over local policies are borne out of real property ownership, what can be said for resident households that do not own real property within the jurisdiction? Lipset (1960) suggests that the more voters are affected by policies, the more likely they turnout to vote. Leaseholders are affected by policies given their position as resident-consumers of local policies and have some incentives to participate (although arguably not to the same extent as homeowners). Hirschman (1970) points out those households who can easily move have few incentives to improve their communities. However, while renters live in a community, it is beneficial for them to put fiscal burdens off into the future. Thus, the ability for some electors to leave public debt behind weakens their incentives to match benefits and costs in establishing policy and bearing the responsibility of the burdens.

Given the incentives, leasevoters can rationally use voice to promote different debt policy than homevoters would. This gives a testable hypothesis that local public debt levels are expected to be higher where the renter share of households is higher, all else equal. In order to test whether a relationship between housing tenure and local public debt exists in practice, an empirical investigation of this relationship is developed to look at whether the housing tenure composition affects the differences in relative debt burdens between local governments. Although no formal voting model is presented, the observed policy outcomes may resemble the predictions that rational voting would suggest. Policy determination is a complex process with many types of parties and potential heterogeneity in those types. It is beyond the scope of this chapter to model all of the parties and how their preferences are translated into actual policies. Voting is just one possible way resident household incentives are converted into policy outcomes. The goal in this chapter remains to verify whether there is a measurable difference in local public debt levels stemming from the resident households' tenure composition.

3.3 Empirical Evaluation

Fiscally Distressed Localities

As a preliminary examination, this section presents data on the composition of housing tenure in localities under fiscal stress. First of all, assessing fiscal health is difficult, but typically there is a consensus of which local governments are fiscally distressed.[14] Fiscally distressed localities have a number of issues that can lead to a cycle of budgetary destruction. Oftentimes, these issues are structural in nature and can be prevented (Beckett-Camarata & Grizzle 2014). If, for whatever reason, a locality has insufficient revenue to cover expenditures it can do one of three things: borrow money, raise taxes, or cut spending. Borrowing money as a budget smoothing

[14] Levine et al. (2012) gives a history and review of the assessment of the measurement of fiscal health and the inherent challenges.

tool should be done with prudence, since eventually it will have to be offset with tax revenue (Buchanan 1958). Taxes affect behavior, and raising taxes can shrink the tax base. The tax base is comprised of households who are also the primary consumers of local public goods, so cutting public expenditures may also shrink the tax base. A shrinking tax base leads to insufficient revenue, and on and on. These options feedback into each other and can deteriorate the fiscal health of a locality until options to satisfy debts are limited. When the budget reaches insolvency, localities are either bailed out by larger jurisdictions, default on their debt, or some combination of both. Ultimately, default is the clearest indicator of fiscal distress as a direct manifestation of insolvency.

Under current limitations, it is unknowable how far from (or past, for that matter) insolvency a locality may lie at a given point in time (Ross & Greenfield 1980). This partly stems from the lack of market pricing mechanisms in the public sector. Thus, precise measurement of fiscal distress is presently impossible, so fiscal distress is usually defined by a number of indicators or indices that reflect poor performance relative to other localities (Levine et al. 2012).

Pennsylvania is a state that is proactive in assisting municipalities facing fiscal distress. Usually, it involves some assumption of parts of the public debt by the commonwealth (usually with altered terms) along with supervision of local budgetary affairs. Since 1987, 30 municipalities have been designated as distressed by the Municipalities Financial Recovery Act (Act 47).[15] Table 3.1 lists the entire population of Act 47 municipalities. The table reports the renter share in the municipality and the difference in renter share between the locality and both the county and the state. The table shows that out of 30 municipalities three had a lower percent of renting households relative to their county, and three had a lower percent relative to Pennsylvania. Note that the county average is inclusive of the municipality in question, so the rest of the county must compensate in the opposite direction for the difference between the stressed municipality and the county. This compensation is even more pronounced in situations where the municipality in question has a large share of the household population of the county. The municipalities in the same county as other general purpose jurisdictions are subject to similar macro-economic shocks (like the decline of steel and coal in Western Pennsylvania), so it is quite telling which jurisdictions have excessively burdensome debts.

[15] Act 47 determines financial distress based on the occurrence of 11 criteria within the legislation, including default on explicit or implicit debt and chapter 9 bankruptcy filing. The crisis faced by Philadelphia in 1991 was managed under Pennsylvania Intergovernmental Cooperation Authority Act for Cities of the First Class, also known as the PICA Act.

Table 3.1: Act 47 Financially Distressed Municipalities of Pennsylvania

Municipality	County	Dates	Renter Share	County Difference	State Diff.
Farrell	Mercer	12-Nov-87	0.30	0.06	0.01
Aliquippa	Beaver	22-Dec-87	0.40	0.14	0.11
Clairton	Allegheny	19-Jan-88	0.33	-0.01	0.04
Wilkinsburg	Allegheny	19-Jan-88	0.58	0.24	0.30
Shenandoah	Schuylkill	20-May-88	0.31	0.09	0.03
Braddock	Allegheny	15-Jun-88	0.50	0.16	0.21
Franklin	Cambria	26-Jul-88	0.25	-0.03	-0.04
Rankin	Allegheny	9-Jan-89	0.58	0.23	0.29
Ambridge	Beaver	10-Apr-90	0.48	0.22	0.20
Duquesne	Allegheny	20-Jun-91	0.48	0.14	0.19
Scranton	Lackawanna	10-Jan-92	0.45	0.13	0.17
Johnstown	Cambria	21-Aug-92	0.50	0.24	0.21
East Pittsburgh	Allegheny	13-Nov-92	0.57	0.23	0.28
Millbourne	Delaware	7-Jan-93	0.73	0.45	0.44
Homestead	Allegheny	22-Mar-93	0.58	0.25	0.30
Chester	Delaware	6-Apr-95	0.52	0.25	0.24
North Braddock	Allegheny	22-May-95	0.41	0.08	0.13
Greenville	Mercer	8-May-02	0.40	0.17	0.12
West Hazleton	Luzerne	27-Mar-03	0.39	0.10	0.11
Pittsburgh	Allegheny	29-Dec-03	0.48	0.14	0.19
Plymouth	Luzerne	27-Jul-04	0.16	-0.14	-0.12
Nanticoke	Luzerne	26-May-06	0.42	0.11	0.12
New Castle	Lawrence	5-Jan-07	0.35	0.11	0.05
Westfall	Pike	14-Apr-09	0.39	0.25	0.09
Reading	Berks	14-Oct-09	0.58	0.31	0.27
Harrisburg	Dauphin	20-Oct-10	0.61	0.26	0.31
Altoona	Blair	1-Apr-12	0.35	0.06	0.05
Shamokin	Northumberland	16-Jun-14	0.41	0.14	0.11
Colwyn	Delaware	6-May-15	0.37	0.08	0.07
Mahoney City	Schuylkill	18-Feb-16	0.30	0.05	-0.01

Table 3.2: Notable Fiscally Distressed Localities (South)

City	State	County	Year	Renter Share	Co. Diff.	State Diff.
Copperhill	TN	Polk	1988	0.25	0.06	-0.05
Lipscomb	AL	Jefferson	1991	0.22	-0.11	-0.05
North Courtland	AL	Lawrence	1992	0.24	0.07	-0.03
Ozan	AR	Hempstead	1995	0.15	-0.15	-0.15
Winstonville	MS	Bolivar	1997	0.41	0.02	0.13
Prichard	AL	Mobile	1999	0.42	0.11	0.14
Millport	AL	Lamar	2004	0.38	0.11	0.07
Marion	MS	Lauderdale	2007	0.60	0.25	0.30
Gould	AR	Lincoln	2008	0.34	0.09	0.01
Prichard	AL	Mobile	2009	0.42	0.09	0.11
-	AL	Jefferson Co.	2011	0.35	-	0.05
Hillview	KY	Bullitt	2015	0.24	0.05	-0.07

Table 3.3: Notable Fiscally Distressed Localities (Midwest)

City	State	County	Year	Renter Share	Co. Diff.	State Diff.
Cleveland	OH	Cuyahogha	1980	0.39	-	0.08
Kinloch	MO	St. Louis	1994	0.69	0.43	0.39
Macks Creek	MO	Camden	2000	0.33	0.15	0.03
Hillsdale	MO	St. Louis	2001	0.46	0.20	0.16
Reeds Spring	MO	Stone	2002	0.37	0.18	0.07
Brooklyn	IL	St. Clair	2003	0.47	0.14	0.14
Washington Park	IL	St. Clair	2004	0.43	0.10	0.10
Alorton	IL	St. Clair	2005	0.56	0.23	0.23
Washington Park	IL	St. Clair	2009	0.45	0.12	0.12
Hamtramck	MI	Wayne	2010	0.51	0.16	0.23
Detroit	MI	Wayne	2013	0.49	0.14	0.21
Chicago	IL	Cook	2016	0.55	0.13	0.23

Tables 3.2 through 3.6 list notable localities by region which have faced fiscal distress. These are general purpose governments that have filed ch. 9, are rumored to, have been bailed out by their state, or are well-known to be in a fiscally precarious situation. The tables also compare the renter share of the locality in question with both the county and state the locality is located in. Out of 43 localities that have distinguishable counties 36 have a higher proportion of renting households than the county they are situated in. The exceptions are generally small towns with the largest (Los Osos, CA) having a population of 12k and the smallest only 85 (Ozan, AR).

Although the renter share is consistently higher in fiscally distressed localities than the surrounding localities, this is not definitive proof that renters cause localities to

Table 3.4: Notable Fiscally Distressed Localities (East)

City	State	County	Year	Renter Share	Co. Diff.	State Diff.
New York City	NY	-	1975	0.77	-	0.30
Bridgeport	CT	Fairfield	1991	0.57	0.26	0.24
Philadelphia	PA	-	1991	0.41	-	0.12
Washington, D.C.	-	-	1995	0.60	-	-
Camden City	NJ	Camden Co.	1999	0.54	0.14	0.20
Waterbury	CT	New Haven	2001	0.52	0.15	0.19
Central Falls	RI	Providence	2011	0.78	0.31	0.38
Atlantic City	NJ	Atlantic Co.	2016	0.71	0.40	0.37
Hartford City	CT	Hartford Co.	2017	0.76	0.41	0.43
Groton	CT	New London	2017	0.48	0.16	0.16

Table 3.5: Notable Fiscally Distressed Localities (Southwest)

City	State	County	Year	Renter Share	Co. Diff.	State Diff.
Westlake	TX	Tarrant	1997	0.07	-0.32	-0.29
Tyrone	OK	Adams	2000	0.24	-0.09	-0.08
Westminster	TX	Collin	2000	0.11	-0.20	-0.25
Kendleton	TX	Fort Bend	2001	0.26	0.07	-0.10
Rio Bravo	TX	Webb	2002	0.18	-0.16	-0.18
Muldrow	OK	Sequoyah	2005	0.32	0.07	0.00
Camp Wood	TX	Real	2005	0.25	0.02	-0.11
Marshall Creek	TX	Denton	2006	0.19	-0.17	-0.17
Moffett	OK	Sequoyah	2006	0.39	0.12	0.06

become overburdened with debt. These results suggest a relationship exists and provide motivation for a more thorough analysis looking at the relation of the renter share and the level of public debt, since localities with higher debt levels relative to their budget should have more episodes of debt distress under equal conditions or shocks.[16]

Literature Review

Given the theory-based prediction that renters prefer higher levels of public debt, ceteris paribus, this chapter analyzes this claim empirically. This chapter appears

[16]Note that, higher debt levels also means that the locality is maximizing the leverage granted them by the future tax base. It is customary in economics, using the principles of calculus, that maximization of outcomes occur when a budget constraint is fully and completely used up. A look at the optimal level of debt (or nearness to insolvency) under some objective is not a question undertaken in this chapter. In summary, it is not possible to say whether fiscally distressed localities are better or worse off than their counterparts.

Table 3.6: Notable Fiscally Distressed Localities (West)

City	State	County	Year	Renter Share	Co. Diff.	State Diff.
North Bonneville	WA	Skamania	1991	0.36	0.10	0.01
-	CA	Orange County	1994	0.39	-	-0.05
Los Osos	CA	San Luis Obispo	2006	0.32	-0.08	-0.12
Vallejo	CA	Solano	2008	0.40	0.04	-0.04
-	ID	Boise County	2011	0.17	-	-0.13
Stockton	CA	San Joaquin	2012	0.48	0.08	0.04
Mammoth Lakes	CA	Mono	2012	0.53	0.09	0.09
San Bernardino City	CA	San Bernardino Co.	2015	0.50	0.12	0.06

to be the first empirical analysis of housing tenure and local public debt levels using U.S. data. There are, however, many studies that look at the housing tenure and other local government policy.

Dollery & Worthington (1996) review the so-called "renter illusion" literature which looks at how higher shares of renting households increase local public expenditures. This relation is consistently observed in various empirical examinations using different data and methods. However, the theoretical explanations for this relation varies primarily from a distinction of whether renters are rational or deceived (i.e., face "illusion") in their behavior.[17] Bergstrom & Goodman (1973) is a well-known early example showing the empirical relationship. The authors estimate the demand for public goods using the income and tax price of the median household, and used percent of owner-occupied housing as a control. The percent of owner-occupied decreases the local public expenditures suggesting that renters differ from homeowners in their demand for public goods.

Besides the impact of housing tenure on expenditures, a couple papers look at the differences in voting behavior (Hanushek 1975, Moomau & Morton 1992). Moomau & Morton (1992) looks at how housing tenure affects voting for a change in the property tax base, using referendum results of a 1982 vote on the homestead exemption in the City of New Orleans. The study finds that voting precincts with higher proportion of renters were more likely to vote in favor of removing the homestead exemption, thereby expanding the real property tax base. The paper concludes that homeowners and renters revealed preferences vary choosing the real property tax base.

Another variation of housing tenure and policy is provided by Ahlfeldt & Maennig (2015), looking at whether housing tenure impacts voting for public service delivery,

[17]Martinez-Vazquez (1983), Martinez-Vazquez & Sjoquist (1988), and Carroll & Yinger (1994) provide some evidence that renters behave rationally. Martinez-Vazquez & Sjoquist (1988) uses a theoretical model to suggest that finds that renters are wholly rational. In their model, homeowners and renters differ in their costs when local public expenditures are financed through a property tax. The model shows that for households of equivalent preferences for public goods and incomes the housing tenure choice affects the amount of public goods the households votes for. The conclusion persuasively argues that housing tenure should be included in all empirical studies of local public expenditures to avoid specification biases.

which affects housing values through capitalization. Framed as a test of the homevoter hypothesis (Fischel 2001*a*), the authors analyze a direct democracy referendum which would alter the geographic distribution of airport services in Berlin; a referendum that would change the distribution of aircraft noise and airport accessibility. The analysis shows that differences in voting patterns exist between homeowners and renters, with homevoters more likely to favor policy that would lead to appreciation of their real property values.

There are two papers that evaluate empirically whether the proportion of renters affects public debt usage. First, Stadelmann & Eichenberger (2012) estimates public debt usage as a function of the composition of housing tenure. The motivation for the analysis in the theoretical model is that rental market frictions prevent the rental price from adjusting to the capitalized public debt. The data used in the estimation are cross-sectional data of 171 communities in the Swiss canton of Zurich. The empirical model uses two dependent variables both scaled by tax revenue. One is a flow variable of new debt and the other the stock of debt. The estimation finds that proportion of homeowners in a community reduces the amount of debt and new debt. Second, Banzhaf & Oates (2013) uses open space referenda data to evaluate a "renter effect," which is defined as spending and debt differences in preferences between renters and homeowners. The estimation results do not find evidence of a "renter effect."

My chapter advances the literature by investigating the relation of local public debt policy and housing tenure by providing a theory of rational household behavior as well as an empirical investigation. The theory in this chapter eschews any position on a collective choice mechanism which aggregates households' preferences, but the empirical evaluation cannot abstain from this issue and make causal inferences. Minimally, it is assumed that local public democratic institutions play some role in translating aggregate household preferences into local fiscal policy, but a specific collective choice framework is not postulated (Persson & Tabellini 2002, Hettich & Winer 2005). In practice, local governments gain authority to incur debt in various ways. The authority may stem from merely the status as elected officials or may require authorization through a direct democracy tool like referendum. Ultimately the preferences of residents have a part in determining policy.

Basis for the Empirical Model

The empirical specification arises from the identity of a local government's long run budget constraint. Single period budget constraints combine to construct the long run budget constraint. The single period budget constraint is based on the cash flowing into public accounts being equal to the cash flowing out of public accounts net of debt/savings changes. Thus, the single period constraint is a flow constraint. In this simple formulation interest rates are ignored, and all debts from the previous period are fully repaid in the proximate period. Using subscripts to denote the time period, designated t, the single period budget constraint is written

$$Revenues_t + Debt\ Incurred_t = Expenditures_t + Debt\ Incurred_{t-1}. \tag{3.1}$$

Formulated this way, debt has a clear role of shifting the balance of expenditures and revenues across time periods. Also, equation 3.1 clearly shows that debt incurred is a substitute with current financing tools. Either future revenue or future debts must settle past debts. Single period budget constraints combines from the present (time 0) up to some arbitrary future date (time T)—when all debts are settled—to form the long run budget constraint:

$$\sum_{t=0}^{T} Revenues_t = \sum_{t=0}^{T} Expenditures_t + Debt\,Outstanding_0. \tag{3.2}$$

As an accounting identity, total revenues equals total expenditures plus debt outstanding. Or put another way, current and future government revenues must cover all current and future liabilities.[18] This is a stock constraint, and the public setting makes the market values of the components difficult to evaluate. For example, tax bases are not bought and sold in a market which starkly contrasts with the assets of firms. The long run budget constraint also implies there is no debt outstanding at time T. While it is not uncommon for local governments to always carry some debt outstanding, this assumption disallows potential ponzi schemes, where governments incur new debt to pay for old debts ad infinitum.[19]

Equation 3.2 is the basis for the empirical analysis. In a multi-period setting, policy decisions are made to reflect what is best for today. In the context of this model, the incumbent households' preferences are being reflected by policy makers into observable outcomes at each point in time. For each observation the current time is zero. Current policies are only determined by current residents and the optimal policy outcomes for them. The estimated coefficient on the housing tenure variable reveals the difference in current household preferences, via housing tenure, for current public debt.

From the long run budget constraint, debt outstanding clearly is a principal component of any empirical analysis. And given the usage of an identity with three components, only one other component needs to be investigated with the other representing the remainder. In this analysis the net present value of revenues is the other component investigated. Thus, current and future expenditures are assumed to follow an optimal path and are taken as given.

Debt outstanding from equation 3.2 is the amount of funding that must be acquired in future periods to maintain solvency. However, debt as it appears in the data of fiscal accounts is the principal of debt outstanding and not the unfunded balance. There are two important things to note regarding available measures of debt. First,

[18]It is recognized that in more rigorous derivations of the long run budget constraint with interest rates and time discounting show that it is the net present value of government revenues is equal to the net present value of expenditures plus debt outstanding (Romer 2006). That complexity is not necessary here.

[19]Each of these constraints implicitly assumes that default on debt is not possible. Borrowing is a result of lenders expectations of sufficient future revenues for repayment. In practice, interest rates include a default risk premium so that the lender's portfolio, with many loans, has sufficient returns in expectation. However, for a single government these constraints may break from time to time because of defaulted debt.

interest payments are not included in the measure. Municipal debt is overwhelmingly issued as fixed coupon bonds,[20] so interest payments are fixed at the time of the bonds offering. Thus the parties have effectively fixed the exposure to interest rate and inflation rate risk.[21] Absent wide variation in the underwriting spread at the time of issuance, the principal (or par value) of a bond issued reflects the net present value of the bond given the expectations of rates throughout the duration of the bond. When municipalities offer fixed coupon bonds as debt they have full and complete knowledge of both the amount and timing of interest and principal payments. This significantly simplifies debt management. For the purposes of this analysis, this type of issuance most closely resembles the basic single period budget constraint constructed above compared to other potential bond structures.

The second notable observation is that funds set aside to pay down debt effectively reduce the debt outstanding. An economically meaningful measure of debt reflects the unfunded portion of previous spending. To achieve this measure the total debt outstanding less the sinking fund is used.[22] This is henceforth referred to as "net debt." Simply put, net debt is the amount of debt net of cash which is set aside for debt settlement. Commonly in corporate finance, net debt matters more than debt outstanding for analyzing financial health. Since this analysis is interested in effective debt outstanding, it is the appropriate measure of debt. Using the measure of net debt as the effective measure of the debt level may also help alleviate concerns related to differences in debt duration across observations. Effectively, it is akin to thinking about the "unfunded" part of a pension fund, which is widely recognized as the most meaningful aspect of pension liabilities. Likewise with explicit debt, the only debt that puts a locality at risk of violating the budget constraint is the amount in excess of the funds set aside. Public finance economists at least as far back as Studenski (1930) knew of the importance of thinking about the relevant measure of debt as the actual debt outstanding less the cash on hand to pay it back. With this mention of public pensions, let it be clear that while implicit debts may represent a large portion of indebtedness by localities, it is not feasible to include them in this analysis.

In the fiscal data available, revenues are measured as single period flow variables. These are used to proxy the stock of the net present value of current and future revenues. Government revenues are inflows of funds comprised of own source and non-own source revenue types. Own source revenues are those funds collected from households within the jurisdiction from taxation and fees. Non-own source revenue is money received from other governments through intergovernmental grants. At its core, local government revenue is grounded in the economic activity of households subject to the jurisdiction. With the main exception of severance taxes on natural resource extraction, the economic activity of households comprises the tax base (and

[20] According to Securities Industry and Financial Market Association (SIFMA) about 95% of municipal debt issued is fixed rate coupon.

[21] Fortunately, the period analyzed had relatively low and stable inflation rates which limits any potential issues of wide variations across jurisdictions from the timing of debt offerings.

[22] The sinking fund is cash set aside by local governments for the settlement of debt in future accounting periods. The treatment of these funds varies from state to state, but Kentucky treats the funds in the sinking funds as inviolate (KRS 67A.891).

the base for fee revenue). Additionally, the revenue from intergovernmental grants, while distributed politically (Holcombe & Zardkoohi 1981), are generally considered subsidies to the resident households within a jurisdiction (Boex & Martinez-Vazquez 2004). Thus, to the extent households have agency, local government's revenue is beholden to resident households.

The empirical design for the regression analysis uses net debt as the primary component of the dependent variable and is a function of the public's preference for cross-temporal financing and revenue requirements. Additionally, the determination of net debt and government revenues occurs under established fiscal institutions' practices and rules, partly a product of the federal system. So for organization, there are two central categories for the determination of net debt and revenues: household preferences and local government fiscal institutions. These categories define the explanatory variables sections.

Unit of Observation

Actual local governance in the U.S. has substantial variability in scope and scale. American federalism leaves the determination of local government functions to the several states allowing for state customs and institutions to generate distinct local governing structures. The functions of local governance are often distributed among multiple governing bodies, of both general and special purpose, each of which governs the same households in various ways.

The proliferation of special districts is a relevant distinction of the organization of public services by local governments between states (McCabe 2000). General purpose governments create special districts by carving off some part of local governance, e.g., a particular administrative task, for a special district to perform. One issue with the carving off responsibility and authority is it expands the number of fiscal jurisdictions that can incur debt and impose taxes. A given household may be simultaneously subject to the jurisdictions of general purpose governments like a county government and a municipality, and many special districts with defined specific purposes such as an elementary school district, a high school district, a water district, a fire district, a prison district, a housing district, a sewer district, etc.

Overlapping local authorities create vertical fiscal externalities when governments impose fiscal burdens on a shared tax base (Greer 2015). Additionally, some authors have suggested that expanding the number of taxing authorities creates an opportunity for fiscal illusion (Dollery & Worthington 1996). This suggestion appears reasonable given the historic use of special district debt to subvert formal debt limitations (Secrist 1914, Studenski 1930, McClelland & Magdovitz 1981). Fortunately, the market can see through any potential fiscal illusion, as the bond prices reflect the value of all debt that is attributed to a tax base (Greer 2015).

Accurate representation of the local government revenue base requires the unit of observation to include all local governments. Thus, in this empirical analysis the fiscal data of all general and special purpose governments are aggregated to the county. In the data provided by the census of governments every local government is assigned to a county, so aggregation is done by this assignment. It is recognized that some special district jurisdictions overlap across multiple counties, but it should not affect the estimates so long as the assignment of overlapping districts are not systematic to counties with higher shares of renters (Carr 2006).[23] The county has many advantages and disadvantages as a unit of observation. One advantage is the stability of county borders through time, allowing for repeated observations and panel data methods. Another is that the county political designation is common to every state and with over 3,000 counties in the United States; thus, the panel has a large N dimension.[24] One disadvantage is that county governments do not directly determine much local fiscal policy.[25] However, as stated earlier, this model does not employ a specific collective choice framework, weakening the relevance of this disadvantage. Another disadvantage is that any within county variation is eliminated by aggregation. Ideally, households would be the unit of observation, requiring household level data as well as the data for each and every local government of which the households are part of. Clearly, this is not feasible. Under current data limitations, the county is the natural choice for this empirical analysis.

Dependent Variables

Counties vary in size across multiple dimensions, so the county measure of net debt is scaled for comparability. Two relevant dimensions are population (or number of households) and the size of the public sector (total government revenues). Although population generally tracks the size of the public sector they differ sufficiently to each scale net debt.[26]

For the main models, net debt per household is the dependent variable. This is chosen first because of the interpretability of the coefficient and ease of applicability. Household was chosen to scale net debt over the very closely tracking general population and total household income.[27] Each of these three has very high correlation

[23]To evaluate the importance of overlapping special districts a subsample of states is used for an additional estimations as a robustness check.

[24]Due to its French heritage, Louisiana does not have counties but parishes. In the context of this study, these political units are equivalent.

[25]Counties account for 17.5% of local government debt and 23% of local government expenditures according to the 2012 Census of Governments.

[26]The calculated correlation coefficient in the data is around 0.67.

[27]Many researchers that want to assess "debt affordability" use a debt to GDP ratio. This is reasonable since GDP gives a general measure of the strength of the tax base that can be called upon in the future to settle the debt. However, there are a few issues with this at the local level. The first issue is household income from the census does not include imputed rents, an important aspect of economic output or GDP. The second issue is measurement of income inclusive of imputed rents. The assignment of GDP (inclusive of imputed rents) by the Bureau of Economic Analysis (BEA) is based on the residence, assuming the production of goods and services is done in the county where one lives. The amount of cross county commuting may distort this measure, especially in industrial centers. The main advantage of using GDP instead of household income is the assignments of rents (payments to owners of fixed factors) but the distortion from commuting may negate part of that advantage. Third, even with accurate assignment of GDP it is not necessarily the most accurate depiction of a local tax base. Federalism insists that local governments are engaged in harsher tax competition than higher levels of governments. Thus, at the local level sales and income tax bases have much higher elasticities. Generally, it is observed that local governments in the

coefficients (0.97+) with one another so the choice is not meaningful in any statistical sense. Since the explanatory variables are all related to household characteristics, per household is a natural scaling value.

Another specification uses the ratio of net debt to total revenue as the dependent variable. This gives a rough approximation of the share of debt utilization in terms of all funding. Ideally the stock of the net present value of revenues would be used to assess the extent that debt is used as a share of the long run budget constraint. Instead the flow of revenues is used as proxy. However, in scaling net debt, a key question is how to make the net debt level comparable across counties. While it is not the ideal, this dependent variable is effective in portraying the size of the government, so this measure is highly useful. As a dependent variable it shares a correlation coefficient of 0.54 with net debt per household.

Explanatory Variables and Controls

Public Preference

Public preferences exercised in a political process determine net debt usage. This section describes the observed household characteristics used to represent household preferences.

The key explanatory variable is the renter share of households in the county. As predicted by the theory, a higher share of renters should result in higher levels of public debt, so a positive coefficient is expected. Since renters participate less in local politics than homeowners and absentee landlords (McCabe 2013), the regressions include the property tax share of revenue as a control variable to explain the influence "landed" interests exercise over policy. Landed interests should have a higher level of engagement to limit the commitment to future taxes they will pay in local governments that rely heavily on property taxes for revenue. Conversely, the landed interests have fewer incentives within jurisdictions where local governments rely very little on property tax revenue. This allows renters to still exhibit some form of preference and influence on debt policy even when they have marginal political activity.

The regressions include measures for general political preferences. County level political ideology is measured by the share of the presidential democratic candidate vote in the county, when only the two major U.S. political parties are considered. The nominate measure of state political ideology from Berry et al. (2010) is used as a state level control. Both measures of political ideology scale from 0 to 1 with liberalism increasing as the measure increases. It is not clear a priori how county and state political ideology will correlate with local public debt levels.

Also included are observable economic characteristics of households within the county. Median personal income is included and has long been associated with household preferences for public spending and taxation (Bergstrom & Goodman 1973,

U.S. utilize property taxes. This helps to alleviate the pressure of fiscal competition for mobile resources. Finally, the correlation coefficient between BEA county GDP and households is relatively high anyway (0.9+).

Greer & Denison 2016). The share of population with a college education controls for households' education levels. The county unemployment rate controls for cross county macro-economy weakness and also may reflect the use of public debt to smooth government spending. The poverty rate controls for tax base weakness at the lower end of the income distribution.

The models use controls for demographics with observable household characteristics. Each of these control variables is typical in empirical analyses of local public spending and the justification of their inclusion is borrowed from the literature. These include: population density, race population shares, and racial fractionalization. Population density controls for some of the differences between rural and urban counties. Racial share variables control for otherwise unobservable traits that may impact the public budget. Racial fractionalization measures of racial diversity, with higher numbers reflecting more diversity (Alesina et al. 2003). Increased racial fractionalization is associated with increased friction and thus lower public spending (Beach & Jones 2017). These variables are included with no prior inclination as what the relation with the local net debt level ought to be.

Institutional constraints

Municipalities operate in a federal free market system that imposes formal and informal institutional constraints on the issuance of public debt. The formal institutional constraints are divided into direct and indirect constraints. These institutional constraints fall outside of the realm of the public locality issuing the debt, that is to say, the imposition of constraints is outside the control of actors within the issuing jurisdiction.

Under American federalism, municipalities are strictly beholden to state policies in issuing public debt. States interests in municipal debt levels stems from a few sources. The fiscal health of a locality spills over into other local governments via fiscal externalities. Vertical fiscal externalities exist for localities that share a single tax base in an overlapping jurisdictions framework (Greer 2015). Horizontal fiscal externalities are present through a potential contagion effect across municipalities within states (Epple & Spatt 1986, Chung 2012, Gao et al. 2017). Consider Rep. Barney Frank's comments from a House Committee on Financial Services hearing:

> No State, no State legislators, no governor, can allow any one of its municipalities to default because then every other municipality would pay through the nose. So that is why this is not just some charity here; this is self-defense. . . . Because if any one municipality falters, every municipality in that State would pay, and there isn't a State governor and legislature in the country who doesn't understand that, and that's why the State guarantee is such a good one. (Chung 2012)

Many states come to the aid of distressed municipalities and bailout insolvent localities while other states may allow for localities to use Chapter 9 of the U.S. Federal Bankruptcy Code (Moldogaziev et al. 2017). Additionally, states can limit fiscal externalities by proactively constraining local debt issuance (Epple & Spatt 1986).

States may put explicit debt limits on the borrowing done by local governments through constitutional or statutory restrictions (Pogue 1970); however, these limits are not without exceptions that frequently render these limits ineffective. Also, the use of net debt as a dependent variable somewhat quiets the issues related to debt limits, since net debt is not directly restricted. One typical direct formal restriction is that the local debt must not exceed a certain percent of assessed value on real property. Thus, the median house price controls for debt limit constraints. However, there are exceptions to this restriction, for example, it may apply only to general obligation and not revenue bonds or special districts may be exempted up to a certain level (McCabe 2000, Carr 2006). To control for this potential exception a local government fragmentation variable is included (Wagner 1976, Magaddino et al. 1980). This variable is an index of the number of jurisdictions within the county border constructed as an Herfindahl–Hirschman index using current operating expenditures by county and sub-county governments. Other common restrictions require a referendum within the jurisdiction or approval of state level agencies before debt is issued. Clearly, each of these restrictions is overcome with sufficient political support. Furthermore, state policies vary substantially in this respect and do not change often over the analyzed time period so most should be absorbed into the fixed effects of the empirical model.

Localities may also have indirect formal constraints on borrowing. This is typified by tax and expenditure limitations (TELs). While not a direct limit to the issuance of debt, the availability of future revenue effectively hinders the ability of a local government to leverage their tax base and borrow against future tax revenues. The most relevant form of TELs in this context is where states (all but CT, HI, NH, and VT) have imposed constitutional or statutory limits on real property tax rates and assessments (Maher et al. 2011). As with explicit debt limits, these too have exceptions through referendum; although, the choice for local voters may differ when raising the property tax rate versus incurring a higher debt burden. A disconnect of the debt burden from taxation may change the statutory burden of future taxes, but it is not given that it would shift the economic incidence. With evidence that the imposition of TELs reduce property taxes (Maher et al. 2011), the local TEL index is included to control for indirect formal constraints (Amiel et al. 2009).

The primary informal limit on local debt levels is imposed by the municipal bond market. Localities that approach the perceived limit of their debt capacity likely have higher interest rates to sell their debt and are less likely to introduce new bonds to the market. In this way, the interest rate functions as a price that the locality must pay to delay tax collection and the market price of debt signals access to the market. For many local jurisdictions to enter the market, an initial step is often to have the debt rated by a credit rating agency. Credit rating agencies assign ratings based on the likelihood that the debt will be paid back in full. Although the exact formulation of the ratings is proprietary, there is statistical evidence that ratings are based on many of the economic and institutional factors already included, among other things (Denison et al. 2007, Marlowe 2011, Johnson & Kriz 2005, Moldogaziev & Guzman 2015).

Other controls

Outside of the two categorizations above, there are a number of variables that are important determinants of public debt within the literature. Three population related variables are included for this purpose. Population controls for potential returns to scale in public service provision (Bahl & Duncombe 1993). In the fiscal distress cases of Detroit, Chicago, Puerto Rico and western Pennsylvania the jurisdictions have seen large outflows of population and tax base. Thus, the annualized population growth is included for changes in population. Jurisdictions may also vary in the relative size of current and future generations so the estimates control for the amount of population under 18 per household.

A ratio that describes differences in income distribution is also included. The mean to median income ratio is included to control for income distribution effects that may be associated with relative debt levels and may impact differences in renters' preferences relative to homeowners (Meltzer & Richard 1981, Martinez-Vazquez 1983, Martinez-Vazquez & Sjoquist 1988, Stadelmann & Eichenberger 2012). Intergovernmental grant revenue as a share of total revenue controls for an important source of local government funding that can be capitalized into local house prices and may be used as collateral for short term loans (Hilber et al. 2011, Ravitch 2014). Finally, the level of total expenditures per household is included from the budget constraint to control for fiscal requirements.

Data

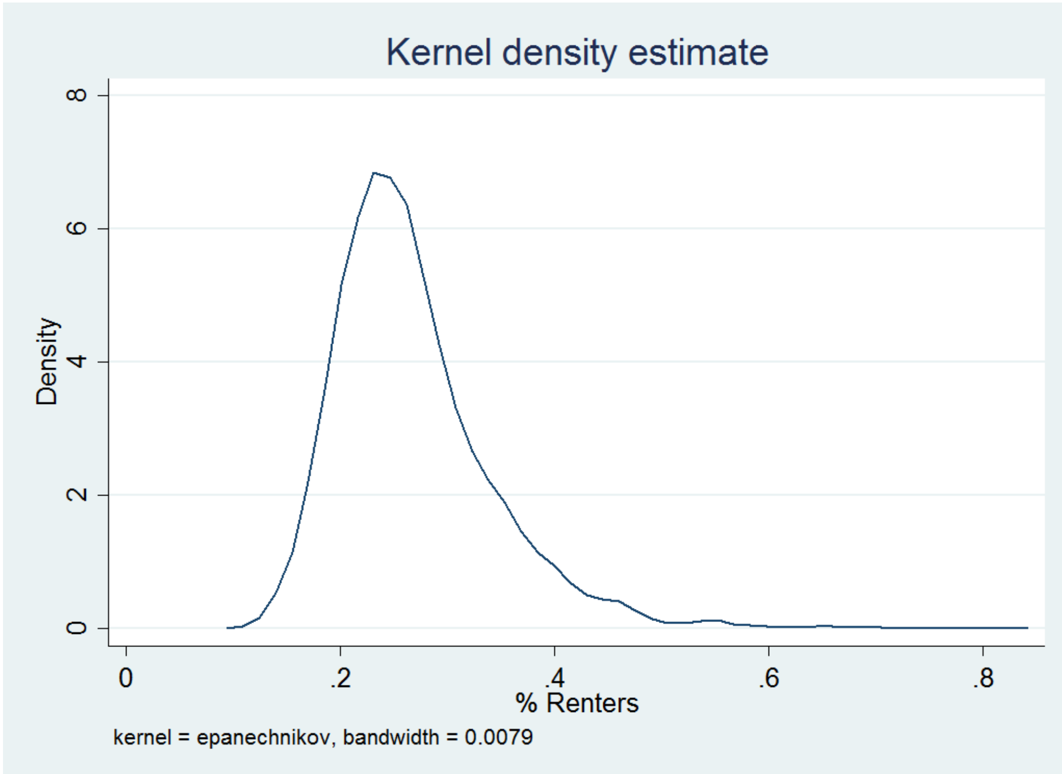
Pierson et al. (2015) provides U.S. local government financial data that are gathered from the census of governments performed by the U.S. Census Bureau. The data include the entire population of local governments for years ending in "2" and "7" starting in 1972. Since local governments are aggregated to the county level, the estimates only uses years with the entire population of local governments. Thus, an observation is a county-year for quinquennial years. The decennial census collects economic and demographic variables, including housing tenure, from 1980-2010.[28]

Using these as my primary sources, my dataset includes virtually the entire population of local governments in the U.S. The only counties with missing data are all Alaskan counties and one county in Hawaii. Counties that were created or destroyed over the period are consolidated into the larger geographic county of which they were (or became) a part of so that the geographic boundaries are unchanged within the data.[29] The five counties comprising New York City are combined to accommodate the fiscal data for the consolidated government of New York City. This results in a dataset comprising 3,106 counties. To match the decennial census data with the quinquennial census of governments data, the decennial census is interpolated to the intervening years. Interpolation of 4 data points into 6 does not create any constant

[28]Median income, median house price, unemployment, and the poverty rate were generated by the American Community Survey for the 2010 census figures.

[29]The four counties created or destroyed over the period are La Paz, AZ; Cibola, NM; Broomfield, CO; and independent city Clifton Forge, VA.

Figure 3.1: Kernel Density of Renter Share



changes across time periods. The slope between each interpolated data point for a given county varies so long as the differences across three consecutive decennial censuses are not constant. Thus, the counties are observed in 1982, 1987, 1992, 1997, 2002, and 2007. With 3,106 counties and six years of data, the total number of observations used in the balanced panel is 18,636 county-years.[30] Figure 3.1 is a kernel density estimate of the renter share variable. Table 3.9 provides the summary statistics, figures 3.3 and 3.4 are scatterplots of the renter share against each dependent variable, and figure 3.5 shows the distribution of 5 year changes in renter share. These are available at the end of the chapter.

Empirical Local Debt Model

Models of scaled long run budget constraints are estimated to examine the impact of the renter share on local public net debt. Borrowing from Bergstrom & Goodman (1973)'s proportionality theorem with accompanying assumptions, estimation using mixed explanatory variables of population share measures and median level measures is valid. The first scaling of the dependent variable (net debt per household) complicates the estimation procedure as median house price is arguably endogenous under

[30] As an additional robustness check, non-interpolated data is used where fiscal data for 1982, 1992, 2002, and 2012 are used. While this loses one-third of the observations, the results are consistent with the dataset that interpolates two additional years.

this specification. The endogeneity occurs due to the capitalization of net debt into real property values.

A two-stage least squares (2SLS) estimator deals with the endogeneity of this type and generates unbiased estimates (Hur 2006). The first stage regresses the endogenous variables on all exogenous variables. First stage estimation results then are used to generate predicted values for the endogenous variables. The second stage must exclude some of the exogenous variables from the first stage to satisfy the rank and order conditions. Then, the second stage uses the predicted values of the endogenous variables as generated regressors. This method assumes the generated regressors are uncorrelated with second stage errors.

In the first stage of the model estimated here, the median home price is predicted. The excluded exogenous variables that identify median house price are the average age of the housing stock and the crime rate per capita (Tita et al. 2006, Wentland et al. 2014). These restrictions satisfy pre-estimation rank and order conditions and pass post-estimation Hausman tests of exogeneity, suggesting satisfactory specification regarding this issue. In the second specification using net debt to total revenue as the dependent variable, the previously endogenous median home price is not clearly endogenous, but is treated as such.

The estimation includes fixed effects to control for unobserved heterogeneity that is constant across counties and time periods. Robust standard errors are initially clustered at the panel (county) level. The estimation approach is as follows:

$$\theta_{it} = \lambda X_{it} + \phi Z_{it} + \rho_i + \pi_t + \mu_{it} \tag{3.3}$$

$$Y_{it} = \beta X_{it} + \gamma \hat{\theta}_{it} + \alpha_i + \delta_t + \epsilon_{it} \tag{3.4}$$

For each model, i indexes counties, t indexes time, and a hat ($\hat{}$) designates a predicted value. Where ρ and α are the county fixed effects, and π and δ are the time fixed effects. Then θ is the endogenous independent variable, X is a vector of included exogenous independent variables, Z is a vector of excluded exogenous independent variables, and Y is the dependent variable.

Given the emphasis on the renter share, the exogeneity of this variable is paramount. This is arguably the case if all differences that are known between owning and renting are capitalized into the price to own, such that the household is indifferent between renting and buying an equivalent home since all meaningful differences are priced in. Stadelmann & Eichenberger (2012) instrument for potential endogeneity of the housing tenure decision based on the argument that "property owners choose to live in jurisdictions that can be *expected* to accumulate less debt in the future (emphasis added)." This is a curious line of reasoning if one generally accepts the capitalization hypothesis. Capitalization is a manifestation of the expectations of future costs and benefits. Expectations of future debts (though probabilistic) are capitalized into the price, and, as such, the burden is placed on existing owners and not prospective buyers.

To see how this is not an issue, consider an household's housing tenure decision under two polar cases, either no capitalization or full capitalization. If there is no capitalization, then there is no difference in the burdens between the home-owning and renting options, and the household is indifferent between the two. Under full capitalization, the household will price in the current and expected future debts into the homeownership option—as it would be for a rental property—and if the housing market is in equilibrium, then the price of owning and renting should be the same for equivalent time periods. This renders any expected changes in public debt meaningless to the housing tenure decision. Furthermore, under partial capitalization, the potential resident will face the same share of the uncapitalized burden whether renting or buying. Thus, there is no opportunity for endogeneity to occur. Anything that is potentially endogenous is expected, and is the burden for owners that did not expect it before it was capitalized.

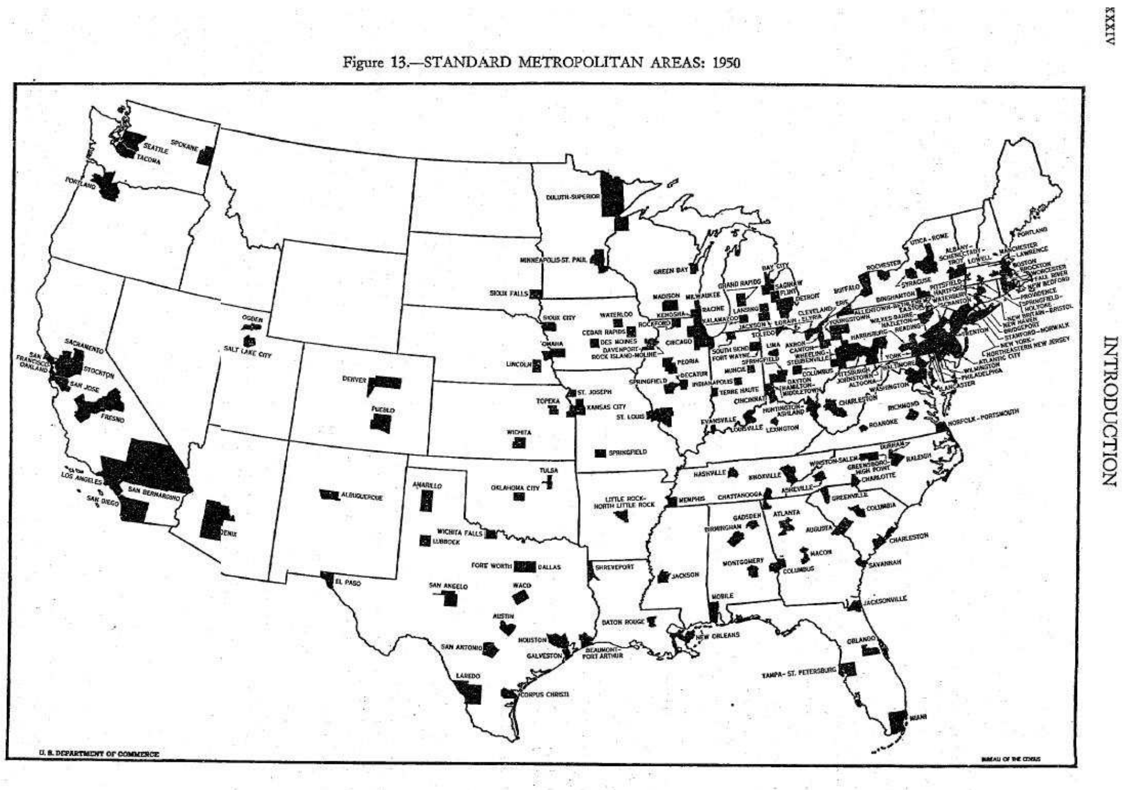
Another potential argument for endogeneity of the housing tenure decision is if there is asymmetric information, such that incumbent homeowners are fully aware of debt obligations while potential homeowners are not. Then the latter could sell to the former at a profit, of course, and the sale price would be somewhere between full and zero capitalization. If the current price shows less than full capitalization, the incumbent homeowners increase the debt and make more profit. However, if homeowners can get a profit through imperfect capitalization under higher levels of debt, then higher rates of homeownership would be associated with higher debt levels. This is the opposite direction of what is otherwise predicted by the theory and could bias the results in the opposite direction.

Although a channel endogeneity of the renter share is not readily apparent, there are other ways a problem can arise. If there are complications from public debt capitalizing differentially across owner-occupier and rental properties, omitted variables driving both the tenure decision and public debt determination, or substantial distortions driving differences in renting and owning markets (e.g., rent controls), then there is potential simultaneity given the limited structure imposed leading to biased coefficient estimates on the renter share variable. Furthermore, the claims of causal inference are bolstered by removing possible channels of endogeneity.

To correct for this issue a control function approach is used for the renter share in a county. The two instruments used in the control function are crime rate per capita and the rural area designation. The enactment of the Housing Act of 1949 created a mechanism for distorting the housing tenure decision for a substantial share of the population. At the time around 36% of the population lived in rural areas compared to 19% in 2010. The 1949 act provided the now United States Department of Agriculture Office of Rural Development (USDA) with funding and instructions to provide home buyers in "rural areas" with loan guarantees on zero-down home loans and loans with low interest rates. Comparatively the rates, fees, and down payment requirements are much lower than loans available from the Housing and Urban Development Agency. This policy removes the potentially prohibitive down payment constraint that would prevent some households from buying a home, and relegate them to renting. The instrumental variable that is used to identify renter share is the designation of "rural areas" which determines access to these programs.

Designation of rural areas by the USDA is done at the sub-county level, so the urban-rural county designation of "standard metropolitan areas" (the predecessor of

Figure 3.2: Map of Standard Metropolitan Areas from the 1950 Census



the "metropolitan statistical area") by the Bureau of the Budget (predecessor of Office of Management and Budget) in 1949 is used as the instrument. Figure 3.2 provides a map of the designated counties used in the 1950 census. Both designations were tasked by the same congress and should represent the congressional understanding of the rural-urban spatial distribution at the time.

At the time of the enactment of this specifically rural homeownership policy there were, and are to this day, many federal policies in support of homeownership. Specifically, the United States Department of Veterans Affairs (VA) has been a very important agency in helping veterans to afford homeownership. However, this and other policies did not target spatial areas differentially. For example, veterans' utilization of VA programs are not limited to only rural areas. For the USDA program, eligibility was conditional on living within a certain geographic area. Other housing policies that do not explicitly distinguish geographic areas for eligibility would not have widely predictable differential effects across areas.

The policy enacted created differences in how conducive counties are to either renting or home-owning. It is arguable that those differences existed before the policy. If so, then they were "pre-existing," which is also a suitable criteria for establishing exogeneity for an instrumental variable, and the designation of the rural areas merely provides this observation formally. Timing is a strong argument for the exogeneity of the instrumental variable since local public debt levels from 1980-2010 did not cause the 1949 designation of rural areas. Statistically, the instrumental variable method used controls for any and all potential endogeneity issues as long as it is valid. Empirically these spatial differences persist through time and are significant in predicting renter share.

One aspect of this instrumental variable is that it does not vary across time. In order to utilize the instrument, a control function approach using between effects is used (Hausman & Taylor 1981). First, the renter share is regressed using the between estimator on the instrumental variable and the other explanatory variables. This regression serves as a control function, so the fitted residuals are generated and used as a new variable to include in the fixed effects regression (along with the predicted value of the median home price). Using a control function allows the fitted residuals to pick up the possible endogeneity (Matzkin 2007).

The control function is defined as follows (Davidson & MacKinnon 1993):

$$\bar{\psi}_i = \eta\bar{\Omega}_i + \tau\bar{X}_i + \bar{\upsilon}_i, \tag{3.5}$$

$$\psi_{it} = \hat{\psi}_{it} + \bar{\upsilon}_i + \hat{e}_{it}. \tag{3.6}$$

Where overbar ($^{-}$) signifies the mean of the variable, ψ is the renter share, and Ω is the instrumental variable. After estimation of equation 3.5 using the between estimator, the fitted residual is generated, denoted $\bar{\upsilon}_i + \hat{e}_{it}$ as described by equation 3.6, and included in the second stage of equation 3.4. In all, the new model estimated using the within estimator is equation 3.7. The between effects, $\bar{\upsilon}_i$, are constant over time within each panel and is absorbed by the fixed effect in the second stage. The independent error, $\hat{e}_{it}$, models the potential endogeneity in the error term, ϵ_{it}, in the second stage. The full specification is modeled:

$$Y_{it} = \beta X_{it} + \gamma\hat{\theta}_{it} + \zeta\psi_{it} + \alpha_i + \delta_t + \epsilon_{it} + \bar{\upsilon}_i + \hat{e}_{it}. \tag{3.7}$$

The identification of ζ follows from the restrictions $E[\epsilon|e] = E[\epsilon|e, \Omega, X]$ and $E[e|\Omega] = 0$ (Matzkin 2007). The null hypothesis on the coefficient of the residuals, $\hat{e}_{it}$, is that the renter share is exogenous.

Results

Prior to estimation, the Phillips-Perron test for unit roots is performed on the dependent variables (Choi 2001). The null hypothesis of this test, that all panels have a unit root, is rejected for each dependent variable. Furthermore, the yearly average level of the dependent variable does not show a trend in the data.

The estimation proceeds with net debt per household as the first dependent variable. A number of post-estimation statistics are checked to analyze model validity for the overidentified median home price (Baum et al. 2003). The Hansen J statistic tests for overidentification on whether the excluded variables used in the first stage are valid instruments. The null hypothesis is that the instruments are valid. This test fails to reject the null with a p-value of 0.698, so no issues are apparent with the excluded variables, average housing age and crime per capita. These instruments are also tested for strength of identification using the Kleibergen-Paap statistic, and the null of underidentification is rejected with a p-value of 0.009. Therefore, the proposed identification of the median home price is not invalidated by the post-estimation statistical tests. The Wu-Hausman statistic results suggest that the median home price is likely endogenous with a p-value of 0.052, justifying the generated regressor treatment. Post-estimation tests cannot be performed on the just-identified control function, but the instrument predicts the renter share at the one percent level and has the expected coefficient sign.

The initial model is regressed using Huber-White standard errors clustered at the panel level, the county. Even though each panel only has six time periods the results are quite strong with the coefficient on renter share showing statistical significance and the expected sign. Other coefficients appear reasonable and are discussed below. After the initial estimation, the Pesaran test checks for the presence of spatial correlation across errors (Pesaran 2004, Hoyos & Sarafidis 2006). This verifies whether the standard error clustering at the county level is appropriate by evaluating whether counties are interdependent. The null under this test is that there is cross sectional independence. This test rejects the null suggesting that the standard errors may have a downward bias. In order to correct for any correlation across counties, two more models are run. First, the model is estimated with standard errors clustered by state, and then the model is estimated using Driscoll-Kraay standard errors (Driscoll & Kraay 1998). Driscoll-Kraay standard errors allow for correlation within and between panels. With only six time periods, Driscoll-Kraay errors may not be not ideal (Hoechle 2007). The most conservative standard errors on the renter share coefficient are those with state clustered standard errors and are reported in the tables. Table 3.7 reports the results of selected variables using net debt per household as the dependent variable. All of the variables previously mentioned are included in the regressions, but those that are not statistically significant are not reported.

The coefficient on the renter share is statistically significant and positive in every model. The first column in results table 3.7 reports the estimates when the renter share is treated as exogenous, or without the control function first stage. Column (2) provides estimates when the control function residual is included. Column (3) provides a robustness check to ensure the results are not driven by large cross-county special districts that result in multi-county debts are not uniformly distributed across counties. The sample for these estimates is trimmed by removing 19 states that have more that 20% of all local borrowing by special districts in at least four of the six observed years.[31] The results are consistent with other estimates suggesting that results are not driven by special districts.

Column (4) is estimated without interpolating the data. This cuts one-third of the observations and uses a different year of fiscal data, 2012. Each decennial census year (1980, 1990, 2000, and 2010) is matched with full population census of government years that end in "2" (1982, 1992, 2002, and 2012). The magnitude of the point estimate across the four models is remarkably steady. Overall, the results consistently reveal that the renter share leads to higher net debt per household.

[31]The states removed are AZ, CA, CO, GA, IL, IN, KY, MA, ME, NE, NJ, NC, OR, PA, SC, SD, TX, UT, and WA.

Table 3.7: Net Debt per Household Results

VARIABLES	(1) 2SLS	(2) IV & 2SLS	(3) IV & 2SLS-Restricted Sample	(4) IV and 2SLS-Not Interpolated
Renter Share	36.066*** (10.72)	40.704*** (12.35)	42.139*** (12.09)	42.607*** (14.13)
Median Home Price	0.140* (0.08)	0.146** (0.06)	0.087** (0.04)	0.186*** (0.06)
Population under 18 per Household	11.350** (5.10)	11.060** (4.63)	11.098* (5.51)	9.593** (4.00)
Total Expenditures per Household	1.618*** (0.50)	1.613*** (0.50)	0.990*** (0.10)	1.228*** (0.29)
Mean to Median Income Ratio	-7.496 (4.83)	-8.213** (3.22)	-7.932** (3.32)	-9.596*** (3.43)
Predicted Residual		-4.616 (10.95)	-8.869 (9.43)	-12.129 (9.73)
Observations	18,636	18,636	10,296	12,424
R-squared	0.143	0.189	0.118	0.227
Number of Counties	3,106	3,106	1,716	3,106

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The effect of renter share is interpretable as a 1 percentage point increase within a county predicts between a \$360 to \$420 increase in net debt per household. The median county-year in the data has a net debt per household level of \$1,700 and the average level of net debt per household is \$5,500. This means that a 1 percentage point change in the renter share predicts a 24% change in the median counties net debt level and a 7% change for a county with the average level of net debt. A 1 percentage point increase in renter share is meaningful as it represents a single standard deviation for the 5 year change. The standard deviation of the renter share is 7.5% and seldom occurred in the data.

Only a few of the coefficients on control variables show consistent statistical significance across all models. The main control from the budget constraint, total expenditure per household, is always significant and positive across all models. The median house price shows a significant positive relationship in every model. This is consistent with the fact that home price may be viewed as a constraint on borrowing. The population under 18 per household is positive and significant in each model. Perhaps this is suggestive that jurisdictions view debt financed expenditures as investments that pay a return, in terms of the size of the tax base, in future periods. The final variable that is significant and positive across all model is expenditure per household which, given its role within the budget constraint, is completely expected. Other coefficients may be significant in some models though not consistently throughout and are not

Table 3.8: Net Debt to Total Revenue Results

VARIABLES	(1) 2SLS	(2) IV & 2SLS	(3) IV & 2SLS-Restricted Sample	(4) IV and 2SLS-Not Interpolated
Renter Share	1.181*** (0.40)	1.413* (0.73)	1.820* (0.71)	1.397** (0.60)
Median Home Price	0.001 (0.00)	0.001 (0.00)	0.003 (0.00)	0.007** (0.00)
Population under 18 per Household	0.394 (0.26)	0.380 (0.27)	0.375 (0.31)	0.478** (0.18)
Total Expenditures per Household	0.028*** (0.01)	0.027*** (0.01)	0.033*** (0.01)	0.017*** (0.00)
Population Growth Rate	3.340*** (4.83)	3.559*** (3.22)	4.591*** (3.32)	2.862*** (3.43)
Predicted Residual		-0.230 (0.49)	-0.122 (0.47)	-0.117 (0.46)
Observations	18,636	18,636	10,296	12,424
R-squared	0.073	0.074	0.087	0.084
Number of Counties	3,106	3,106	1,716	3,106

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

discussed. Across all models the coefficient on the predicted residual from the control function is insignificant. A significant coefficient would suggest that the renter share is endogenous.

The same procedures related to the first set of results are duplicated for the alternate dependent variable. The only difference of note is the Wu-Hausman test results suggest that the median home price is not endogenous with respect to net debt to total revenue. However, the generated regressor is still used in all the models at a cost of some efficiency. Thus, the columns of table 3.8 correspond to the methods and data used previously. The renter share coefficient is again significant across all models with a positive sign, suggesting a robust finding. The consistently significant coefficients for these models are on total expenditure per household and population growth, and are positive. Lastly, the coefficient on the control function residual is not significant in any of these models.

The various methods, samples, and specifications all report a significant positive relationship between renter share and scaled net debt. This confirms what was expected given the theory and the previous study in Zurich (Stadelmann & Eichenberger 2012). Additionally, this relationship is arguably causal given the theoretical arguments and the empirical approach.

3.4 Conclusion

The theory in this chapter uses the assumptions for Ricardian equivalence for local governments to predict how household preferences related to local public debt will be shaped. Households that own durable property, like a home, within the jurisdiction will treat local public debt as equivalent to current taxes, while households that do not own homes will not view local public debt as equivalent. This stems from the varying ability of households to use exit to avoid the burden of public debt. Since households are heterogeneous in local public debt burden because of their housing tenure, public debt policy should vary with aggregate housing tenure to the extent local preferences are reflected in policy outcomes.

Next, local government policy is a reflection of local household preferences. Local households can use voice in policy making by voting, both for electing representatives and in direct democracy processes. Each likely impacts the communicated preferences and outcomes of public debt. Taking the heterogeneous preferences for public debt with the right of resident households to vote results in a hypothesis; higher proportions of renting households within a jurisdiction leads to higher local public debt levels.

This hypothesis is tested empirically using an instrumental variable approach. The data used is U.S. local data from 1982-2012 from the Census of Governments and the 1980-2010 decennial censuses. The empirical results suggest that the proportion of renting households causes higher levels of public debt. This is robust across multiple models. Thus, the proportion of renters is an important predictor of the level of local public debt.

The results can be taken in a number of ways. First, the set up of the hypothesis is reliant on the institutional structure in place. Namely, the American free market democracy decentralizes a number of policies, allowing for local determination of them. Thus, local preferences are manifest in local policies.

Second, a key avenue for impacting local policies, especially intergenerational redistribution, is through suffrage (Lindert 2004). The extension of suffrage beyond all property owners appears to have a real effect on the fiscal policies. While this adds light to a largely settled historic debate, the sometimes restrictive voting rules employed by special districts that require property ownership may be well-founded.

Third, there are implications for local public debt markets. This study shows one way the aggregate appetite for public debt in a locality can be measured. This informs municipal bond market participants' expectations regarding likely public debt usage as part of the budget. For municipalities that are fiscally distressed or that file for municipal bankruptcy protection, the state control boards and bankruptcy court judges should be aware of the impact of housing composition and the associated burden of initial debt and default resolutions, especially in a declining tax base scenario.

Further research on this issue should try disentangling the political economy mechanism under which renting households preferences are represented. This can be both theoretical and empirically focused. For example, additional empirical research can use data from debt referenda to further evaluate the direct democracy impact of the role of housing composition on debt. While a theoretical focus would likely be to model housing tenure and public debt burdens in a probabilistic voting model.

3.5 Additional Tables and Figures

Table 3.9: Summary Statistics

VARIABLES	mean	sd	min	max
Net Debt per Household (000s)	5.508	14.33	-48.38	821.6
Net Debt to Total Revenue	0.491	0.614	-5.234	26.52
Renter Share of Households	0.268	0.074	0.102	0.834
Property Tax Share of Revenue	0.247	0.127	0.014	0.954
County Ideology	0.434	0.122	0.067	0.927
State Ideology	0.528	0.184	0.0787	0.908
Median Income (000s)	45.77	11.87	16.88	120.0
% College Graduate	0.149	0.074	0.020	0.678
Unemployment Rate	0.064	0.028	0	0.349
Poverty Rate	0.155	0.070	0	0.599
Households per Square Mile	0.738	3.312	4.85e-04	101.4
% Hispanic	0.055	0.116	0	0.974
% Black	0.087	0.145	0	0.864
% Asian	0.007	0.023	0	0.667
% Other	0.062	0.111	0	0.972
Racial Fractionalization	0.212	0.176	4.79e-04	0.722
Median House Price (000s)	112.0	65.94	8.266	1,291
Local Government Fragmentation	0.313	0.211	0.0273	1
TEL Index	0.154	0.090	0	0.380
Population (000,000s)	0.085	0.302	7.00e-05	9.710
Population Growth Rate (annualized)	0.007	0.014	-0.051	0.138
Population under 18 per Household	0.714	0.156	0.242	2.261
Mean to Median Income Ratio	1.283	0.105	0.981	2.868
Grants Share of Total Revenue	0.419	0.139	0	0.927
Total Expenditure per Household (000s)	10.31	5.245	1.081	157.7
Crime Rate per Capita	0.002	0.003	0	0.045
Average Age of Housing	31.76	8.832	6.708	62.30
5 Year Change in % Renters	0.001	0.011	-0.074	0.099

Figure 3.3: Scatterplot- Renter Share and Net Debt per Household

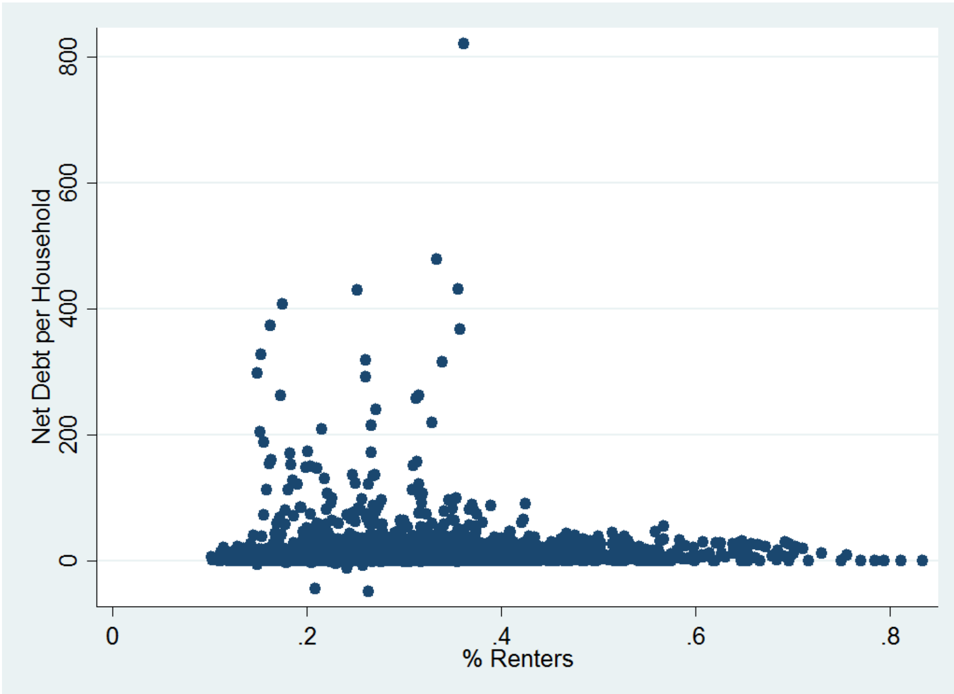


Figure 3.4: Scatterplot- Renter Share and Net Debt to Total Revenue

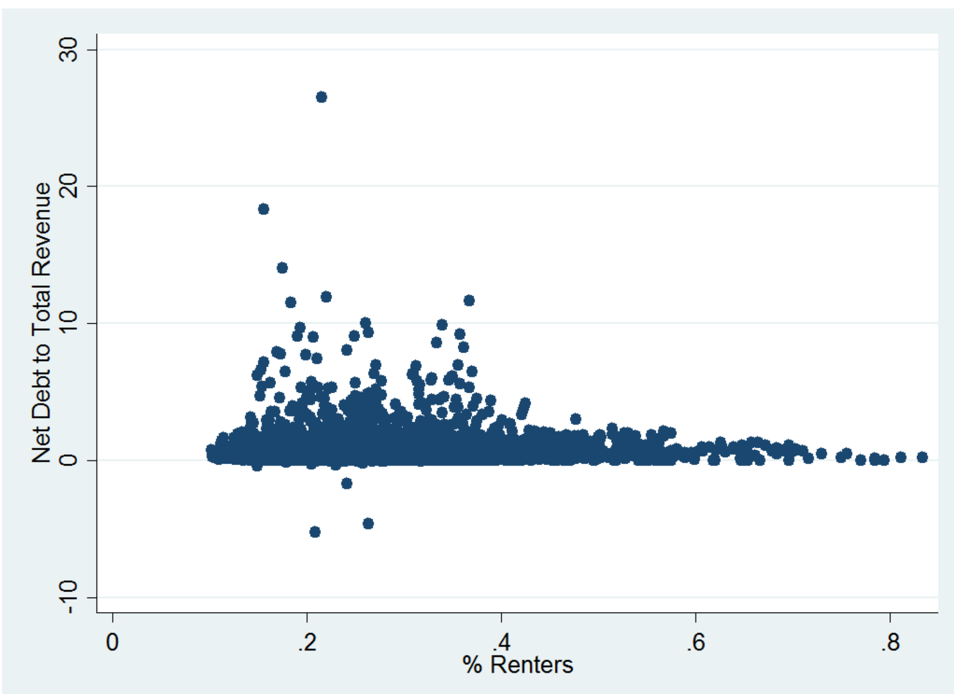
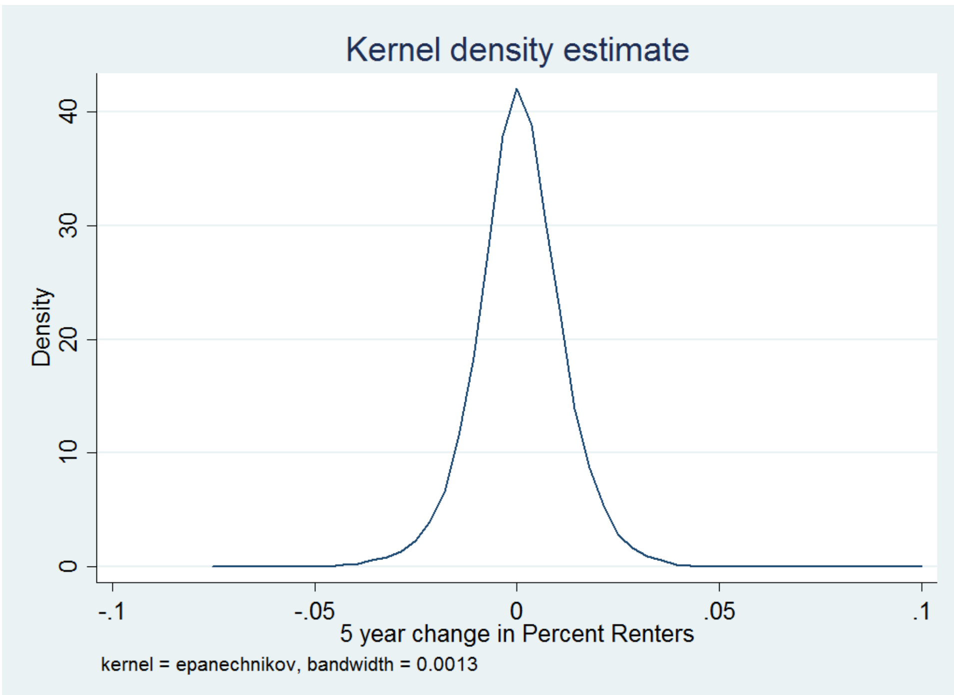


Figure 3.5: Kernel Density Estimate of 5 year change of Renter Share



Chapter 4 A Spatial Econometric Analysis of Local Households' Housing Tenure on Local Public Debt Levels: Implications for Federalism

4.1 Introduction

The hypothesis that a household's local public debt preference varies by real property ownership, ceteris paribus, is based on the spatial fixity of real property through time. Through the capitalization of local public debt into real property values, home-owning households view current taxes and public debt (or future taxes) as equivalent. Conversely, households that rent their home from a landlord do not have these same incentives related to the value of the real property they occupy, so current taxes are not equivalent to public debt for them. In formulating the empirical analysis of this hypothesis in the preceding chapter, fixed geographical areas (counties) are used to define the panels of data.[1] The spatial structure of the data provides an opportunity to utilize spatial econometric methods to examine the data.

Empirical tests in the previous chapter established the presence of cross-sectional dependence between the panels in the data. Cross-sectional correlation among aggregate counties of public debt levels is not a surprising development. Fiscal policies of local governments could conceivably be spatially correlated for many reasons. Local governments are "creatures of the state," controlled, to some degree, by states which impose policies regarding their fiscal operation and legal organization. Some important powers that states have over local governments include: setting public debt limits, choosing the public debt default regime, and setting the rules for special district creation. Constitutional guarantees of freedom of interstate commerce and household mobility create economic linkages among states and their localities. Finally, all governments in the U.S. are tied together through complicated intergovernmental transfer relationships that redistribute government funds. These are just some of the ways spatial dependence can emerge from the U.S. federal system.

In addition to spatial relations that may stem from the fiscal federalism considerations noted above, spatial correlations may also arise from geographic features that determine economic activity and affect agglomeration economies. The endowment of natural resources has led to spatial clustering of certain economic activities. Consider the spatial distribution of steel production or of specific agricultural activities in the U.S. When the steel crisis of the 1970s and 80s occurred, the effects impacted counties in the Steel Belt through the loss of industry and population.[2] Likewise, natural disasters, weather patterns, or world price shocks can affect the agricultural production and economic stability of entire regions. Thus, localities may exhibit spatial dependence with respect to local public debt levels through general economic

[1] Counties that were created or destroyed over the time period are engulfed by an adjacent county to maintain spatial fixity throughout the dataset, and thus the panel is balanced.

[2] The Municipalities Financial Recovery Act (Act 47) in Pennsylvania, investigated in depth in the previous chapter, was adopted in 1987 and the municipalities that were designated as distressed in the proximate years under the act are spatially clustered in the western half of the commonwealth.

considerations or the role of federalism.

Spatial econometrics provides tools for understanding the potential spatial processes at work. Specifically, this chapter investigates two sources of spatial dependence. First is spatial interactions (or spatial autocorrelation). This occurs when policy outcomes of a given jurisdiction are affected by their neighbors outcomes. This type of spatial dependence is frequently motivated in the fiscal literature by policy spillovers or by "competition" between jurisdictions (Brueckner & Saavedra 2001, Brueckner 2003). Competition is typically characterized in one of two ways. Interaction can occur through competition for mobile households (the tax base), or the competition can be characterized by yardstick competition where households are aware of neighboring jurisdictions debt policy and mimic their policies.

The second source of spatial dependence is spatial heterogeneity in the error term. In the previous chapter, the Pesaran test of cross-sectional dependence revealed correlation in the error terms across panels. This issue is addressed with robust standard errors clustered at the state level. However, explicit modelling of the error structure may be informative as to whether the spatial location of counties are crucial to this correlation (Anselin 2001). Fiscal interactions across county aggregates with respect to public debt is not a topic with a rich empirical history, but spatial examinations of fiscal variables generally return evidence of positive spatial spillovers (Brueckner & Saavedra 2001, Füss & Lerbs 2017).

After this introductory section, this chapter proceeds with defining the spatial empirical model and weights matrix. Following that section are the results and interpretation of the findings. The final section concludes. The analysis in this chapter finds strong evidence of spatial dependence.

Spillovers and Special Districts

In the presence of policy spillovers, fiscal federalism suggests that policy ought to be undertaken by a government which can internalize all of the costs and benefits (Wildasin 2004). In the U.S. local government setting, this could mean providing public goods at the county or state level, for example, rather than at the level of the municipality or smaller government. Alternatively, for spillovers that are larger than the county but smaller than the state, formal coordination can be done through the creation of a special district. Special districts are local governments that are designated to perform specific government functions. The variation in size, scope, and utilization by state has motivated ample attention in the literature (McCabe 2000, Carr 2006, Bauroth 2015). It is this uneven organization of local governments that motivates the aggregation of all local governments to the county level in the empirical analyses in this dissertation.

The empirical analysis of the previous chapter is designed to draw out the impact of household preferences on local government debt policies. One step taken to accomplish this task is the choice of the unit of observation. The unit of observation in these chapters is a county-year, where all local government fiscal measures are aggregated to the county level. This removes the impact of the institutional variation that effect the debt levels of individual jurisdictions. The functions performed by distinct types of local governments vary across states and my even vary across counties within the same state. Fiscal policy decisions can occur at many places within a county that may or may not have overlapping jurisdiction over households. Aggregating fiscal outcomes to the county level removes these potential institutional variations and deemphasizes the role of local government institutions and officials, allowing for consistent cross-county comparisons of household preferences.

However, this aggregation comes at a cost as it washes out any potential within county variation. In terms of this spatial analysis, it means spillovers that do not cross county boundaries are not observed. The potential decision makers in this model are households that may interact with households of other counties. This can be done formally through coordination efforts that generate explicit cross-county fiscal arrangements. Or, informally as households move domiciles, commute, travel, or are generally aware of neighboring counties' fiscal policies. Additionally, modelling spatial heterogeneity in the error term allows for the effects of unobserved cross-county shocks.

4.2 Model

The spatial econometric model used in this analysis is known as spatial autoregression with autoregressive disturbances or a Cliff-Ord type spatial model (Cliff & Ord 1968, 1981, Baltagi 2008, Elhorst 2014). This model contains both paths of spatial dependence stated above, a spatial lag and a spatial error. It is written as follows:

$$Y_t = \rho W Y_t + \beta X_t + \alpha + u_t, \tag{4.1}$$

$$u_t = \lambda W u_t + \epsilon_t \tag{4.2}$$

For n counties, let Y_t, an $n \times 1$ vector, denote net debt per household. The first term on the right of equation 4.1 is the spatial lag, with ρ, a scalar, as the spatial lag coefficient and W the spatial weight matrix. The spatial weight matrix describes the spatial relationship between panels. The matrix is $n \times n$ with the diagonal elements all set to zero. Formally, the matrix is $W = (w_{ij} : i, j = 1, ..., n)$, with $w_{ii} = 0$ for all $i = 1, ..., n$. Thus, each element of the matrix, w_{ij}, is the spatial influence of county j on county i. The process of generating the weights used is described in the next subsection. Since each row in the matrix is standardized to one so the effect of ρ is a weighted average of the effects of one's neighbors, and thus ρ must be less than one. The ρ coefficient is the measure of spatial dependence that indicates the effect of one's dependent variable on the neighbor's dependent variable in the focal area. As is standard, let β (a $k \times 1$ vector) be the direct effect of explanatory variables X_t (an $n \times k$ matrix), with α (an $n \times 1$ vector) as fixed effects. Since this spatial panel model has a short time dimension, time dummies are included in the explanatory variables (Lee & Yu 2010a,b).

Equation 4.2 defines the spatial error, with the scalar λ denoting the spatial nuisance coefficient. This explicitly models part of the error as a spatial process, and thus assumes cross-county disturbances. The parameter λ is not directly interpretable, but improves the efficiency of the substantive parameters to the extent spatial dependence is present from unobserved time-varying explanatory variables.

Combining these two equations and simplifying leads to a reduced form[3]:

$$Y_t = (I - \rho W)^{-1}\beta X_t + (I - \rho W)^{-1}\alpha + (I - \rho W)^{-1}(I - \lambda W)^{-1}\epsilon_t \tag{4.3}$$

The term $(I - \rho W)$ is known as a spatial filter, and diminishes or enhances the impact of β on the global average. The effect of a change in X on Y is $(I - \rho W)^{-1}\beta = I\beta + [W\rho\beta + W^2\rho^2\beta + W^3\rho^3\beta + ...]$. This effect can be broken into two parts, the direct effect, $I\beta$, and the indirect effect in the brackets. Interpretation of the impact of X on Y is done in this chapter through combining the direct with the indirect effect which is calculated by simulation of the indirect impacts. The simulation of indirect effects changes an explanatory variable in a given county and calculates the effects of its neighbors, neighbor's neighbors, and so on, over many iterations. Essentially, the indirect impact spreads the spillover through space, with diminishing strength as the power on the $W\rho$ grows. Depending on where the effect starts, the spillover has different impacts on the spatial equilibrium of the dependent variable. Also, it should be noted that once there is a spillover from an original jurisdiction to its neighbor, the original jurisdiction is a neighbor of its neighbor and will have feedback from the spillover.

Note the appearance of the inverse of the spatial filter in the final term. Similar to the expansion into an infinite series for interpreting the impacts, the error term at all locations enters into the estimation. Thus, estimating this model via OLS would result in biased estimates due to the correlation of the errors, so it will be estimated here using generalized method of moments (GMM) following the conditions set forth by Kelejian & Prucha (1999). GMM is also used in a two-stage estimation to instrument for the proportion of renters (denoted hereafter as renter share). This estimator uses the residuals of a feasible generalized least squares estimator in the first stage to obtain a consistent estimate of the autoregressive disturbance, λ, and then takes that estimate as given for the second stage GMM estimator to obtain the estimates for ρ and β.[4]

Weight Matrix

Since the weight matrix is effectively choosing a functional form for the spatial interactions, I use multiple weight structures that are common in the literature. My preferred weights are from a combined boundary and distance structure which was pi-

[3]Note that the reduced form it is the debt preferences of neighbors and neighbors of neighbors, etc. that affect debt levels.

[4]Following this procedure, standard errors for λ are not available (Bell & Bockstael 2000, Baller et al. 2001, Buettner 2001, Schlenker et al. 2006, Baltagi et al. 2007). There are no substantive conclusions that can be drawn from the error, so the efficiency with which the spatial nuisance is estimated is not relevant for meaningful economic analysis. It serves to model the errors in order to improve the efficiency of parameters that carry economic meaning and are analyzed in the chapter.

oneered by Cliff & Ord (1981). The Cliff-Ord weights for the preferred weight matrix are defined as:

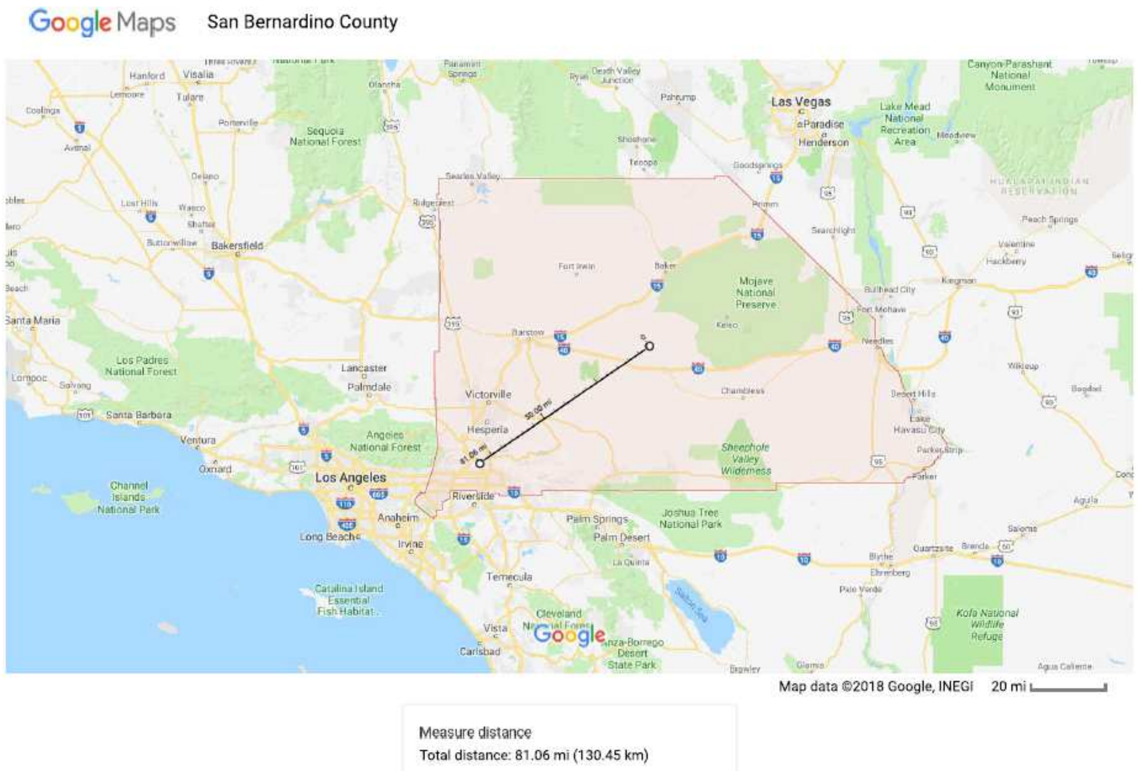
$$w_{ij} = \frac{b_{ij} d_{ij}^{-\gamma}}{[i \neq j] n \sum b_{ij} d_{ij}^{-\gamma}}. \tag{4.4}$$

Where $b_{ij} = 1$ if the counties share a border, and 0 otherwise, and d_{ij} is the distance between the centroid of county i and the centroid of county j. Lastly, I assume $\gamma = 1$. The denominator sets the weights to be row standardized. This form incorporates boundaries but does not assign equal weights to neighbors. Instead it projects closer neighbors with higher weights.

Other potential weight structures include shared-border neighbors, also known as binary contiguity weights, where each neighbor has the same weighted impact on a given county. A contiguity matrix is used as a check on the robustness of the results. The assumption of equal neighbor impacts is dubious for some of the larger counties with vast empty spaces since much of the population may reside near a county border. Additionally, this structure creates many single neighbor counties from the independent cities in Virginia that are completely engulfed by larger counties. Another common weight structure is based on the inverse distance between county centroids. These often are adjusted to only include no more than a given number of nearest neighbors, since ensuring that each county has at least one neighbor puts a high threshold on the minimum distance band. This procedure results in most counties having a given number of neighbors. An important consideration in defining the weight structure is to create a balanced neighbor distribution for the observations. This means that the distribution of the number of neighbors should be symmetric and have a reasonable range. The weights are used to create an average of the neighbors, and the number of neighbors used to compute the average should be stable.

To compute the distances I use population weighted centroids from the 2000 decennial census. This changes the distance significantly for some county pairs. Figure 4.1 shows the shifting of the geographic centroid to the population weighted centroid in San Bernardino County, CA. Notably, using the population weighted centroid puts more weight on neighboring counties in southern California and less on Clark County, NV (Las Vegas). This improves the neighbors for larger counties in the West that see relatively larger differences in these two types of centroids.

Figure 4.1: San Bernardino County Centroids



In order to improve the distribution of boundaries from borders based on political county boundaries, I use the population weighted centroids to construct Thiessen polygons.[5] This procedure reduces the state-to-state variation in the conventional design of county borders. Effectively it reduces the number of counties with a single neighbor down to 1, from 14, those with two neighbors down to 2, from 24, and shrinks the range from 14 to 10. Table 4.1 provides the distribution of links. This procedure improves the number of neighbors mostly for small counties in the East. The polygon procedure creates neighbors on coasts and edges that may be quite far a part, for instance, a county in south Texas has a polygon border with a south Florida county. I remove these by restricting the distance band to 200 miles. Figure 4.2 shows what these polygons look like compared to figure 4.1. Figure 4.3 provides an image of these polygons in parts of southern Virginia.

[5]Thiessen Polygons are constructed in the software GeoDa. The documentation describes the process as follows:

> Thiessen polygons (also called Voronoi polygons or Dirichlet tesselation) are included in GeoDa to allow users to convert point shape files to polygons. Each point is assigned an area whose boundaries are defined by the median distance between itself and its nearest neighbors. In more technical terms, Thiessen polygons are based on the perpendicular bisectors of the lines between all points. The value of the point is assigned to the polygon surrounding the point.

Table 4.1: Tabulation of links

Number of links	Observations
1	1
2	2
3	17
4	181
5	819
6	1271
7	635
8	148
9	26
10	6
Total	3,106

Figure 4.2: San Bernardino and Neighboring Counties Polygons from Population Weighted Centroids

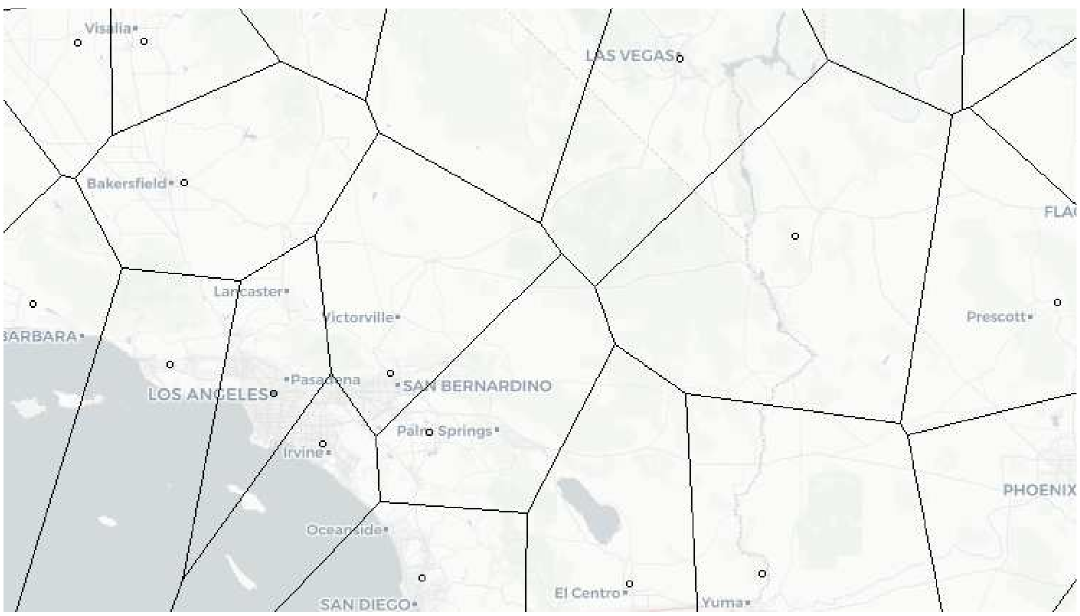
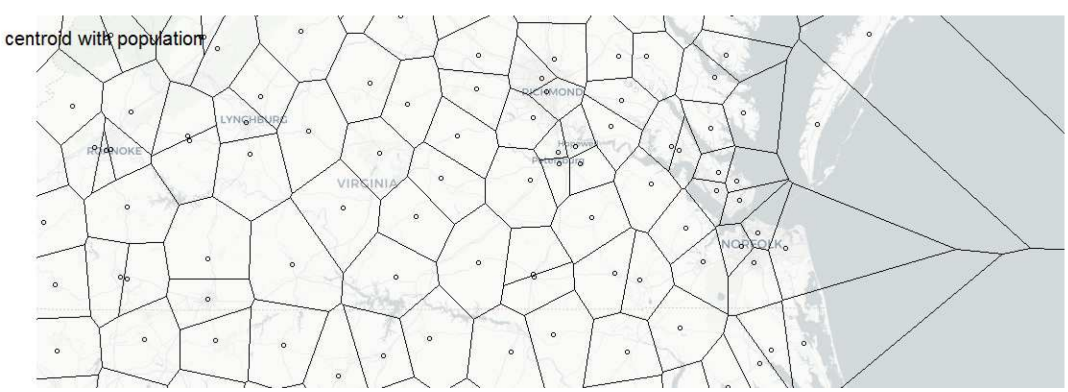


Figure 4.3: Virginia Counties Polygons from Population Weighted Centroids



4.3 Results

The data used for estimation in this chapter is the same quinquennial census of government and the decennial census sourced data used in the previous chapter. This includes 3,106 aggregate counties in 1982, 1987, 1992, 1997, 2002, and 2007. This is the full population of the contiguous U.S. and Hawaii local governments for those years.[6] The controls for public preference, institutional, and other controls in the previous chapter are also used. In this chapter, housing age is used to proxy for the median home price because of the endogeneity of the home price with net debt per household. In order to emphasize the coefficient on renter share and the spatial parameters, the results from the control variables are not reported in this chapter. Suffices to say there are not any meaningful changes in sign or significance to the controls from the results in the previous chapter.

Tests for Spatial Dependence

In the previous chapter, the Pesaran test for independence across panels was rejected, inviting further analysis of inter-county dependence. Now that a spatial structure is defined through the weight matrix, four Lagrange Multiplier tests for spatial dependence under this weight matrix are performed to evaluate the spatial specification proposed against the alternative of no spatial dependence (Anselin 1990, Anselin et al. 1996, LeSage & Pace 2009). The first test is a Lagrange Multiplier test for spatial lag correlation. The null hypothesis of this test, and the others in this section, is that the observations display spatial independence. The null hypothesis is rejected by the Lagrange Multiplier test for a spatial lag. Next, the spatial independence of the error terms are tested under a Lagrange Multiplier test for a spatial error. The null is rejected. These tests results may reflect a type I error because a spatial lag alone may result in rejection of both tests, or a spatial nuisance may also lead to the rejection of both tests. With both tests rejecting the null hypothesis more testing is needed.

Given the results of the first two tests, two more tests are performed that are robust to, or allowing for, the potential for the other type of spatial dependence. The robust Lagrange Multiplier test for spatial lags returns a test statistic value of 9.2. Next, the Lagrange Multiplier test for spatial errors robust to spatial lags is performed and yields a test statistic of 53.3. These statistics have a $\chi^2(1)$ distribution, which has a critical value of 6.635 at the 1% level. Both of these statistics reject the null hypothesis of spatial independence; however, the difference in magnitude is suggestive that the spatial error is stronger than the spatial lag (Anselin 2013). For this reason, the use of Cliff-Ord spatial model, with both the spatial lag and error not assumed to be zero, is justified.

[6] Counties that are destroyed or created during the time period are accounted for within the county they separated from or became a part of. See also footnote 1 in this chapter.

Table 4.2: IV Estimation Results

	OLS	IV-2SLS	IV-GMM	IV-GMM
Renter Share	31.28***	55.14	50.03**	41.99*
	(9.971)	(77.13)	(22.77)	(23.33)
Spatial Lag (ρ)	-	-	-0.071**	-0.062**
	-	-	(0.032)	(0.031)
Observations	18,636	18,636	18,636	18,636
Spatial Error (λ)	-	-	0.115	-

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Two-stage IV estimation

Aside from generating spatial dependence parameters to reveal the magnitude and direction of spatial spillovers, spatial regression can also improve the efficiency of estimators when the data are spatially correlated (Anselin 2013). This section presents an example of this improved efficiency under a two-stage IV estimator using GMM.

As noted in chapter 3, the requirement of exogeneity for the variable renter share is necessary for interpretation and inference. Aside from the theoretical arguments of exogeneity, I use a control function approach to eliminate potential endogeneity. The coefficient on the control function is insignificant, failing to reject a null hypothesis of exogeneity. Another way to approach the potential endogeneity of renter share is by generating a predicted regressor for renter share to use in the estimation of the net debt per household. In the first stage estimation of renter share, I use two excluded exogenous variables. The first is the ratio of the median home price to the median rent price, which is effectively the number of months paying the median rent to buy the median home. This ratio has been shown to be one determinant of home ownership (Carliner 1974). The second variable used is the crime rate per capita. Crime rate per capita is a community characteristic that is correlated with homeownership rates (Dietz & Haurin 2003) and not with public debt. Regarding the exclusion of these two instruments, the Sargan-Hansen test is used to assess whether these are correctly excluded from the second stage estimation. The test statistic fails to reject the null that the instruments are correctly excluded, suggesting that these are valid instruments. However, the Durbin-Wu-Hausman statistic results suggest that renter share is not endogenous, meaning renter share can be treated as exogenous.

The results to the various two-stage estimates are reported in table 4.2. The first result to note is the loss of efficiency from using two-stage least square (2SLS) estimation. In this case the standard error of renter share balloons to seven times its previous magnitude. Clearly, the coefficient on renter share is not statistically significant. Given the results of the tests of spatial dependence, modelling the spatial dependence results in improved efficiency for two-stage IV estimation. This is expected in the presence of spatial dependence across panels (Anselin 2013). Column 3 reports the spatial model that is estimated with spatial disturbances and a spatial lag. The point estimate of the coefficient for renter share is similar and now signifi-

Table 4.3: Spatial GMM Results

	(1)	(2)	(3)	(4)
	Inverse Distance	Inverse Distance	Contiguity	W/in State Inverse Dist.
Renter Share	31.81***	31.96***	32.21***	32.11***
	(5.632)	(5.802)	(5.777)	(5.853)
Spatial Lag (ρ)	-0.061*	-0.076**	-0.091**	-0.140***
	(0.031)	(0.032)	(0.039)	(0.030)
Observations	18,636	18,636	18,636	18,630
Spatial Error (λ)	-	0.122	0.119	0.168
Total Impact	-	29.69	-	28.17

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

cant at the 5% level because of a much lower standard error. The coefficient on the spatial lag, ρ, is negative and also significant at the 5% level. The coefficient on the spatial disturbance is observed to be positive. Next in column 4, a second two-stage IV-GMM estimate is performed with only a spatial lag, i.e., $\lambda = 0$. The resulting estimate of the coefficient of renter share is nearly significant at 5%. In this case ρ is still negative and again significant at 5%. The inclusion, or exclusion, of the spatial nuisance does not change the sign of the spatial spillover parameter.

A negative spatial lag parameter suggests that the spillovers are negative and that the spatial pattern of the dependent variable is like a "checkerboard," an alternating high-low pattern. The positive λ coefficient suggests that shocks are clustered spatially. These results confirm the use of renter share as exogenous and the presence of meaningful spatial dependence, but an important feature of spatial analysis is missing. Simulation of the indirect impacts of the spatial lag cannot be done under IV-GMM estimation, and, thus, the impact of the spatial lag is unknown. For these reasons, the next section reports the GMM results when renter share is treated as exogenous.

Impact of the Spatial Lag

Results for the GMM estimation results and the total impacts are reported in table 4.3.[7] Each column shows improved efficiency in the estimates relative to the two-stage procedure, a negative spatial lag, and a positive spatial error. The model in column 1 of table 4.3 omits the spatial error to verify the sign on the spatial lag parameter is not driven by the spatial error. Columns 2 and 4 are the results of the full model

[7]While maximum likelihood estimation (MLE) has stricter assumptions on the distribution of errors relative to GMM, MLE estimates provide standard errors on the spatial nuisance parameter. This is not to suggest that the spatial nuisance has any policy relevant interpretation, but to further affirm its inclusion in the model. In the MLE estimates using the inverse distance matrix and clustering the robust standard errors at the state, the spatial error coefficient is 0.178 with a standard error of 0.054 (significant at the 1% level).

with the total impact simulations reported. Column 2 is the preferred model with the preferred weight matrix. Column 3 provides a robustness check by using a simple binary contiguity weight matrix.

Column 4 uses a modified weights matrix. Starting with the preferred weight matrix, I impose a zero weight on counties in other states. This treats every state as an island and eliminates Washington, D.C. from the data. The spatial weight matrix is effectively assuming a functional form, so estimation using this matrix shows the extent to which the spatial effects being measured are strictly within the states. Note that the spatial lag and spatial error are stronger, suggesting the spatial spillovers in the data may be driven by within-state effects. I restrict the sample to county aggregates that are on a state border to analyze this claim further.

The impacts of the spillovers are simulated to provide a sense of the magnitude of the spatial lag coefficient. Following the procedure of LeSage & Pace (2009), the simulation of the column 2 model has an indirect effect of -2.27 of renter share on net debt per household, which combined with the direct effect results in a total effect of 29.69. This is interpretable as a one percentage point increase in renter share leads to a $297 global average increase in net debt per household. Thus, accounting for the negative spillover to other counties reduces the impact of renter share on local public debt levels. This is evidence that yardstick competition is not occurring among county aggregates.

If the analysis is limited to the spillover effects within states the indirect effect is stronger. Simulation of column 4 results in an indirect effect of -3.95 and a total effect of 28.17. Thus, a one percentage point increase in renter share leads to a $282 global average increase in net debt per household. By limiting the analysis to strictly within state spillovers, the spatial lag coefficient is noticeably larger in absolute value, suggesting that the spillovers are mostly contained within states. Therefore, intervention from the federal government does not appear necessary to internalize the externalities.

Restricted Sample

The model in column 1 of table 4.4 provides additional evidence of the effect of state borders on the spatial lag parameter. Limiting the sample to counties on a state border results in a positive direct effect of renter share on debt, but now the spatial lag point estimate is positive and not significantly different from zero. The previously identified spillovers are dissipating at state borders.

Geographic Segmentation

The apparent limitation of spillovers to within states is an important finding in this data and relevant for discussions on the role of federalism in local public debt policies. A potential explanation of this result could be the geographic segmentation of municipal bond markets (Marlin 1995, Greer & Denison 2014). In the literature, it is posited that geographic segmentation arises from a few potential sources. First is the deductibility of municipal bond interest from state income taxes. The deductibility

Table 4.4: Restricted Sample Spatial GMM Results

	(1)	(2)
Weight Matrix	State Borders Contiguity	Contiguity
Renter Share	58.99***	28.65***
	(11.27)	(6.431)
Spatial Lag (ρ)	0.034	0.276***
	(0.033)	(0.055)
Observations	7,068	10,272
Spatial Error (λ)	-0.056	-0.168

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

of interest is not a uniform policy across states, creating after-tax differentials in the effective yields of municipal bonds. A second source of segmentation is differences in the cost of information. Bond buyers that live in close proximity (proxied by the same state) are more likely to know about the local economic and governance conditions as well as the potential success of a public debt offering, so they feel more comfortable purchasing bonds from closer localities (Greer & Denison 2014). Finally, the default regime of local public debt is determined severally by each state and is priced into the yields on bonds (Gao et al. 2017, Moldogaziev et al. 2017). For each of these three sources of market segmentation the interest rates on municipal bonds across states reflect these differences. The negative spatial lag observed can be explained by municipalities within states competing with one another to a greater extent than with municipalities in other states. Additionally, the models here have no explanatory variable for interest rate, so the spatial error process could potentially pick up the geographically clustered deviations in interest rates. At the same time, the spatial nuisance can be a result of unobserved time-varying variables like pensions or other budget operations that may be geographically clustered. It is unknowable which of these is driving this result without additional data. However, these results are suggestive that state autonomy in how local governments incur and settle public debt is appropriate for managing spillovers from local public debt.

Implications for Special Districts

Another possible explanation of the "checkerboard" pattern that accompanies a negative spatial lag parameter is that special district debt is assigned to only one county in the data, but the special district may provide services to and collect revenue from neighboring counties. This is a pragmatic organizational explanation stemming from the structure of the data and the role of special districts. The multi-county overlap of special districts is not unique to this type of government; however, the potential magnitude of special district is substantially larger than sub-county general purpose governments. This assuages the potential impact of municipalities with boundaries that overlap into multiple counties. Also, special districts are not the only source of potential co-operative public debt issuance and public service provision. Given the limitations of the data, special districts represent a feasible way that this kind of fiscal cooperation can be investigated as a source of spatial dependence. Generally, inter-county public projects through special districts, or other agreement, are facilitated by location within a common state. This could also explain how the negative spatial lag would be stronger within a state.

Special districts frequently encompass multiple counties and play a significant role in the distribution of local public debts (MacManus 1982, McCabe 2000, Carr 2006). Consider some 2002 data on special districts and debt with special attention paid to Nebraska. In Nebraska, 53% of local public debt was owed by special districts, and at least 25% of 1,146 special districts had legal boundaries in two or more counties. Overall, 20% of local public debt in the U.S. was special district debt. Also, at least 12% of special districts in the U.S. had legal boundaries in two or more counties. It is plausible that the special districts that overlap into multiple counties have larger debts and account for more than 12% of the special district debt. Special districts are an important share of public debt that have significant variation in their geographic borders. In order to minimize the role of special districts in the estimates, I re-estimate the spatial model using a sample that removes states that have a relatively high proportion of local public debt by special districts.

The estimates in column 2 of table 4.4 are from this limited sample. In all, the sample drops 20 states, leaving 1,712 counties for estimation. The results show that the signs of the spatial parameters are reversed and not significant. This supports the idea that the negative spatial lag from earlier could possibly be a result of special district borrowing. At a minimum, special district borrowing appears to play a significant role in the spatial pattern of local public debt across aggregated counties in the U.S. This raises some concern to the assumption that the expectation of overlapping special district debt across counties is not conditional on the proportion of renters. It is conceivable under these results that counties with high concentrations of renting households also "host" special districts that take on large amounts of debt for public good provision among many counties. Additional research into the distribution of special district debt can shed light onto this potential issue.

If the entire local public debt spillover is driven by the organization of special districts that overlap, then policy makers at higher levels of government should be largely unconcerned with the local policies, like homeownership, insofar as they are not correcting for public debt spillovers across counties and states. Given the spatial lag appears to be driven by within state spatial spillovers, the control over local debt policies and institutions by states appears to be well-placed. There is no evidence here that the federal government ought to manage local public debt levels.

4.4 Conclusion

In this chapter, the empirical relationship between renter share and net debt per household is analyzed using a Cliff-Ord spatial specification. The spatial model is estimated using GMM and with various weights matrices. The adjustments made to the weight matrix help find the driving forces behind the spillover effects, providing implications for state and federal level policies. Throughout the analysis renter share predicts net debt per household. The coefficient is consistently positive and significant with a stable magnitude.

Regarding spatial dependence, there are two primary findings in this chapter and each is suggestive of additional research that may be performed. First, aggregate county public debt levels have a spatial pattern. There is evidence that the spatial dependence operates through a negative spatial lag, or that there are negative spillovers from local public debt. The substantive interpretation of the negative coefficient on the spatial lag is that the impact of renter share on global average of local public net debt is diminished. These spatial effects are stronger within states, suggesting that state borders at least temper spillovers in this model. There is evidence that errors are clustered spatially, but no clear policy implications can be made from the error term. For policy purposes, this suggests that states are the appropriate level of government for the oversight of local public debt policy.

The second primary finding is that special districts appear to play a substantial role in explaining the spatial pattern of local public debt. In fact, the results that reveal spatial dependence may be entirely driven by special district debt. This invites further research into special district debt and its spatial qualities. The primary distinction for special districts that generates the spatial process in these data are those that are cross-county. Data on the relative importance of cross-county special districts can serve to improve the analysis of the role of special districts. The most apparent policy conclusions is that special districts appear to be driving inter-county spatial correlation, which may reflect that they are operating as intended.

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