CENTRAL CITY FISCAL CONDITIONS AND SUBURBAN SPRAWL AND URBAN DECLINE

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The rapid suburbanization of America since World War II has (in many cases) come at the expense of central cities, which have experienced declining population, median income and employment. In attempt to arrest such decline, many city governments have undertaken local fiscal measures to encourage new firms or households to locate within their jurisdiction. These programs (low interest loans, tax abatement, improved educational funding, etc.) redistribute income between various agents in the local economy (e.g. from households to firms). The impact of such policies is not limited by the city's political boundaries. Development projects undertaken in the central city may have large spillovers to the economic welfare of the surrounding suburbs. The equilibrium model developed here shows that this is not only true for so-called "regional assets" (public goods from which suburban residents receive a direct benefit), but also for public goods which seemingly benefit only city residents or firms. Most importantly from a policy standpoint, under certain conditions the policies will make the suburb relatively more attractive to current city residents potentially contributing to suburban sprawl.

Using Census block-level data from the 1990 Census of Housing and Population and the 1992 Census of Governments we look for an empirical relationship between central city fiscal conditions and suburban land rents. Further empirical work regarding MSA population distribution

and relative population shifts from central city to suburb is performed using a panel of Census data from 1960 through 1980.

Results indicate that central city fiscal policies have a significant impact on neighboring suburban jurisdictions both in terms of land rent and population. This conclusion should provide the impetus for additional work in this area. It is important that we understand fully this interrelationship when designing urban redevelopment efforts. Failure to take this interrelatedness into account could result in urban policies leading to unexpected and undesirable results.

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TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

1.1 THE PROBLEM

The central cities of many metropolitan areas have seen substantial economic and social decline in the past several decades. The middle and upper classes have fled to the suburbs and many firms have moved to areas with lower land and labor costs. Many cities faced with such decline have undertaken redistributive fiscal policies to spur local economic growth. However, these central city jurisdictions do not exist in a vacuum. The typical metropolitan area is composed of hundreds of independent governmental jurisdictions (county governments, local municipal governments, school districts, and other special districts) each of which raises revenue through taxation and provides various goods and services in return. Although politically independent, these local jurisdictions are economically interdependent at least because of the mobility of labor within a particular geographic area. Stanback (1991) aptly describes this relationship between city and suburb as being symbiotic and yet competitive. Cities depend on the labor of suburban residents, and suburbs depend heavily on the stream of income provided by these commuters. Yet there is competition for new jobs and new firms. (See Savitch *et al.* (1993) for an additional useful discussion of other causes and consequences of the interdependence of metropolitan jurisdictions).

Local fiscal conditions can affect land rents and wages (cf. Gyourko and Tracy, 1989a). Therefore, given the interdependence of local jurisdictions, economic development programs undertaken in the central city will have effects reaching beyond its political boundaries. The focus of this dissertation is to examine the impact of central city taxing and spending behavior, accounting for the economic interdependence of suburban and city jurisdictions. Specifically, it attempts to determine under what conditions central city policies help the city at the expense of the metro area and conditions under which the region as a whole may benefit.

1.2 Motivation

The post-war era has seen a rapid suburbanization of America. Today, nearly two thirds of metropolitan statistical area (MSA) residents live in suburbs compared to only 43 percent in 1950 (Mieszkowski and Mills, 1993). Throughout the 1950s and 1960s, owning a suburban tract house was as central a feature of the American dream as the station wagon and 2.5 children. Rising incomes and increasing education levels made this dream a reality for millions of Americans. Suburban living offered a way for the working class to escape the crowded, dirty cities at the end of the work day and return home to a well planned neighborhood of single-family homes, green lawns, and picket fences. Widespread automobile ownership, large systems of expressways, and (to a lesser extent) mass transportation have made longer commutes possible. With the development of the suburban shopping mall and the availability of other household services, suburbs have become virtually self-sufficient.[1]

In many metropolitan areas, the development and evolution of the suburbs has come at the expense of the central city itself which has experienced declining population, median income, and employment.[2] This has tended to exacerbate the very conditions those moving to the suburbs were trying to escape. As of 1990, the median income of the typical central city was more than

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[1]Not only have suburbs developed rapidly, but in recent decades they have evolved from simply "bedroom" communities for those working in the central city into "edge cities" supporting not only a large residential population, but also a significant amount of employment. Many firms, lured by lower land values and often lower taxes, have relocated many operations to suburban locations. Although suburban employment will not be a feature of the model presented below, such an addition should be considered for future research. In a somewhat different context, Ross and Yinger (1995) take some steps in this direction.

[2]Stanback (1991) provides an interesting classification of three types of city-suburb relationships. (1) The city becomes the center for more advanced services while the suburbs gain those services previously performed in the city, but more suited for the suburb. (2) The city dominates the export oriented activities, while the suburb performs residential functions and provides skilled workers. And (3) the suburbs (or sub-centers) build rapidly at the expense of the central city economy. Obviously, in the first two cases the symbiotic relationship is dominant, while competition is primary in the latter case.

30 percent below that of its suburbs. The average central city poverty rate is more than twice the suburban poverty rate (18 percent versus 8.1 percent), and in many cities the disparity is even greater, for example, the central city poverty rate in Detroit is five times that of its suburbs (Stegman, 1997). Many city governments have taken an active role in the local economy in attempt to arrest such urban decline. Local fiscal measures often include various sorts of programs which either implicitly or explicitly redistribute income between different types of households, from households to firms, or vice versa. Whether intended or not, the impact of such policies does not usually end at the city's political boundaries. Labor is very mobile within an MSA, thus to the extent that the surrounding suburbs and the city share a labor market, fiscal conditions prevailing in the central city will (at least) affect suburban residents indirectly through their effect on wage rates. Schweizer (1985) recognized that suburban commuters free ride by consuming some types of local public goods produced in the central city.

City governments have for some time undertaken indirect redistribution of income within a jurisdiction through the provision of local public services. Wealthy households generally pay more in local school taxes, for example, than the benefit they receive from public education, while in contrast, poor families tend to receive more benefits than for which they pay. More recently, we have seen increasing use of more pro-active local fiscal policy in the form of various programs (low- or no-interest loans, tax abatement, direct grants, etc.) in attempt to encourage firms to locate or expand production in the city. These too lead to redistribution of resources, either from households to firms or from existing firms to new arrivals. Such subsidy programs are sold to the taxpayers as a way to either spur economic growth in the metropolitan area (e.g. encouraging a large firm which will employ both city and suburban residents to locate in the city rather than in another area) or improve the economic climate of the central city itself (e.g. persuading an existing firm in the city to stay there rather than relocate to a suburban location). In addition to subsidizing firms, cities are also seen subsidizing the purchase or construction of upper or upper-middle income homes as a way to improve the property tax base and slow the flight of the middle class to the suburbs.

Regardless of the form such redistribution programs take, a subsidy or public good which benefits one particular group will lead to equilibrium land rent and wage adjustments to offset the benefit received by the subsidized group. Such policies may have different impacts on city and suburban residents. Any change in equilibrium wages will affect suburbanites as well as urban dwellers since they work in the same labor market. As a result, suburban land values can be affected by central city fiscal policies. The extent to which this happens will depend on the amount of benefit (if any) suburban residents can derive from the public good and whether suburbanites can be required to pay for such benefits directly. (Depending on the local tax structure, the suburban residents may or may not share the burden of paying for public goods provided by the central city government).

It is often argued that development projects undertaken in the central city will have large spillovers to the economic welfare of the surrounding suburbs. The model outlined below shows that this is in fact true not only for so-called "regional assets" (public goods from which suburban dwellers receive a direct benefit), but also for public goods which seemingly benefit only city residents or firms. Under certain conditions, the policies will make the suburbs more attractive to current city residents potentially contributing to suburban sprawl.

Previous work in local public finance and urban economics has not satisfactorily addressed the interrelatedness of local jurisdictions nor considered the potential policy implications of this interrelationship. The present work speaks to this omission.

The remainder of the dissertation is organized as follows: CHAPTER 2 provides a review and analysis of the relevant literature in public finance and urban economics. CHAPTER 3 presents the theoretical equilibrium model of inter- and intra-urban location. For ease of both exposition and comparison, this chapter also illustrates a version of the single-jurisdiction model described by other researchers. CHAPTER 4 is an empirical study of some of the relationship between central city fiscal policies and suburban land rents. The results indicated that central city taxing and spending behavior is an important determinant of suburban land values. CHAPTER 5 presents an empirical analysis of the relationship between central city fiscal policies and the suburbanization of population. This analysis uses a panel of Census data at the MSA-level spanning 1960 to 1990 and finds that central city fiscal policies have a significant impact on suburbanization. Finally, CHAPTER 6 provides an overall conclusion and some suggestions for future research.

2.0 LITERATURE REVIEW

The debate over the effects (and effectiveness) of local income redistribution policies (and more generally to what level of government various tasks should be assigned) dates at least to the late eighteenth century and the founding of the United States.[1] Since Tiebout (1956) put forth his theory of local public goods, economists have created a significant body of literature analyzing the efficiency of centralized versus decentralized redistribution. (See Crampton (1996) for a detailed review of recent tests and modifications of the basic Tiebout framework). The traditional view might be that of Oates (1972), namely that decentralized redistribution will lead to a type of adverse selection, that is, those who benefit from redistribution will have an incentive to move into the jurisdiction while those who contribute will move away. However, this is by far not the only view. Many authors have presented cases in which decentralized income redistribution is preferable (see for example Pauly (1973)).

Several recent papers have developed models of local income redistribution. Most of these have been concerned with the efficiency of such redistribution and/or the amount of redistribution chosen by a majoritarian government. Cassidy, Epple and Romer (1989) and Epple and Romer (1991) present a multi-jurisdiction public choice model in which voters choose local tax/transfer policies taking into account the effects of taxation on housing prices as well as the way such policies

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1 The general debate is really much older as this quote from Aristotle attests:

> "We should also know over which matters several local tribunals are to have jurisdiction, and in which authority should be centralized"
>
> --POLITICS 4.15

affect in- or out-migration. While both papers uphold the view that local redistribution leads to the poorest households locating in the communities that provide the most redistribution, they nonetheless show that a significant amount of local redistribution is possible. Obviously, the incentives of owners and renters would vary in such a model. Property owners would prefer higher housing prices while renters would want house prices to decrease. Not surprisingly, their simulation results indicate that owner-occupants prefer much lower levels of redistribution than do renters, and the overall amount of redistribution that is possible in a community depends on the ratio of renters to owners.

The model of local income redistribution presented in Wildasin (1991) stresses the importance of analyzing redistribution when the jurisdictions form a single labor market. In this situation, changes in redistributive policy in one jurisdiction will have effects on the others as migration tends to equalize incomes (net of taxes and transfers) across jurisdictions. Wildasin concludes that efficient redistribution is only possible with a system of grants from a central government such that communities offer identical levels of redistribution. (Communities with weaker preferences for redistribution receive larger grants).

Whether efficient or not, local income redistribution is a fact of life in the United States. Furthermore, localities differ widely in their spending on such things as public education, police protection, economic development programs, and other local public goods. These interjurisdictional differences obviously play a role in household (and firm) location decisions, and thus impact property values. The present paper is interested in the impact of central city redistribution policies on land values and wages in both the city and its suburbs. We are specifically interested in the effects of transfers between households and firms (as is often seen in economic development programs), but the model can be used to analyze other types of redistribution. Our model also allows the examination of various tax instruments.

The theoretical model presented below grew out of the model used previously by several authors in empirical work on interurban wage and rent differentials and quality of life indices (see for example Rosen 1979). These authors used some form of the hedonic price model to estimate the implicit prices of various urban amenities. Under the assumption that workers have similar preferences for such amenities, a set of equalizing cost of living and wage differentials should exist among cities. Cities with preferred attributes (good weather, cultural attractions) will offer comparatively lower wages and higher land rents as people move into the city, increasing the labor supply and the demand for housing. Conversely, cities with such disamenities as high crime rates or environmental pollution must provide higher wages and lower housing prices to induce workers to live there. Estimates of these implicit price differences can be used to calculate quality of life rankings for cities. (See Kahn (1995) and Mattey (1996) for more recent discussion of quality of life indices and their calculation).

Studies like Rosen (1979) focused only on the consumer side of the market without accounting for the behavior of firms. In fact Rosen (1974) had already pointed out the shortcoming of such analyses, namely that implicit prices of attributes represent not only the marginal valuation of consumers, but also the marginal cost to firms. Building on this previous work and borrowing heavily from trade theory, Roback (1982) develops a full hedonic model of intercity location incorporating both land and labor markets which must clear simultaneously. She concludes that both land rents and wages are affected by location specific amenities and empirically finds that amenity differences largely explain regional wage differentials.

Since Roback's initial work on this model both she and several other authors have expanded the model's reach. Roback (1988) relaxes the original assumption of identical workers and evaluates relative population sizes in addition to rent-amenity and wage-amenity gradients. Introducing different types of workers leads her to two additional theoretical implications. Assuming that the workers are complementary inputs, she shows that the wages of one type of worker are dependent on the preferences of the other type. The tastes of one type of worker affect their wages, which in turn affects the costs of production, and thus acts as a constraint on the wages the firm can offer the other type of worker. Her results also indicate that including the cost of living in regional earnings differentials increases the size of the differences. This is in contrast to the conventional wisdom that wage differentials exist to equalize utility in the face of variations in the cost of living from one city to another. Her model shows that both wage differences and rent differences (usually of opposite signs) result from differences in amenities across locations. Since differences in rents account for a large part of cost of living differences, she concludes that cost of living differences are part of the equalizing difference paid for amenities.

The issue of heterogeneous workers in the context of this model is also addressed by Beeson (1991) who examines regional differences in the structure of wages based on regional differences in the supply of worker characteristics. She finds that if a worker characteristic affects the value of amenities relative to land consumption, the return to that characteristic in the form of wages may vary across locations. So, to use her example, if the value of the amenities increases less than land consumption with increases in years of schooling, educated workers pay more than their valuation for the area's amenities in the form of land rents. Thus, their wages must be higher in high amenity areas. The opposite holds for less educated workers (p. 230).

Beeson and Eberts (1989) extend Roback's model to include housing production and a local non-traded goods sector. They illustrate that empirical estimates without these additions will potentially be biased. Beeson and Eberts also attempt to determine the relative size of the amenity and productivity components of the intercity wage differentials. They conclude that, on average, productivity differences account for a larger portion of the total wage differential, but that the relative importance varies from city to city.

Several authors have reformulated the Roback model to incorporate intraregional variation. Each correctly argues that wrong conclusions regarding the relationship between rents, wages, and amenities may be obtained if one ignores intraregional variation in local attributes.

Hoehn, Berger and Blomquist (1987) develop and estimate the first of these extensions of Roback's model. These authors criticize the Roback model since it ignores intraurban commuting costs that could potentially play a compensating role. Henderson (1982) asserts that such costs tend to cancel out the intercity housing price effect. Hoehn *et al.* (1987) develop and estimate a model that incorporates commuting costs based on distance from a central business district (CBD). The basic predictions of the model are not fundamentally changed by this addition; however, the authors are able to show that city size is positively related to amenities (and negatively related to disamenities).

Blomquist, Berger and Hoehn (1988) (hereafter BBH) develop a model in which they allow amenities to vary not only between metropolitan areas, but also within a single urban area. They envision a world in which individual location decisions are between counties rather than MSAs (which are collections of counties). Amenities vary from county to county, while agglomeration economies for firms are reflected in total MSA size.

BBH make two strong, and potentially troubling, assumptions. First, they assume no relationship between wages in adjacent counties, and further that there is no commuting across county lines. Given the way in which MSAs are defined, these assumptions seem overly restrictive.[2] Intercounty commuting (at least at the margin) should lead to equalization of wages within the MSA (thought to be a unified labor market). The assumed mobility of households, should, at the

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2 Generally, a metropolitan area is defined as "a core area containing a large population nucleus, together with adjacent communities having a high degree of economic and social integration with the core." An MSA is composed of "the county that contains the largest city...along with any adjacent counties that have at least 50 percent of their population in the urbanized area surrounding the largest city [and] additional 'outlying counties'...if they meet specified requirements of commuting to the central counties and other selected requirements of metropolitan character...." (U.S. Bureau of the Census, 1998)

very least, result in some correlation of wages between the counties. Given BBH's assumptions, the only thing tying the counties in the MSA together is agglomeration economies.

BBH's second assumption is that all firms, regardless of their location, receive the same benefit (agglomeration economies) from MSA growth. Although not impossible, it seems unlikely that a firm located in a peripheral county would reap the exact same cost savings from an increase in MSA population as a firm located near the core. Their results imply that the sign of the wage differential depends on the sign of the agglomeration effect. In general, even for a consumption amenity, they do not find a negative wage and positive land rent differential. The incorporation of agglomeration effects introduces an additional source of ambiguity.

Voith (1991) develops a model of compensating variation that incorporates both local and regional attributes and distinguishes between the type of community (residential, commercial, or mixed-use). He argues that the effect of locational characteristics on wages and rents should vary depending on whether households, firms or both are present. His theory and empirical results suggest that in mixed-use communities rents negatively effect equilibrium wages, but not in residential localities. Higher wages result in higher rents in all locations.

The authors whose work we have discussed thus far have all been concerned solely with "pure" amenities, that is, amenities that are not produced, but exist freely in nature. As stated above, the present paper is interested in locally produced public goods which are analogous to amenities that are produced (and paid for) by local residents (or the government). In a series of articles, Gyourko and Tracy (1989a, 1989b, 1989c, 1991) (hereafter G&T) have extended Roback's model to the case of differences in local fiscal conditions, represented by tax rates and publicly produced goods. G&T find that differences in local tax rates and public services generate compensating wage and rent differentials just as pure amenities do and affect the quality of life across metropolitan regions. G&T (1989b, 1989c) relax the implicit assumption that all locational rents are capitalized into land rents and private-sector wages, allowing for rent seeking by public-sector unions. Such behavior can give rise to explicit tax prices even for pure amenities; thus, some of the amenity's value is reflected in the increased tax burden necessary to finance the union wage premium. They report evidence of lower land rents in cities where local public sector employees earn substantially higher wages than similar employees in other cities do.

Two other recent papers have considered the relationship between local government structure and urban residential location. Sasaki (1991) constructs a model of provision and finance of local public goods in a model with interjurisdictional commuting. Sasaki discusses conditions leading to Pareto-efficient location, production and commuting. His model lacks the intermetropolitan choice component of model below. Crampton (1996) develops a two jurisdiction model in which the level of local public services and property tax rates can be used by municipal governments as strategic variables to, for example, attract wealthier residents or maximize property values. This is in the same thread as Hoyt (1992) who discusses the ability of central cities to affect suburban land rents in a game theoretic model.

The model presented in the following section further augments the Roback model along the lines of G&T considering issues raised by several other recent authors. We develop a model in which there are two political jurisdictions (a central city and a suburb) which differ in their local fiscal conditions. The jurisdictions form a single labor market with (costless) commuting from suburb to central city. The model shows that central city fiscal policies affect not only city land rents, but also suburban rents through the shared labor market. The theoretical framework also permits the examination of the affects of different types of taxes and of various local income redistribution programs.

3.0 THE EFFECTS OF LOCAL FISCAL CONDITIONS ON THE RELATIONSHIP BETWEEN A CENTRAL CITY AND ITS SUBURB: A THEORETICAL ANALYSIS OF WAGES AND LAND RENTS

This chapter presents an equilibrium model of inter- and intra-urban location, building on the work of Roback (1980, 1982) and Gyourko and Tracy (1989a, 1989b, 1989c, 1991). The model allows one to examine the effects of varying local fiscal conditions on central city and suburban rents and wages and can be used to analyze both the effects of different fiscal policies (e.g., subsidies to firms or households) and the impact of different tax structures on city and suburban residents.

3.1 Simple Model without Suburb

We will begin by discussing the simple form of this model, consisting of only one political jurisdiction, which has been examined previously (in a slightly different form) by Roback (1980, 1982) and Gyourko and Tracy (1989a).[1] The detailed exposition of the single jurisdiction form of the model and its comparative static results will provide two benefits: (1) a good introduction to the workings of this model before adding the relative complexities brought on by multiple political jurisdictions, and (2) a benchmark against which we can compare the results obtained when we do add the suburb in Section 3.2 below. Three types of taxes are considered in this analysis, a per

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1 The exposition presented below follows closely that of Roback (1980).

capita tax of t_H on households and t_F per unit of output on firms, a property tax of t_r^H percent on the value of land used for housing and t_r^F percent of the value of land used in production, and a wage tax of t_w percent of the wages paid by firms. The derivations presented below are for the lump-sum tax only; the other cases, which lead to very similar results, are presented in APPENDIX 1. It should also be noted that the public good analyzed in these models does not have the non-rival characteristic of a pure public good. It is instead a publicly provided private good in that there is a tax cost associated with providing the public service to additional households.

In this model, each identical household supplies a single unit of labor, independent of the wage rate. Given a level of taxes (t_H) and public goods provision (g), each household maximizes utility by choosing a quantity of X (the composite consumption commodity) and h (residential land consumed) subject to a budget constraint:

$$\max \; U\left(X, h; t_H, g\right) \quad s.t. \quad w - I = X - hr \tag{1}$$

where w is the wage rate, r is the land rental rate, t_H is a lump-sum tax on households, and g is a public good. (There is no housing production in the model). Non-labor income (I) is assumed to be independent of location and is thus suppressed in the following analysis.[2] Each of the other variables may vary from one city to another; however, they are constant within a particular city.

Households move (costlessly) to cities that provide a higher level of utility than their current location. In equilibrium, wages and rents must adjust to equalize utility in all occupied locations; otherwise, some workers would have an incentive to move. Thus, the market equilibrium condition for households can be expressed as

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2 We are implicitly assuming that all land is either (1) owned by an absentee landlord, or (2) that each person owns an equal share of land in all cities, regardless of his or her own location. As Roback (1980) points out, under the latter assumption migration patterns will certainly influence the overall level of I, however, individuals can be assumed to ignore their own effect on rents and hence rental income is independent of location.

$$V = V(w, r; t_H, g) = k \qquad (2)$$

where k is some constant level of utility.

The indirect utility function, V, is decreasing in prices (r) and increasing in income (w) and the level of public goods (g). Roy's Identity implies that $V_r / V_w = -h$. We define $P_g = V_g / V_w$ to be the marginal valuation of the public good in terms of money.

The consumption good X is produced according to a constant returns to scale production function, $X = f(L_P, N; t_F, g)$, where L_P is land used in production, N is the total number of workers in the city, and t_F represents a tax per unit of output.[3] All firms are assumed to be identical. The representative firm will minimize costs subject to the production function. The equilibrium condition for firms (equation (3)) is that unit costs equal product price; otherwise, firms would have an incentive to move their capital to more profitable cities. For simplicity, we assume price is equal to unity.

$$C = C(w, r, t_F, g) = 1 \qquad (3)$$

The unit cost function is increasing in both factor prices. If the public good provides some benefit to firms (cost savings), then C_g is negative. As usual, $C_w = N/X$ and $C_r = L_P/X$.

Totally differentiating (2) and (3), we can solve for the land rent and wage differentials which are given by equations (4) and (5), where L_H is land used by households, L_P is land used in production, L $(= L_H + L_P)$ is the (exogenous) total land area of the city, N is population, X is output of the firms, h is land used in one unit of housing, P_g $(= V_g / V_w)$ is the implicit value to households of the public good, and C_g is the cost savings to firms from the public good.

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[3] Capital is assumed to be perfectly mobile and is uninfluenced by public goods; thus, its after tax rate of return will be equal in all places. Hence, the capital input can be assumed to be optimized out of the problem (Roback 1980). The same assumption about the ownership of land applies to the ownership of capital.

$$\frac{dr}{dg} = \frac{-l}{L}\left[N\left(\frac{dt_H}{dg} - P_g\right) - X\left(\frac{dt_F}{dg} - C_g\right)\right] \tag{4}$$

$$\frac{dw}{dg} = \frac{hL_p}{L}\left[\frac{N}{L_H}\left(\frac{dt_H}{dg} - P_g\right) - \frac{X}{L_p}\left(\frac{dt_F}{dg} - C_g\right)\right] \tag{5}$$

We will call a local government "efficient" if the sum of the marginal benefits received from the public good just equals its marginal cost (as reflected in the sum of the marginal taxes collected to finance production of that public good). Thus, an "efficient" government involves three assumptions: (1) the government is producing the optimal amount of the public good (allocative efficiency), (2) the government is using the least cost production method (productive efficiency), and (3) taxes accurately reflect production costs. In the simple model, equation (6) must hold for an efficient government.

$$NP_g - XC_g = N\frac{dt_H}{dg} - X\frac{dt_F}{dg} \tag{6}$$

It is clear from equation (4) that land rents do not change as long as the local government is efficient, that is, the sum of the marginal benefits of the public good equals the marginal cost. When marginal costs exceed the sum of the marginal benefits we say that the government is inefficient. Such a condition could arise due to production inefficiency or rent-seeking by public sector unions or elected officials (see Gyourko and Tracy 1989b, 1989c, 1991). In this case, the higher taxes paid to finance the union wage premium would be capitalized into lower land values and higher wages.

If the local government is not efficient, then both land rents and wages must adjust to account for the inefficiency. For example, consider the case where the taxes paid by households exceed the value of the public good (i.e., $dt_H/dg > P_g > 0$). Further, assume that firms receive no benefits and pay no taxes (i.e., $C_g = dt_F/dg = 0$). From equations (4) and (5) it is easy to see that $dr/dg < 0$ and $dw/dg > 0$. Thus, if the public good provides benefits to households, yet the value they receive is less than the tax revenue, land rents will fall and wages will rise. In the case of firms receiving the benefit from the public good from an inefficient provider, both rents and wages will fall.

By combining equations (4) and (6), it is straight forward to confirm, as was stated above, that any change in the level of public goods provision that is paid for with an equivalent increase in taxes will cause no change in land rents, regardless of who receives the benefits of the public good and who pays the tax. Furthermore, using equations (5) and (6), notice that if the added tax burden falls entirely on the group benefiting from the public good (e.g. $P_g = dt_H/dg$), there will be no change in equilibrium wages. If however, the taxes of one group are used to subsidize the provision of a benefit for the other group (e.g. $-C_g = dt_H/dg$ and $P_g = dt_F/dg = 0$), wages (but not rents) will adjust to keep utility constant across cities. Thus, if households are paying for a public good that benefits firms, then wages will rise, while if the taxes of firms are used to subsidize households, wages will fall. We will refer to such situations as "cross subsidization."

Changes in equilibrium wages and rents occur as households and firms move to more desirable locations. APPENDIX 2 presents the comparative statics for population (N) and output (X). Population and production respond to changes in the relative wage. We expect to see population and production fall when the relative wage rises. Thus, we expect to see larger populations and more production in locations that provide extra benefits to households.

Recall that we have assumed costless mobility of households and firms in our model. Clearly, our results depend on this mobility. Costly movement would lessen the degree of adjustment discussed above. If our agents were immobile, there would be no equilibrium adjustmnet possible.

Although this model consists of only two groups (households and firms), the results easily generalize to situations in which there are multiple types of households and/or multiple types of firms (see Roback (1988) and Beeson (1991)). Specifically, we would expect cross subsidization (one group paying for benefits that accrue to another) to result in equilibrium wage rate adjustments but not in land rent changes as long as the efficient government condition holds.

3.2 Model with Suburb

In the model discussed above, households and firms choose to locate in one metropolitan area over another based on the public goods and tax mix associated with that city. However, in the real world, households and firms do not simply choose to locate in one urban area or another, but also choose a location (or political jurisdiction) within a metropolitan area. It is quite likely that households would choose to live in one jurisdiction (because they value the fiscal mix, amenities, land rents, etc.) while choosing to work in another (perhaps because of higher wages).[4] While tax rates and the availability of public goods may vary from one municipality to another, wage rates are expected to be the same throughout a metro area since commuting across political boundaries allows us to consider this as one labor market. (For information on intraurban wage gradients see for example McMillen and Singell (1992)).

There are two potential links between central city fiscal conditions and suburban land rents (and utility). The first, which we will refer to as the wage effect, arises because of the common labor market assumption (which implies that all workers receive the same wage whether they live in the city or the suburb). Whenever a change in central city taxes or public goods provision leads to an adjustment in the gross wage paid to city residents, suburban residents will be affected since their gross wage must change as well. This wage change may lead to additional suburban rent

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[4] Blomquist, Berger, and Hoehn (1987), using 1980 Census data report that 19 percent of people who live in urban counties work in a different county. If we look at smaller political jurisdictions, this percentage would be significantly larger.

adjustments in equilibrium. The second linkage, the externality effect, results because suburbanites may receive benefits (or costs) from public goods produced in the city. A particular public good provided with taxes collected from city residents may provide significant benefits to those living outside of the city. Likewise it is possible that suburban residents help finance (through a wage tax) a public good from which they receive little or no benefit. Such situations will lead to suburban rent and/or wage adjustments in equilibrium. (In this section, we will consider public goods from which the suburban residents receive no benefit, thus eliminating the positive externality effect. APPENDIX 3 presents the results allowing for such an externality.)

The model considered in this section adds a suburban housing market to the model developed above. All firms (and thus employment) are constrained to center city locations. Suburban residents are assumed to receive the same gross wage rate as city residents, that is, firms are assumed to be unable to discriminate based on employee residence. The suburb has land rents, tax rates, and public goods that are distinct from those in the city. Additionally, it is possible to consider both cases in which suburban residents receive some benefit from public goods provided in the city such as a baseball stadium or a highway (see APPENDIX 3) and in which suburbanites are required to share the tax burden for such public goods provided by the city government through a wage tax on all those working in the city regardless of residence (see SECTION 3.3).

We consider four different types of taxes used by the central city: a tax of t_c^H per household and t_c^F per unit of output on firms, a property tax with tax rate t_{rc}^H on residential land and t_{rc}^F on commercial land, a wage tax of rate t_{wc} paid by anyone who works in the city (type I, also known as a commuter wage tax), and a wage tax paid only by city residents (type II). In this section, we will derive comparative statics results for the per capita/per unit of output tax case. Complete comparative statics for the property tax (which is very similar to this case) can be found in APPENDIX 4. The two wage taxes are handled separately in SECTION 3.3, below.

Just as in the single jurisdiction model, each identical household supplies a single unit of labor independent of the wage rate. Households maximize utility, given a level of taxes and public goods provision. Equations (7) and (8) present the maximization problems for city and suburban residents, respectively. (Where *c* subscripts indicate city-specific variables and *s* subscripts represent suburb-specific variables). Notice that the suburban utility function differs from that of the city residents in that it allows for the possibility of suburbanites receiving utility from both city and suburban public goods.

$$\max U_s\left(X, h_s ; t_s^H, g_s, g_c\right) s.t.\, w - I = X - r_s h_s \tag{7}$$

$$\max U_c\left(X, h_c ; t_c^H, g_c\right) s.t.\, w - I = X - r_c h_c \tag{8}$$

We will again assume that non-labor income (I) is independent of location and can therefore be ignored in the analysis that follows. Households will move to locations (either another MSA or a different jurisdiction within an MSA) that provide higher levels of utility, so, in equilibrium, wages and rents must adjust so that utility is equalized in all occupied locations. Thus, the household market equilibrium conditions are given in equations (9) and (10) for city and suburban households, respectively. The indirect utility functions, V_c and V_s, have all of the usual properties as stated in SECTION 3.1, above.

$$V_s = V_s\left(w, r_s, t_s^H, g_s, g_c\right) = k\ ) \tag{9}$$

$$V_c = V_c\left(w, r_c, t_c^H, g_c\right) = k\ ) \tag{10}$$

Production of the consumption good takes place just as in the single jurisdiction model. thus, the equilibrium condition for firms is simply that unit costs be equal to price (assumed to be unity). This is presented in equation (11).

$$C = C\left(w, r_c; t_c^F, g_c\right) = 1 \tag{11}$$

Totally differentiating (9) and (11) and rearranging, we can solve for the equilibrium city land rent differential ($dr_c\,dg_c$) which is presented in equation (12).

$$\frac{dr_c}{dg_c} = \frac{-1}{L_H - N_s h_c - L_p}\left[\left(N_s - N_c\right)\left(\frac{dt_c^H}{dg_c} - P_{gc}^c\right) - X\left(\frac{dt_c^F}{dg_c} - C_{gc}\right)\right] \tag{12}$$

where N_s and N_c are the populations of the suburb and city respectively, L_H is land used for housing in the city, L_p is land used for production (in the city), and all other variables are as defined previously.

From equation (12), one can see that, unlike in the single jurisdiction model, in many cases city land rents will change even if the city government is efficient. Let us again consider a city government to be "efficient" if the sum of the marginal benefits from a public good is equal to the associated marginal costs.[5] Generally,

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5 Note that this is the definition of efficiency from the perspective of the city government. It considers only the benefits received and costs incurred by city residents and firms. In this model, one could also define efficiency from the perspective of a "social planner," specifically,

$$N_c P_{gc}^c - N_s P_{gc}^s - XC_{gc} = N_c \frac{dt_c^H}{dg_c} - X\frac{dt_c^F}{dg_c}$$

$$N_c P^c_{gc} - XC_{gc} = N_c \frac{dt^H_c}{dg_c} - X \frac{dt^F_c}{dg_c} \quad \textbf{(13)}$$

Obviously, there are some public goods provided in the city which provide little or no benefit to suburbanites (e.g., trash pickup or street sweeping), while other public goods, so called "regional assets," may provide as much benefit to those living near the city as to the city residents themselves (e.g. baseball stadiums or highways). In this section of the paper, we consider only cases in which suburban residents receive no benefit from the public good. All other cases are discussed in APPENDIX 3.

Using equations (13) and (12), we can find the city land rent differential for an efficient government, presented in equation (14).

$$\frac{dr_c}{dg_c} = \frac{-1}{L_H - N_s h_c - L_p}\left[N_s \left(\frac{dt^H_c}{dg_c} - P^c_{gc} \right) \right] \quad \textbf{(14)}$$

It should be clear that, unlike in the single jurisdiction model above (SECTION 3.1), even the efficient provision of a public good will almost always lead to equilibrium land rent adjustments. This will not be true only if there is no cross subsidization (households to firms or firms to households). When g^c (the level of public services) increases in all other cases, city land rents fall even when the public good is being efficiently provided. Intuitively, we expect to see wages rise any time city households are paying more in taxes than they receive in benefits from the public good

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This alternative definition includes the external benefit received by suburban residents as part of the marginal benefit of the public good. The analysis to follow has been completed using both definitions of efficiency. Although the results are not identical, they primarily differ only in magnitude not in direction.

(and when firms receive more benefits than for which they are paying). Since wage discrimination based on residence is not possible, increases in (gross) wages serve to make the suburb more attractive. As households move from the city to the suburb, city rents would fall and suburban rents would rise, offsetting the wage increase that is also enjoyed by the suburbanites. To keep utility constant between the two jurisdictions, city rents must fall and/or wages of city residents must rise. This scenario can be verified by calculating the wage and suburban land rent differentials.

Equations (15) and (16) represent the wage and suburban land rent differentials, respectively, still assuming an efficient city government.

$$\frac{dw}{dg_c} = \frac{L_H - L_P}{L_H - N_s h_c - L_P}\left[\frac{dt_c^H}{dg_c} - P_{gc}^c\right] \tag{15}$$

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}\left(\frac{L_H - L_P}{L_H - N_s h_c - L_P}\right)\left[\frac{dt_c^H}{dg_c} - P_{gc}^c\right] \tag{16}$$

The above equations reveal that if there is no cross subsidization between households and firms (i.e., $dt_c^H\ dg_c = P_{gc}^c$), there will be no changes in city rents, wages or suburban rents, just as in the single jurisdiction model presented above. In this case, there is no wage effect because without cross subsidization there is no pressure on the wages of city residents. Likewise, there is no externality effect because the suburbanites are not receiving any benefit (or paying any costs) from the public good. If we relax either of these conditions, this result no longer holds.

Let us examine the effects of cross subsidization, while maintaining the restriction that suburban residents gain nothing from the public good. Looking at equations (14), (15) and (16), if the taxes paid by city households are used to finance a public good which benefits firms (which implies that $dt_c^H\ dg_c > P_{gc}^c$), the wages of city residents must rise to keep utility constant. However, the higher wages also benefit the suburbanites, making the suburbs more attractive. As people move from the city to the suburb, suburban land rents rise (decreasing the attractiveness of the suburb) and city land rents fall (increasing the attractiveness of the city). Thus a new equilibrium will be reached with higher wages and suburban land rents and lower city land rents. From APPENDIX 2, we can verify that such an increase in the relative wage will lead to lower population and production in the central city.

On the other hand, if the taxes paid by firms are used to produce a public good which benefits city households (i.e., $dt_c^H \, dg_c < P_{gc}^c$), wages fall (because firms are in effect paying for a public good in lieu of wages), making the suburb a less desirable location (because in the suburb you do not receive the benefit of the public good, but you do receive the lower wage). As the metro population shifts from suburb to city, suburban rents fall and city rents rise, until a new equilibrium is reached. Thus the city's relative wage will fall leading to increases in central city population and production. This seems to have the interesting policy prescription that in order to grow the city, public goods which benefit households should be provided while firms should be taxed to pay for them.

3.3. EFFECT OF THE WAGE TAX

The above comparative statics results hold without modification for the property tax (see APPENDIX 4). The property tax is very similar to the per capita/per unit of output tax in that it is paid by both households and firms in the city. It differs in that it distorts the relevant price of land, potentially changing the agent's consumption decisions. The wage taxes likewise distort the price of labor. The wage taxes differ, however, in that both residents and non-residents of the city may pay them. In this section, we will consider the two types of wage tax in greater detail. We will refer to a wage tax paid by both residents and non-residents as a Type I wage tax, while one paid only by city residents will be termed a Type II wage tax.

Equations (17) and (18) present the city and suburban household equilibrium conditions, respectively, for the Type I wage tax. Equation (19) is the firm's equilibrium condition, where $w^* = (1-t_{wc})w$ (the gross wage). [For the Type II wage tax, w^* replaces w in the suburban equilibrium condition.]

$$V_c = V_c(w, r_c; g_c) = k \quad (17)$$

$$V_s = V_s(w, r_s; g_s, g_c) = k \quad (18)$$

$$C = C(w^*, r_c; g_c) = 1 \quad (19)$$

Totally differentiating (17) and (19) and rearranging, we can solve for the central city land rent differential, (20).

$$\frac{dr_c}{dg_c} = \frac{-1}{(1-t_w)(L_H - N_s h_c) - L_P}\left[(N_s - N_c)\left(w\frac{dt_w}{dg_c} - P_{gc}^{c*}\right) - X C_{gc}\right] \quad (20)$$

where P_{gc}^* ($=(1-t_{wc})P_{gc}$) is the implicit value of the public good evaluated in pre-tax dollars. [Equation (20) applies to either type of wage tax.]

We will again assume that the city government is "efficient" (as defined in SECTION 3.2) and restrict our discussion to situations in which suburban residents do not benefit from the public good. (Note that for the Type I wage tax, this does not eliminate externality effects since the suburbanites face an external cost (the tax) from the central city public good). We can now solve for the city and suburban land rent differentials and the gross and net wage differentials for both types of wage tax. These are presented in equations (21) through (24) for the Type I wage tax and (25) through (28) for the Type II wage tax. (See following page)

We will first consider the case in which (only) city households reap the benefits from the public good (i.e., $P_{gc}^{c} > 0$, $C_{gc} = 0$). For the Type I wage tax, city residents are thus receiving benefits which are being partially paid for by the suburban residents: this increases the relative attractiveness of the city. The net wage falls to offset the benefits received by city residents: this too makes the suburb less attractive to households. As people move into the city, the city land rents rise and the suburban land rents fall. As city land rents rise, the gross wage must fall to keep unit costs constant for firms. Thus we expect central city production and population to increase.

$$\frac{dr_c}{dg_c} = \frac{-1}{(1-t_w)(L_H - N_s h_c) - L_p}[-N_s P_{gc}^{c*}] \tag{21}$$

$$\frac{dr_c}{dg_c} = \frac{-1}{(1-t_w)(L_H - N_s h_c) - L_p}\left[-N_s\left(w\frac{dt_w}{dg_c} - P_{gc}^{c*}\right)\right] \tag{22}$$

$$\frac{dw}{dg_c} = \frac{(1-t_w)L_H - L_p}{(1-t_w)(L_H - N_s h_c) - L_p}[-P_{gc}^{c}] \tag{23}$$

$$\frac{dw^*}{dg_c} = \frac{(1-t_w)L_H - L_p}{(1-t_w)(L_H - N_s h_c) - L_p}\left[\left(\frac{(1-t_w)(L_H - N_s h_c) - L_p}{(1-t_w)L_H - L_p}\right)w\frac{dt_w}{dg_c} - P_{gc}^{c*}\right] \tag{24}$$

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}\left(\frac{(1-t_w)L_H - L_p}{(1-t_w)(L_H - N_s h_c) - L_p}\right)(-P_{gc}^{c}) \tag{25}$$

$$\frac{dw}{dg_c} = \frac{-1}{(1-t_w)(L_H - N_s h_c) - L_p}\left[N_s h_c w \frac{dt_w}{dg_c} - ((1-t_w)L_H - L_p)P^c_{gc}\right] \quad \textbf{(26)}$$

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}\left(\frac{(1-t_w)L_H - L_p}{(1-t_w)(L_H - N_s h_c) - L_p}\right)\left(w\frac{dt_w}{dg_c} - P^{c*}_{gc}\right) \quad \textbf{(27)}$$

$$\frac{dw^*}{dg_c} = \frac{(1-t_w)L_H - L_p}{(1-t_w)(L_H - N_s h_c) - L_p}\left[w\frac{dt_w}{dg_c} - P^{c*}_{gc}\right] \quad \textbf{(28)}$$

In the same situation for the Type II wage tax, on the other hand, the wage of city residents (w) falls because they are receiving some public good in lieu of part of the gross wage; however, there are no changes elsewhere because the utility gained from consuming the public good has just been offset by the decrease in utility caused by the decline in w. Thus, there is no incentive for households to move.

We can now repeat our analysis for the situations in which (only) firms benefit from the public good (i.e., $P_{gc}^c = 0$, $C_{gc} < 0$). For the Type I wage tax, firms pay for the benefits they receive through an increase in the gross wage they must pay their workers. The gross wage adjusts such that the net wage (and thus worker utility) is unchanged; thus, there is no further change in land rents.

For the Type II wage tax, again the gross wage (w*) rises to offset the tax paid by city residents; however, this makes the suburbs (where you do not pay the tax) more attractive. As households move to the suburb, city rents fall and suburban rents rise. This decrease in city land rents also acts to offset some of the tax paid by households, thus the gross wage does not increase enough to leave the net wage of city dwellers unchanged (it will decrease).

This analysis seems to indicate that central cities which are able to impose a Type I wage tax (paid by all who work in the city) to finance public good provision will experience more in-migration of households and higher land rents compared to those using a Type II tax (paid only by city residents). If the Type II tax is used to produce a public good from which suburban residents receive some benefit, then the suburbs actually become a more attractive place to live. Out-migration will shrink the central city's tax base, potentially necessitating higher central city tax rates, thus exacerbating the problem. A central city can also expect to see out-migration when firms benefit from a public good paid for through a Type II wage tax since the resulting increase in the gross wage will lure households to the suburbs.

3.4 Summary and Empirical Implications

This chapter presents an equilibrium model of inter- and intra-urban location in which households and firms choose locations based on wages, land rents, and local fiscal conditions. Each urban area consists of two political jurisdictions (a "city" and a "suburb") which form a common labor market yet have distinct rents, tax rates, and levels of public services. The model is used to analyze the effects of four different tax instruments and the impact of cross subsidization (one group paying for benefits that accrue to another).

The model illustrates that even when the central city government is providing the public good efficiently (i.e., the sum of the marginal benefits equals the marginal cost), equilibrium land rent and wage adjustments will occur (this is in sharp contrast to the single-jurisdiction model analyzed by Gyourko and Tracy (1989a) and others). This results because of the two potential links between a central city and its suburb. The wage effect arises because of the common labor market assumption. Whenever a change in city taxes or public goods provision leads to an adjustment in the gross wage paid to city residents, suburban residents will be affected since their gross wage will change as well. (Remember that firms pay the same wage to all employees regardless of residence). This wage change may lead to additional adjustments in equilibrium. The externality effect results because suburbanites may receive benefits (or costs) from public goods produced in the city. A particular public good provided with taxes collected from city residents may provide significant benefits to those living outside of the city. Likewise, it is possible that suburban residents help finance (through a commuter wage tax) a public good from which they receive little or no benefit. Such situations will lead to suburban rent and/or wage adjustments in equilibrium.

This analysis shows that, given our assumptions, there is virtually no difference in the effects of a lump-sum tax or a property tax; however, the two wage taxes considered (one paid by all those who work in the city and one paid by city residents only) differ substantially. Cities which tax the wages of suburban residents will see much less out-migration and experience higher city land values than those that can tax only city residents' wages.

The model also shows that the mix of public goods (i.e., whether they benefit households or firms) as well as who bears the burden of financing them has implications regarding land values and shifts in relative population and production. Consider the case in which the taxes paid by city households are used to finance a public good that benefits firms. The wages of city residents would rise to keep utility constant; however, this wage increase would benefit suburban residents as well. Thus the suburb has become the more attractive location for households. To regain equilibrium, suburban population would increase (increasing suburban land rents), and city population would decrease (lowering city land rents). The opposite effect is expected when firms subsidize a public good that benefits households.

The model has several interesting empirical implications. Most notably, it implies that tax structures can affect suburban growth and urban decline. For example, metropolitan areas more dependent on resident wage taxes may experience more severe urban decline than areas that rely on other types of taxes. Similarly, the mix of public goods and the relative tax burdens faced by households and firms could also matter. The model predicts very little difference between property and per capita taxes, but does indicate different effects for the two wage taxes. We would expect to find that cities imposing a Type I wage tax (paid by all those working in the city) would see more population and production growth (both in the central city and in the MSA) than similar cities taxing only city residents. On the contrary, in these MSAs you would expect to see more growth (or at least higher land rents) in the suburbs.

Similarly, the effects of the mix of public goods and the relative tax burdens faced by households and firms could also be explored empirically. The model predicts more population and production if a city's fiscal conditions tend to lower the relative wage. As discussed above, lower relative wages are expected when central cities provide public goods that benefit households and tax firms to pay for them.

4.0 THE EFFECTS OF CENTRAL CITY FISCAL CONDITIONS ON SUBURBAN LAND RENT[1] AND HOUSING MARKETS

This chapter empirically examines the relationship between central city fiscal conditions and suburban land rents. The theoretical model presented in CHAPTER 3 suggests some ways in which a central city's fiscal policy may affect its suburbs. For example, since a central city and its suburbs form a common labor market, policies that affect wages will also affect the utility of suburban residents, and hence, may affect population and land rents. There may also be fiscal spillovers from the central city to its suburbs. But there are ways in which central city fiscal conditions may affect suburbs that are not captured in the model presented in CHAPTER 3. For example, an increase in the average cost of public services caused by a decline of the central city tax bade will make the suburbs more attractive, increasing population and land rents in the suburbs. The empirical analysis in this chapter does not attempt to discriminate between the many different ways in which central city fiscal policies and suburban populations and land rents are linked. Rather, the goal of this chapter is to see whether such a relationship exists. Such a relationship, if documented empirically, should be considered when analyzing urban public policy. By considering both the internal and external effects of their taxing and spending behavior, municipalities can potentially predict more accurately the impacts of their policies and implement more effective economic development programs.

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1 Throughout this chapter we will use the terms "land rent" and "land value" interchangeably. In all cases we are referring to the value of owner-occupied homes.

A cross section of data collected at the Census block level from 1990 for 28 MSAs located in the northeastern and midwestern U.S. is used to estimate land rent equations that incorporate various measures of local fiscal conditions. We find that central city tax levels have significant and positive impacts on suburban land rents. We also find that city spending on certain public goods that seem to have no external benefits (that is, they benefit only city residents) also has a significant effect on land rents in the suburbs. The following section provides a description of the empirical model and estimation plan. Section 4.2 describes the data set in detail. The estimation results are discussed in Sections 4.3 and 4.4, while the final section concludes the chapter with a summary of our findings and suggestions for additional research.

4.1 The Model

Land rent in a particular location clearly depends both on the characteristics of the property and any improvements (buildings) on that property. Rosen (1979) and others have illustrated empirically that the value of the characteristics of the general location (for example weather conditions, access to employment or shopping, etc.), which are generically referred to as amenities, are also capitalized into local land rents. That is, people are willing to pay more for property in a location that enjoys positive amenities (good weather) and will pay less for land burdened by some disamenity (high pollution levels). Other researchers (most notably Gyourko and Tracy, 1989, 1991) have shown that local public services and local tax rates act as additional amenities produced by the local government, and therefore, also affect local land rent and wages. Our purpose is to determine whether the impact of such produced amenities is limited by political boundaries, or whether the local public services and tax rates of one municipality can affect the land rents experienced in a neighboring municipality.

Given the discussion of the preceding paragraph, most generally,

$$\textit{Land Rent} = f(\textit{Housing Characteristics; Local Amenities; Fiscal Conditions}) \tag{29}$$

The theoretical model presented in CHAPTER 3 suggests that suburban land rents will be affected by not only the fiscal conditions of their own municipality but also those of the neighboring central city. Recall that central city fiscal conditions may have some effect both because of external benefits or costs received by suburban residents and because of the labor market impacts of central city taxing and spending behavior. (See CHAPTER 3, Section 3 for more detail) Accounting for this,

$$\textit{Suburban Land Rent} = f(\textit{Housing Characteristics; Local Amenities; Suburban Fiscal Conditions; CC Fiscal Conditions}) \tag{30}$$

We expect suburban and central city tax and spending variables to have opposite signs. So for example, a central city tax affecting households, controlling for the level of public services, will make the city a relatively less desirable location, thus leading to higher suburban and lower city land rents. A suburban municipality's taxes, on the other hand, should be capitalized into lower land values in that municipality.

$$lnRENT^{s}_{bjm} = \gamma_1 H_{bjm} + \gamma_2 G^{c}_{m} + \gamma_3 G^{s}_{jm} + \gamma_4 L_{jm} + \gamma_5 A_m + \xi_{bjm} \tag{31}$$

Equation (31) presents the rent equation to be estimated, where *b*, *j*, and *m* index the Census block, jurisdiction (municipality), and MSA, respectively, and *s* and *c* superscripts likewise indicate suburban and city variables. H_{bjm} is a vector of housing characteristics, G^{s}_{jm} is a vector of fiscal characteristics for the local (suburban) jurisdiction, G^{c}_{m} is a vector of fiscal characteristics for the central city, L_{jm} is a set of state location dummies, and A_m is a vector of amenities.

In our estimating equations, we include various measures of the level of housing services and of housing quality typically seen in the literature. Such measures include percent of housing stock built last year, median year built, the number of rooms and bedrooms, percent with no plumbing, percent vacant in block, and distance from the central city.

Fiscal characteristics for both the city and suburb include both measures of taxes collected and expenditures made.[2] Many of the expenditure categories could potentially suffer from simultaneity problems. For example, high police expenditures would be seen in cities with high crime rates, thus police spending could be proxying crime (a disamenity). Since a full set of controls for each category is not available, we will run the regressions both with and without the expenditure variables.

Finally, we include various amenities, such as measures of weather conditions (cooling and heating degree days), availability of cultural and recreational opportunities, MSA growth, and the local crime rate. A complete list of variables and variable definitions is included in APPENDIX 5, TABLE A1.

In addition to utilizing the entire data set, we estimate our models for several different sub-samples of the data. Since labor market interactions form an important link between suburb and city in our theoretical model, we empirically consider a sub-set of suburbs which are relatively close to the central city since given their proximity they may be more closely tied to the central city. In addition to providing better access, these suburbs may differ in other important aspects (for a discussion see Rusk, (1995)). For our purposes we arbitrarily define 'close' suburbs as those whose distance from the central city is equal to or less than the mean distance from the central city for that MSA.[3]

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2 Theoretically, total taxes and total expenditures are expected to be nearly equal in most municipalities. This would lead to colinearity problems if we enter both total (or per capita) spending and tax revenues in our regression. Several alternatives were considered. As seen below, we settled on per capita tax collections and a set of variables describing the percentage of total spending by various categories and percentage of taxes by source. This seems to be most in line with the flavor of the theoretical model presented in CHAPTER 3.

3 Several other definitions of the close suburbs were considered ranging from up to one-third of the mean distance from the central city with no remarkable changes to the results.

Metropolitan areas vary widely in terms of total population. In our sample, the largest MSA is more than one hundred times the size of the smallest. Our model may apply differently to metropolitan areas of different sizes since they differ in so many characteristics. We therefore also estimate our empirical models for sub-samples of the 12 largest and 16 smallest MSAs.

We estimate equation (31) for the suburban observations in our data set first using ordinary least squares. Since each observation in our data set is not independent (i.e. there are multiple observations on the same MSA and jurisdiction) and since some variables (e.g. the central city fiscal conditions and the amenities) only vary at the MSA level, it is necessary to adjust the standard errors produced by the OLS model to account for the number of groups (MSAs) in the data set.

As is commonly noted in the spatial economics literature, there are potentially unobservable, MSA-specific effects which may be correlated with some of our model's explanatory variables, specifically with the local fiscal conditions which are of interest in this analysis. For example, all municipalities in a particular MSA may face some common external factor (say high crime or bad weather) or common state mandated service level (say all ambulance personnel must be certified Emergency Medical Technicians as required in Pennsylvania) which impacts on spending. Additionally, local jurisdictions may be limited by state or county rules to particular tax instruments or rates (in Pennsylvania, for example, except for the City of Philadelphia, municipalities are limited to a 1 percent wage tax).

A common technique to tackle this specific effects issue is to transform the data into deviations from MSA means (or to estimate a fixed effects model). However, since many of the variables we are most interested in (central city fiscal conditions) do not vary within an MSA, these techniques are unsatisfactory as they do not allow the estimation of the coefficients for such variables. A random effects model would allow for the estimation of these important coefficients, but this framework assumes no correlation between the individual effects and the explanatory variables. In the presence of such correlation the random effects estimator is inconsistent, while the fixed effects estimator is consistent and efficient. The appropriateness of the random effects model can be tested with a Wu-Hausman Specification test, which compares the common coefficient estimates of the fixed and random effects models. The test statistic

$$H = (\hat{\beta}_{RE} - \hat{\beta}_{FE})'(\Sigma_{FE} - \Sigma_{RE})^{-1}(\hat{\beta}_{RE} - \hat{\beta}_{FE}) \quad (32)$$

is distributed asymptotically as χ^2 with k (=the number of explanatory variables) degrees of freedom under the null hypothesis that the random effects estimator is correct (Johnston and DiNardo, 1997).

There are several potential alternatives should the results of the Wu-Hausman test indicate that random effects are unsuitable for our model that would allow us to estimate the coefficients on the explanatory variables that do not vary within an MSA. The first is to collect data from an another time period. Then assuming that the correlated MSA effect is constant over time, one could control for the correlation since you have two observations on the same jurisdiction. Unfortunately, this is not currently feasible.

Hausman and Taylor (1981, hereafter HT) propose another alternative method of dealing with these unobserved MSA effects which does allow one to estimate the necessary coefficients. Although the HT technique was devised for application to panel data, it can be applied to our spatial cross section if we allow the MSAs to take the role of individuals and assume that each jurisdiction is a different observation on that individual (that is, it is like the time dimension in a traditional panel). Following the notation of Sevestre and Trognon (1996), assume the explanatory variables can be divided into two groups: the X_{jm} variables that vary across both MSAs and jurisdictions within an MSA, and the S_m variables that vary only across MSAs. To create a consistent estimator, HT assume that among the explanatory variables there are some X and S variables which are uncorrelated with the disturbances (exogenous). To ensure identifiability, it is necessary that the number of uncorrelated X variables exceeds the number of correlated S variables. Breusch, Mizon and Schmidt (1989) show that the HT estimator is equivalent to estimating the original model using the uncorrelated X variables expressed both in deviations from MSA means and as MSA means. the correlated X variables expressed as deviations from MSA means. and the uncorrelated S variables as instruments. For our application of the HT technique below we assume that the housing characteristic variables (Xs) and the amenities (Ss) are exogenous.[4]

4.2 Data

Previous researchers working with the single jurisdiction model were able to utilize housing characteristic and demographic data collected at the individual- or household-level from the Census Public Use Micro Sample (PUMS) or the American Housing Survey. To protect the anonymity of the survey respondents, the only geographic descriptors included in these data sets are the county and MSA of residence and a dummy variable indicating whether the individual resides in the central city.[5, 6] Using either of these data sources, it is therefore impossible to match household demographics to specific municipal fiscal data unless the household is located in the central city. To use this type of data for our purposes would require assigning all non-central city households some "average" suburban tax and spending mix. Since theory tells us that suburbs should differ considerably in their local fiscal policies (àlà Teibout), this is an undesirable restriction to place on the data.

By abandoning the typical individual-level data sources in favor of aggregated data, we are able to obtain the necessary geographic descriptors. For this analysis. we will use data aggregated to

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4 A third approach to this problem could be to use the random correlated effects technique of Chamberlain (1982): however. this method seems applicable only to true panel data and therefore is not appropriate to our case.

5 Since 1940. only geographic areas with populations greater than 25.000 could be identified in publicly available micro data.

6 One exception among micro data sets is the University of Michigan Panel Study of Income Dynamics (PSID) which in addition to demographic data. housing characteristics. and county location information includes some neighborhood information. This is the data set employed by Voith (1991). However. there is insufficient information in the PSID to match households to municipalities. which is necessary for our purposes.

the Census block-level obtained from the 1990 Census of Housing and Population Summary Tape File 3 (STF3). By using block-level (as opposed to individual or household) data we obviously give up some amount of variation in our housing characteristics; however, given the small size (both in area and population) of a Census block it seems reasonable to hope that the blocks are relatively homogeneous with respect to housing characteristics and demographics. Since blocks are subdivisions of Census tracts (which according to the Census Bureau are designed to be homogeneous with respect to population characteristics, economic status, and living conditions), we feel comfortable using this level of aggregation in lieu of individual data.

To complete the data set, the demographic and housing characteristics from the STF3 are matched to specific tax and spending measures by political jurisdiction from the 1992 Census of Governments. Finally, these data are matched to revenue and expenditure data on school districts from the 1990 Census School District Special Tabulation. Data on MSA amenities (e.g. weather conditions) are from the 1997 Places Rated Almanac and the 1994 County and City Data Book. (APPENDIX 5, TABLE A1 indicates the data source for each variable). Thus, each data record (a Census block) contains the average demographic and housing characteristics of the block, the tax collections and expenditures of the municipal jurisdiction in which the block is located, the revenue and expenditures of the corresponding school district, and MSA-level amenities. Additionally, each record contains the geographic location of the block (i.e., county, MSA, and state) and the relevant central city for suburban blocks.

The current data set consists of observations from four states: Michigan, Minnesota, New Jersey, and Pennsylvania. The correspondence between STF3 data and Census of Governments data is not as straight forward in other states; therefore, the necessary matching is imprecise. The data set contains approximately 18,000 complete records (Census blocks) in 28 MSAs.

A complete list of the MSAs in the data set is included in APPENDIX 5, TABLE A2. Note that the states and MSAs included span much of the traditional rust belt. This limitation in the data has both beneficial and detrimental aspects. Limiting our analysis to such a sample eliminates some of the unobservable characteristics of MSAs that would be present in a more diverse sample. Further, many cities in our sample, when faced with severe economic hardship, are known to have undertaken substantial local economic redevelopment efforts (to which our model could potentially be addressed). On the other hand, using this data set we will not be able to test our model's applicability to a sample of cities facing different economic conditions, like those of the Sun Belt, which have seen remarkable growth in the last two decades. This sample does contain MSAs of various sizes (both in population and land area); thus we will be able to consider how well our model predicts as we vary this characteristic.

Descriptive statistics for the relevant variables are included in APPENDIX 5, TABLE A3. Examining these means we see that (not surprisingly) suburbs have a newer housing stock compared to the central cities as is evidenced by a more recent median year built (1956 versus 1945) and larger percentage built in the last year (1.5 percent versus 0.4 percent). The median house value (the natural log of which is our dependent variable) is more than twice as high in the suburbs compared to the city ($99,448 versus $45,440). Suburban Census blocks on average also enjoy a smaller percentage of vacant housing units (5.5 percent versus 8.7 percent), are less likely to be without complete plumbing, and have a 25 percent lower crime rate. Surprisingly, suburban and city houses tend to be very similar in size (number of rooms). Further, even though central city residents are much more likely to work in the central city (69 percent) compared to their suburban counterparts (23 percent), there is very little difference in average travel time to work.

A comparison of household demographic characteristics confirms the conventional wisdom, most notably, suburbanites are better educated (12.7 percent hold bachelor's degrees and 6.9 percent hold graduate degrees) than city resident (8.6 percent and 5.3 percent, respectively). Suburban dwellers are more likely to be married (59.6 percent versus 37.9 percent) and much less likely to live in a household headed by a single female (5.3 percent versus 13.2 percent). Finally, there are substantially fewer minorities in the suburbs whose population is on average in our sample 89.7 percent Caucasian (compared to 55.3 percent for the typical central city). Given these statistics, it is not surprising that suburban median household income exceeds that of the city by more that $13,000 ($36,617 versus $23,302). It seems that the stereotype of the educated, white, middle-class suburb describes our data well.

On the fiscal side, suburban governments rely much more heavily on property taxes as a source of municipal revenue, deriving 74.2 percent of tax revenue from this source while the average city raises only 44.6 percent of its tax revenue in this manner. Income taxes, on the other hand, seem to be more the tax instrument of choice in the cities where they account for 37.6 percent of tax revenue (as opposed to just 15.3 percent in suburban jurisdictions). Of all jurisdictions in the sample, only 13 percent receive more than half of their tax revenue from income taxes, while property taxes account for the majority of revenues in 76 percent of jurisdictions. Because of legal differences, the prevalence of tax instruments varies across states. In our sample, municipal income taxes were present only in Pennsylvania and Michigan and common only in Pennsylvania, where they were used in 85 percent of municipalities. Sales taxes on the other hand were absent in Michigan and most common in Minnesota. Virtually all municipalities used the property tax. (There are nine exceptions in the data set, eight in Pennsylvania and one in Michigan, which rely on a combination of sales, income and other taxes). In our sample, central cities collect more than two times as much tax per capita as suburban jurisdictions ($606 versus $272)[7]

Municipal expenditure patterns also differ between cities and suburbs. The central cities in our sample on average spend a larger proportion of their budget than the suburban governments on public health, hospitals, public housing, prisons, public parks and recreation, and parking. With the (possible) exception of parks, these are all items we associate with the typical problems of the big

7 This is the opposite of the per capita tax pattern seen in the data set of CHAPTER 5 below. This could be due simply to sample selection (that is, the cities in this northeastern/midwestern sample have higher taxes than central cities in the rest of the county).

city. Suburbs, in comparison, spend proportionately more than cities on central administrative services and highways and roads. Further, suburban school districts spend an average of $300 more per pupil and receive a substantially larger proportion of their revenue from local sources (primarily taxes).

The column 4 of TABLE A3 presents the suburban means for the close suburbs which we have defined as those with distance from the central city less than or equal to the mean for their MSA. Approximately two-thirds of our suburban observations fit this definition. The close suburbs appear to be more like the average suburb than was expected. They only differ substantially in a few characteristics. Close suburbs tend to be older (with median year built of 1953 and opposed to 1956 for all suburbs); however, they exhibit a higher median house value. Their residents tend to be slightly better educated (more have bachelors and graduate degrees) and there are more minority residents. On the fiscal side, close suburban jurisdictions tend to have higher per capita taxes.

Many characteristics also differ between larger and smaller MSAs. Dividing the sample roughly in half by total MSA population yields the "large MSA" and "small MSA" columns in APPENDIX 5, TABLE A4. The different sized MSAs do not differ in most of the housing characteristic variables; however, small MSA residents are much more likely to live in homes without complete plumbing (1 percent versus 0.5 percent). This difference results entirely from the difference in the suburban housing stock. As one would expect, the larger MSAs have much better access to cultural amenities and suffer from a significantly higher crime rate (5,188 known crimes per 100,000 residents compared to 3,725). Central city residents in large MSAs experience longer average commuting times than their small MSA counterparts; however, suburban residents travel roughly the same amount of time. The median house value also differs markedly with size ($73,417 versus $56,747). This difference is much less notable in the city housing markets where the MSA size difference is less than $5,000.

Larger MSAs tend to have fewer white residents and more minorities than smaller metro areas (17 percent African American in the large MSA sub-sample versus only 5.6 percent in the small sub-sample). The suburbs of both size groups remain almost entirely white. The suburban residents of larger MSAs are more highly educated and enjoy a higher median household income than like residents of the smaller MSAs. Neither of these characteristics carries over to the central city residents who appear to be very similar.

Fiscal conditions also vary notably by size. The municipalities in large MSAs (especially the central cities) are much less reliant on the property tax. In fact, in the large MSA central cities income taxes account for a slightly larger proportion of revenues. Further, jurisdictions within the larger MSAs collect two to two and a half times more in taxes per capita than those in the smaller MSA sub-sample. As one might expect, government spending patterns also differ with large MSA governments spending a larger percentage of their budget on police, prisons, pubic health, hospitals, and general services, while small MSA governments expend relatively more on highways and central administration. Interestingly, the central cities of small MSAs spend relatively more on police and public housing than those of large MSAs with the difference being made up by higher judicial, prison, and hospital spending in the large MSAs. (None of the small MSA central cities in our sample support a public hospital). The school districts in the larger MSAs spend more on average per student, and the suburban districts tend to raise a larger proportion of their revenue through local taxes; however, the central cities of the two size classes are more similar in this characteristic.

Given these numerous differences, our decision to estimate our models individually for the large and small MSAs (as well as for the whole sample as one) seems justified.

4.3 Estimation and Results

Using the data set described above, we examine the hypothesis that suburban land rents are affected by central city fiscal policies. Our first crude empirical test of this hypothesis is to regress per capita taxes in both the city and local suburban jurisdictions on land rents (using all available observations). We enter both local taxes per capita and the per capita taxes of the central city interacted with a suburban dummy variable. (Thus, for suburban observations, land rent is regressed against both local and city taxes, while for central city observations, land rent is regressed against only own local taxes). As seen below, municipal taxes are an important determinant of metropolitan land rents (admittedly without controlling for any other factors). As predicted, land values decrease with increases in the local tax rate and in the suburb increase with increases in the central city's tax rate.

$$\underset{}{ln(value)} = \underset{(1132)}{10.7} \; \underset{(-10.1)}{-0.163\, TAX\_PC_{Local}} \; \underset{(62.4)}{-0.830(TAX\_PC_{City} \, X \, SUBURB)} \qquad (33)$$

(t-Statistics in parentheses)

To explore this relationship further we must control for other factors which are known to affect land rent such as housing and location characteristics and include more detailed measures of fiscal conditions as described in equation (31). The results of this regression, using OLS and the 12,575 suburban observations from our data set, are reported in the last column of TABLE 1.[8, 9] (All regression results tables report t-statistics in parentheses). The signs of the housing characteristic variables are mostly as we would expect. We see higher land rents associated with Census blocks having a newer housing stock (measured by the percentage of new housing in the block and the median year built) and those that on average have more rooms per housing unit. On

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8 The first three columns of TABLE 1 report the OLS regression results of entering only the local (own jurisdiction) fiscal conditions, for the total sample, the central city only, and the suburb only. Column 2 would be roughly equivalent to the regressions of Gyourko and Tracy (1989a). As expected (and as found by previous researchers), higher local per capita taxes are associated with lower land rents. Column 4 illustrates the effect of central city fiscal conditions on suburban land rents without local fiscal conditions entering the regression. Here, as expected, we find that per capita central city taxes are positively related to suburban land rents. Similar OLS regressions without the fiscal conditions are reported in APPENDIX 5, TABLE A5

9 As described in Section 4.2, the standard errors have been adjusted to reflect the non-independence of the observations.

the other hand, land rents are lower in blocks where a larger percentage of housing units have no plumbing or where more units are vacant (insignificant). Note that the negative signs on the number of bedrooms variables are not unexpected since we are controlling for the total number of rooms: they simply indicate a negative tradeoff between the number of bedrooms and other rooms in the house. (Removing the number of rooms from the regression does, in fact, change the signs on these variables). The only unexpected sign is on the distance from the center city variable, which is positive, but insignificant. Except where already noted, all of the housing characteristic variables are significant at the one percent level with the exception of the percentage with no plumbing, which is significant at the five percent level.

Of the amenity variables, MSA population and population change since 1980 are both positive and significant, as expected. The coefficients on annual rainfall (+), the availability of arts related entertainment (-), the county crime rate (+), and the local student teacher ratio (+) are also significant (at at least the 10 percent level), but do not have the expected signs.[10] The other amenity variables were all found to be insignificant. Of the state dummy variables, Minnesota is positive and significant indicating higher land rents compared to the omitted state of Michigan. The New Jersey and Pennsylvania dummies were insignificant.

The effect of the local fiscal conditions is as expected. Notably, the total tax collected per capita is negative indicating the capitalization of local taxes into land rents. (This variable is, nevertheless, insignificant). Examining the suburban tax source variables, we see that sales taxes lead to significantly higher local land rents (other taxes is the omitted category). Given that sales taxes are easy to export and the fact that sales taxes are likely to be viewed more as business taxes, this result is intuitive. Although insignificant after adjusting the standard errors, the percent of tax revenue earned from the local income tax has a negative effect on land rents. By similar reasoning

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10 A high student-teacher ratio could be a sign of a rapidly expanding school district, so perhaps this variable is picking up some of the effects of local population growth. Likewise a higher crime rate may be observed in a county with higher property values simply because there are more opportunities

TABLE 1: OLS Regression Results

		1	*2*	*3*	*4*	*5*
	SAMPLE =>	*TOTAL*	*CENTRAL CITY*	*SUBURB*	*SUBURB*	*SUBURB*
	VARIABLE	*with Own Fiscal Conditions*			*with CC Fiscal Conditions*	*with CC & Own Fiscal Conditions*
HOUSING	Percent New	0.239 ***	0.745	0.194 ***	0.175	0.197 ***
		(2.442)	(1.790)	(2.773)	(1.554)	(2.799)
	Median Year Built	0.0134 ***	0.014 ***	0.119 ***	0.014 ***	0.012 ***
		(10.833)	(10.072)	(11.751)	(10.260)	(11.082)
	Percent with 1 bedroom	-1.139 ***	-1.472 ***	-0.577 ***	-0.420	-0.558 ***
		(-4.228)	(-7.425)	(-5.759)	(-1.846)	(-5.877)
	Percent with 2 bedrooms	-2.210 ***	-3.122 ***	-1.311 ***	-1.397 ***	-1.253 ***
		(-5.430)	(-8.915)	(-14.789)	(-8.066)	(-14.794)
	Percent with 3 bedrooms	-2.447 ***	-3.804 ***	-1.444 ***	-1.702 ***	-1.434 ***
		(-5.430)	(-5.691)	(-10.964)	(-6.408)	(-11.215)
	Percent with 4 bedrooms	-2.813 ***	-4.550 ***	-1.484 ***	-1.785 ***	-1.449 ***
		(-4.564)	(-6.773)	(-9.757)	(-7.846)	(-8.810)
	Percent with 5+ bedrooms	-2.516 ***	-4.386 ***	-0.805 ***	-1.203 ***	-0.817 ***
		(-4.276)	(-5.675)	(-4.895)	(-4.405)	(-5.677)
	Average Rooms/House	0.372 ***	0.551 ***	0.291 ***	0.383 ***	0.291 ***
		(9.575)	(8.655)	(12.003)	(10.471)	(11.672)
	Percent without plumbing	-1.515 *	-2.391 ***	-0.755 ***	-1.111 **	-0.618 **
		(-1.982)	(-2.634)	(-2.492)	(-2.250)	(-2.072)
	Percent Vacant	-0.848 **	-2.081 ***	-0.131	-0.278	-0.216
		(-2.168)	(-7.458)	(-0.640)	(-0.914)	(-1.001)
	Distance from the CC (X1000)	0.003 ***	0.02 ***	0.001 **	-0.0001	0.001
		(3.224)	(7.288)	(2.044)	(-0.218)	(1.181)
	Student Teacher Ratio	-0.0048	-0.053 ***	0.001	-0.022 ***	0.004
		(-0.950)	(-6.575)	(0.168)	(-2.698)	(0.726)
	Municipal Population (X1000)	-0.0003***	-0.008 ***	0.0004	0.0006	0.0003
		(-3.252)	(-6.607)	(0.820)	(1.728)	(0.744)
AMENITIES	MSA Population (X1000)	0.00002	0.001	0.00004	0.0002	0.0001 ***
		(0.726)	(6.525)	(2.327)	(2.791)	(2.788)
	Cooling Degree Days	0.0005	-0.001 ***	0.001	0.0002	0.0002
		(1.196)	(-3.685)	(1.115)	(0.433)	(0.361)
	Heating Degree Days	0.0002	0.0002 ***	0.0001	0.0002	0.0001
		(1.620)	(7.446)	(0.882)	(0.964)	(0.637)
	Annual Precipitation	0.0089	0.024 ***	0.007	0.039 ***	0.026 **
		(1.342)	(3.931)	(0.899)	(2.943)	(2.051)
	Arts Facilities	0.00001	-0.0003***	-0.00002	-0.0001**	-0.0002 ***
		(0.632)	(-3.563)	(-0.927)	(-2.107)	(-3.117)
	Recreation Facilities	-0.00009	-0.0002***	-0.0001***	0.00002	-0.00003
		(-2.998)***	(-5.717)	(-3.013)	(0.234)	(-0.497)

for property theft.

TABLE 1 (cont'd)

	County Crime Rate	0.00003*** (3.943)	0.0001 *** (5.236)	0.00003*** (2.962)	0.00003*** (3.797)	0.00003 * (1.867)
	County Population Density	0.00004*** (4.338)	0.0005 *** (10.824)	-0.000008 (-0.356)	0.000002 (0.111)	-0.00002 (-0.739)
	MSA Population Change	0.0192 *** (6.849)	0.015 *** (3.496)	0.016 *** (5.404)	0.017 *** (3.739)	0.011 *** (3.384)
	Pennsylvania Dummy	0.333 *** (3.364)	1.051 *** (8.082)	0.334 *** (2.663)	0.043 (0.274)	0.023 (0.169)
	New Jersey Dummy	0.434 *** (3.573)	3.928 *** (3.462)	0.360 *** (2.754)	-0.215 (-1.369)	0.001 (0.009)
	Minnesota Dummy	0.052 (0.262)	0.592 *** (3.539)	0.164 (0.641)	0.750 (1.624)	0.976 *** (2.833)
LOCAL FISCAL COND	% Tax Revenue from Property Tax	-0.102 (-1.007)	1.740 *** (5.003)	-0.096 (-1.376)	--	0.004 (0.050)
	% Tax Revenue from Sales Tax	0.888 ** (2.240)	2.881 *** (5.209)	1.055 * (1.948)	--	1.154 ** (2.298)
	% Tax Revenue from Income Tax	-0.067 (-0.511)	2.226 *** (8.848)	-0.167 * (-1.934)	--	-0.099 (-1.099)
	Tax Per Capita	-0.071 (-1.276)	-1.430 *** (-2.762)	-0.095 (-0.934)	--	-0.111 (-0.953)
	% of Spending on Fire Protection	0.082 (0.461)	-3.898 *** (-3.313)	-0.304 * (-2.019)	--	-0.413 ** (-2.696)
	% of Spending on Administration of Justice	0.050 (0.467)	-2.384 *** (-2.262)	-0.197 ** (-2.151)	--	-0.219 ** (-2.461)
	% of Spending on Health and Housing	-0.188 (-0.951)	-3.444 *** (-4.467)	-0.707 *** (-2.885)	--	-0.765 *** (-3.509)
	% of Spending on Public Works	0.142 (1.021)	-4.647 *** (-4.886)	-0.160 (-1.326)	--	-0.111 (-0.972)
	% of Spending on Administration	0.042 (0.348)	-4.559 *** (-5.191)	-0.174 * (-2.027)	--	-0.181 * (-1.965)
	% of Spending on Libraries	0.696 (1.602)	-1.993 (-1.542)	0.220 (0.656)	--	0.281 (0.824)
	School: Percent Local Revenue	1.045 *** (15.957)	1.127 *** (3.533)	1.000 *** (10.161)	--	0.983 *** (10.286)
	Expenditure Per Student	0.012 (0.726)	-0.879 (-2.005)	0.015 (1.493)	--	0.018 * (1.821)
CITY FISCAL	% Tax Revenue from Property Tax	--	--	--	-1.832 *** (-2.442)	-1.846 ** (-2.641)
	% Tax Revenue from Sales Tax	--	--	--	-3.303 *** (-2.835)	-3.020 ** (-2.467)
	% Tax Revenue from Income Tax	--	--	--	-1.599 *** (-2.293)	-1.511 ** (-2.342)
	Tax Per Capita	--	--	--	0.296 *** (3.644)	0.292 *** (3.186)
	% of Spending on Fire Protection	--	--	--	1.699 (1.123)	2.945 ** (2.353)
	% of Spending on Administration of Justice	--	--	--	0.868 (0.921)	1.772 ** (2.217)
	% of Spending on Health and Housing	--	--	--	0.767 (0.740)	1.687 * (1.919)

TABLE 1 (cont'd)

% of Spending on Public Works	--	--	--	0.769 (0.648)	2.029 ** (2.084)
% of Spending on Administration	--	--	--	1.151 (0.865)	1.976 * (1.752)
% of Spending on Libraries	--	--	--	-0.709 (-0.224)	-2.102 (-0.858)
School: Percent Local Revenue	--	--	--	0.678 (2.153)	0.253 (0.906)
Expenditure Per Student	--	--	--	-0.143 (-1.773)	-0.175 (0.783)
(Intercept)	-17.909*** (-6.601)	-16.890*** (-6.562)	-14.715*** (-5.416)	-18.68 *** (-5..804)	-15.606 *** (-6.221)
R-Squared	0.7084	0.5557	0.7371	0.6626	0.7512

(income taxes cannot be exported easily and are clearly taxes on households), this too is an intuitive result. Recall that the theoretical model predicted little difference between types of taxes. The insignificance of our tax source variables here seems to support this. Examining the category of spending variables we see that the percentage of total local spending in each category, other than libraries, leads to lower land rents compared to spending on the omitted category public parks. (Libraries and public works spending have insignificant coefficients). Since we expect households to prefer municipalities that spend on public goods which provide a direct benefit to them (and parks and libraries seem to fall in this classification), these results meet our expectations.

A variable of particular interest in this analysis is the level of taxation in the central city. We expect that high taxes in the central city (particularly taxes on households) will make suburban jurisdictions more attractive, thus driving up land rents. Central city spending on public goods (again, especially those that benefit households) tend to lower suburban land rents.[11] Our empirical results support this view. Per capita taxes in the central city are associated with significantly higher suburban land values. Note that the use of a sales tax in the city substantially reduces this effect (since suburban residents who enter the city jurisdiction to shop are affected by this tax). Higher percentages of city tax revenue raised through income and property taxes also lower suburban land values (compared to the percentage raised through omitted "other taxes"), but the effect is smaller than that of the sales tax. City spending on libraries has a negative (but insignificant) effect on suburban land rents, while all other categories of city spending tend to be associated with (significant) higher suburban property values (again, the omitted category is public parks). This is consistent with the idea that cities which provide more household amenities are more attractive to potential suburban residents.[12]

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11 It should be noted that the model outlined in CHAPTER 3 may not be the only theoretical model to predict the negative relationship between city taxes and suburban land rents. For example, it could be that the higher taxes are the result of population shifts to the suburbs, not the cause of these shifts.

12 The spending categories used here are aggregates from the original data (see variable definitions in APPENDIX 5, TABLE A1). Similar results are found using the disaggregated categories. Among the

Results from the school district variables are mixed. We find a positive and significant coefficient on the percentage of local revenue variable, which does not meet our expectations since local revenue was our proxy for local school taxes. Given that larger state and federal transfers tend to go to financially distressed districts, high values for the percent local variable could indicate that the district has higher property values (our dependent variable) and thus qualifies for fewer intergovernmental grants since it can raise more revenue locally. The school district expenditure per student is positive (as expected) and significant at the ten percent level. The city school district variables, although they have the expected signs, are both insignificant.

A potential problem with our expenditure variables is that rather than measuring public good provision they may be picking up the effects of some other related city characteristic. For example, cities with high crime rates tend to have larger police forces and cities with severe winters spend more on road repairs. Thus the expenditure results above may be suspect. Since our real variable of interest is the city per capita tax level, we can estimate our regressions without the expenditure categories to determine what effect, if any, this simultaneity has. The results of this regression are in APPENDIX 5, TABLE A6. There are no significant differences in these results compared to those in TABLE 1, which seems to indicate that there is no problem with our use of expenditure data.

Remembering that our data likely contains unobserved MSA specific effects, we estimate fixed and random effects models. We expect that the specific effects are correlated with the explanatory variables (especially the fiscal conditions), thus we expect the fixed effects model to give consistent and efficient estimates. To verify this presumption, we calculate a Wu-Hausman specification test statistic as described in Section 4.2. We reject the null hypothesis that there was no systematic difference in the coefficients of the fixed and random effects models with a Chi-square

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notable differences, suburban spending on both libraries and parking have a positive effect on land values while hospital spending is large and negative. Spending by the city on public buildings and courts have positive suburban effects, while spending on public health has a large negative impact.

statistic of 203. This implies that the random effects coefficients are inconsistent.[13] The interested reader will find the estimation results of the fixed and random effects models use for the Wu-Hausman Test in TABLE 2, columns 2 and 3.

Since it is not possible to calculate fixed effects estimates of the coefficients on the central city fiscal variables (since they do not vary within an MSA), we apply the Hausman-Taylor (HT) technique discussed previously. We assume that the housing characteristics and the amenities are uncorrelated (exogenous) and estimate the model using the instrumental variable method described by Breusch, Minzon and Schmidt.[14] The results of applying the HT method are in TABLE 2, column 4.

Looking at the HT results, one first notices that there are very few changes in the coefficients on the housing characteristics variables or the amenities. (No plumbing, percent vacant and distance from the central city are now insignificant and most of the amenities have lost their significance). The percent of new houses, the median year built, and the number of rooms all positively affect land rents, while the increasing the number of bedrooms (holding total rooms fixed) decreases value. Just as in our OLS results, we find a negative and significant (at the 5 percent level) coefficient on the number of arts entertainment facilities and positive and significant coefficients on the MSA population and population change variables.

There are significant differences in the coefficient estimates for the fiscal conditions variables when compared to the OLS results discussed above. The local sales tax variable is no longer significant. Further, the coefficients on most of the local expenditure variables have changed sign (and lost significance). They are each positive when compared to the omitted parks spending

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13 The reader may not want to completely discount the random effects results, since, given our large sample size, it would be very unusual to reject the Wu-Hausman null hypothesis.

14 Thus the (assumed) exogenous X variables are percent new, median year built, the percentage with 1, 2, 3, 4, or 5 or more bedrooms, the number of rooms, the percentage without complete plumbing, the percent vacant, the distance from the center city, the student-teacher ratio, and the local municipal population. The exogenous S variables are the MSA population, cooling and heating degree days, annual precipitation, the number of arts and recreational facilities, the county crime rate, county population density, and population change since 1980.

TABLE 2: Fixed Effects, Random Effects, and Hausman-Taylor Regression Results

		1	2	3	4
	VARIABLE	**OLS**	**Fixed Effects**	**Random Effects**	**Hausman-Taylor**
HOUSING CHARACTERISTICS	Percent New	0.197 ***	0.201 ***	0.197 ***	0.187 *
		(2.799)	(3.088)	(2.982)	(2.014)
	Median Year Built	0.012 ***	0.012 ***	0.012 ***	0.010 ***
		(11.082)	(54.221)	(52.820)	(6.123))
	Percent with 1 bedroom	-0.558 ***	-0.574 ***	-0.558 ***	-0.651 ***
		(-5.877)	(-5.313)	(-5.088)	(-5.629)
	Percent with 2 bedrooms	-1.253 ***	-1.249 ***	-1.253 ***	-1.090 ***
		(-14.794)	(-12.158)	(-12.014)	(-7.937)
	Percent with 3 bedrooms	-1.434 ***	-1.442 ***	-1.434 ***	-1.221 ***
		(-11.215)	(-13.421)	(-13.155)	(-8.288)
	Percent with 4 bedrooms	-1.449 ***	-1.445 ***	-1.449 ***	-1.114 ***
		(-8.810)	(-11.844)	(-11.706)	(-4.704)
	Percent with 5+ bedrooms	-0.817 ***	-0.831 ***	-0.817 ***	-0.444 *
		(-5.677)	(-6.028)	(-5.844)	(-1.915)
	Average Rooms/House	0.291 ***	0.290 ***	0.291 ***	0.216 ***
		(11.672)	(33.225)	(32.891)	(5.046)
	Percent without plumbing	-0.618 **	-0.608 ***	-0.618 ***	-0.251
		(-2.072)	(-4.412)	(-4.422)	(-1.124)
	Percent Vacant	-0.216	-0.169 ***	-0.216 ***	-0.167
		(-1.001)	(-4.501)	(-5.724)	(-1.053)
	Distance from the CC (X1000)	0.001	0.0007 ***	0.001 ***	0.001
		(1.181)	(5.529)	(7.430)	(1.376)
	Student Teacher Ratio	0.004	-0.0005	0.004 **	0.014
		(0.726)	(-0.301)	(2.310)	(1.433)
	Municipal Population (X1000)	0.0003	0.0003 ***	0.0003 ***	0.0005
		(0.744)	(3.680)	(3.781)	(0.528)
AMENITIES	MSA Population (X1000)	0.0001 ***	0.00009	0.0001 ***	0.00009 *
		(2.788)	(0.000)	(10.854)	(1.792)
	Cooling Degree Days	0.0002	--	0.0002	0.00002
		(0.361)		(1.354)	(0.064)
	Heating Degree Days	0.0001	--	0.0001 ***	0.00007
		(0.637)		(2.882)	(0.489)
	Annual Precipitation	0.026 **	--	0.026 ***	0.018
		(2.051)		(11.598)	(1.310)
	Arts Facilities	-0.0002 ***	--	-0.0002 ***	-0.0001 **
		(-3.117)		(-9.061)	(-2.191)
	Recreation Facilities	-0.00003	--	-0.00003 **	-0.00005
		(-0.497)		(-2.144)	(-1.207)
	County Crime Rate	0.00003	0.00002	0.00003 ***	0.00002
		(1.867)	(0.000)	(8.942)	(0.967)
	County Population Density	-0.00002	-0.00002 ***	-0.00002 ***	-0.00002
		(-0.739)	(-3.053)	(-2.823)	(-0.727)
	MSA Population Change	0.011 ***	0.007 ***	0.011 ***	0.007 *
		(3.384)	(6.205)	(11.008)	(1.708)
	Pennsylvania Dummy	0.023	--	0.023	0.227 *
		(0.169)		(0.620)	(1.733)

TABLE 2 (cont'd)

	New Jersey Dummy	0.001	-0.021	0.001	0.466 **
		(0.009)	(-1.272)	(0.029)	(2.092)
	Minnesota Dummy	0.976 ***	--	0.976 ***	1.178 ***
		(2.833)		(9.526)	(3.564)
LOCAL FISCAL CONDITIONS	% Tax Revenue from Property Tax	0.004	0.009	0.004	0.185
		(0.050)	(0.259)	(0.109)	(1.558)
	% Tax Revenue from Sales Tax	1.154 **	1.119 ***	1.154 ***	1.094
		(2.298)	(9.055)	(9.206)	(1.271)
	% Tax Revenue from Income Tax	-0.099	-0.093 **	-0.099 ***	0.191
		(-1.099)	(-2.720)	(-2.869)	(1.033)
	Tax Per Capita	-0.111	-0.134 ***	-0.111 ***	-0.426 *
		(-0.953)	(-5.428)	(-4.442)	(-1.887)
	% of Spending on Fire Protection	-0.413 **	-0.480 ***	-0.413 ***	0.139
		(-2.696)	(-8.469)	(-7.259)	(0.326)
	% of Spending on Administration of Justice	-0.219 **	-0.288 ***	-0.219 ***	0.066
		(-2.461)	(-5.712)	(-4.310)	(0.202)
	% of Spending on Health and Housing	-0.765 ***	-0.799 ***	-0.765 ***	-0.123
		(-3.509)	(-13.376)	(-12.662)	(-0.207)
	% of Spending on Public Works	-0.111	-0.125 ***	-0.111 **	0.265
		(-0.972)	(-2.640)	(-2.319)	(0.747)
	% of Spending on Administration	-0.181 *	-0.217 ***	-0.181 ***	0.176
		(-1.965)	(-4.586)	(-3.780)	(0.510)
	% of Spending on Libraries	0.281	0.337 ***	-0.281 ***	0.377
		(0.824)	(3.648)	(3.005)	(0.626)
	School: Percent Local Revenue	0.983 ***	0.965 ***	0.983 ***	2.330 ***
		(10.286)	(52.227)	(52.657)	(3.868)
	Expenditure Per Student	0.018 *	0.017 ***	0.018 ***	-0.031
		(1.821)	(6.012)	(6.416)	(-0.985)
CITY FISCAL	% Tax Revenue from Property Tax	-1.846 **	--	-1.846 ***	-1.605 **
		(-2.641)		(-12.160)	(-2.291)
	% Tax Revenue from Sales Tax	-3.020 **	--	-3.020 ***	-2.488 *
		(-2.467)		(-12.617)	(-1.855)
	% Tax Revenue from Income Tax	-1.511 **	--	-1.511 ***	-1.283 *
		(-2.342)		(-11.207)	(-1.933)
	Tax Per Capita	0.292 ***	--	0.292 ***	0.315 ***
		(3.186)		(12.428)	(2.820)
	% of Spending on Fire Protection	2.945 **	--	2.945 ***	2.692 **
		(2.353)		(8.120)	(2.435)
	% of Spending on Administration of Justice	1.772 **	--	1.772 ***	1.601 *
		(2.217)		(7.073)	(2.047)
	% of Spending on Health and Housing	1.687 *	--	1.687 ***	1.679 **
		(1.919)		(6.721)	(2.066)
	% of Spending on Public Works	2.029 **	--	2.029 ***	1.973 **
		(2.084)		(6.818)	(2.324)
	% of Spending on Administration	1.976 *	--	1.976 ***	1.767
		(1.752)		(6.382)	(1.674)
	% of Spending on Libraries	-2.102	--	-2.102 ***	-2.480
		(-0.858)		(-2.917)	(-0.999)
	School: Percent Local Revenue	0.253	--	0.253 ***	-0.164
		(0.906)		(4.275)	(-0.459)

TABLE 2 (cont'd)

Expenditure Per Student	-0.175 (0.783)	--	-0.0175 (-0.874)	0.049 (0.675)
(Intercept)	-15.606 *** (-6.221)	-13.187 (0.000)	-15.606 *** (-25.656)	-12.168 *** (-3.693)
R-Squared: (Within)	0.7512	0.6545	0.6535	0.6478
(Between)		0.1655	0.8752	
(Overall)		0.3705	0.7512	
	Wu-Hausman Test Statistic:		203.49	
	(probability > χ^2)		(0.000)	

category with the exception of health and housing spending. Per capita local taxes has the expected negative (and significant at the 10 percent level) effect on land values. Recall that this variable was found to be insignificant in the OLS regressions. The coefficient on the percentage of revenue raised locally by the school district has more than doubled in magnitude, while local expenditures per student has changed sign and become insignificant.

Among the central city spending variables there are no notable changes from the observed OLS results: we still find increased city spending in all categories other than libraries to have a positive impact on suburban land values when compared to increased spending in the omitted public parks category. Library spending has a negative (but not significant) effect. The coefficients on the central city tax variables remain as in the OLS results. The proportion of tax revenue raised through property, sales, and income taxes have a negative effect on suburban land rents compared to the omitted category of other taxes. The sales tax category has almost twice the effect as the other categories. Per capita central city taxes has the expected positive effect on the suburb's land values. The city school district variables remain insignificant; however, their signs have reversed.

The HT results seem to support the conclusions drawn from the OLS regressions, namely that central city fiscal conditions are an important determinant of suburban land rents. In both cases we find the expected negative coefficient on local taxes per capita and positive coefficient on central city taxes per capita. In the OLS case we also find the expected opposite signs on the expenditure variables. This is not true of the HT results where the local expenditure variables had insignificant coefficients.

4.4 Estimations with Other Samples

The OLS and HT regression results for the close suburban sub-sample appear in TABLE 3. The results are very similar to those obtained using the entire sample. The coefficients on the no plumbing and percent vacant variables are double the size of those in the total sample results; the

TABLE 3: Regression Results, Close Suburbs Sub-Sample

	VARIABLE	OLS	Hausman-Taylor
	Percent New	0.300**	0.248**
		(2.530)	(2.375)
	Median Year Built	0.012***	0.010***
		(10.877)	(6.375)
	Percent with 1 bedroom	-0.575***	-0.614***
		(-2.992)	(-3.988)
H	Percent with 2 bedrooms	-1.354***	-1.184***
O		(-8.565)	(-6.703)
U	Percent with 3 bedrooms	-1.577***	-1.136***
S		(-6.798)	(-6.258)
I	Percent with 4 bedrooms	-1.661***	-1.326***
N		(-8.357)	(-5.226)
G	Percent with 5+ bedrooms	-0.906***	-0.574**
		(-4.893)	(-2.566)
	Average Rooms/House	0.318***	0.256***
		(12.098)	(6.513)
	Percent without plumbing	-1.216***	-0.918***
		(-2.873)	(-2.867)
	Percent Vacant	-0.575**	-0.379
		(-2.172)	(-1.474)
	Distance from the CC	0.004	0.003
	(X1000)	(1.365)	(1.272)
	Student Teacher Ratio	-0.002	0.007
		(-0.288)	(0.641)
	Municipal Population	0.0004	0.0004
	(X1000)	(0.974)	(0.474)
	MSA Population	0.0001**	0.00008
	(X1000)	(2.193)	(1.628)
A	Cooling Degree Days	0.0002	0.0002
M		(0.504)	(0.438)
E	Heating Degree Days	0.0002	0.0002
N		(1.018)	(1.397)
I	Annual Precipitation	0.029**	0.026**
T		(2.336)	(2.301)
I	Arts Facilities	-0.0002***	-0.0002***
E		(-3.254)	(-2.951)
S	Recreation Facilities	-0.00004	-0.00009**
		(-0.721)	(-2.385)
	County Crime Rate	0.000007	0.000007
		(0.621)	(0.445)
	County Population Density	0.00002	0.00003
		(0.886)	(0.720)
	MSA Population Change	0.010*	0.011*
		(1.910)	(1.780)
	Pennsylvania Dummy	-0.038	0.017
		(-0.273)	(0.173)
	New Jersey Dummy	-0.113	0.170
		(-0.803)	(1.223)

TABLE 3 (cont'd)

	Minnesota Dummy	0.987** (2.564)	0.978** (2.648)
LOCAL FISCAL	% Tax Revenue from Property Tax	0.073 (0.999)	0.177 (1.652)
	% Tax Revenue from Sales Tax	1.173* (1.743)	1.542 (1.425)
	% Tax Revenue from Income Tax	-0.031 (-0.322)	0.242 (1.530)
	Tax Per Capita	0.005 (0.031)	-0.263 (-1.082)
	% of Spending on Fire Protection	-0.707*** (-3.753)	-0.172 (-0.530)
	% of Spending on Administration of Justice	-0.418*** (-3.130)	-0.063 (-0.210)
	% of Spending on Health and Housing	-1.177*** (-4.744)	-0.388 (-0.672)
	% of Spending on Public Works	-0.237* (-1.738)	0.171 (0.556)
	% of Spending on Administration	-0.401*** (-3.160)	0.090 (0.259)
	% of Spending on Libraries	0.273 (0.505)	0.378 (0.558)
	School: Percent Local Revenue	0.898*** (12.638)	1.949*** (4.401)
	Expenditure Per Student	0.014 (1.450)	-0.009 (-0.438)
CITY FISCAL	% Tax Revenue from Property Tax	-2.028*** (-2.946)	-2.106*** (-3.033)
	% Tax Revenue from Sales Tax	-3.367*** (3.245)	-3.074*** (-2.896)
	% Tax Revenue from Income Tax	-1.627** (-2.668)	-1.663** (-2.663)
	Tax Per Capita	0.488*** (5.175)	0.578*** (4.583)
	% of Spending on Fire Protection	3.461*** (2.775)	3.711*** (2.965)
	% of Spending on Administration of Justice	2.706*** (3.280)	2.684*** (3.300)
	% of Spending on Health and Housing	2.285** (2.640)	2.543*** (3.020)
	% of Spending on Public Works	2.644** (2.679)	2.902*** (2.999)
	% of Spending on Administration	2.564** (2.344)	2.721** (2.583)
	% of Spending on Libraries	-1.121 (-0.506)	-1.734 (-0.698)
	School: Percent Local Revenue	0.155 (0.650)	-0.275 (-0.801)
	Expenditure Per Student	-0.025 (-0.468)	0.030 (0.464)
	(Intercept)	-15.751*** (-6.148)	-13.393*** (-4.364)
	R-Squared:	0.7703	0.7084

impact of distance from the central city has increased as well. The values of most of the fiscal condition variables have increased in absolute magnitude but not in sign. We thus can conclude that central city fiscal conditions have perhaps an even more important impact on land rents in suburbs that are in closer proximity to the central city jurisdiction.[15]

TABLES 4 and 5 present the results of the OLS, fixed effects, random effects, and HT regressions for the large and small MSA sub-samples respectively. Note that since each sub-sample contains fewer MSAs, we eliminate some of the amenity variables and central city spending categories (which do not vary within an MSA) from the estimations. In the case of the large MSAs, we were unable to reject the Wu-Hausman test null hypothesis that the fixed and random effects estimates are systematically different. The large MSA results are very similar to those found in our other regressions discussed above. We find the coefficients on local per capita taxes to be negative (although insignificant) and on central city per capita taxes to be positive and significant. The other variables behave much the same as seen in our other regressions. In the small MSA sub-sample, we find the central city per capita tax and spending variables to be insignificant in almost every case. This lends weight to the conclusion that our model is more applicable to the larger MSAs, which tend to have more employment in the central cities and more well defined suburbs. Smaller MSAs are much less metropolitan in flavor and tend to have more diffuse employment and populations.

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15 For the sake of completeness, similar regressions were run for the far suburban observations and for the "very close" suburbs which were defined as jurisdictions less than two-thirds of the mean distance from the center city. The results were virtually identical to those presented here.

TABLE 4: OLS, Fixed Effects, Random Effects, and Hausman-Taylor Regression Results, Large MSAs

	VARIABLE	OLS	FE	RE	HT
	Percent New	0.254 ***	0.254 ***	0.254 ***	0.208 ***
H		(3.619)	(3.607)	(3.607)	(3.557)
O	Median Year Built	0.012 ***	0.012 ***	0.012 ***	0.010 **
U		(8.906)	(47.249)	(47.251)	(2.840)
S	Percent with 1 bedroom	-0.467 ***	-0.467 ***	-0.467 ***	-0.560 **
I		(-8.071)	(-3.980)	(-3.981)	(-2.461)
N	Percent with 2 bedrooms	-1.190 ***	-1.190 ***	-1.190 ***	-1.076 ***
G		(-12.653)	(-10.676)	(-10.677)	(-6.488)
	Percent with 3 bedrooms	-1.423 ***	-1.423 ***	-1.423 ***	-1.256 ***
C		(-9.735)	(-12.216)	(-12.217)	(-5.828)
H	Percent with 4 bedrooms	-1.447 ***	-1.447 ***	-1.447 ***	-1.184 **
A		(-6.638)	(-10.941)	(-10.941)	(-2.909)
R	Percent with 5+ bedrooms	-0.804 ***	-0.804 ***	-0.804 ***	-0.471
A		(-4.371)	(-5.368)	(-5.368)	(-0.969)
C	Average Rooms/House	0.300 ***	0.300 ***	0.300 ***	0.240 **
T		(9.906)	(31.688)	(31.689)	(2.336)
E	Percent without plumbing	-0.925 *	-0.925 ***	-0.925 ***	-0.506
R		(-2.151)	(-5.466)	(-5.466)	(-0.698)
I	Percent Vacant	-0.500	-0.500 ***	-0.500 ***	-0.315
S		(-1.618)	(-10.485)	(-10.485)	(-0.653)
T	Distance from the CC	0.002	0.002 ***	0.001 ***	0.002
I	(X1000)	(1.631)	(10.210)	(10.210)	(1.400)
C	Student Teacher Ratio	-0.001	-0.001	-0.001	0.0055
S		(-0.355)	(-0.836)	(-0.836)	(0.501)
	Municipal Population	0.0009 **	0.0009 ***	0.0008 ***	0.0009
	(X1000)	(2.518)	(11.999)	(12.000)	(1.405)
	MSA Population	-0.000006	0.00003	-0.000006	0.00007
A	(X1000)	(-0.149)	(0.000)	(-0.184)	(-0.629)
E	Cooling Degree Days	-0.001 ***	--	-0.001 ***	-0.002 ***
N		(-4.616)		(-6.329)	(-3.261)
I	County Crime Rate	0.00002	0.00002 ***	0.00002 ***	0.00002
T		(1.103)	(5.409)	(5.409)	(0.657)
I	County Population Density	-0.0000003	-0.0000003	-0.0000003	-0.0000005
E		(-0.017)	(-0.052)	(0.052)	(-0.250)
S	MSA Population Change	-0.000000006	0.010 ***	0.010 ***	0.007
		(-0.149)	(8.539)	(8.540)	(1.663)
	Pennsylvania Dummy	0.544 ***	--	0.544 ***	0.575 **
		(3.220)		(6.106)	(2.656)
	New Jersey Dummy	0.555 ***	0.011	0.555 ***	0.782
		(3.949)	(0.626)	(6.364)	(1.724)

TABLE 4 (cont'd)

	Minnesota Dummy	-0.173	--	-0.173	-0.113
		(-0.691)		(-1.066)	(-0.299)
LOCAL FISCAL	% Tax Revenue from Property Tax	-0.089	-0.089 **	-0.089 **	-0.005
		(-1.426)	(-2.456)	(-2.456)	(-0.034)
	% Tax Revenue from Income Tax	-0.196 *	-0.196 ***	-0.196 ***	-0.022
		(-1.914)	(-5.342)	(-5.343)	(-0.080)
	Tax Per Capita	-0.108	-0.108 ***	-0.108 ***	-0.336
		(-0.836)	(-4.005)	(-4.005)	(-0.688)
	% of Spending on Health and Housing	-0.613 ***	-0.613 ***	-0.613 ***	-0.380
		(-3.182)	(-13.646)	(13.646)	(-0.961)
	% of Spending on Public Works	0.143	0.143 ***	0.143 ***	0.169 *
		(1.327)	(6.248)	(6.248)	(2.122)
	School: Percent Local Revenue	0.988 ***	0.988 ***	0.988 ***	1.971
		(8.413)	(49.433)	(49.435)	(1.243)
	Expenditure Per Student	0.024 *	0.024 ***	0.024 ***	-0.018
		(2.048)	(7.540)	(7.540)	(-0.282)
CC FISCAL	% Tax Revenue from Property Tax	2.090 ***	--	2.090 ***	2.649 ***
		(5.011)		(4.844)	(3.115)
	% Tax Revenue from Income Tax	1.109 ***	--	1.109 ***	1.367 ***
		(5.741)		(5.131)	(3.938)
	Tax Per Capita	1.096 **	--	1.096 ***	1.708
		(2.506)		(3.127)	(1.700)
	% of Spending on Health and Housing	1.247 ***	--	1.247 ***	1.466 ***
		(4.784)		(8.350)	(3.374)
	% of Spending on Public Works	4.638 ***	--	4.638 ***	5.041 ***
		(7.174)		(9.069)	(7.515)
	School: Percent Local Revenue	-1.551 **	--	-1.551 ***	-2.274 *
		(-2.375)		(-3.375)	(-1.837)
	Expenditure Per Student	0.115	--	0.115	0.220
		(1.210)		(1.595)	(1.352)
	(Intercept)	-14.620 ***	-12.944	-14.620 ***	-12.694 **
		(-5.458)	(0.000)	(-22.848)	(2.199)
	R-Squared: (within)	0.7532	0.6656	0.6656	0.6971
	(between)		0.2773	1.0000	
	(overall)		0.6015	0.7532	
	Wu-Hausman Test Statistic:			0.000	
	(probability > χ^2)			(1.000)	

TABLE 5: OLS, Fixed Effects, Random Effects, and Hausman-Taylor Regression Results, Small MSAs

	VARIABLE	OLS	FE	RE	HT
HOUSING	Percent New	0.403 **	0.423 **	0.403 **	0.472 *
		(2.165)	(2.435)	(2.310)	(2.109)
	Median Year Built	0.012 ***	0.012 ***	0.012 ***	0.011 ***
		(13.048)	(25.010)	(25.012)	(12.691)
	Percent with 1 bedroom	-1.540 ***	-1.499 ***	-1.540 ***	-1.356 ***
		(-4.003)	(-5.648)	(-5.783)	(-3.912)
	Percent with 2 bedrooms	-1.987 ***	-1.969 ***	-1.987 ***	-1.639 ***
		(-5.878)	(-7.768)	(-7.805)	(-5.266)
	Percent with 3 bedrooms	-2.200 ***	-2.171 ***	-2.200 ***	-1.792 ***
		(-5.894)	(-8.108)	(-8.175)	(-5.332)
	Percent with 4 bedrooms	-2.079 ***	-2.084 ***	-2.079 ***	-1.596 ***
		(-5.654)	(-6.845)	(-6.790)	(-4.529)
	Percent with 5+ bedrooms	-2.056 ***	-2.053 ***	-2.065 ***	-1.624 ***
		(-4.588)	(-6.064)	(-6.042)	(-3.761)
	Average Rooms/House	0.294 ***	0.298 ***	0.294 ***	0.229 ***
		(11.891)	(13.247)	(13.024)	(7.593)
	Percent without plumbing	-0.377	-0.365 *	-0.377 *	-0.062
		(-1.350)	(-1.733)	(-1.787)	(-0.273)
	Percent Vacant	0.418 **	0.408 ***	0.418 ***	0.286 **
		(2.657)	(7.260)	(7.476)	(2.421)
	Distance from the CC	-0.001 *	-0.002 ***	-0.001 ***	-0.002 *
	(X1000)	(-2.001)	(-5.687)	(-4.477)	(-1.920)
	Student Teacher Ratio	0.022 ***	0.022 ***	0.022 ***	0.035 ***
		(4.588)	(6.946)	(6.980)	(3.417)
	Municipal Population	-0.0009	-0.001	-0.0009	-0.005 ***
	(X1000)	(-1.290)	(-1.259)	(-1.123)	(-3.876)
AMENITIES	MSA Population	0.0002	0.009	0.0002	0.0004 **
	(X1000)	(1.428)	(0.000)	(1.448)	(2.668)
	Cooling Degree Days	0.0006 ***	--	0.0006 ***	0.0001
		(3.655)		(5.401)	(0.647)
	County Crime Rate	0.00004 **	0.00002	0.00005 ***	0.00008 ***
		(2.495)	(1.426)	(3.292)	(5.364)
	County Population Density	-0.0003 ***	-0.0005 ***	-0.0003 ***	-0.0003 **
		(-3.179)	(-3.664)	(-3.170)	(-2.788)
	MSA Population Change	0.0003	0.002	0.0003	0.014 ***
		(0.054)	(0.257)	(0.074)	(3.598)
	Pennsylvania Dummy	0.292 ***	--	0.292 ***	0.454 ***
		(4.062)		(6.161)	(8.459)
	New Jersey Dummy	0.213	--	0.213	-0.172
		(0.574)		(0.626)	(-0.636)
	Minnesota Dummy	0.223 *	--	0.223 ***	0.640 ***
		(1.802)		(3.047)	(4.398)
LOCAL	% Tax Revenue from	0.025	-0.0009	0.025	0.309 **
	Property Tax	(0.168)	(-0.012)	(0.356)	(2.419)
	% Tax Revenue from	0.063	0.039	0.063	0.467 ***
	Income Tax	(0.476)	(0.545)	(0.892)	(3.833)

TABLE 5 (cont'd)

	Tax Per Capita	-0.020 (-0.280)	-0.055 (-0.932)	-0.020 (-0.344)	-0.416 ** (-2.356)
	% of Spending on Health and Housing	-0.021 (-0.170)	-0.012 (-0.170)	-0.021 (-0.296)	0.154 (1.283)
	% of Spending on Public Works	-0.022 (-0.334)	-0.018 (-0.477)	-0.022 (-0.587)	-0.013 (-0.204)
	School: Percent Local Revenue	0.900 *** (10.020)	0.869 *** (18.187)	0.900 *** (18.916)	2.041 *** (7.485)
	Expenditure Per Student	-0.012 (-1.523)	-0.013 ** (-2.447)	-0.012 ** (-2.184)	-0.022 (-1.450)
C C	% Tax Revenue from Property Tax	-0.367 ** (-2.369)	--	-0.367 *** (-3.147)	-0.026 (-0.221)
C	% Tax Revenue from Income Tax	-0.870 *** (-3.997)	--	-0.870 *** (-6.044)	-0.109 (-0.472)
F I	Tax Per Capita	-0.016 (-0.120)	--	-0.016 (-0.130)	0.303 ** (2.858)
S C	% of Spending on Health and Housing	-0.774 ** (-2.880)	--	-0.774 *** (-4.131)	0.149 (0.512)
A L	% of Spending on Public Works	-0.140 (-1.399)	--	-0.140 (-1.509)	0.086 (0.950)
	School: Percent Local Revenue	0.439 *** (4.413)	--	0.439 *** (4.546)	0.089 (0.631)
	Expenditure Per Student	-0.002 (-0.107)	--	-0.002 (-0.113)	-0.027 (-1.430)
	(Intercept)	-14.119 *** (-7.963)	-15.785 (0.000)	-14.119 *** (-14.062)	-12.358 *** (-7.661)
	R-Squared: (within)	0.7683	0.5706	0.5685	0.6963
	(between)		0.4048	0.9901	
	(overall)		0.3870	0.7683	
			Wu-Hausman Test Statistic:	41.12	
			(probability > χ^2)	(0.0162)	

4.5 Conclusion

This chapter estimates an empirical model of suburban land rents accounting for individual characteristics, amenities, and local fiscal conditions. We find support for our hypothesis that fiscal policies of central city governments have significant impacts on suburban residents. The strongest support comes from the observation that per capita central city taxes consistently lead to significantly higher suburban land values even after controlling for a variety of factors known to affect land rent. Further support comes from the significance of central city spending on public goods such as fire and police protection, roads and public works, and libraries. As expected, city spending on public goods that clearly benefit households (parks and libraries) has a negative impact on suburban land rents, while spending on other goods has a positive impact. We also find that city spending on goods like administration or fire protection, which have little direct impact on suburban residents, are statistically significant. This may reflect interactions between the suburbs and central city of the sort discussed in Chapter 3.

There are two significant improvements to the empirical analysis presented here that should be considered for future research. Both center on the availability of additional data sources. First would be to obtain data for multiple years which would allow for better control of the correlated MSA specific effects by taking advantage of the cross time variation. Second would be the use of census data at the individual level. Access to such a confidential data source would allow a more precise matching of demographic characteristics to government finances. Further work along these lines should be pursued given the potentially important policy implications involved. Regional economic (re)development is an important issue for many of our nation's metropolitan (and not-so-metropolitan) areas. Difficult questions regarding how to finance such programs, what sorts of programs to institute, who should benefit, and what level of government should be in control are debated every day. Additional analyses could shed light on these critical issues.

5.0 THE IMPACT OF CENTRAL CITY[1] FISCAL CONDITIONS ON THE DISTRIBUTION OF MSA POPULATION

This chapter presents an empirical examination of the relationship between central city fiscal policy and the distribution of MSA population between a central city and its suburbs. In the preceding chapter, we found evidence that central city fiscal policies affected land rents. Here we look to see whether this empirical evidence extends to population distribution. The model presented in CHAPTER 3 suggests that central city fiscal policies that raise the relative wage to lead to a smaller city population and a larger suburban population. An example of such a policy is seen in some economic redevelopment programs in which increased taxes on city households are used to pay for production subsidies. Such a policy may or may not lead to a larger MSA population (the model has no clear prediction here), but will result in suburban growth which, at least to some extent, comes at the expense of the central city. The analysis utilizes a panel of county level Census of Population and Census of Governments data spanning 1960 to 1990 to examine these issues. We find evidence

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1 "Central city" is use to refer to the hypothetical central business district of the monocentric city models; empirically, we use the (Census Bureau defined) central city political jurisdiction. Where the Census Bureau defines more than one central city for an MSA, the one with the larger population (i.e. that which is named first in the MSA's official name) is chosen. MSAs with no defined central city (e.g. Dutchess County, NY PMSA) have been eliminated from the sample.

that central city fiscal conditions are observed to have the expected effect on the relative size of an MSA's city and suburban populations. The following section provides a description of the empirical model. Section 5.2 describes the data set and variables. The estimation results are discussed in Sections 5.3 and 5.4, while the final section concludes.

5.1 THE MODEL

In this chapter, we examine the effect of central city fiscal conditions on the distribution of population in a metropolitan area, using the ratio of suburban population to MSA population as a dependent variable.[2] Obviously there are many factors which determine the size and distribution of an MSA's population--some are economic, but many are the result of historical or geographic accident. For example, larger land areas may be associated with larger (potential) populations. Older MSAs will have more densely populated cities. Geographic barriers and political boundaries may limit expansion in particular areas. Since we are unable to control for all such factors, we rely on the assumption that these unobservables are constant over time within an MSA in order to account for their influence, incorporating both time and MSA fixed effects. We explicitly control for the MSA growth rate since we expect growing MSAs to have relatively more suburban population growth than city population growth both for cultural (more people seem to prefer suburban life) and practical (there is typically more room for growth in the suburbs) reasons. We also must address any physical changes in the size of the city and MSA due to land annexation, etc. We obtain consistent MSA definitions by collecting data at the county level and then aggregating to the June 1996 Census Bureau MSA definitions. There was no significant change in the physical size of any of the counties over the time period in question (less than 0.1 percent), so land annexation does not appear to be a significant issue in terms of MSAs. There was more variation in

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2 For this analysis we define Asuburban@ as is most commonly seen in the literature, specifically, the Asuburban@ population of an MSA refers to all MSA residents not living in the central city.

the land area of the central cities; however, this proved difficult to deal with because of frequent missing values and inconsistent measurement. (For example, land area may be rounded to the nearest square mile in one period and the nearest tenth square mile in another). The three central cities which annexed significant land areas (greater than 10 percent) were simply eliminated from the analysis. Thus our estimating equation takes the form:

$$\ln\left(\frac{SUBPOP}{MSAPOP}\right) = \beta_0 - \beta_1 MSAGROW - \beta_2 SUBTAX - \beta_3 CITYTAX - \beta_4 SUBEXP - \beta_5 CITYEXP - \mu \quad \textbf{(34)}$$

where SUBPOP and MSAPOP represent the suburban and MSA population, MSAGROW is the MSA population change in the past ten years, SUBTAX and CITYTAX represent suburban and city tax variables, and likewise, SUBEXP and CITYEXP represent suburban and city expenditure variables. The dependent variable is used in natural log form. A complete list of variable definitions is included in APPENDIX 6, TABLE A7. As discussed below, because of data limitations, not all variables are available in all time periods.

We also consider two alternative dependent variables, the (natural log of the) ratio of new suburban housing units to new MSA housing units (where new implies constructed in the past ten years) and the (natural log of the) ratio of net suburban housing unit change to net MSA housing unit change. These variables are expected to move with population.

We expect city taxes to have a positive effect and city expenditures to have a negative effect on the suburb-MSA population ratio, *ceteris paribus*. On the other hand, suburban taxes and expenditures are expected to have the opposite effect. Recall that the model presented above predicted that who benefits from the public goods may be important, so we may expect differing effects for public goods that clearly benefit one group or another.

5.2 DATA

Data for this analysis is from the County and City Data Book Consolidated File, 1944-1977 and the 1983, 1988, and 1994 County and City Data Books.[3] These sources contain both demographic and housing data and MSA characteristics obtained from the decennial Census of Housing and Population and basic government taxation and expenditure data from the 1962, 1967, 1977, and 1987 Census of Governments (COG) (county data) and 1959-60, 1969-70, 1979-80, and 1989-90 Survey of Governments (SOG) (city data).[4] This data is assembled first at the county-level and then aggregated to the MSA-level so that consistent MSA definitions (those defined in 1996) can be used (NECMAs are used in New England). Subtracting MSA values from the center city values creates suburban variables. Unfortunately, city and county government data are from different fiscal years (typically two years apart, for example the 1967 COG is matched to the 1969-70 SOG). Other than accounting for inflation, there was no way of improving the comparibility of these data. It was not possible to even average say the data from the 1967 and 1972 COGs since different data are reported in each year. The complete data set consists of observations on 331 MSAs for each of the census year spanning 1960 to 1990. The Census defined 322 MSAs, PMSAs, and NECMAs in June 1996, four of which were in Puerto Rico and thus immediately eliminated from consideration.[5] Many other records (especially those from earlier Census years) are incomplete because Census Bureau publications report data only for cities with 25,000 or more residents. There are also a few MSAs that do not have central cities. The useable data set consists of observations on 294 different MSAs: 253 MSAs in 1960, 250 in 1970, 287 in 1980, and 279 in 1990. Two hundred and fifteen MSAs are represented consistently in all four Census years.

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3 This data was made available through the Inter-university Consortium for Political and Social Research (ICPSR).

4 Data from the 1962 COG was used (rather than the 1957 COG) because the 1957 data contained no information on expenditure by category.

5 We use the term MSA, generically, to refer to MSAs, PMSAs, and NECMAs.

Different tax and expenditure categories were reported from the COG and SOG in different years. The following table summarizes the data items available.

TABLE 6: Expenditure Categories By Data Source

Expenditure Category	COG 1962	SOG 1959-60	COG 1967	SOG 1969-70	COG 1977	SOC 1979-80
Police	X	X		X**	X	X
Fire		X		X**		
Highways	X	X	X	X	X	X
Education	X	X	X	X	X	X
Public Welfare	X	X	X	X		
Health. Hospitals	X	X	X		X	X
Sanitation. Sewerage		X*		X		X

No expediture data by category was reported in the 1994 County and City Data Book.
* Sanitation only
** Combined Police and Fire expenditures

Descriptive statistics for the data set can be found in APPENDIX 6. TABLE A8. The sample means seem to illustrate several interesting stylized facts, especially if one examines their changes over time. First, as we expect, the percentage of MSA population in the suburbs has risen 58.3 percent to over 63 percent between 1960 and 1990. This is quite a bit less than the 21 percentage point increase reported by O'Sullivan (1996, p. 251) for the 1948 to 1980 period. The difference is no doubt due both to sample differences and the known rapid suburbanization of the 1950s. Since 1960, central city population was growing on average less than 1 percent every 10 years, while suburban population increased at an average rate of 36 percent every 10 years. Similarly, central cities saw much slower rates of change in available housing units and a smaller proportion of new homes than in the suburbs (approximately 10 percent difference in each case). Central cities were also much more likely to see a negative net housing stock change. Interestingly, the relative rate of suburban versus city growth seems relatively constant over this time period as seen both in the consistent population growth rates and relative change in the physical housing stock (the proportion of new housing and net rate of change in the suburban versus MSA housing stock has remained relatively stable).

Real per capita taxes[6] and spending vary substantially from central city to suburb. Suburban real per capita taxes remained relatively constant over time at approximately $170 (1967$) although there was a substantial spike in the 1970 Census year (data from the 1967 Census of Governments) which could not be traced to any obvious outlier or miscoding in the data. Central city real per capita taxes, on the other hand, increased steadily between 1960 and 1990, from $61 in 1960 to $105 in 1990. A similar pattern can be seen in city and suburban spending. Real per capita central city spending doubled between 1960 and 1990 (from $113 to $262) while suburban spending was relatively flat.

Comparing the sample means across MSAs of different sizes can also be informative. For this analysis, the sample is divided into (approximate) quartiles based on initial MSA population (less than 100,000, 100,000 to 249,999, 250,000 to 749,999, and 750,000 or more). Descriptive Statistics by MSA size are presented in APPENDIX 6, TABLE A9. Not surprisingly, in large MSAs, a larger proportion of the population lives in the suburbs. Larger MSAs also have seen more suburban growth as measured by net changes in the housing stock and construction of new homes. Smaller MSAs are observed to have slower population growth rates both in the city and suburb (the smaller MSAs central cities decreased in size over this period, while the larger ones grew at a moderate pace).

Suburban real per capita taxes seem relatively constant across MSA size, while central city per capita taxes are substantially higher in larger MSAs. A similar pattern is seen on the spending side with the central cities of large MSAs spending more per capita than the central cities of smaller MSAs. Large MSAs are likely to have large central cities; thus, these differences are probably due

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6 All real amounts are in 1967 dollars and were calculated from the nominal figures using the July value Consumer Price Index (all goods).

to the increased level of public services seen in large cities as well as the increased cost of dealing with the social ills of the big city. Suburban spending, on the contrary, does not seem to be related to overall MSA size.

TABLE 7: Correlations between tax variables and population change variables

	Change in central city population	Change in suburban population	Change in MSA population
TOTAL			
CC per capita taxes	0.1898	0.3954	0.3512
Suburb per capita taxes	0.0982	-0.0336	0.0231
MSA Size 1 (Smallest)			
CC per capita taxes	-0.1808	0.2208	0.2288
Suburb per capita taxes	0.2111	-0.5198	-0.4018
MSA Size 2			
CC per capita taxes	-0.0994	0.1519	0.1303
Suburb per capita taxes	0.4537	-0.3790	0.0039
MSA Size 3			
CC per capita taxes	-0.0794	0.1276	0.1000
Suburb per capita taxes	0.2786	-0.2772	-0.0253
MSA Size 4 (Largest)			
CC per capita taxes	-0.0134	0.2749	0.1941
Suburb per capita taxes	0.2504	-0.0064	0.1279

Since our primary focus in this chapter is on the relationship of central city taxes and suburban and MSA growth, we naturally want to compare our fiscal variables across MSAs that experienced different levels of growth since 1960. TABLE 7 presents simple correlations between the per capita tax and population growth variables in our data set, for both the total sample, and the sub-samples by MSA size. Notice that in the total sample, central city per capita taxes are positively correlated with all three population growth measures, while suburban per capita taxes are negatively correlated with suburban population growth and positively correlated with city and total MSA growth. Note the stronger correlation between central city taxes and suburban population growth. The same correlations for the various size sub-samples are even more in tune with what our model predicts. Specifically, within each size class, central city taxes are negatively correlated with central city growth and positively correlated with suburban and MSA growth. Since these simple correlations seem to indicate support for our model's predictions, we now turn to a more detailed analysis.

5.3 Estimation and Results

Tables 8, 9, and 10 report the results of estimating several variations on equation (34).[7] In Table 8, we regress the log of the population ratio against MSA population change, suburban and central city tax variables, and a time trend. Since the expenditure variables cause us to lose observations (since, as discussed above, different expenditure categories are reported for different years), not entering any expenditure variables gives us the most useable observations (1,067) and the most MSAs (292). In Table 8, Column 1 reports OLS regression results. Note that the coefficients on our variables of interest, the real per capita city and suburban tax variables, are significant and have the expected signs. Higher suburban taxes are found to be negatively related to the population ratio, while city taxes exhibit a positive relationship. The percentage of suburban tax revenue raised through property taxes is also negative and significant indicating that higher property taxes reinforce the per capita tax effect in decreasing the size of the suburban population relative to the MSA. The percentage of city property taxes also tends to reinforce the relationship between city taxes and the population ratio. The population change variable is positive and significant (at the 5 level) as expected, indicating that faster growing MSAs have relatively larger suburbs.

The model presented in Chapter 3 suggests that the distribution of spending, not only overall spending and tax levels are important, so we run several regressions including various expenditure measures. These additional regressions also help to examine the robustness of the coefficient estimates for our tax variables. The County and City Data Book (CCDB) consistently

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7 The standard errors have been adjusted to account for the grouping in the data. T-statistics are reported in parentheses.

reported only two expenditure categories for both counties and cities over the 1960 to 1980 period. education and highway spending (no expenditure data for counties was reported for 1990). TABLE 9, Column 1 reports the OLS regression results adding the percentage of city and suburban expenditures on highways and education.[8] Because of the data limitations for this regression we use only 623 observations on 289 MSAs.

TABLE 8: Regression Results for the Simple Model

	1	*2*	*3*	*4*
Variable	**OLS**	**MSA Fixed Effects**	**Time Fixed Effects**	**MSA and Time FE**
Real Suburban Per Capita	-1.619 ***	-0.285 ***	-1.603 ***	-0.243 ***
Taxes	(-11.968)	(-7.204)	(-22.650)	(-6.054)
% Suburb Tax Rev. from	-0.505 ***	-0.036 **	-0.529 ***	-0.055 **
Property Tax	(-8.173)	(-2.303)	(-10.010)	(-2.300)
Real City Per Capita Taxes	1.171 ***	0.608 ***	1.139 ***	0.360 ***
	(4.043)	(6.655)	(8.193)	(3.718)
% City Tax Rev. from	0.084 *	-0.093 ***	0.095 ***	0.002
Property Tax	(1.882)	(-3.616)	(2.762)	(0.065)
Population Change	0.104 **	-0.057 ***	0.116 ***	-0.002
	(2.172)	(-2.804)	(2.781)	(-0.177)
Intercept	0.001	-0.442 ***	0.012	-0.450 ***
	(0.016)	(-16.168)	(0.219)	(-14.049)
R-Squared	0.4245	0.2286	0.4238	0.2383

The dependent variable is Ln(population ratio). N=1067 observations on 282 MSAs.

The coefficients on the real per capita tax and percent property tax variables are very similar to the previous regression, although the city property tax variable is insignificant in this case. Suburban spending on education has a negative and significant impact on the population ratio. This is not the effect we expect. Suburban highway expenditures are positive and significant as predicted. Both city expenditure categories have negative and significant coefficients, as our model would predict, indicating that cities that spend on such public goods are relatively more attractive

8 The education variable is still suspect since many central cities reported a value of 0, indicating that there was an independent school district operating in the city. Little change is observed running the same regression without the education variable.

locations for households. The MSA population change and the trend variable were both insignificant in this regression

TABLE 9: Regression Results with Expenditures

Variable	*1* OLS	*2* MSA Fixed Effects	*3* Time Fixed Effects	*4* MSA and Time FE
Real Suburban Per Capita Taxes	-1.402 ***	-0.233 ***	-1.362 ***	-0.199 ***
	(-10.687)	(-5.363)	(-16.558)	(-4.428)
% Suburb Tax Rev. from Property Tax	-0.445 ***	-0.028 *	-0.505 ***	-0.027
	(-7.436)	(-1.686)	(-8.403)	(-0.998)
% Suburb Spend. on Education	-0.142 **	-0.018	-0.140 ***	-0.030 *
	(-2.369)	(-1.097)	(-7.113)	(-1.835)
% Suburb Spend. on Highways	0.343 *	0.027	0.345 ***	0.099
	(1.792)	(0.390)	(2.990)	(1.417)
Real City Per Capita Taxes	1.534 ***	0.734 ***	1.548 ***	0.395 **
	(3.602)	(4.700)	(6.755)	(2.381)
% City Tax Rev. from Property Tax	0.078	-0.193 ***	0.081 *	-0.149 ***
	(1.487)	(-4.089)	(1.767)	(-3.216)
% City Spend. on Education	-0.347 ***	-0.203 ***	-0.341 ***	-0.114 *
	(-3.099)	(-3.536)	(-3.792)	(-1.956)
% City Spend. on Highways	-0.427 **	-0.107	-0.400 **	0.065
	(-2.001)	(-1.117)	(-2.131)	(0.658)
Population Change	0.070	-0.016	0.075	0.027
	(1.143)	(-0.432)	(1.189)	(0.721)
Intercept	0.047	-0.363 ***	0.070	-0.410 ***
	(0.506)	(-8.277)	(1.132)	(-9.447)
R-Squared	0.4530	0.3603	0.4526	0.4069

The dependent variable is ln(population ratio). N=623 observations on 289 MSAs.

The CCDB reports more detailed expenditure data for cities than for suburbs. In order to take advantage of this, TABLE 10 presents regressions containing these additional central city expenditure variables (city spending on sanitation, fire protection, and police protection), deleting the suburban expenditure variables (education and highways) in order to maximize available observations. We continue to find negative and significant coefficients on suburban per capita taxes and positive and significant coefficients on the city per capita tax variable. Property taxes seem to reinforce this effect in both cases. Among the city expenditure categories, highway and sanitation spending have significant and negative coefficients, while police expenditures are positive and significant. Increased police spending may be associated with cities with high crime rates (and crime is a disamenity) which could explain the increased suburban populations. Otherwise, increased public goods spending seems to increase the relative attractiveness of the central city.

TABLE 10: Regression Results with More City Expenditure Categories

	1	*2*	*3*	*4*
Variable	**OLS**	**MSA Fixed Effects**	**Time Fixed Effects**	**MSA and Time FE**
Real Suburban Per Capita Taxes	-2.305 ***	0.336	-2.334 ***	0.271
	(-11.107)	(0.929)	(-14.835)	(0.757)
% Suburb Tax Rev. from Property Tax	-0.311 **	-0.092	-0.302 ***	-0.051
	(-2.404)	(-0.903)	(-3.124)	(-0.497)
Real City Per Capita Taxes	0.996 ***	0.337 *	0.924 ***	0.244
	(3.241)	(1.936)	(4.370)	(1.363)
% City Tax Rev. from Property Tax	0.306 ***	-0.452 ***	0.316 ***	-0.410 ***
	(4.988)	(-3.744)	(5.263)	(-3.369)
% City Spend. on Education	-0.156	0.084	-0.070	0.164
	(-1.082)	(0.654)	(-0.500)	(1.218)
% City Spend. on Highways	-0.725 ***	-0.245	-0.633 **	-0.046
	(-2.728)	(-0.938)	(-2.410)	(-0.162)
% City Spend. on Sanitation	-0.421 **	-0.193	-0.452 **	-0.127
	(-1.973)	(-0.684)	(-2.166)	(-0.450)
% City Spend. on Fire Protection	-0.503	-0.649	-0.416	-0.458
	(-1.107)	(-0.863)	(-0.779)	(-0.610)
% City Spend. on Police	1.433 ***	0.929	1.323 ***	0.756
	(3.856)	(1.596)	(3.093)	(1.298)
Population Change	0.047	-0.101	0.103	0.003
	(0.549)	(-0.776)	(0.986)	(0.024)
Intercept	-0.152	-0.257	-0.169	-0.331 **
	(-1.032)	(-1.604)	(-1.443)	(-2.025)
R-Squared	0.4833	0.4374	0.4873	0.4598

Dependent Variable is Ln(population ratio). N=366 observations on 279 MSAs.

Columns 2, 3, and 4 of the preceding tables add MSA and time fixed effects to the regressions reported in Column 1.[9] Column 2 of each table presents the regression results including

9 For each model, we perform a Wu-Hausman specification test (see CHAPTER 4 for a description) to check the appropriateness of the fixed effects model. In each case we reject the null hypothesis that the fixed and random effects coefficients are equivalent indicating that there is correlation between

MSA fixed effects. Note that the coefficient on the percent of city tax revenue from property taxes is consistently negative with the MSA fixed effects, while it was always positive in the Column 1 regressions. The coefficient on MSA population also changes sign when we add the MSA fixed effects. The magnitude of all of the coefficients is substantially decreased and in the TABLE 10 model, city per capita taxes have become insignificant. Column 3 reports our regression results including time fixed effects, with results virtually identical to those seen in Column 1. The final column includes both time and MSA fixed effects with results very similar to Column 2.

Changes in our dependent variable (suburban population divided by MSA population) could be caused by either changes in the city or suburban population or both. (That is, a decrease in the population ratio could imply a decrease in the suburban population, an increase in the city population, or both). To determine whether central city fiscal policies are primarily affecting central city populations or suburban populations, we run several regressions using (the natural log of) central city and suburban population separately as dependent variables. TABLE 11 presents the OLS regression results for city and suburban population regressed against both city and suburban tax variables.[10] The suburban per capita tax variable has a negative effect on suburban population (Column 1) while the city tax variable has a positive effect (Column 2). Both suburban and city taxes seem to have a positive effect on city population (contrary to our expectations); however, including MSA fixed effects alters these results. (See preceding footnote). Our model predicts that city taxes should have a large effect on suburban population, and comparing the R^2's for the regressions in TABLE 11, the largest R^2 is recorded for the regression of city tax variables on suburban population.

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the specific effects and the explanatory variables and the appropriateness of the fixed effects model.

10 We also run these regressions including MSA and time fixed effects with very little change in the results. The only notable exception is that when we include MSA fixed effects, the city tax variable has the expected negative (and significant) effect on city population and the suburban tax variable has an insignificant effect on city population.

TABLE 11: OLS Regression Results with Population Dependent Variables

	1	*2*	*3*	*4*
Variable	**ln(Suburb Population)**		**ln(Central City Population)**	
Real Suburban Per Capita Taxes	-1.850 *** (-4.740)	--	1.229 *** (3.445)	--
% Suburb Tax Rev. from Property Tax	-0.668 *** (-4.093)	--	0.324 *** (2.881)	--
Real City Per Capita Taxes	--	7.753 *** (4.976)	--	4.362 *** (4.172)
% City Tax Rev. from Property Tax	--	-0.365 * (-1.717)	--	-0.407 ** (-2.227)
Population Change	0.330 (1.537)	0.375 * (1.894)	0.010 (0.055)	-0.028 (-0.149)
Trend	0.143 *** (7.523)	0.019 (0.610)	0.057 *** (3.332)	-0.048 * (-1.761)
Intercept	12.644 *** (58.440)	11.523 *** (59.090)	10.937 *** (64.573)	11.499 *** (63.910)
R-Squared	0.0698	0.1871	0.0327	0.0881

The dependent variable is Ln(suburban population) or Ln(city population). N=1067 observations on 292 MSAs.

TABLE A10 in APPENDIX 6 reports the OLS regressions for the model of TABLE 8 by MSA size category. The results differ in almost no remarkable way from each other or from the similar results for the whole sample, the only exception being that the coefficients on central city per capita taxes is insignificant for the smallest size group. F-tests (Chow, 1960) performed on the sub-samples indicate no significant difference between the middle size groups, and significant (at the 1 percent level) differences between every other combination. The last column of TABLE A9 reports the results of dummy variable analysis of the size differences. The size 1 and 2 dummies (smallest two groups) have significant negative coefficients while the coefficient on the size 3 dummy is insignificant. Although not reported in the table, adding MSA fixed effects to this model results in insignificant coefficients on all three dummies.

5.4 Alternative Dependent Variables

We consider two other dependent variables which we expect to be related to the population ratio examined above: the natural log of the ratio of new homes built in the suburb to new homes built in the MSA and the natural log of the ratio of the change in suburban housing units to the change in total MSA housing units. The simple correlation coefficient between the population ratio and the new homes ratio is 0.87 while it is 0.64 between the population ratio and the net change in housing units ratio. TABLES 12 and 13 present the results of regressing these dependent variables against real city and suburban per capita taxes, the percent of tax revenue from property taxes, and the MSA population change (model comparable to TABLE 8). As above, Column 1 presents OLS regression results, Column 2 adds MSA fixed effects, Column 3 includes time fixed effects and Column 4 includes both MSA and time fixed effects. The OLS results for dependent variables look very similar to the results seen with the population ratio. The per capita tax variables are both significant and have the expected signs. When we add MSA fixed effects, the suburban tax variable becomes positive and significant in the new home ratio estimation (TABLE 12). Perhaps this implies that higher taxes are needed in areas with more new construction to pay for additional services. In the net change in housing stock ratio model, the city tax variable is insignificant when we add the MSA fixed effects. The results with the time fixed effects (Column 3) are much like the OLS results, while the city per capita tax variable is insignificant in both cases when we add both MSA and time fixed effects.

Although not as consistent as the results seen with the population ratio, our alternative dependent variables also seem to at least partially support our predictions that central city taxes are an important determinant of suburban population shifts.

TABLE 12: Regression Results Using the Ratio of New Housing Units

	1	*2*	*3*	*4*
Variable	**OLS**	**MSA Fixed Effects**	**Time Fixed Effects**	**MSA and Time FE**
Real Suburban Per Capita	-1.548 ***	0.177 **	-1.506 ***	0.207 **
Taxes	(-9.119)	(1.987)	(-15.866)	(2.288)
% Suburb Tax Rev. from	-0.629 ***	-0.024	-0.717 ***	-0.145 ***
Property Tax	(-8.325)	(-0.682)	(-10.114)	(-2.658)
Real City Per Capita Taxes	1.474 ***	0.586 ***	1.476 ***	0.196
	(4.943)	(2.846)	(7.919)	(0.901)
% City Tax Rev. from	0.119 **	-0.075	0.100 **	-0.045
Property Tax	(2.364)	(-1.292)	(2.176)	(-0.697)
Population Change	0.044	-0.033	0.029	0.026
	(0.785)	(-0.725)	(0.526)	(0.538)
Intercept	0.137	-0.470 ***	0.211 ***	-0.295 ***
	(1.578)	(-7.629)	(3.210)	(-4.089)
R-Squared	0.3074	0.0006	0.3034	0.0029

The dependent variable is Ln(new housing unit ratio). N=1067 observations on 292 MSAs.

TABLE 13: Regression Results Using the Ratio of Net Change in Housing Units

	1	*2*	*3*	*4*
Variable	**OLS**	**MSA Fixed Effects**	**Time Fixed Effects**	**MSA and Time FE**
Real Suburban Per Capita	-1.573 ***	-0.547 ***	-1.579 ***	-0.499 **
Taxes	(-6.367)	(-2.748)	(-10.647)	(-2.472)
% Suburb Tax Rev. from	-0.469 ***	-0.105	-0.411 ***	0.212 *
Property Tax	(-5.414)	(-1.332)	(-3.725)	(1.743)
Real City Per Capita Taxes	1.915 ***	0.405	1.920 ***	0.018
	(3.862)	(0.879)	(6.675)	(0.038)
% City Tax Rev. from	0.044	-0.538 ***	0.079	-0.175
Property Tax	(0.574)	(-3.925)	(1.102)	(-1.164)
Population Change	-0.284 **	-0.213 *	-0.266 ***	-0.070
	(-2.216)	(-1.881)	(-2.826)	(-0.591)
Intercept	0.087	0.074	0.017	-0.419 ***
	(0.722)	(0.533)	(0.166)	(-2.569)
R-Squared	0.1749	0.0441	0.1739	0.0537

The dependent variable is Ln(net change in housing units ratio). N=1067 observations on 292 MSAs.

5.5 CONCLUSION

This chapter presents an empirical analysis of the relationship between the distribution of metropolitan area population between central city and suburb over time. We find that central city taxing and spending behavior have a significant impact on the distribution of population within an MSA. Specifically, we find that MSAs in which the central city has higher real per capita taxes tend to have a relatively larger proportion of population in the suburb. Central city expenditures on certain public goods, most notably sanitation and roads and highways, tend to lessen this effect. These results have important implications for the design of local and regional economic development policies. Politicians and urban planners need to take the interjurisdictional effects of their policies into account in order to best achieve their goals and serve the public interest.

A possible extension to the analysis here would be to consider alternative definitions of "suburb." One could, for example, examine the relationship between the central county (as opposed to city) and the rest of the MSA for multi-county MSAs, or one could concentrate only on the central county defining the suburban population as all central county population not in the central city. This might be done to account for the fact that commuting patterns (and thus location choice decisions) differ between "near suburban" residents and "far suburban" residents. Another improvement would be to collect data from earlier time periods during which more rapid suburbanization occurred; however, comparable county data is not readily available for the pre-1940 period and individual household data from that time is not as detailed as is available today.

6.0 CONCLUSION

6.1 Summary of Results

This dissertation examines the interrelationship of cities and suburbs from a local public finance perspective. We argue that the expenditure and taxation decisions of a central city can have important impacts on neighboring suburbs. Following a general introduction and literature review in the first two chapters, CHAPTER 3 develops an equilibrium model of inter- and intra- urban location which is used to analyze the theoretical effects of various central city taxing and spending policies. The model illustrates that even when the central city government is providing a public good efficiently, equilibrium land rent and wage adjustments will occur across the metropolitan area. Whenever a change in city taxes or public goods provision leads to an adjustment in the gross wage paid to city residents, suburban residents will be affected since their gross wage must change as well. This wage change may lead to additional adjustments in equilibrium. The analysis above shows that there is virtually no difference in the effects of a lump-sum tax or property tax; however, the two wage taxes considered (one paid by all those who work in the city and one paid by city residents only) differ substantially. Cities which tax the wages of suburban residents will see much less out-migration and experience higher city land values than those that can tax only city residents' wages. The model also shows that the mix of public goods (i.e., whether they benefit households or firms), as well as who bears the burden of financing them, has implications regarding land values and shifts in relative population and production.

We undertake two empirical examinations of the affects of a central city's fiscal policies on its suburbs. First in CHAPTER 4, we examine the relationship between central city tax and spending policies and suburban land rents using a cross section of Census block-level data for 28 MSAs. The data set was compiled from the 1990 Census of Housing and Population and the 1992 Census of Governments. We find that the fiscal policies of central city governments have significant impacts on land rents faced by suburban residents. In particular, we find that per capita central city taxes consistently lead to significantly higher suburban land values even after controlling for a variety of factors known to affect land rent. Further support comes from the significance of central city spending on public goods such as fire and police protection, roads and public works, and libraries. As expected, city spending on public goods that clearly benefit households (parks and libraries) has a negative impact on suburban land rents, while spending on other goods has a positive impact. Finally, we find that city spending on goods like administration and fire protection (which would seem to have little direct impact on suburban residents) has a statistically significant effect on suburban land rents.

In CHAPTER 5, we turn to an empirical examination of the relationship between central city fiscal policies and the distribution of population within an MSA. The model presented in CHAPTER 3 suggests that fiscal policies leading to changes in the relative wage (wage compared to land rent) can lead to shifts in metropolitan population since one jurisdiction may become relatively more or less attractive. In this chapter, we use a panel of data for a sample of approximately 300 MSAs spanning 1960 to 1990 to examine the effects of central city taxing and spending behavior on the relative size of the suburban population over time. We find that higher central city taxes are consistently associated with a relatively larger proportion of MSA residents living in the suburbs, even accounting for other factors (MSA growth rate, suburban tax structure) which may affect the attractiveness of the suburbs. We also find evidence that provision of certain public services in the central city (as evidenced by government spending) can make the city more attractive to residents.

6.2 Potential Extensions and Improvements

The theoretical model could benefit from several further extensions that should be considered for future research. The addition of commuting costs would specifically allow the examination of the effects of public goods (highways, mass transit) designed to lower such costs. Such public goods directly benefit suburban households more than city households and would no doubt add another interesting facet to the model. Other authors in the local public finance literature have discussed the different incentives of owners and renters. One could easily model two types of households (owners and renters) within this framework, allowing owners' utility to increase with land rents while renters= utility decreases with higher land rents. It might also be interesting to see how suburban growth limits would affect the equilibrium in this model. If a suburb limits how much in-migration can occur, this would prevent the complete adjustment of land rents to reach equilibrium as we saw above. As discussed by Gyourko and Tracy (1989c), rent-seeking by elected officials or unions has an impact on equilibrium land rents. Incorporating public sector unions into the two jurisdiction model would allow one to examine not only rent-seeking behavior but also the impact of residency rules.

The most significant improvements in the empirical models would be the application of additional data resources. Expanding the block-level data set used in Chapter 4 to multiple years would allow for better control of the correlated MSA specific effects by taking advantage of the cross time variation. Use of census data at the individual level would also be beneficial as such a data source would allow a more precise matching of demographic characteristics to government finances. Addition of earlier time periods to the panel data analysis of Chapter 5 may also provide new insights as the first large waves of suburbanization occurred before the time period studied in this analysis.

6.3 General Conclusion

The political fragmentation of modern metropolitan areas has become a topic of heated debate. There are those who argue that this system promotes efficiency through competition, while others hold the belief that numerous political jurisdictions lead to inefficiencies because of needless duplication of services and lost economies of scale. The only certainty in this debate is that the existence of multiple jurisdictions has an impact on the behavior of economic agents in metropolitan areas. Nevertheless, this important aspect of regional economies is often neglected in our theoretical and empirical modeling. This dissertation attempts to address this neglect in regards to local fiscal conditions and the behavior of households and firms.

Further work along these lines should be pursued given the potentially important policy implications involved. Regional economic (re)development is an important issue for many of our nation's metropolitan (and not-so-metropolitan) areas . Difficult questions regarding how to finance such programs, what sorts of programs to institute, who should benefit, and what level of government should be in control are debated every day. Additional analyses could shed light on these critical issues.

APPENDICES

APPENDIX 1

COMPARATIVE STATICS FOR SINGLE JURISDICTION PROPERTY TAX

In the single jurisdiction model, the type of tax used to finance the public good makes almost no difference in the comparative statics results. This appendix presents the derivations of the rent and wage differentials for the property tax (with rate t_r^H on residential land and t_r^F on land used in production) and wage tax (with tax rate t_w on wages).

Equations (A1.1) and (A1.2) are the household equilibrium conditions for the property tax

$$V = V(w, r_h^*, g) = k \qquad \textbf{(A1.1)}$$

$$V = V(w, r, g) = k \qquad \textbf{(A1.2)}$$

and wage tax cases, respectively, where $r_H{}^* = (1-t_r^H)r$ and $w^* = (1-t_w)w$.

Equations (A1.3) and (A1.4) are the firm's respective equilibrium conditions, where $r_F{}^* = (1-t_r^F)r$.

$$C = C(w, r_F^*, g) = 1 \qquad \textbf{(A1.3)}$$

$$C = C(w^*, r, g) = 1 \qquad \textbf{(A1.4)}$$

Totally differentiating and rearranging, we can solve for the land rent and wage differentials, presented in equations (A1.5), (A1.6), (A1.7), and (A1.8), where P_g^* ($=(1-t_w)P_g$) is the implicit value of the public good evaluated in pre-tax dollars (in the wage tax model) and all other notation is as defined in the main body of the paper.

$$\frac{dr}{dg}=\frac{-1}{(1-t_r^H)L_H-(1-t_r^F)L_p}[(rL_H\frac{dt_r^H}{dg}-NP_g)-(rL_P\frac{dt_r^F}{dg}-XC_g)] \quad \textbf{(A1.5)}$$

$$\frac{dw}{dg}=\frac{hL_p}{(1-t_r^H)L_H-(1-t_r^F)L_p}[(1-t_r^F)(r\frac{dt_r^H}{dg}-\frac{N}{L_H}P_g) -(1-t_r^H)(r\frac{dt_r^F}{dg}-\frac{X}{L_p}C_g)] \quad \textbf{(A1.6)}$$

$$\frac{dr}{dg}=\frac{-1}{(1-t_w)L_H-L_p}[N(w\frac{dt_w}{dg}-P_g^*)-XC_g] \quad \textbf{(A1.7)}$$

$$\frac{dw}{dg}=\frac{hL_p}{(1-t_w)L_H-L_p}[N(\frac{w}{L_p}\frac{dt_w}{dg}-\frac{P_g^*}{L_H})-\frac{X}{L_p}C_g] \quad \textbf{(A1.8)}$$

Again we will define efficient government provision as the case in which the sum of the marginal benefits of the public good equal the associated marginal costs. Thus, equations (A1.9) and (A1.10) must hold for the property tax and wage tax, respectively.

$$NP_g - X C_g = rL_H \frac{dt_r^H}{dg} - rL_P \frac{dt_r^F}{dg} \qquad \textbf{(A1.9)}$$

$$NP_g^{\bullet} - X C_g = Nw \frac{dt_w}{dg} \qquad \textbf{(A1.10)}$$

Combining equations (A1.5) through (A1.10) we can see that the comparative statics results derived for the lump-sum case hold, almost without modification, for the other two taxes under consideration. Specifically, there will be no change in land rents as long as the efficient government condition holds, and wages adjust only when the tax burden is disproportionate to the benefit received by one group. Wages rise when households pay for public goods that benefit firms, and fall when the reverse is true.

APPENDIX 2

POPULATION COMPARATIVE STATICS

This appendix provides the comparative statics of population change for both the single jurisdiction model as derived by Roback (1980) and for the two jurisdiction model presented in SECTIONS 3.2 and 3.3.

A2.1. SINGLE JURISDICTION MODEL

We will analyze population changes by totally differentiating the land market clearing condition. Recall that supply of land in a given city, L, is exogenous. Market clearing implies that L is equal to the sum of the land demanded by households (L_H) and the land demanded by firms (L_p). The consumers' utility maximization problem gives us the quantity of land consumed by each household, $h = -V_r\, V_w$. Thus, total land demanded by households is $L_H = hN$. The land market clearing condition can be written as

$$L = hN - L_p \qquad \textbf{(A2.1)}$$

By Sheppard's Lemma the unit cost function yields the firms' input demand functions, specifically, $N = C_w X$ (demand for labor) and $L_p = C_r X$ (demand for land). Using this, we can rewrite the land market clearing condition as

$$L = \frac{N}{C_w}(hC_w - C_r) \quad \textbf{(A2.2)}$$

Totally differentiating and rearranging, it is not trivial to show that

$$\hat{N} = -\hat{h}\zeta_{Lc} - (\hat{w} - \hat{r})\sigma_{wr}\zeta_{Lp} \quad \textbf{(A2.3)}$$

where the notation $\hat{x} = dx/x$, ζ_{Lc} is the share of land used in consumption, ζ_{Lp} is the share of land used in production, and σ_{wr} is the cross elasticity of substitution in production. Thus, we expect population to decrease with increases in land consumed per capita. Population will also fall with increases in the relative wage rate since labor demand will fall as firms substitute away from high priced labor. The magnitude of this effect increases with the elasticity of substitution. We concluded above that the relative wage rate falls in locations providing extra benefits to households, we should expect to see larger populations in such areas. It is easy to see that production and population must move in the same direction by substituting (A2.3) into the demand for labor expression, $N = C_w X$ (which implies that $dX/X = (dN/N)/C_w$).

A2.2. Two Jurisdiction Model

We can calculate the three relevant expressions for population change (central city population, suburban population and MSA population) by totally differentiating the three corresponding land market clearing conditions, given below. (Where L_c (=L_H + L_p) is the (exogenous) total land area of the central city and L_s is the (exogenous) land area of the suburb).

$$L_c = \frac{N_c}{C_w}(h_c C_w - C_{rc}) - \frac{N_s}{C_w}C_{rc} \quad \textbf{(A2.4)}$$

$$L_s = h_s N_s \tag{A2.5}$$

Totally differentiating and rearranging it is possible to show that

$$L = \frac{N_c}{C_w}(h_c C_w - C_{r_c}) - \frac{N_s}{C_w}(h_s C_w - C_{r_c}) \tag{A2.6}$$

$$\hat{N}_c = \frac{1}{NL_H - N_c L_p}[-\hat{h}_c NL_H - \hat{h}_s N_s L_p - (\hat{w} - \hat{r})\sigma_{wr} N L_p] \tag{A2.7}$$

$$\hat{N} = \frac{-1}{NL_H - N_c L_p}[\hat{h}_c N_c L_H - \hat{h}_s N_s L_H - (\hat{w} - \hat{r})\sigma_{wr} N_c L_p] \tag{A2.8}$$

$$\hat{N}_s = -\hat{h}_s \tag{A2.9}$$

We thus expect to see both MSA and central city population fall when the relative wage increases.

APPENDIX 3

COMPARATIVE STATICS ALLOWING FOR EXTERNALITY EFFECT

This appendix presents the two jurisdiction model comparative statics results for the per capita/per unit of output tax and the wage taxes, allowing suburban residents to benefit from central city public goods. (The property tax is virtually identical).

By their very nature, some public goods provided by the city government benefit only central city residents, while the benefits from others may have significant spillovers to suburbanites. To capture this reality, recall that the suburban utility function includes as an argument the level of public goods provided in the city, g_c.

$$V_s = V_s(w, r_s; t_s^H, g_s, g_c) = k \qquad \text{(A3.1)}$$

When we differentiate (A3.1) and solve for suburban land rents we find

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}\left[\frac{dw}{dg_c} - P_{gc}^s\right] \qquad \text{(A3.2)}$$

where $P_{gc}^s = V_{gc}^s / V_w$ is the external benefit (in terms of money) received by suburban resident.

By substituting the appropriate wage differential in for dw/dg_c, equation (A3.2) can be used to find the suburban land rent differential for the per capita/per unit of output tax and the type I wage tax. For the type II wage tax (paid only be city residents), the gross wage differential (dw^*/dg_c) is used in place of dw/dg_c. We will define $\phi_{cs} \subset [0,1]$, the ratio of the benefit from the public good received by suburbanites to the benefit received by city residents, such that

$$P^s_{gc} = \phi_{cs} P^c_{gc} \tag{A3.3}$$

Thus, by using (A3.2), (A3.3), and the appropriate wage differential found in Section III, we find equations (A3.4), (A3.5), and (A3.6), the suburban land rent differential for the per capita/ per unit of output tax, the type I wage tax and the type II wage tax, respectively.

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}\left[\frac{L_H - L_p}{L_H - N_s h_c - L_p}\frac{dt^H_{rc}}{dg_c} - \frac{L_H - L_p}{L_H - N_s h_c - L_p} P^c_{gc} - \phi_{cs} P^c_{gc}\right] \tag{A3.5}$$

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}\left[\frac{(1-t_w)L_H - L_p}{(1-t_w)(L_H - N_s h_c) - L_p}(-P^c_{gc}) - \phi_{cs} P^c_{gc}\right] \tag{A3.4}$$

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}\left[\frac{(1-t_w)L_H - L_p}{(1-t_w)(L_H - N_s h_c) - L_p} w \frac{dt_w}{dg_c} - \frac{(1-t_w)L_H - L_p}{(1-t_w)(L_H - N_s h_c) - L_p} P^{c*}_{gc} - \phi_{cs} P^c_{gc}\right] \tag{A3.6}$$

Let us first consider the property tax case (equation (A3.4)). If there is no cross subsidization (i.e., $dt_{rc}^{H}/dg = P_{gc}^{c}$) then the first two terms cancel, leaving $dr_s/dg = h_s^{-1}\phi_{cs}P_{gc}^{c}$. Thus suburban land rents will increase if households benefit from the public good (and be unchanged otherwise). Intuitively, suburbanites in this MSA would receive a free benefit; the resulting in-migration would result in higher land rents.

If households subsidize firms (i.e., $dt_{rc}^{H}/dg > P_{gc}^{c}$), then suburban land rents will rise since suburban residents (who do not pay the property taxes) would be relatively better off. This is the same result obtained in SECTION 3.2 above, but here we can see that the magnitude of the increase in suburban rents will increase as suburban residents receive more benefit.

Above we illustrated that if the taxes of firms subsidize public goods which benefit households, then suburban rents will decrease. As the suburban benefit rises (i.e., ϕ_{cs} becomes larger), this decrease in r_s will shrink in magnitude, remaining negative as long as $\phi_{cs} < (L_H - L_P)/(L_H - N_s h_c - L_P)$. When ϕ_{cs} exceeds this value, the external benefit to the suburban residents has become large enough to outweigh the effects of the extra benefits that city residents are receiving. The suburb is relatively more attractive than the central city to those moving to the MSA.

For the wage tax cases we need only consider cases in which households receive benefit from the public good. If only firms benefit, then the results in SECTION 3.3 apply without modification since in this model there are no firms located in the suburbs. Recall that for the Type I wage tax, if only center city households benefit (i.e., $\phi_{cs} = 0$ and $P_{gc}^{c} = dt_w/dg_c > 0$), then the suburban residents are paying taxes for a public good from which they receive nothing. This makes the suburb less attractive and we concluded that suburban rents would fall. If we allow suburbanites to receive some benefit, this decrease will be tempered. If the suburbanites receive sufficient benefit (to make up for the taxes paid to the central city government) then suburban land rents may rise as the suburb becomes the preferred location (i.e., if $\phi_{cs} > [(1-t_w)L_H - L_P]/[(1-t_w)(L_H - N_s h_c) - L_P]$).

In the same situation for the Type II wage tax, any external benefit received by the suburban dwellers will make that location relatively more attractive since they are not paying for its provision. Thus suburban land rents will rise in relation to the size of ϕ_{ts}.

APPENDIX 4

COMPARATIVE STATICS FOR TWO JURISDICTION PROPERTY TAX

This appendix presents the comparative statics for the property tax case in the two jurisdiction model. Equations (A4.1), (A4.2), and (A4.3) are the city household, suburban household, and firm equilibrium conditions, respectively, where $r_c^{H*} = (1-t_{rc}^{H})r_c$ and $r_c^{F*} = (1-t_{rc}^{F})r_c$ are the tax-inclusive rents of land used for housing and production.[1]

$$V_c = V_c(w, r_c^{H*}, g_c) = k \qquad \textbf{(A4.1)}$$

$$V_s = V_s(w, r_s^{H*}, g_s, g_c) = k \qquad \textbf{(A4.2)}$$

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1 We also analyzed a uniform property tax case, with similar results, which can be easily derived from what is presented here.

$$C = C(w, r_c^{F*}, g_c) = 1 \qquad \textbf{(A4.3)}$$

By differentiating (A4.1) and (A4.3) and making use of the fact that $dr_c^{H*}\ dg_c$ = $(1-t_{rc}^{H})dr_c\, dg_c - r_c dt_{rc}^{H}\ dg_c$, we can solve for equation (A4.4), the city land rent differential.

$$\frac{dr_c}{dg_c} = \frac{-1}{(1-t_r^H)(L_H - N_s h_c) - (1-t_r^F)L_p}\left[(N_s - N_c)\left(r_c h_c \frac{dt_{rc}^H}{dg_c} - P_{gc}^c\right) - \left(r_c L_P \frac{dt_{rc}^F}{dg_c} - XC_g\right)\right] \qquad \textbf{(A4.4)}$$

The efficient government condition given in SECTION 3.2 can be modified for the property tax case, such that

$$N_c P_{gc}^c - XC_{gc} = L_H r_c \frac{dt_{rc}^H}{dg_c} - L_p r_c \frac{dt_{rc}^F}{dg_c} \qquad \textbf{(A4.5)}$$

Again assuming that suburbanites receive no benefit from the public good, we can solve for the city land rent, wage, and suburban land rent differentials which are presented in equations (A4.6), (A4.7), and (A4.8).

$$\frac{dr_c}{dg_c} = \frac{-1}{(1-t_r^H)(L_H - N_s h_c) - (1-t_r^F)L_p}\left[N_s\left(r_c h_c \frac{dt_{rc}^H}{dg_c} - P_{gc}^c\right)\right] \qquad \textbf{(A4.6)}$$

$$\frac{dw}{dg_c} = \frac{(1-t_r^H)L_H - (1-t_r^F)L_p}{(1-t_r^H)(L_H - N_s h_c) - (1-t_r^F)L_p}[r_c h_c \frac{dt_{rc}^H}{dg_c} - P_{gc}^c] \quad \textbf{(A4.7)}$$

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}(\frac{(1-t_r^H)L_H - (1-t_r^F)L_p}{(1-t_r^H)(L_H - N_s h_c) - (1-t_r^F)L_p})[r_c h_c \frac{dt_{rc}^H}{dg_c} - P_{gc}^c] \quad \textbf{(A4.8)}$$

Comparing these to equations (14), (15), and (16) in SECTION 3.2. above, the similarities are immediately evident. All comparative statics results discussed there hold for the property tax case without modification.

APPENDIX 5

SUPPLEMENTAL TABLES FOR CHAPTER 4

TABLE A1: Variable Definitions for CHAPTER 4 Data Set

Data sources are indicated by the following code:

(1) U.S. Census Bureau, Summary Tape File 3, 1990
(2) U.S. Census Bureau, Census of Governments, Financial Statistics, 1992
(3) U.S. Census Bureau, School District Special Tabulation, 1990
(4) U.S. Census Bureau, County and City Data Book, 1994
(5) Places Rated Almanac, 1997

Dependent variable:
Natural log(median owner-occupied home price in current dollars) (1)

Explanatory variables:
Percent of housing units in block built in the last year (1989) (1)
Median year built for housing units in block (1)
Percent of housing units in block with 1 bedroom (1)
Percent of housing units in block with 2, 3, 4, or 5+ bedrooms are defined analogously. Omitted category is no bedrooms (1)
Average number of rooms per housing unit (1)
Percent of housing units in block without complete plumbing (1)
Percent of housing units in block vacant (1)
Distance (in yards) from the geographic center of the block to the geographic center of the central city jurisdiction (1)
Student-teacher ratio in the local school district (3)

MSA population, 1990, (4)
Cooling degree days (4)
Heating degree days (4)
Annual rainfall, inches (4)
Arts and cultural entertainment facilities in MSA (5)
Recreational facilities in MSA (5)
County crime rate (crimes per 100,000 people) (4)
County population density (4)
County population change, 1980-1990 (4)

Pennsylvania dummy=1 if jurisdiction is in Pennsylvania
New Jersey dummy=1 if jurisdiction is in New Jersey
Minnesota dummy=1 if jurisdiction is in Minnesota

Percent of total tax revenue earned from property taxes (2)
Percent of total tax revenue earned from sales taxes (2)
Percent of total tax revenue earned from income (wage) taxes (2)
Per capita taxes from all sources, $1000s (2)
Percent of total expenditures on fire protection (2)
Percent of total expenditures on administration of justice, sum of:

Percent of total expenditures on police protection (2)
Percent of total expenditures on courts and judiciary (2)
Percent of total expenditures on prisons and jails (2)

TABLE A1 (cont'd)

Percent of total expenditures on health and human services, sum of:
- Percent of total expenditures on public health (2)
- Percent of total expenditures on hospitals (2)
- Percent of total expenditures on housing (2)
- Percent of total expenditures on safety inspection (2)

Percent of total expenditures on public works, sum of:
- Percent of total expenditures on parking (2)
- Percent of total expenditures on highways and roads (2)
- Percent of total expenditures on public buildings (2)

Percent of total expenditures on administration, sum of:
- Percent of total expenditures on central administration (2)
- Percent of total expenditures on general services (2)

Percent of total expenditures on libraries (2)
Percent of total expenditures on public parks and recreation (omitted category) (2)
Percent of local school district revenue derived from local sources (3)
Percent of local school district revenue derived from state sources (3)
Percent of local school district revenue derived from federal sources (3)
Expenditure per student, $1000s (3)

All government variables are analogously defined for the central city jurisdiction.

TABLE A2: Metropolitan Statistical Areas in CHAPTER 4 Data Set

240	Allentown-Bethlehem-Easton, PA
280	Altoona, PA
560	Atlantic City-Cape May, NJ
780	Battle Creek, MI
870	Benton Harbor, MI
2162	Detroit, MI
2240	Duluth-Superior, MN-WI
2360	Erie, PA
2640	Flint, MI
3000	Grand Rapids-Muskegon-Holland, MI
3240	Harrisburg-Lebanon-Carlisle, PA
3520	Jackson, MI
3680	Johnstown, PA
3720	Kalamazoo, MI
4000	Lancaster, PA
4040	Lansing-East Lansing, MI
5120	Minneapolis-St. Paul, MN-WI
5320	Muskegon, MI
6162	Philadelphia, PA
6282	Pittsburgh, PA
6680	Reading, PA
6820	Rochester, MN
6960	Saginaw-Bay City-Midland, MI
6980	St. Cloud, MN
7560	Scranton-Wilkes Barre-Hazleton, PA
7610	Sharon, PA
8050	State College, PA
9140	Williamsport, PA
9280	York, PA

TABLE A3: Descriptive Statistics for CHAPTER 4 Data Set

VARIABLE	Total	CC	Suburb	Close Suburbs
Median House Value ($)	85.788	45.440	99.448	101.394
	(63850)	(38006)	(65041)	(67275)
ln(Median House Value)	11.12	10.51	11.33	11.34
	(0.698)	(0.617)	(0.595)	(0.612)
Percent New	0.0120	0.0037	0.0149	0.0101
	(0.034)	(0.019)	(0.038)	(0.033)
Median Year Built	1954	1945	1957	1954
	(13.107)	(8.972)	(12.984)	(12.093)
Percent with 0 Bedrooms	0.0129	0.0201	0.0105	0.0126
	(0.035)	(0.048)	(0.030)	(0.035)
Percent with 1 Bedroom	0.1174	0.1431	0.1087	0.1249
	(0.129)	(0.142)	(0.127)	(0.136)
Percent with 2 Bedrooms	0.2660	0.2803	0.2612	0.2670
	(0.143)	(0.143)	(0.143)	(0.148)
Percent with 3 Bedrooms	0.4257	0.4127	0.4302	0.4235
	(0.179)	(0.202)	(0.171)	(0.187)
Percent with 4 Bedrooms	0.1402	0.1032	0.1527	0.1359
	(0.113)	(0.086)	(0.119)	(0.112)
Percent with 5+ Bedrooms	0.0378	0.0407	0.0368	0.0362
	(0.058)	(0.069)	(0.053)	(0.060)
Percent without Plumbing	0.0064	0.0080	0.0058	0.0045
	(0.019)	(0.022)	(0.018)	(0.015)
Percent Vacant	0.0638	0.0873	0.0558	0.0469
	(0.076)	(0.075)	(0.074)	(0.055)
Average Rooms/House	5.751	5.501	5.836	5.716
	(0.933)	(0.821)	(0.953)	(0.995)
Distance from the CC (yards)	31.518	7.634	39.605	22.893
	(26416)	(5039)	(25824)	(11591)
Average Travel Time (minutes)	22.08	22.46	21.96	21.47
	(5.467)	(6.776)	(4.939)	(4.715)
Municipal Population	225.259	788.084	34.053	48.247
	(456365)	(624079)	(50443)	(63641)
Percent Working in the CC	0.3483	0.6963	0.2305	0.2952
	(0.278)	(0.157)	(0.201)	(0.200)
Median Household Income ($)	33.249	23.302	36.617	36.392
	(15723)	(11.377)	(15564)	(15489)
Percent w/ Less than High School	0.2556	0.3362	0.2283	0.2336
	(0.147)	(0.166)	(0.130)	(0.136)
Percent w/ High School Educ.	0.3425	0.3194	0.3503	0.3371
	(0.113)	(0.116)	(0.111)	(0.110)
Percent w/ Some College	0.2203	0.2051	0.2254	0.2235
	(0.087)	(0.097)	(0.083)	(0.079)
Percent w/ Bachelor's Degree	0.1170	0.0863	0.1273	0.1336
	(0.094)	(0.088)	(0.094)	(0.096)
Percent w/ Graduate Degree	0.0647	0.0530	0.0689	0.0722
	(0.078)	(0.083)	(0.075)	(0.077)
Percent White	0.8104	0.5551	0.8969	0.8667
	(0.308)	(0.403)	(0.206)	(0.240)
Percent African-American	0.1534	0.3964	0.0712	0.0928

TABLE A3: Descriptive Statistics for CHAPTER 4 Data Set

VARIABLE	Total	CC	Suburb	Close Suburbs
	(0.298)	(0.409)	(0.188)	(0.221)
Percent Other Minority	0.0361	0.0485	0.0319	0.0405
	(0.074)	(0.102)	(0.061)	(0.073)
Percent Married	0.5408	0.3785	0.5957	0.5648
	(0.191)	(0.170)	(0.164)	(0.165)
Percent Female Head of HH	0.7324	0.1319	0.0534	0.0570
	(0.086)	(0.117)	(0.061)	(0.067)
% Tax Revenue from Property Tax	0.6670	0.4456	0.7418	0.7782
	(0.289)	(0.201)	(0.275)	(0.253)
% Tax Revenue from Sales Tax	0.0224	0.0681	0.0070	0.0114
	(0.052)	(0.073)	(0.030)	(0.039)
% Tax Revenue from Income Tax	0.2090	0.3758	0.1526	0.1211
	(0.250)	(0.209)	(0.237)	(0.209)
% Tax Revenue from Other Taxes	0.1016	0.1104	0.0986	0.0894
	(0.086)	(0.077)	(0.089)	(0.087)
Per Capita Tax Revenue ($100)	0.3560	0.6056	0.2717	0.3181
	(1.223)	(0.324)	(1.392)	(0.269)
% Spending on Police	0.2070	0.1886	0.2132	0.2390
	(0.109)	((0.056)	(0.122)	(0.103)
% Spending of Judiciary	0.0234	0.0342	0.0197	0.0210
	(0.025)	(0.031)	(0.021)	(0.019)
% Spending on Prisons	0.0055	0.0211	0.0002	0.0003
	(0.018)	(0.031)	(0.002)	(0.001)
% Spending on Hospitals	0.0096	0.0274	0.0036	0.000005
	(0.070)	(0.114)	(0.045)	(0.000)
% Spending on Public Health	0.0222	0.0645	0.0079	0.0095
	(0.039)	(0.056)	(0.015)	(0.015)
% Spending on Safety Inspection	0.0132	0.0104	0.0142	0.0123
	(0.016)	(0.005)	(0.019)	(0.013)
% Spending on Housing	0.0335	0.0666	0.0223	0.0321
	(0.058)	(0.065)	(0.051)	(0.059)
% Spending on Central Admin.	0.0658	0.0280	0.0785	0.0592
	(0.077)	(0.021)	(0.084)	(0.062)
% Spending on General Admin/Services	0.2432	0.2613	0.2371	0.2429
	(0.123)	(0.085)	(0.132)	(0.123)
% Spending on Highways	0.1740	0.0833	0.2046	0.1747
	(0.149)	(0.051)	(0.159)	(0.119)
% Spending of Parking	0.0047	0.0123	0.0021	0.0022
	(0.017)	(0.026)	(0.012)	(0.013)

TABLE A3 (cont'd)

% Spending on Public Buildings	0.0300	0.0286	0.0305	0.0264
	(0.036)	(0.021)	(0.039)	(0.033)
% Spending on Fire Protection	0.0934	0.0947	0.0929	0.0985
	(0.075)	(0.053)	(0.080)	(0.072)
% Spending of Libraries	0.0202	0.0165	0.0215	0.0249
	(0.029)	(0.010)	(0.033)	(0.028)
% Spending on Parks	0.0543	0.0624	0.0515	0.0571
	(0.049)	(0.028)	(0.054)	(0.051)
School Revenue Percent Local	0.5944	0.4403	0.6465	0.6676
	(0.207)	(0.116)	(0.206)	(0.208)
School Revenue Percent State	0.3597	0.4725	0.3215	0.2984
	(0.185)	(0.103)	(0.191)	(0.190)
School Revenue Percent Federal	0.0459	0.0872	0.0320	0.0339
	(0.033)	(0.024)	(0.023)	(0.026)
Expenditure Per Student ($100)	6.183	5.960	6.258	6.490
	(1.350)	(1.019)	(1.438)	(1.297)
County Crime Rate (per 100,000)	4.985	6.013	4.637	5.303
	(2414)	(2519)	(2274)	(2367)
Student-Teacher Ratio	16.12	17.16	15.76	15.43
	(2.375)	(2.111)	(2.356)	(2.247)
Cooling Degree Days	740.9	758.3	733.5	727.9
	(166.7)	(182.2)	(159.1)	(145.2)
Heating Degree Days	6.198	6.095	6.241	6.295
	(980.4)	(1006)	(966.2)	(930.7)
Annual Precipitation	36.47	37.10	36.21	35.78
	(5.642)	(5.826)	(5.543)	(5.395)
Arts Facilities	1.801	1.997	1.719	1.673
	(1288)	(1367)	(1244)	(1182)
Recreation Facilities	1.846	1.800	1.865	1.924
	(650.0)	(641.1)	(652.7)	(656.1)

TABLE A4: Descriptive Statistics By MSA Size for CHAPTER 4 Data Set

	LARGE MSAs			SMALL MSAs		
VARIABLE	Total	CC	Suburb	Total	CC	Suburb
Median House Value ($)	73.417	46.104	84.763	56.747	41.928	63.174
	(50984)	(40192)	(50692)	(28287)	(22942)	(27975)
ln(Median House Value)	11.00	10.51	11.21	10.83	10.52	10.97
	(0.644)	(0.638)	(0.524)	(0.490)	(0.490)	(0.424)
Percent New	0.0122	0.0033	0.0159	0.0145	0.0057	0.0183
	(0.036)	(0.016)	(0.041)	(0.031)	(0.027)	(0.031)
Median Year Built	1954	1945	1957	1955	1946	1959
	(13.318)	(8.441)	(13.184)	(13.12)	(11.256)	(12.038)
Percent with 0 Bedrooms	0.0121	0.0202	0.0087	0.0114	0.0195	0.0079
	(0.034)	(0.048)	(0.026)	(0.032)	(0.046)	(0.022)
Percent with 1 Bedroom	0.1117	0.1418	0.0991	0.0986	0.1498	0.0764
	(0.124)	(0.140)	(0.114)	(0.111)	(0.148)	(0.081)
Percent with 2 Bedrooms	0.2622	0.2786	0.2554	0.2769	0.2890	0.2717
	(0.144)	(0.144)	(0.143)	(0.119)	(0.134)	(0.111)
Percent with 3 Bedrooms	0.4408	0.4182	0.4502	0.4373	0.3839	0.4605
	(0.183)	(0.208)	(0.171)	(0.141)	(0.164)	(0.123)
Percent with 4 Bedrooms	0.1375	0.1006	0.1528	0.1412	0.1169	0.1517
	(0.114)	(0.087)	(0.121)	(0.079)	(0.080)	(0.076)
Percent with 5+ Bedrooms	0.0357	0.0406	0.0337	0.0347	0.0409	0.0319
	(0.057)	(0.071)	(0.049)	(0.043)	(0.057)	(0.034)
Percent without Plumbing	0.0058	0.0082	0.0047	0.0102	0.0069	0.0116
	(0.017)	(0.021)	(0.016)	(0.028)	(0.026)	(0.028)
Percent Vacant	0.0619	0.0890	0.0506	0.0815	0.0787	0.0826
	(0.068)	(0.073)	(0.062)	(0.110)	(0.079)	(0.121)
Average Rooms/House	5.769	5.501	5.881	5.755	5.503	5.864
	(0.903)	(0.815)	(0.914)	(0.730)	(0.849)	(0.643)
Distance from the CC (yards)	29.320	8.367	38.023	23.550	3.753	32.135
	(25213)	(5028)	(25123)	(29029)	(2843)	(31000)
Average Travel Time (minutes)	22.27	23.78	21.64	17.93	15.44	19.01
	(5.253)	(6.438)	(4.528)	(4.614)	(3.323)	(4.678)
Municipal Population	296.571	925.724	33.922	23.266	59.994	7.338
	(517876)	(586329)	(49164)	(29569)	(28338)	(8158)
Percent Working in the CC	0.3910	0.7015	0.2620	0.3713	0.6687	0.2423
	(0.391)	(0.150)	(0.199)	(0.283)	(0.191)	(0.210)
Median Household Income ($)	32.234	23.412	35.898	27.679	22.717	29.830
	(15145)	(11633)	(14923)	(9787)	(9896)	(8921)
Percent w/ Less than High School	0.2547	0.3432	0.2179	0.2608	0.2987	0.2444
	(0.150)	(0.166)	(0.125)	(0.124)	(0.158)	(0.102)
Percent w/ High School Educ.	0.3396	0.3105	0.3517	0.3956	0.3660	0.4085
	(0.114)	(0.112)	(0.112)	(0.106)	(0.123)	(0.096)
Percent w/ Some College	0.2277	0.2055	0.2369	0.2042	0.2029	0.2048
	(0.089)	(0.097)	(0.084)	(0.088)	(0.101)	(0.082)
Percent w/ Bachelor's Degree	0.1145	0.0866	0.1262	0.0919	0.0852	0.0947
	(0.095)	(0.090)	(0.095)	(0.071)	(0.081)	(0.065)
Percent w/ Graduate Degree	0.0635	0.0541	0.0674	0.0475	0.0471	0.0476
	(0.079)	(0.086)	(0.076)	(0.055)	(0.068)	(0.048)
Percent White	0.7975	0.5026	0.9200	0.9218	0.8327	0.9604
	(0.326)	(0.406)	(0.174)	(0.177)	(0.241)	(0.122)

TABLE A4 (cont'd)

Percent African-American	0.1712	0.4467	0.0567	0.0590	0.1301	0.0280
	(0.317)	(0.416)	(0.161)	(0.164)	(0.225)	(0.116)
Percent Other Minority	0.0313	0.0506	0.0233	0.0193	0.0372	0.0115
	(0.071)	(0.106)	(0.047)	(0.045)	(0.069)	(0.025)
Percent Married	0.5286	0.3667	0.5959	0.5789	0.4411	0.6387
	(0.196)	(0.166)	(0.166)	(0.176)	(0.178)	(0.137)
Percent Female Head of HH	0.0782	0.1382	0.0533	0.0621	0.0989	0.0461
	(0.090)	(0.119)	(0.059)	(0.070)	(0.095)	(0.047)
% Tax Revenue from Property Tax	0.6261	0.3979	0.7210	0.5863	0.6938	0.5392
	(0.283)	(0.173)	(0.266)	(0.287)	(0.140)	(0.321)
% Tax Revenue from Sales Tax	0.0264	0.0699	0.0083	0.0200	0.0583	0.0032
	(0.049)	(0.053)	(0.034)	(0.081)	(0.137)	(0.018)
% Tax Revenue from Income Tax	0.2386	0.4187	0.1637	0.2754	0.1529	0.3291
	(0.252)	(0.192)	(0.236)	(0.261)	(0.139)	(0.282)
% Tax Revenue from Other Taxes	0.1089	0.1134	0.1070	0.1183	0.0950	0.1285
	(0.086)	(0.077)	(0.089)	(0.090)	(0.074)	(0.094)
Per Capita Tax Revenue ($100)	0.3389	0.6505	0.2093	0.1956	0.3724	0.1181
	(0.262)	(0.235)	(0.131)	(0.346)	(0.547)	(0.146)
% Spending on Police	0.2040	0.1837	0.2125	0.1749	0.2137	0.1579
	(0.110)	(0.050)	(0.126)	(0.129)	(0.074)	(0.143)
% Spending of Judiciary	0.0256	0.0394	0.0198	0.0096	0.0073	0.0106
	(0.027)	(0.031)	(0.023)	(0.014)	(0.004)	(0.017)
% Spending on Prisons	0.0075	0.0247	0.0003	0.0009	0.0029	0.00004
	(0.021)	(0.032)	(0.002)	(0.007)	(0.012)	(0.001)
% Spending on Hospitals	0.0122	0.0327	0.0037	0.0060	0	0.0086
	(0.077)	(0.123)	(0.043)	(0.062)	(0)	(0.074)
% Spending on Public Health	0.0255	0.0759	0.0045	0.0042	0.0052	0.0038
	(0.045)	(0.053)	(0.013)	(0.012)	(0.011)	(0.013)
% Spending on Safety Inspection	0.0135	0.0106	0.0147	0.0117	0.0097	0.0126
	(0.017)	(0.004)	(0.020)	(0.019)	(0.007)	(0.022)
% Spending on Housing	0.0331	0.0593	0.0222	0.0358	0.1050	0.0054
	(0.053)	(0.050)	(0.050)	(0.079)	(0.107)	(0.031)
% Spending on Central Admin.	0.0659	0.0242	0.0832	0.1020	0.0476	0.1259
	(0.075)	(0.017)	(0.082)	(0.104)	(0.029)	(0.116)
% Spending on General Admin/Services	0.2411	0.2734	0.2276	0.1749	0.1985	0.1645
	(0.121)	(0.070)	(0.135)	(0.120)	(0.123)	(0.116)
% Spending on Highways	0.1701	0.0699	0.2118	0.2752	0.1528	0.3288
	(0.139)	(0.025)	(0.146)	(0.204)	(0.085)	(0.217)
% Spending of Parking	0.0055	0.0132	0.0022	0.0025	0.0077	0.0002
	(0.019)	(0.028)	(0.012)	(0.007)	(0.011)	(0.004)

TABLE A4 (cont'd)

% Spending on Public Buildings	0.0305	0.0301	0.0307	0.0323	0.0206	0.0375
	(0.036)	(0.022)	(0.040)	(0.044)	(0.010)	(0.051)
% Spending on Fire Protection	0.0882	0.0837	0.0901	0.1173	0.1523	0.1019
	(0.066)	(0.044)	(0.073)	(0.108)	(0.060)	(0.119)
% Spending of Libraries	0.0187	0.0178	0.0190	0.0084	0.0094	0.0080
	(0.030)	(0.008)	(0.035)	(0.020)	(0.014)	(0.022)
% Spending on Parks	0.0587	0.0615	0.0576	0.0444	0.0674	0.0343
	(0.050)	(0.026)	(0.058)	(0.047)	(0.036)	(0.048)
School Revenue Percent Local	0.5958	0.4384	0.6611	0.4991	0.4499	0.5205
	(0.203)	(0.113)	(0.197)	(0.164)	(0.131)	(0.172)
School Revenue Percent State	0.3565	0.4704	0.3092	0.4580	0.4838	0.4468
	(0.180)	(0.097)	(0.185)	(0.156)	(0.131)	(0.165)
School Revenue Percent Federal	0.0477	0.0911	0.0297	0.0429	0.0663	0.0327
	(0.035)	(0.021)	(0.021)	(0.026)	(0.023)	(0.019)
Expenditure Per Student ($100)	6.075	6.033	6.092	5.336	5.575	5.233
	(1.255)	(1.040)	(1.333)	(1.099)	(0.799)	(1.192)
County Crime Rate (per 100.000)	5.188	6.410	4.681	3.726	3.914	3.644
	(2503)	(2368)	(2378)	(2032)	(2235)	(1932)
Student-Teacher Ratio	16.34	17.23	15.97	16.67	16.79	16.61
	(2.389)	(1.922)	(2.465)	(2.471)	(2.887)	(2.266)
Cooling Degree Days	763.6	790.8	752.2	617.0	586.4	630.3
	(153.2)	(164.2)	(146.9)	(181.9)	(176.5)	(182.8)
Heating Degree Days	6.138	5.989	6.200	6.527	6.656	6.471
	(899.2)	(897.2)	(892.8)	(1290)	(1316)	(1275)
Annual Precipitation	36.17	37.01	35.82	38.15	37.56	38.40
	(5.505)	(5.764)	(5.356)	(6.072)	(6.128)	(6.031)
Arts Facilities	2.083	2.319	1.985	263.8	293.3	250.9
	(1203)	(1252)	(1168)	(156.7)	(164.4)	(151.5)
Recreation Facilities	1.926	1.860	1.953	1.410	1.483	1.378
	(642.1)	(640.0)	(641.0)	(503.0)	(546.8)	(479.4)

TABLE A5: OLS Regressions without Fiscal Conditions

	1	*2*	*3*
VARIABLE	**Total Sample**	**Suburb**	**Central City**
Percent New	0.311 ***	0.193 **	0.809 ***
	(3.521)	(2.465)	(2.527)
Median Year Built	0.015 ***	0.014 ***	0.015 ***
	(57.346)	(54.281)	(19.421)
Percent with 1 bedroom	-1.202 ***	-0.420 ***	-1.470 ***
	(-11.653)	(-3.241)	(-9.035)
Percent with 2 bedrooms	-2.505 ***	-1.448 ***	-3.122 ***
	(-25.851)	(-11.769)	(-19.923)
Percent with 3 bedrooms	-2.851 ***	-1.722 ***	-3.787 ***
	(-27.477)	(-13.431)	(-21.480)
Percent with 4 bedrooms	-3.276 ***	-1.836 ***	-4.513 ***
	(-26.5896)	(-12.618)	(-20.835)
Percent with 5+ bedrooms	-3.121 ***	-1.198 ***	-4.356 ***
	(-22.620)	(-7.285)	(-17.618)
Average Rooms/House	0.448 ***	0.386 ***	0.546 ***
	(44.643)	(37.816)	(25.057)
Percent without plumbing	-1.900 ***	-1.442 ***	-2.403 ***
	(-12.600)	(-8.867)	(-8.836)
Percent Vacant	-0.946 ***	-0.216 ***	-2.135 ***
	(-22.286)	(-5.011)	(-22.960)
Distance from the CC	0.001 ***	0.0004 ***	0.021 ***
(X1000)	(10.299)	(2.832)	(13.553)
Student Teacher Ratio	-0.026 ***	-0.023 ***	-0.020 **
	(-15.736)	(-15.008)	(-2.286)
Municipal Population	-0.0007 ***	0.0007 ***	-0.002 ***
(X1000)	(-42.941)	(8.911)	(-4.402)
MSA Population	0.000004 ***	0.000007 ***	0.0004 ***
(X1000)	(8.626)	(12.262)	(4.011)
Cooling Degree Days	0.0004 ***	0.0006 ***	-0.0003
	(4.034)	(6.147)	(-1.260)
Heating Degree Days	0.0002 ***	0.0002 ***	0.0002 ***
	(4.567)	(5.513)	(2.617)
Annual Precipitation	0.009 ***	0.009 ***	0.006
	(6.180)	(6.294)	(1.482)
Arts Facilities	0.000007	-0.00004 ***	-0.00003
	(0.849)	(-4.351)	(-0.526)
Recreation Facilities	-0.00002 *	-0.00007 ***	-0.00007 ***
	(-1.820)	(-6.894)	(-2.802)
County Crime Rate	0.00003 ***	0.00004 ***	0.00004 ***
	(10.520)	(13.560)	(2.370)
County Population Density	0.00007 ***	0.00001 **	0.0002 ***
	(24.798)	(1.965)	(3.798)

TABLE A5 (cont'd)

MSA Population Change	0.026 ***	0.024 ***	0.035 ***
	(28.996)	(27.592)	(9.500)
Pennsylvania Dummy	0.282 ***	0.292 ***	0.409 ***
	(11.473)	(11.983)	(5.256)
New Jersey Dummy	0.142 ***	0.073 ***	0.765 ***
	(5.082)	(2.718)	(5.242)
Minnesota Dummy	0.040	-0.051	0.110
	(0.643)	(-0.787)	(0.564)
(Intercept)	-19.667 ***	-18.565 ***	-18.954 ***
	(-33.249)	(-31.278)	(-11.270)
R-Squared	0.6478	0.6493	0.5434

TABLE A6: OLS Regressions without Expenditure Categories

VARIABLE	Total Sample
Percent New	0.1768 *** (2.786)
Median Year Built	0.0124 *** (11.179)
Percent with 1 bedroom	-0.5243 *** (-4.437)
Percent with 2 bedrooms	-1.223 *** (-12.917)
Percent with 3 bedrooms	-1.416 *** (-10.142)
Percent with 4 bedrooms	-1.418 *** (-9.150)
Percent with 5+ bedrooms	-0.777 *** (-5.157)
Average Rooms/House	0.297 *** (11.872)
Percent without plumbing	-0.583 * (-1.897)
Percent Vacant	-0.225 (-0.968)
Distance from the CC (X1000)	0.0001 (1.329)
Student Teacher Ratio	-0.00005 (-0.006)
Municipal Population (X1000)	0.00001 (0.252)
MSA Population (X1000)	0.00008 ** (2.228)
Cooling Degree Days	0.0002 (0.408)
Heating Degree Days	0.0001 (0.666)
Annual Precipitation	0.0163 ** (2.459)
Arts Facilities	-0.0001 ** (-2.377)
Recreation Facilities	-0.00005 (-1.088)
County Crime Rate	0.00003 * (1.962)
County Population Density	-0.000005 (-0.262)

TABLE A6 (cont'd)

MSA Population Change	0.014 ***
	(3.769)
Pennsylvania Dummy	0.262 *
	(2.001)
New Jersey Dummy	0.222 **
	(2.113)
Minnesota Dummy	0.618 *
	(1.983)
% Tax Revenue from Property Tax	0.055
	(0.562)
% Tax Revenue from Sales Tax	1.119 *
	(1.829)
% Tax Revenue from Income Tax	-0.056
	(-0.586)
Tax Per Capita	-0.141
	(-1.144)
School: Percent Local Revenue	1.081 ***
	(9.107)
% Tax Revenue from Property Tax (CC)	-1.186 **
	(-2.701)
% Tax Revenue from Sales Tax (CC)	-2.376 ***
	(-2.806)
% Tax Revenue from Income Tax (CC)	-1.037 **
	(-2.119)
Tax Per Capita (CC)	0.204 **
	(2.465)
School: Percent Local Revenue (CC)	-0.126 *
	(-1.743)
(Intercept)	-15.232 ***
	(-5.720)
R-Squared	0.7404

APPENDIX 6

SUPPLEMENTAL TABLES FOR CHAPTER 5

TABLE A7: Variable Definitions for CHAPTER 5 Data Set

Dependent Variables: (all used in natural log form)

Ratio of suburban population to MSA population
Suburban population
Central city population
Ratio of suburban housing units constructed in the past 10 years to MSA housing units constructed in past 10 years
Ratio of net change in suburban housing units over the last 10 years to net change in MSA housing units.

Explanatory Variables:

Percentage change in MSA population over the last 10 years

Suburban tax revenue per capita in $1000
Percentage of suburban tax revenue from property taxes
Percentage of suburban expenditures on education
Percentage of suburban expenditures on roads and maintenance
Central city tax revenue per capita in $1000
Percentage of city tax revenue from property taxes
Percentage of city expenditures on education
Percentage of city expenditures on roads and maintenance
Percentage of city expenditures on sanitation
Percentage of city expenditures on fire protection
Percentage of city expenditures on police

TABLE A8: Descriptive Statistics for CHAPTER 5 Data Set By Year

VARIABLE	Total Sample	1960	1970	1980	1990
suburban pop./MSA pop.	0.613	0.583	0.602	0.626	0.636
new suburban houses/new MSA houses	0.681	0.662	0.688	0.663	0.711
net sub. house change/net MSA change	0.731	0.629	0.763	0.763	0.753
real suburban per capita taxes ($100)	0.201	0.170	0.351	0.128	0.170
real city per capita taxes ($100)	0.083	0.061	0.079	0.083	0.105
real suburban per capita spending ($100)	0.367	0.344	0.301	0.317	0.498
real city per capita spending ($100)	0.195	0.113	0.162	0.231	0.262
% suburban tax rev. from property taxes	0.776	0.923	0.599	0.960	0.865
% city tax revenue from property taxes	0.632	0.750	0.674	0.571	0.551
% suburban spending on education	0.708	0.515	0.729	0.747	–
% city spending on education	0.085	0.272	0.080	0.065	0.051
% suburban spending on highways	0.066	0.081	0.078	0.041	–
% city spending on highways	0.118	0.155	0.124	0.103	0.096
% city spending on sanitation	0.143	0.141	0.134	0.150	0.148
% population change 1980-90	0.213	0.333	0.203	0.128	0.123
Central city population	181.766	179.970	180.376	176.675	189.907
MSA population	514.502	416.071	495.005	535.056	608.539
suburban population	359.378	278.786	335.276	372.777	441.707
change in central city population (%)	0.965	–	0.996	0.971	0.932
change in suburban population (%)	36.485	–	30.305	44.460	33.930
change in MSA population (%)	4.293	–	3.897	4.468	4.486
central city % change in housing units	0.152	0.189	0.114	0.176	0.128
suburb % change in housing units	0.259	0.251	0.187	0.377	0.204
central city % new housing units	0.203	0.237	0.211	0.210	0.156
suburb % change new housing units	0.299	0.351	0.327	0.281	0.246

TABLE A9: Descriptive Statistics for CHAPTER 5 Data Set By MSA Size

VARIABLE	Total Sample	SIZE 1 Smallest	SIZE 2	SIZE 3	SIZE 4 Largest
suburban pop./MSA pop.	0.613	0.462	0.595	0.659	0.675
new suburban houses/new MSA houses	0.681	0.504	0.652	0.729	0.780
net sub. house change/net MSA change	0.731	0.508	0.685	0.775	0.869
real suburban per capita taxes	0.201	0.252	0.194	0.182	0.211
real city per capita taxes	0.083	0.053	0.070	0.081	0.122
real suburban per capita spending	0.367	0.410	0.374	0.346	0.360
real city per capita spending	0.195	0.132	0.173	0.190	0.273
% suburban tax rev. from property taxes	0.776	0.747	0.784	0.795	0.747
% city tax revenue from property taxes	0.632	0.692	0.617	0.625	0.631
% suburban spending on education	0.708	0.922	0.707	0.693	0.589
% city spending on education	0.085	0.082	0.079	0.078	0.102
% suburban spending on highways	0.066	0.104	0.061	0.057	0.056
% city spending on highways	0.118	0.149	0.129	0.114	0.090
% city spending on sanitation	0.143	0.166	0.150	0.141	0.123
population change 1980-90	0.213	0.269	0.201	0.200	0.207
central city population	181.766	42.628	61.172	144.022	505.201
MSA population	514.502	77.473	152.801	423.011	1.792.927
suburban population	359.378	38.059	92.412	279.731	1.217.765
change in central city population	0.965	-0.505	-0.339	0.978	4.262
change in suburban population	36.485	2.851	8.083	26.474	121.758
change in MSA population	4.293	-0.193	0.476	3.041	16.476
central city % change in housing units	0.152	0.186	0.169	0.152	0.108
suburb % change in housing units	0.259	0.239	0.241	0.254	0.308
central city % new housing units	0.203	0.256	0.215	0.191	0.168
suburb % new housing units	0.299	0.310	0.294	0.293	0.312

TABLE A10: OLS Regression Results By MSA Size

Variable	*1* MSA Size 1 (Smallest)	*2* MSA Size 2	*3* MSA Size 3	*4* MSA Size 4 (Largest)	*5* Dummy Variables
N	138	386	339	204	1067
Real Suburban Per Capita Taxes	-1.496 *** (-4.556)	-1.671 *** (-9.679)	-1.671 *** (-6.490)	-0.915 *** (-3.255)	-1.559 *** (-11.857)
% Suburb Tax Rev. from Property Tax	-0.622 *** (-4.283)	-0.526 *** (-6.673)	-0.479 *** (-5.054)	-0.220 ** (-2.461)	-0.497 *** (-8.767)
Real City Per Capita Taxes	-0.135 (-0.205)	0.775 *** (2.983)	1.223 *** (4.496)	0.603 ** (2.238)	0.757 *** (3.367)
% City Tax Rev. from Property Tax	0.040 (0.389)	0.116 * (1.900)	0.154 ** (2.106)	0.065 (0.790)	0.114 *** (2.791)
Population Change	-0.017 (-0.103)	0.233 *** (3.735)	0.047 (0.800)	-0.072 (-0.529)	0.088 ** (2.014)
Size 1 Dummy	--	--	--	--	-0.318 *** (-6.382)
Size 2 Dummy	--	--	--	--	-0.116 *** (-3.107)
Size 3 Dummy	--	--	--	--	-0.022 (-0.610)
Intercept	-0.029 (-0.174)	-0.009 (-0.099)	0.022 (0.197)	-0.168 (-1.261)	0.092 (1.219)
R-Squared	0.5027	0.5274	0.3490	0.1818	0.4900

The dependent variable is Ln(population ratio).

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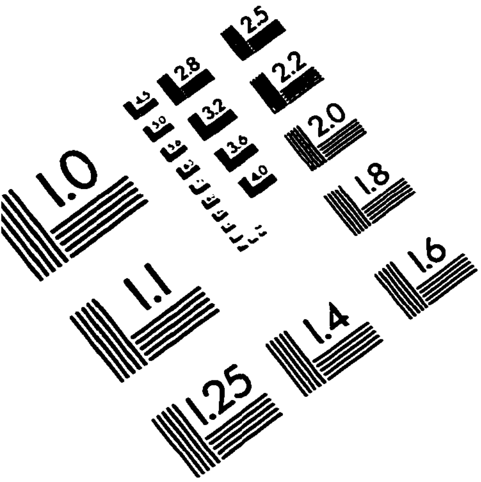
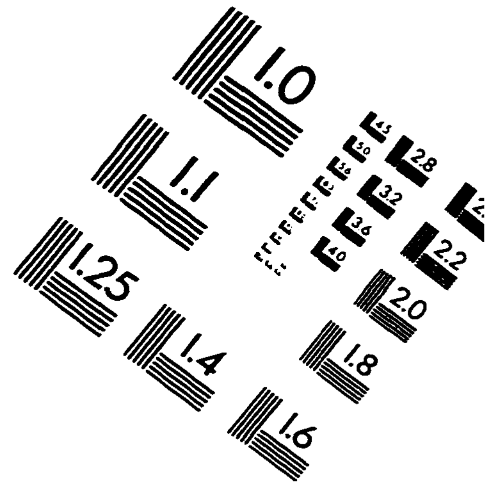
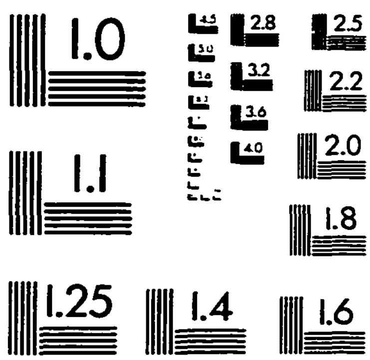
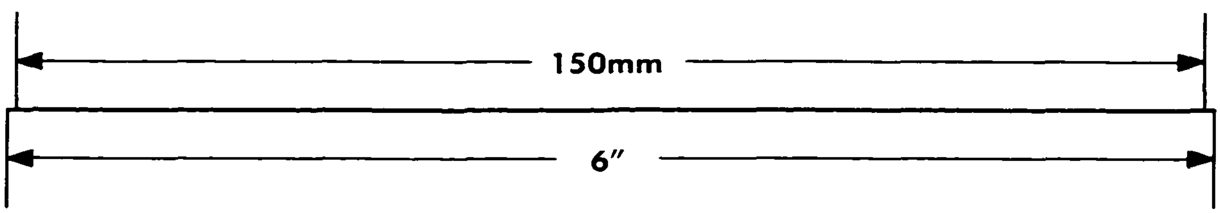
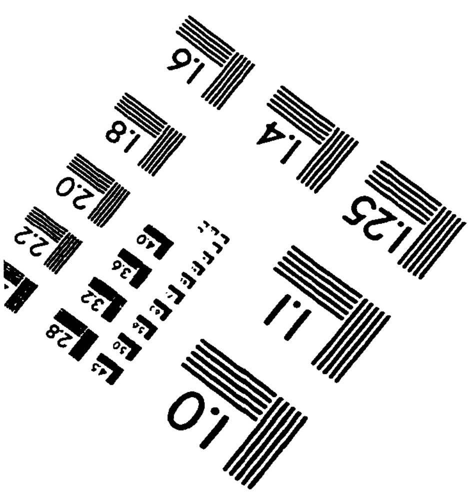
IMAGE EVALUATION TEST TARGET (QA-3)

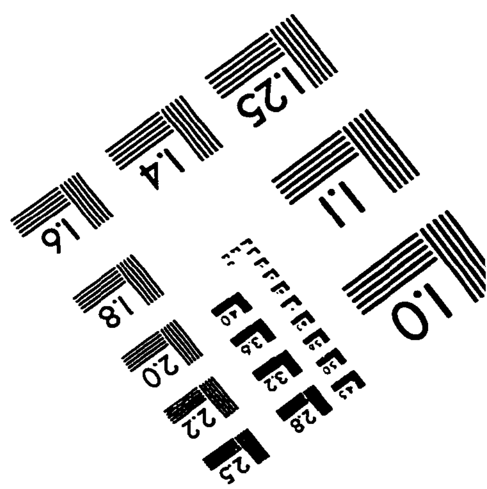












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