Spillover Effects of Local Fiscal Policy

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Cities and suburbs share a special interrelationship—they are both dependent on one another yet, simultaneously, in competition with one another. Because of their impact on the regional land and labor markets, fiscal policies undertaken in the central city can have effects that extend beyond its political jurisdiction. An understanding of these potential spillovers is critical in the design of regional economic policy. With no such understanding, one municipality's policies could lead to undesirable consequences for the metropolitan area as a whole, such as increasing suburban sprawl. This paper develops a general equilibrium model of an inter- and intrametropolitan location that allows the examination of such effects. The model can be used to determine what types of policies best serve the metropolitan area. (JEL H70, R30) *Atlantic Econ. J., 29(4): pp. 406-419, Dec. 01.*

Introduction and Literature Review

The modern 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. The relationship between a city and its suburbs can be seen as being symbiotic yet competitive [Stanback, 1991]. 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.[1]

Given the interdependence of local jurisdictions within a metropolitan area, the fiscal policies of one municipality may have effects reaching beyond its political boundaries. An understanding of this interrelationship would have strong empirical and policy implications. For example, when central city governments take an active role in the local economy in an attempt to arrest urban decline, their actions no doubt impact the surrounding suburbs. If these policies have a strong negative effect on the suburban economy, the city's policy may be counterproductive from a regional perspective. Policy makers must understand the full impact of their actions. Although previous authors have described various aspects of this interrelatedness [De Bartolome and Ross, 2000; Blomquist et al., 1988] and the impact of local fiscal conditions on land and labor markets [Gyourko and Tracy 1989, 1991], a model that incorporates both features has not been developed—until now. This paper presents such a model.

The impact of central city fiscal policies on land values, wages, and populations in both the city and its suburbs is the focus of this paper. It is specifically interested in the effects of

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transfers between households and firms (as is often seen in economic (re)development programs), but the model can be used to analyze other types of redistribution. The model also allows the examination of various tax instruments.

The theoretical model presented here grew out of the model used previously in several empirical works on interurban wage and rent differentials and quality of life indices [Mattey, 1996; Roback, 1982; 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. Borrowing heavily from trade theory, Roback develops a full hedonic model of intercity location, incorporating both land and labor markets that 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.

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 et al. [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. Hoehn et al. develop and estimate a model that incorporates commuting costs based on distance from a central business district. 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). De Bartolome and Ross [2000] also developed a model based on commuting distance, which is used to describe the sorting of households among jurisdictions based on income levels.

Blomquist et al. [1988] 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 metropolitan statistical areas (MSAs) (which are collections of counties). Amenities vary from county to county while agglomeration economies for firms are reflected in total MSA size.

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 affect equilibrium wages, but not in residential localities. Higher wages result in higher rents in all locations.

The works discussed thus far have all been concerned solely with pure amenities, that is, amenities that are not produced but exist freely in nature. As previously mentioned, this paper is interested in locally produced public goods that are analogous to amenities produced (and paid for) by local residents (or the government). Gyourko and Tracy [1989, 1991] have extended Roback's model to the case of differences in local fiscal conditions, represented by tax rates and publicly produced goods. They find that differences in local tax rates and public services generate compensating wage and rent differentials just as pure amenities do, and they affect the quality of life across metropolitan regions.

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. He discusses conditions leading to Pareto-efficient location, production, and commuting. However, his model lacks the intermetropolitan choice component of this present model. 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, for example, to 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 here further augments the Roback model along the lines of Gyourko and Tracy [1989, 1991], considering issues raised by other recent authors. This paper develops a general equilibrium model of inter- and intraurban location in which there are two political jurisdictions (a central city and a suburb) that differ in their local fiscal conditions. The jurisdictions form a single labor market with (costless) commuting from the suburbs to the 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.

A Simple Model Without Suburbs

The simple form of this model consists of only one political jurisdiction, which has been examined previously (in a slightly different form) by Roback [1982] and Gyourko and Tracy [1989]. The detailed exposition of the one-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 the results can be compared when the suburbs are later added.

A per capita tax of t_H on households and t_F per unit of output on firms will be considered. A property tax and a wage tax were also considered, leading to similar results.

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 the public good 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:

$$\max U(X, h;\, t_H, g) \quad \text{subject to} \quad w + I = X + hr \quad , \tag{1}$$

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. Nonlabor 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, but 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:

$$V = V(w, r;\, t_H, g) = k \quad , \tag{2}$$

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 $V_r / V_w = -h$. Here, $P_g = V_g / V_w$ is defined as 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 is a tax per unit of output.[3] The representative firm will minimize costs subject to the production function. The equilibrium condition for firms is that unit costs equal product price, otherwise, firms would have an incentive to move their capital to more profitable cities. For simplicity, assume price is equal to unity:

$$C = C(w, r, t_F, g) = 1 \quad . \tag{3}$$

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 $C_r = L_p / X$.

By totally differentiating (2) and (3), solve for the land rent and wage differentials:

$$\frac{dr}{dg} = \frac{-1}{L}\left[N\left(\frac{dt_H}{dg} - P_g\right) + X\left(\frac{dt_F}{dg} + C_g\right)\right] \quad , \tag{4}$$

and

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

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. Following Roback, a local government is considered 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, (6) must hold for an efficient government:

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

It is clear from (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 costs. When marginal costs exceed the sum of the marginal benefits, the government is inefficient. Such a condition could arise due to production inefficiency or rent seeking by public sector unions or elected officials [Gyourko and Tracy, 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 (that is, $dt_H/dg > P_g > 0$). Further, assume that firms receive no benefits and pay no taxes (that is, $C_g = dt_F/dg = 0$). From (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 (4) and (6), it is straightforward to confirm that any change in the level of the public good provision that is paid 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 (5) and (6), notice that if the added tax burden falls entirely on the group benefitting from the public good (for example, $P_g = dt_H/dg$), there will be no change in equilibrium wages. However, if the taxes of one group are used to subsidize the provision of a benefit for the other group (for example, $-C_g = dt_H/dg$ 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, but if the taxes of firms are used to subsidize households, wages will fall. This will be referred to as cross-subsidization.

Changes in equilibrium wages and rents occur as households and firms move to more desirable locations. The Appendix presents the comparative statics for population, *N*, and output, *X*. Population and production respond to changes in the relative wage. Specifically, population and production fall when the relative wage rises. Thus, larger populations and more production are expected to be seen in locations that provide extra benefits to households.

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 or multiple types of firms [Roback, 1988; Beeson, 1991]. Specifically, cross-subsidization (one group paying for benefits that accrue to another) is expected to result in equilibrium wage rate adjustments but not land rent changes as long as the efficient government condition holds.

A Model with Suburbs

In the previous model, 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, and the like) while choosing to work in another.[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 metropolitan area since commuting across political boundaries allows for considering this as one labor market.[5]

There are two potential links between central city fiscal conditions and suburban land rents (and utility). The first, 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 suburbs). Whenever a change in central city taxes or the public good 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 adjustments in equilibrium. The second linkage, externality effect, results because suburban residents 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 the city. Such situations will lead to suburban rent or wage adjustments in equilibrium. This model will consider public goods from which the suburban residents receive no benefit, thus eliminating the positive externality effect. However, the Appendix presents the results allowing for such an externality.

The model considered here adds a suburban housing market to the model previously developed. All firms (and thus employment) are constrained to central 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. Again, consider a tax per household, t_c^H, and per unit of output on firms, t_c^F. A property tax and a wage tax were considered with similar results.

Just as in the one-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 the public good provision. Equations (7) and (8) present the maximization problems for city and suburban residents, respectively. Note that the suburban utility function differs from that of the city residents in that it allows for the possibility of suburban residents to receive utility from both city and suburban public goods:

$$\max U_s(X, h_s; t_s^H, g_s, g_c) \quad \text{subject to} \quad w + I = X + r_s h_s \quad , \tag{7}$$

and

$$\max U_c(X, h_c; t_c^H, g_c) \quad \text{subject to} \quad w + I = X + r_c h_c \quad , \tag{8}$$

where *c* indicates city-specific variables and *s* represent suburb-specific variables.

Again assume that nonlabor income, I, is independent of location and therefore can 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 (9) and (10) for city and suburban households, respectively:

$$V_c = V_c(w, r_c, t_c^H, g_c) = k \quad , \tag{9}$$

and

$$V_s = V_s(w, r_s, t_s^H, g_s, g_c) = k \quad . \tag{10}$$

The indirect utility functions, V_c and V_s, have all of the usual properties as stated in the previous model.

Production of the consumption good takes place just as in the one-jurisdiction model, thus, the equilibrium condition for firms is simply that unit costs be equal to price (assumed to be unity):

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

By totally differentiating (9) and (11) and rearranging, the equilibrium city land rent differential, dr_c / dg_c, can be solved:

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

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 previously defined.

From (12), it is shown that unlike the one-jurisdiction model, in many cases, city land rents will change even if the city government is efficient. A city government is again considered to be efficient if the sum of the marginal benefits from a public good is equal to the associated marginal costs.[6] Generally:

$$N_c P_{gc}^c - XC_{gc} = N_c \frac{dt_c^H}{dg_c} + X\frac{dt_c^F}{dg_c} \quad . \tag{13}$$

Obviously, there are some public goods provided in the city that provide little or no benefit to suburban residents (for example, trash pickup or street sweeping), while other public goods, the so-called regional assets, may provide as much benefit to those living near the city as to the city residents themselves (for example, baseball stadiums or highways). This paper now considers only the cases in which suburban residents receive no benefit from the public good. All other cases are discussed in the Appendix.

Using (12) and (13) helps to find the city land rent differential for an efficient government:

$$\frac{dr_c}{dg_c} = \frac{-1}{L_H + N_s h_c + L_p}\left[N_s\left(\frac{dt_c^H}{dg_c} - P_{gc}^c\right)\right] \quad . \tag{14}$$

It should be clear that unlike the one-jurisdiction model, 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 the level of public services, g^c, increases in all other cases, city land rents fall even when the public good is being efficiently provided. Intuitively, wages are expected to rise any time city households are paying more in taxes than they receive in benefits from the public good (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 suburbs more attractive. As households move from the city to the suburbs, city rents would fall and suburban rents would rise, offsetting the wage increase that is also enjoyed by the suburban residents. To keep utility constant between the two jurisdictions, city rents must fall 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:

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

and

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

The above equations reveal that if there is no cross-subsidization between households and firms (that is, $dt_c^H / dg_c = P_{gc}^c$), there will be no changes in city rents, wages, or suburban rents just as in the one-jurisdiction model. 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 suburban residents are receiving no benefits (nor paying costs) from the public good. If either of these conditions is relaxed, this result no longer holds.

Now examine the effects of cross-subsidization while maintaining the restriction that suburban residents gain nothing from the public good. Looking at (14), (15), and (16), if the taxes paid by city households are used to finance a public good that 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 suburban residents, making the suburbs more attractive. As people move from the city to the suburbs, suburban land rents rise (decreasing the attractiveness of the suburbs) 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 the Appendix, it can be verified 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 that benefits city households (that is, $dt_c^H / dg_c < P_{gc}^c$), wages fall (because firms are, in effect, paying for a public good in lieu of wages), making the suburbs a less desirable location (because the suburbs do not receive the benefit of the public good but do receive the lower wage). As the metropolitan population shifts from the suburbs to the 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 for the city to grow, the public goods that benefit households should be provided while firms should be taxed to pay for them.

Summary and Empirical Implications

This paper presents a general equilibrium model of inter- and intraurban 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 the suburbs) that form a common labor market yet have distinct rents, tax rates, and levels of public services. The model is used to analyze 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 (that is, the sum of the marginal benefits equals the marginal costs), equilibrium land rent and wage adjustments will occur (this is in sharp contrast to the one-jurisdiction model analyzed by Gyourko and Tracy [1989] and others). This results because of the two potential links between the central city and its suburbs. The wage effect arises because of the common labor market assumption. Whenever a change in city taxes or the public good 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. (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 suburban residents 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 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 or wage adjustments in equilibrium.

The model shows that the mix of public goods (that is, 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 suburbs have become the more attractive location for households. To regain equilibrium, the suburban population would increase (raising suburban land rents), and the 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 could be used to test the effect of the mix of public goods and the relative tax burdens faced by households and firms. The model predicts more population and production if a city's fiscal conditions tend to lower the relative wage. Lower relative wages are expected when central cities provide public goods that benefit households and tax firms to pay for them. This has significant implications for the design of economic (re)development policies that currently tend to focus on providing benefits to lure new firms into an area while directly or indirectly taxing households to pay for them.

APPENDIX

Population Comparative Statics

One-Jurisdiction Model

Population changes can be analyzed 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 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:

$$L = hN + L_p \quad . \tag{A1}$$

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, the land market clearing condition can be rewritten as:

$$L = \frac{N}{C_w}(hC_w + C_r) \quad . \tag{A2}$$

By totally differentiating and rearranging, it is not trivial to show that:

$$\hat{N} = -\hat{h}\zeta_{Lc} - (\hat{w} - \hat{r})\sigma_{wr}\zeta_{Lp} \quad , \tag{A3}$$

where $\hat{x} = dx/x$, 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, population is expected 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. This analysis concluded that the relative wage rate falls in locations providing extra benefits to households, thus expecting larger populations in such areas. It is easy to see that production and population must move in the same direction by substituting (A3) into the demand for labor expression, $N = C_w X$ (which implies that $dx / X = (dN/N)/C_w$).

Two-Jurisdiction Model

The three relevant expressions for population change (central city population, suburban population, and MSA population) can be calculated by totally differentiating the three corresponding land market-clearing conditions:

$$L_c = \frac{N_c}{C_w}(h_c C_w + C_{r_c}) + \frac{N_s}{C_w} C_{r_c} \quad , \tag{A4}$$

$$L_s = -h_s N_s \quad , \tag{A5}$$

and

$$L = \frac{N_c}{C_w}(h_c C_w + C_{r_c}) + \frac{N_s}{C_w}(h_s C_w + C_{r_c}) \quad , \tag{A6}$$

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 suburbs. By totally differentiating and rearranging, it is possible to show that:

$$\hat{N}_c = \frac{1}{NL_H + N_c L_p}[-\hat{h}_c N L_H + \hat{h}_s N_s L_p - (\hat{w} - \hat{r})\sigma_{wr} N L_p] \quad , \tag{A7}$$

$$\hat{N} = \frac{-1}{NL_H + N_c L_p}[\hat{h}_c N_c L_H - \hat{h}_s N_s L_H - (\hat{w} - \hat{r})\sigma_{wr} N_c L_p] \quad , \tag{A8}$$

and

$$\hat{N}_s = -\hat{h}_s \quad . \tag{A9}$$

Thus, it is expected that both MSA and central city population will fall when the relative wage increases.

Comparative Statics Allowing for the Externality Effect

Here, the two-jurisdiction model comparative static results are presented for the per capita/per unit of output tax, allowing suburban residents to benefit from central city public goods. 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 suburban residents. 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:

$$V_s = V_s(w, r_s; t_s^H, g_s, g_c) = k \quad . \tag{A10}$$

When differentiating (A10) and solving for suburban land rents, then:

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}\left[\frac{dw}{dg_c} + P_{gc}^s\right] \quad , \tag{A11}$$

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

By substituting the appropriate wage differential for dw / dg_c, (A11) can be used to find the suburban land rent differential for the per capita/per unit of output tax. Define $\varphi_{cs} \in [0, 1]$ to be the ratio of the benefit from the public good received by suburban residents to the benefit received by city residents, such that:

$$P_{gc}^s = \varphi_{cs} P_{gc}^c \quad . \tag{A12}$$

Thus, by using (A11), (A12), and the appropriate wage differential, the suburban land rent differential for the per capita/ per unit of output tax can be found:

$$\frac{dr_s}{dg_c} = \frac{1}{h_s}\left[\frac{(1 + t_w)L_H + L_p}{(1 + t_w)(L_H + N_s h_c) + L_p}(-P_{gc}^c) + \varphi_{cs} P_{gc}^c\right] \quad . \tag{A13}$$

If there is no cross-subsidization (that is, $dt_{rc} H / dg = P_{gc}^c$) then the first two terms cancel, leaving $dr_s / dg = h_s^{-1} \varphi_{cs} P_{gc}^c$. Thus, suburban land rents will increase if households benefit from the public good (and are unchanged otherwise). Intuitively, suburban residents in this MSA would receive a free benefit: the resulting in-migration would result in higher land rents.

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

This illustrates that if the taxes of firms subsidize the public goods that benefit households, then suburban rents will decrease. As the suburban benefit rises (that is, φ_{cs} becomes larger), this decrease in r_s will shrink in magnitude, remaining negative as long as:

$$P^s_{gc} = \varphi_{cs} P^c_{gc} \quad .$$

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.

Footnotes

1. See Savitch et al. [1993] for an additional useful discussion of other causes and consequences of the interdependence of metropolitan jurisdictions.
2. The implicit assumption is that all land is either owned by an absentee landlord or each person owns an equal share of land in all cities, regardless of his own location. 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, hence rental income is independent of location.
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, capital input can be assumed to be optimized out of the problem [Roback 1982]. The same assumption about the ownership of land applies to the ownership of capital.
4. Using 1980 Census A data, Blomquist et al. [1988] report that 19 percent of people who live in urban counties work in a different county. For smaller political jurisdictions, this percentage would be significantly larger.
5. For information on intraurban wage gradients, see McMillen and Singell [1992].
6. Note 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. This model could also define efficiency from the perspective of a social planner, specifically:

$$N_c P^c_{gc} + N_s P^s_{gc} - XC_{gc} = N_c \frac{dt^H_c}{dg_c} + X \frac{dt^F_c}{dg_c} \quad .$$

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

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