

# Land Taxation in New York City: A General Equilibrium Analysis

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## **Abstract**

The efficiency of land taxation has long been a subject of interest among urban economists and scholars of local public finance. This paper first develops a computable general equilibrium model of the New York City economy, calibrated to the fiscal and economic environment in which the city operates. We then provide simulations of the effects of replacing part or all of the City's current tax system with a land tax. Since some of the key underlying parameters are unknown, the paper describes the research that is needed for a thorough evaluation of such a policy change. We describe the results given the assumptions we have adopted, and conclude with a discussion of the benefits of moving to land taxation in New York, including a discussion of the political economy of local taxation.

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Few topics have so engaged public finance scholars, among them Dick Netzer, as the land value tax.<sup>1</sup> Since at least Henry George (1879), economists have urged the efficiency of a land tax, particularly relative to the current primary local tax, that on property value. Over the years, the land value tax has served admirably as a lesson in humility for economists: despite its highly touted efficiency benefits, policy makers have virtually never adopted it. This dissonance between research and practice has been persistent enough that it has itself become a major theme of economists' recent discussions of the land tax (see, for example, the collection of papers in Netzer 1998).

This paper explores the consequences of adopting a land value tax in New York City, the city that has also been among Netzer's major intellectual projects of the last forty years. New York, with its enormous public sector and complex local taxation system, is unique in the American federal system. Yet in other aspects, particularly its essentially complete openness to factor movements and trade, New York is like other local economies in the US and elsewhere. This paper develops and calibrates an equilibrium model of the New York City economy and provides simulations of the effects of adopting a land value tax in place of parts or all of the current local tax system. We believe that an application to a single municipality is instructive both as a contrast to the current academic literature, as well as a description of the actual arrangement of fiscal institutions in the US. Given the significant local control of local taxes, there is a high likelihood that the adoption of land taxation, if it is to take place at all, will occur on a locality-by-locality basis, albeit with authorization from the states.

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<sup>1</sup> Netzer's contributions to the study of land and property taxes are too numerous to exhaustively catalogue here, but are nicely bracketed by early work on the economics of local taxation (Netzer

The paper is organized as follows: Section I describes the model and its calibration to the New York City economy in 1997, the most recent year for which complete fiscal data are available. Section II discusses the effects on the equilibrium of replacing some or all of the current tax system with a land value tax. Section III discusses the results and their implications for the political economy of land value taxation in New York and, by extension, other localities.

## I. Model and Calibration

### *Model*

We specify an equilibrium open city model with endogenous local factor prices. The model is described in detail in Haughwout & Inman (2001); here, we provide an overview of its structure and important features before discussing calibration to the New York City economy in some detail.

We consider a single heterogeneous jurisdiction that we will call *the city*, which hosts producers, resident workers and an exogenously determined population of non-working residents within a fixed land area. The city's work force may also include commuters, who work at city firms but consume housing and other goods in other jurisdictions. The city is a small, open part of the larger national and world economies.

### *Households*

The population of the city is made up of two major groups:

1. An endogenous number of resident workers ( $n$ ), who work, live and consume in the city, and are paid an endogenously determined local wage,  $W$ ;

2. Dependent households ( $d$ ), who do not work, but receive an exogenous transfer income,  $\bar{Y}$ .  
 Dependent populations are exogenously given, and contain both poor and elderly households.

The city workforce also contains commuting managers ( $m$ ), who work in the city but consume housing and composite good in the suburbs. Managers are supplied perfectly elastically to the city at the exogenously determined managerial wage  $s$ .

All households share a common set of preferences for land ( $l_r$ ), housing capital ( $h$ ), composite non-housing consumption ( $x$ ) and a local public good ( $G$ ):  $U=U(x, h, l, G)$ . We measure units of housing capital and the composite good such that their prices =1. Working households' choice of consumption is made subject to the constraint that their annual gross-of-tax expenditure not exceed annual wages ( $W$ ) less taxes.

$$(1) (1 + \tau_s)x + (r + \tau_p)h + (r + \tau_p)(R/r)l_r = (1 - \tau_w)W$$

Here,  $\tau_i$  represents the local tax rate on sales ( $i=s$ ), property ( $i=p$ ), or income ( $i=W$ ),  $R$  is the price of land and  $r$  is the discount rate. For dependent households, expenditure is constrained by the size of the exogenously determined transfer payment,  $\bar{Y}$ . We assume that dependent households are exempt from income taxes, but must pay sales and property taxes.

### *Firms*

Private businesses in the model combine land ( $\phi$ ), resident labor ( $n$ ), commuter-managers ( $m$ ) and capital ( $k$ ) to produce the composite output good  $X$ . We assume that production technology exhibits

constant returns to scale across the private inputs, but is enhanced by the public good,  $G$ , which acts as a Hicks-neutral external scale economy. Firms choose their private input mix so as to minimize gross-of-tax unit costs, subject to the production function.

$$(2) \quad C = (1 + \mathbf{t}_p)R / r \cdot \ell_f + W \cdot n + (1 + \mathbf{t}_p / r)k + (1 + \mathbf{t}_m)m$$

We measure units such that the prices of the composite output good ( $P_x$ ), private capital ( $P_k$ ) and managerial labor ( $s$ ) are equal to 1.

### *Government*

City government produces the public good  $G$  from pre-existing public infrastructure stocks ( $G_0$ ), aid from higher levels of government ( $Z$ ), income from pre-existing financial assets ( $A$ ) and locally-generated tax revenues ( $T$ ). Local governments also bear the local share of transfer costs ( $\mathbf{y} \cdot \bar{Y}$ ), the costs of depreciation (at annual rate  $\sigma$ ), and remaining interest due on  $G_0$ , at annual rate  $r^o$ . Aggregate public good availability is then determined by the public sector budget constraint

$$(3) \quad G = \frac{\{T + Z + A - \mathbf{y} \cdot \bar{Y}\} / (r + \mathbf{s}) + [(r - r^o) / (r + \mathbf{s})]G_0}{C}$$

where  $T = \sum_i \mathbf{t}_i B_i$  ( $i=X, s, p, W, m$ ) is aggregate local tax revenue and  $C$  is the unit cost of public sector output.

### *City Equilibrium*

Our equilibrium concept is identical to that in Roback (1982) and the subsequent literature: mobile households (firms) cannot earn excess utility (profits) simply by virtue of their locations. In

our context, resident workers are the mobile group, and their bids in local land and labor markets reflect their evaluations of each location and determine the shape and position of the household indifference curve  $V(\bullet)$  in Figure 1. Dependent household utility, by contrast, is endogenous in the model.

The city is one of many places in which firms and households may locate. In order to attract firms and households, the city must offer at least the level of profits and utility that prevail elsewhere in the economy. As in Roback (1982) and the subsequent "quality of life" literature (see Gyourko, Tracy and Kahn 1999 for a review), land and labor price adjustments provide the mechanism which allows both attractive and unattractive places to host activities.

Figure 1 provides the standard depiction of the equilibrium. The upward sloping curve is a household indifference curve in the price space. In order to be left indifferent, households must be compensated for higher wages with a higher land price. For firms, both wages and land rents are costs that must be traded off. Thus the firm iso-profit function is represented by the downward sloping curve in Figure 1. At  $(W^*, R^*)$ , both firms and households are in equilibrium, earning zero locational rents.

Local fiscal policies, including both taxes and spending, have the potential to exert importance influences over local equilibrium prices (Gyourko, Tracy and Kahn 1999). Consider two otherwise identical cities levying a tax that is legally incident on both firms and households (in New York and many other localities the property tax has this character). Figure 2 depicts the effect of differences in this tax, holding public good provision constant. For a given city, this kind of difference in constant service tax rates might be created by differentials in grants-in-aid from the state. Across cities, differential historical public investment that has led to differing surviving city

infrastructure stocks will also shift the curves. As shown in the diagram, the city with the lower tax rate will, *ceteris paribus*, have higher land prices and potentially higher or lower wages, depending on parameters of production technology and working household preferences. Analogous arguments can be constructed for increases in public goods, taxes constant (Haughwout 2002).

Of particular note here is the effect of distortionary taxation on the local price equilibrium. When local public services are financed with distortionary tax instruments, their cost is increased, because a \$1 increase in public spending comes at the cost of  $$(1 + \eta)$  in private utility, where  $\eta$  measures the excess burden of the tax. Eliminating this excess burden by shifting to a more efficient tax system reduces the marginal cost of public funds, allowing more public services to be provided for a given local tax burden. Put another way, a more efficient tax system acts like a tax cut, with public services unchanged. We discuss the details of the efficiency of local taxation below, but for now note that Figure 2 may also be viewed as a depiction of the effect of reduced distortions from local taxation. Thus we would anticipate that replacement of some or all of the local tax structure with a land tax would increase local land prices, and have ambiguous effects on local wages.

Prices, of course, have important effects on behavior. When local land prices go up, residents and firms are encouraged to economize on land. Assuming that no land is vacant in the City (i.e., ignoring brownfields and counting speculative landholding as a business investment), this implies that more efficient taxation is associated with increased city density. Similarly, higher wages induce firms to substitute out of labor and into other factors of production. Household behavior will likewise be affected as incomes and land prices change. Finally, local public goods simultaneously reflect and affect the local economy. As prices and quantities change, so will tax

revenue and public spending. Since public spending affects prices, the cycle begins again. Formally, the model contains eighteen endogenous variables, which are listed in the appendix. Readers interested in the details are referred to Haughwout & Inman (2001).

### *Solving the Model*

The solution procedure begins with parameterizations of household preferences and firm production technologies which are then solved for expressions for the model's endogenous variables as functions of the city's exogenous fiscal and economic characteristics. These specifications and data are shown in Table 1 and are discussed further below. Note that taxes are exogenous in the model; when combined with local tax bases, these rates determine local public services through equation (3). Since the public and private sectors are interdependent, we initially solve the model for an arbitrary level of public spending. This yields a set of private market outcomes which yields a new equilibrium level of public services, and the process is repeated until the model converges. Convergence is achieved when the public sector equilibrium yields household utility and firm costs that are within 0.1% of their equilibrium values.

### *Calibrating the model to New York City in 1997*

Calibration of the basic simulation model to New York City requires identification of the exogenous determinants of the New York City economic, fiscal, and demographic environment. This section describes the setting and provides the functional and numerical inputs required to solve for the model's 18 endogenous variables. The appendix lists the required variables.



### *Technology and Preferences*

The city's firms' technology is represented by a Cobb-Douglas specification between land ( $L$ ) and a composite joint labor-capital input produced by a CES combination of resident workers ( $N$ ), commuter workers (modeled as managers,  $M$ ), and firm capital ( $K$ ). Firm capital is specified as a complement to managerial labor, while city labor is substitutable with the composite input of capital and managers.

$$(4) \quad X = L_f^a [\mu N^{0.4} + \lambda_2 (\lambda_1 K^r + \lambda_2 M^r)^{1/r}]^{(1-a)/\epsilon} G^c$$

where  $\mu$ 's and  $\lambda$ 's are parameters which determine factor income shares and  $a$  and  $c$  determine the marginal productivities of land, the labor-capital composite input, and public infrastructure.

Within the labor-capital composite input, the elasticity of substitution between capital ( $K$ ) or managers ( $M$ ) and labor ( $N$ ) is  $1/(1-\epsilon)$ , while the elasticity of substitution between capital and managers is specified by  $1/(1-\rho)$ .

Our specification for the degree of complementarity between  $M$  and  $K$  and substitutability between  $N$  and the  $M$ - $K$  composite are from Krusell, Ohanian, Rios-Rull, and Violante (2000), and are shown in Table 1. We assume that capital and managers are complements, and that both are substitutes for city labor. Complementarity between capital and managers requires that  $\epsilon > \rho$ ; see Fallon and Layard (1975). The specification in Table 1 meets this requirement as  $\epsilon = .40 > -.50 = \rho$ . The relative weights on  $K$  and  $M$  within the capital/manager composite input and then the relative weight between  $N$  and the capital/manager composite are selected to approximate national

income shares among these three inputs; see Table 2 below. The Cobb-Douglas exponent on land,  $a$ , is set equal to 0.05 in the baseline model, following Mieszkowski (1972), Arnott and MacKinnon (1977), and Sullivan (1985); to our knowledge more recent estimates of the role of unimproved land in firm production are not available. The final elasticity measuring the marginal contribution of public infrastructure ( $G$ ) to firm output is set equal to 0.04 using estimates from Haughwout (2002) for a sample of 33 U.S. cities, but excluding New York. We model  $G$  in two ways: as a pure public good, and as a congestible public service, a distinction we discuss further below.

Households' preferences are represented by a Cobb-Douglas utility function, implying unitary price and income elasticities of demand for the all-purpose consumption good ( $x_{r,d}$ ), for housing structures ( $h_{r,d}$ ), and for residential land ( $l_{r,d}$ ); see Rosen (1979) and more recently Gyourko and Voith (2000) for evidence consistent with this assumption of elastic demand for residential housing and land. Work effort by resident workers is exogenous and suppressed in the specification of  $U(\bullet)$ ; dependent residents do not work. Resident workers and dependent residents are assumed to have the identical preferences for  $x$ ,  $h$ , and  $l$  but, of course, not identical utilities in equilibrium. Preferences are specified as shown in Table 1:

$$(5) \quad U = x^a h^b l^{(1-a-b)} G^g$$

Households allocate 70% of their annual after-wage-tax income to the all-purpose consumption good ( $x_{r,d}$ ), 20% to housing structures ( $h_{r,d}$ ), and 10% to land ( $l_{r,d}$ ). These after-tax budget shares are chosen to approximate actual share allocations for typical New York homeowners. Local public goods ( $G$ ) are also included in resident-worker and dependent-

resident utility, with the budget share set equal to .05, again based upon the recent empirical work in Haughwout (2002).<sup>2</sup> City residents in our model take city  $G$  as exogenous.

### **What are the functional forms of firm and household demands for city land?**

A key determinant of the response of the city's public and private economies to the elimination of distortionary taxation is the response of city residents (and potential residents) to changes in land prices (Nechyba 1998). In both the firm (eq. (4)) and household (eq. (5)) specifications adopted here, land demands are unitary price elastic – that is the price elasticity of demand is equal to -1.0. In spite of the importance of these parameters for policy analysis of the sort conducted here (as well as estimating the effects of many other local policy changes), little is known about them. Extremely careful recent work by Gyourko and Voith (2000) indicates that price elasticity of the demand for land is -1.6. But there is little evidence of which we are aware on the demand for land by firms.

In addition, experimentation with the current model demonstrates that the results are sensitive to the relative importance of land ( $l$ ) and housing capital ( $h$ ) in consumption. When housing makes up a smaller share of resident worker and non-worker expenditures than is assumed here, the simulated benefits of a switch to land taxes are much larger than those reported below. Households' responses to the elimination of distortionary taxation are determined in part by what happens to local wages. When wages and/or land prices rise, as they do with the elimination of sales and capital taxes (see Table 3), the extent to which households change their use of land and

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<sup>2</sup> The budget share of .05 is also very close to the average share of income allocated to local public goods by Philadelphia suburban area households under the assumption that suburban households can choose – a la Tiebout -- their preferred level of local public goods; see Inman and Ritter (1999).

housing capital is determined by the share of these goods in consumption. Assumption of a relatively low housing share (15% instead of the current model's 30%) leads to much more dramatic city-level effects of the elimination of distortionary taxes (Haughwout 2001).

One test of the assumptions is whether the model can replicate actual policy changes. Haughwout and Inman (2001) find that a model using a parameterization very similar to the one used in this paper fits the tax change data for Philadelphia quite well. Nonetheless, given the lack of evidence on this front, the results in the current paper must be evaluated with care. Lower price elasticities or a lower housing share in consumption would reduce the simulated benefits of a shift to land taxation from those reported here and higher elasticities or shares would increase them (Nechyba 1998, Haughwout 2001). One clear implication is that more empirical work is needed here. We return to this issue in the conclusion.

### *The City*

Table 1 describes the fiscal and economic assumptions made in the implementation of the model. New York is, of course, the Nation's largest city, and has arguably its most complex local government. As a consolidated city made up of five counties, New York, like several other US cities (among them Philadelphia, San Francisco and Baltimore) performs both municipal and county functions. In addition to this distinction, New York has a unique political culture which has contributed to an unusual set of fiscal institutions in the City. One result of these institutional and cultural traits is that New York spends much more per resident than most other cities. In fiscal year 1993-1994, for example, New York's general expenditure amounted to nearly \$5,600 per capita, roughly 3.5 times as much as the average expenditure of the nation's 23 largest cities in that

year (Haughwout 1997).

Helping to finance these expenditures is a complex revenue system centered upon four major taxes, described in Table 1. A few complications arise in the context of City taxes. In addition to the taxes specified in Table 1, New York levies a general corporate tax that has a dual structure. Corporations must pay the maximum of either an 8.85% levy on its net income (defined as revenue minus allowable expenses) or a 0.15% levy on the value of its capital assets in the City. Since we ignore the purchase of intermediate inputs, net income is not clearly defined in our model. We thus treat the general corporation tax as an additional tax on business capital. Thus the effective capital tax rate for firms is 2.95% in the simulations.

New York's property tax base is divided into four classes. Each class has different assessment rules, and by implication different effective tax rates. Data limitations make it impossible for us to distinguish these bases here, and we thus apply the weighted average rate to all capital and land in the City. Finally, the City's income tax, as noted above, is progressive. Earlier empirical research indicates that the incentive effects of income taxation in New York are dominated by the top marginal rate, which is the measure used for the calibration (Haughwout, Inman, Craig and Luce 2000). Future research could refine the treatment of these taxes.

In 1997, New York City received over \$16.5 billion in aid from the state and national governments, or about \$5,800 per household (New York City Comptroller's Office). The City owned a public capital stock valued at almost \$95 billion in that year, while outstanding debts were costing the average household \$649 annually (Haughwout & Inman 1996, updated). We set the municipal interest rate at 4%, and the City's share of the (assumed) \$13,500 annual transfer payments to dependent households at 9.5% (Haughwout & Inman 2001). Total City land available

for private development was 110,734 acres (New York City Department of Planning, 1995).<sup>3</sup>

### *The World Economy*

The simulation model requires values for the price of the composite output good  $X$ , equilibrium utility available to households in other cities, and the equilibrium profit rate. In addition to these normalization rules (shown in Table 1), we measure private capital such that its annual rental price is \$1 per unit, assume a discount rate of 5%, and a suburban wage  $S$  of \$53,000, the average income earned by residents of the Nassau-Suffolk and Newark MSAs, as reported in the 1990 Census.

### **How public are City services?**

Models like the one described here must confront the difficult question of the degree of congestibility of the goods and services produced by the public sector. The definition of public goods requires that they be "non-rivalrous", implying that congestion is not an issue in the analysis of public goods. Yet it is clear that many publicly funded programs are subject to at least some congestibility: a police officer can be at only one crime scene at a time, for example. Previous estimates of the congestibility of large city public capital stocks (Haughwout 2002) find modest evidence that they are not congested at current levels of usage. Yet the model here includes the entire public sector, not just the capital stock, and research has indicated that some urban public services are indeed congested at the margin. Further, the tax changes modeled here result in large increases in economic activity in New York. That one might argue that the 1990 infrastructure

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<sup>3</sup>We exclude streets, bodies of water, public land, and recreational land from the definition of available land.

stock of the City was sufficient for its 1990 population is not much comfort when one considers a situation in which the City's population is substantially higher.

Because public spending is endogenously determined within the model, aggregate City revenues increase as the City grows. But how much the city grows and the value of the additional public services that growth creates will be determined in part by how congestible public goods are. We address this issue by conducting two sets of simulations, each with a different specification of the way public spending enters into utility and production. In the "no congestion" specification, public spending is treated as a pure (local) public good: all city firms and residents share equally in the spending generated by the public sector. In the "fully congestion" simulations, public goods is treated as equivalent to private goods. (See Table 1 for the specifications.) This approach allows the reader to see the extreme cases; the reality is likely somewhere in between.

### **Model results and actual outcomes**

Table 2 compares the model's results with actual outcomes in New York in 1997. For most of the endogenous variables, the model performs reasonably well. The model predicts a resident wage (\$36,000- \$39,000 in the "no" and "full" congestion baselines, respectively) that is between the City's actual median (\$30,000) and mean earned incomes (\$48,285). The model simulates median home values that bracket the City's median price in 1996. Aggregate output figures for municipalities are notoriously difficult to generate. The Comptroller's Office estimate provided here is produced with a methodology based on resident incomes. It shows gross city product (which presumably includes housing services and other components not measured as output in the model) considerably higher than the private business output estimate produced by the model.

While the model predicts aggregate jobs relatively closely, it simulates a higher ratio of commuters to resident workers than is true in reality. The simulations indicate that the typical New York City worker has access to more private capital than her counterpart in the rest of the country, as expected.

The model does a relatively good job of predicting sales and income tax revenues per household, but is too high on property and corporate tax revenues. There are three sources of error likely to arise here. First, the model treats all capital as if it were new, whereas most of the City's private capital stock is in fact depreciated. Second, not all business capital is in fact taxable under the property tax. Some, like office machines, is generally excluded. Other business capital escapes taxation because of special deals offered by the City, whose value is difficult to estimate (NYC IBO 2001). Finally, the City's actual general corporation tax allows firms to choose their filing method (8.85% of net revenue or 0.15% of City capital stock). Assuming that firms choose the method that minimizes their tax liability, the predictions of the model (which assume that all firms pay the property base liability) will be an overestimate of corporate tax payments. Overall, however, the baseline simulation provides a reasonable starting place from which to get a sense of the effects of a change in the structure of City taxation.

## II. Replacing the New York City property tax with a land tax

### *Fixed tax rates*

Table 3 reports the results of replacing the City's sales, income, property and general corporation taxes with a land tax, under the baseline assumptions about technology and preferences. In these simulations, the current tax on property (and the surcharge on business



capital) is set at zero, and the current land tax rate (2.83%) is left unchanged. With no change in the rate of tax on land, the elimination of other taxes results in two principal effects on the City. First, the elimination of tax distortions to decisions and the overall reduction of tax burdens makes the City more attractive to both firms and households. On the other hand, reducing taxes reduces revenues and public good provision.

The results are consistent with expectations, and indicate substantial benefits are available from this elimination of distortionary taxation in New York. Turning to the first (full congestion) column of Table 3, note the increases in private output and land values ( $> 100\%$ ), private capital stock ( $> 200\%$ ) and population (over 80%) that are simulated to accompany this change. Note also that aggregate public good provision and per capita tax revenues each fall by over 50%.

The second column of Table 3 identifies one source of the magnitude of these results. The public good congestibility parameters in the firm (eq. 1) and household (eq. 2) behavioral equations have substantial effects on the magnitude of the local benefit from the elimination of capital taxation. Virtually all of the outcomes reported in the table are less responsive to the elimination of distortionary taxes when public goods are modeled as non-congestible.<sup>4</sup> Nonetheless, the increases in land values and capital intensity shown in the no congestion column remain rather impressive.

In both the simulations reported in Table 3, dramatic reductions in poverty rates occur as workers enter the City. Yet since local dependent workers pay little in local taxes, they benefit

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<sup>4</sup> The sources of this difference are complex. In the full congestion simulations, the shift to land taxes induces land price increases and wage declines, making resident labor a relatively attractive factor of production compared to land, commuter labor and private capital. This induces firms to both increase output and hire more resident workers per unit produced. Meanwhile, the amount of land demanded by each of these workers falls in response to lower wages and higher land prices, leaving more land available for firm production. In the no-congestion simulations, these relative price changes are less dramatic, as both wages and land prices increase, the latter not as much as in the congestible public goods simulations.

little from the elimination of distortionary taxes. Meanwhile the tax system is shifting from one which they partially escape (because of their assumed exemption from income tax) to a land tax, which they face fully. The second potential effect on the well-being of non-working households is the reduction in public good provision engendered by the change in the City's tax structure. We would thus expect, and indeed get, negative effects on the poor. In all of the simulations reported here (Tables 3 and 4), however, such effects are relatively small, and other simulations (not reported) indicate that landowners could compensate dependent households for their lost utility.

#### *Fixed tax revenues*

Table 4 reports, for the full congestion scenario only, results for the land tax simulations when aggregate tax revenues are constrained to their baseline level. The additional line at the top of the table reports the required land value tax rate, 21.7%. At this rate of tax, aggregate revenues would remain unchanged, but revenues per capita fall as population rises. Again, many of the City aggregate indicators, especially its private capital stock, increase sharply. One interesting feature of Table 4, however, is that land values are estimated to *fall* when the public sector is constrained to remain the same size, the removal of distortionary taxes makes the City less attractive overall as a place to live and do business. We return to this apparent anomaly in the next section, where we discuss these results in the context of the literature.

#### *Comparison with recent literature on local taxation*

These results are near the tops of the ranges reported by Nechyba (1998) using a similar model applied to the US state-local public sector as a whole. In those simulations, Nechyba finds

that (depending on the elasticity of substitution between land and capital), capital stock would rise between 14% and 122%, with output increasing 10% – 90%. Why would our results for New York be at the high end of Nechyba's ranges?

The most obvious place to look is in the specifications of the current model when compared with Nechyba (1998). The production and preference functions represented in Table 1 assume a unitary elasticity of substitution between land and other inputs (in production) and other goods (in consumption); see above. Nechyba (1998) points out that this elasticity is an important determinant of the benefits predicted from adoption of a land tax. While we argue that the (admittedly modest) empirical evidence supports this specification, it is clear that more empirical estimation of land demand functions is required to enhance the precision of the model. Land expenditure's shares of firm costs and household budgets also have an important effects of the simulated benefits of a land tax. Other things equal, lower land shares lead to higher estimated benefits, as firms and households use city land more intensively; see Haughwout (2001). Finally, the congestibility of public goods and services has important effects on the estimated benefits of a reduction in tax distortions.

While these technical factors surely explain part of the high benefits simulated here, there may be also good political economic reasons to expect the real New York economy to react more strongly than the average US locality to an increase in the efficiency of its tax policy. In particular, New York is a city with a very large public sector and concomitantly high levels of distortionary taxation. In previous work, Haughwout, Inman, Craig and Luce (2000) found that New York is very near the peak of its revenue schedule (local Laffer curve) on three of the four taxes modeled here (property, sales and income). This suggests that the excess burden of local taxation ( $\eta$ ) is very

high in New York, and that reductions in tax distortions may have especially large economic efficiency payoffs.

This empirical result also helps explain how the sign of the land price effect in Table 4 can be negative in the face of a reduction in distortionary taxation. Recalling that public goods enter production technology and preferences as a pure public good, the public good level produced by this high tax rate levied on a very large tax base is not worth its cost. This problem would be even worse (i.e., land prices would be even lower) were this large public sector to be financed with distortionary taxes. Indeed, from a rate of 21.7%, the net effect of reductions in land tax rates and public services is to increase land values.

### III. The political economy of land taxation and concluding remarks

The benefits to be had from eliminating the distortion introduced by capital and labor taxation, particularly in cities in which rates (and their associated distortive effect) are high, appear to be enormous. Does the current model shed any light on the sources of opposition to a land tax?

The answer does not seem to lie in the obvious rich-poor or business-household schisms in local politics. When businesses and middle-class households are freely mobile, there are only two groups whose well-being can be directly affected by the efficiency of local taxation. Dependent households' well-being does not seem to be much affected either way, while land owners stand to gain substantially from a move to a land tax, at least under certain conditions. But it may be these very conditions in which the trouble lies: as demonstrated in Table 4, transitioning to a land tax does not necessarily lead to an increase in land values. It is only when the structure of taxation *and*

*the amount of revenue collected* can both be altered that landowners unambiguously benefit. But of course this means that the politics of the land tax are closely identified with the politics of local government size. Conflict over the latter is likely to remain significant, particularly in cases where city government is already “too large” from landowners’ perspectives. This suggests that the most likely candidates to adopt a land tax may not be the Nation’s largest cities, where preference and income heterogeneity makes these conflicts most intensive, but more homogenous Tiebout suburbs. Unfortunately, as others have pointed out, it is in such communities that local taxation is probably least distortive (Hamilton 1976, Fischel 1998).

If this view is correct, then the adoption of a land tax is most likely where its alternatives are least onerous, and where its benefits are smallest. In places where it could really make a difference, it is likely to be doomed to the usual fate of dramatic policy proposals with small or uncertain benefits to crucial interest groups. The best we can hope for may be incrementalism in both kinds of places, perhaps with land taxes being the ones raised when revenue shortfalls develop, when another tax is exogenously eliminated, or when crisis strikes in another form.

But what is perhaps most clear from this work is that while theoretical public finance can offer consistent predictions of the signs of most of the effects of a shift to land taxation, we are far short of the empirical knowledge required to accurately predict their magnitude. If moving to land taxation were politically costless, it presumably would have been accomplished long ago. The range of benefit estimates presented here and in Nechyba (1998) imply that more work on the role of land in consumption and more particularly in production needs to be done before economists can make a clear and convincing case that policy makers would be well-advised to pay the required costs.

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## Table 1: Assumptions and Parameterization

### Production Technology

$$X = L_f^{0.05} [0.5N^{0.4} + 0.5(0.5K^{-0.5} + 0.5M^{-0.5})^{0.4/(-0.5)}]^{0.95/0.4} G^{0.04} \text{ (No congestion)}$$

or

$$X = L_f^{0.10} [0.5N^{0.4} + 0.5(0.5K^{-0.5} + 0.5M^{-0.5})^{0.4/(-0.5)}]^{0.90/0.4} \left(\frac{G}{N^*}\right)^{0.04} \text{ (Full congestion)}$$

### Household Preferences

$$U = x^{0.7} h^{0.2} \ell^{0.1} G^{0.05} \text{ (No congestion)}$$

or

$$U = x^{0.7} h^{0.2} \ell^{0.1} \left(\frac{G}{N^*}\right)^{0.05} \text{ (Full congestion)}$$

### New York City, FY 1997

$\tau_p$ , property tax rate = 0.0283\*

$\tau_s$ , sales tax rate = 0.04

$\tau_w$ , income tax rate = 0.0446

$\tau_m$ , commuter tax rate = 0.0045

$Y_d$ , = \$13,500/dependent household

$r_m$ , municipal interest rate = 0.04

D, Dependent pop. = 831,068

Z, Aid from other governments = \$5,783 per household

$G_0$ , surviving infrastructure stock = 94,479 million

A, Net income from assets = -649 per household

$r^o$ , interest cost per dollar of surviving city debt = 0.0052

$\psi$ , local share of dependent income = 0.095

$L_s$ , available land = 110,734 acres

### World economy

P, price of composite output = 1.00

r, discount rate = 0.05

S, suburban wage = \$53,000

\* 0.0295 on firm capital.

$V_0$ , reservation utility level = 1.00

$\Pi_0$ , equilibrium profit rate = 0.00



**Table 2: Calibration to NYC economy, 1997**

| <i>Public Good Congestibility:</i>              | Full congestion  | No congestion    | Actual Data      | Data Source   |
|---|------------------|------------------|------------------|---|
| <b>Wage (resident workers, \$ per year)</b>     | <b>39,172</b>    | <b>36,125</b>    | <b>30,000</b>    | NY City Housing and Vacancy Survey, 1999 data, median       |
| <b>Median home value (\$)</b>                   | <b>143,392</b>   | <b>88,159</b>    | <b>151,920</b>   | NY City Housing and Vacancy Survey, 1996 data, median*      |
| <b>Output (\$ million per year)</b>             | <b>167,446</b>   | <b>150,370</b>   | <b>299,548</b>   | NY City Comptroller's Office (1998)                         |
| <b>Jobs</b>                                     | <b>3,073,053</b> | <b>2,941,060</b> | <b>2,953,900</b> | NY State Dep. of Labor                                      |
| <i>Resident workers</i>                         | 2,025,898        | 2,026,042        | 2,429,732        | Estimated using Census Journey to Work data                 |
| <i>Commuters</i>                                | 1,047,155        | 915,018          | 524,168          |   |
| <b>Productive capital stock per worker (\$)</b> | <b>97,820</b>    | <b>89,312</b>    | <b>79,083</b>    | National data from <i>Survey of Current Business</i> (1998) |
| <b>Tax revenues (\$ per household)</b>          | <b>9,581</b>     | <b>8,185</b>     | <b>5,763</b>     | New York City, Comptroller's Office, 1997                   |
| <i>Income</i>                                   | 1,320            | 1,143            | 1,532            |   |
| <i>Property + Corporate</i>                     | 7,416            | 6,182            | 3,203            |   |
| <i>Sales</i>                                    | 839              | 783              | 1,028            |   |

\* Calculated as present discounted value of median rent, using a 5% real discount rate and 1% annual depreciation rate. Approximately 70% of occupied NYC housing units are rented.

**Table 3: Eliminating NYC sales, capital and income taxes***Percentage Changes from Baseline*

| <i>Public Good Congestibility:</i>                         | Full<br>congestion | No congestion |
|--|--------------------|---------------|
| <b>City wage (W*)</b>                                      | <b>-3%</b>         | <b>3%</b>     |
| <b>City land price (R*)</b>                                | <b>118%</b>        | <b>68%</b>    |
| <b>Capital per unit of land (<math>[K^*+H^*]/L</math>)</b> | <b>228%</b>        | <b>88%</b>    |
| <b>Jobs (N*+M*)</b>  | <b>133%</b>        | <b>24%</b>    |
| <b>Residents (N*)</b>                                      | <i>126%</i>        | <i>16%</i>    |
| <b>Commuters (M*)</b>                                      | <i>146%</i>        | <i>41%</i>    |
| <b>Population ([N+D])</b>                                  | <b>89%</b>         | <b>11%</b>    |
| <b>Poverty rate (d)</b>                                    | <b>-47%</b>        | <b>-10%</b>   |
| <b>Dependent population utility (V<sub>d</sub>)</b>        | <b>-1%</b>         | <b>-8%</b>    |
| <b>Per capita tax revenue (T)</b>                          | <b>-74%</b>        | <b>-73%</b>   |
| <b>Relevant public good provision<br/>(G*/N* or G*)</b>    | <b>-65%</b>        | <b>-44%</b>   |
| <b>Aggregate output (X*)</b>                               | <b>127%</b>        | <b>27%</b>    |

*Note: Figures in table are the percentage increases from the relevant baseline level. Simulations set sales, capital and income tax rates to zero, but leave land tax rates at their baseline levels. See text.*

**Table 4: Eliminating NYC sales, capital and income taxes without changing aggregate tax revenue**

|  | No Congestion |
|--|---------------|
| Required land tax rate                     | 21.7%         |
| City wage ( $W^*$ )                        | 4%            |
| City land price ( $R^*$ )                  | -28%          |
| Capital per unit of land ( $[K^*+H^*]/L$ ) | 168%          |
| Jobs ( $N^*+M^*$ )                         | 84%           |
| Residents ( $N^*$ )                        | 72%           |
| Commuters ( $M^*$ )                        | 112%          |
| Population ( $[N+D]$ )                     | 51%           |
| Poverty rate ( $d$ )                       | -34%          |
| Dependent population utility ( $V_d$ )     | -8%           |
| Per capita tax revenue ( $T$ )             | -34%          |
| Aggregate public good provision ( $G^*$ )  | 0%            |
| Aggregate output ( $X^*$ )                 | 91%           |

*Note: Figures in table are the percentage increases from the relevant baseline level. Simulations set sales, capital and income tax rates to zero, and change the land tax rate to keep Aggregate tax revenue at its baseline level. See text for more information.*

*Appendix: Model Variables and Solution Procedure*

Endogenous variables (see Tables 2-5 for selected equilibrium values)

*Equilibrium local prices*

$R^*$  [land rent],  $W^*$  [labor]

*Equilibrium firm input use per unit output*

$k$  [private capital],  $l_f$  [land],  $n$  [resident labor],  $m$  [commuter/managers]

*Equilibrium resident worker household consumption (per household)*

$x_r$  [composite good],  $h_r$  [housing capital],  $l_r$  [land]

*Equilibrium dependent household consumption and utility (per household)*

$x_d$  [composite good],  $h_d$  [housing capital],  $l_d$  [land],  $V_d$  [utility]

*City-level economy and demography*

$X$  [aggregate output],  $N+M$  [employment],  $\delta$  [poverty rate]

*City fisc*

$\mathfrak{R}$  [tax revenues],  $G$  [public services, present value]

Exogenous variables (See Table 1 for values)

$V_0$  [reservation utility level],  $\Pi_0$  [equilibrium profit rate],  $P$  [price of composite output],  
 $r$  [discount rate],  $S$  [suburban wage],  $L_s$  [city land area],  $D$  [dependent population],  
 $Y_d$  [dependent household income],  $Z$  [Aid from other governments],  $G_0$  [pre-existing infrastructure  
stock],  $A$  [net income from city-owned assets],  $r_0$  [interest cost per dollar of surviving city debt],  
 $\psi$  [local share of dependent income]  $r_m$  [municipal interest rate],  $\mathbf{t}$  [tax rates]

Note: Current public services  $G$  are modeled as the annual services from  $G_0$  plus current revenues less interest costs (Haughwout & Inman 2001).

## *Equilibrium*

An open city equilibrium exists within our model when no mobile firm, resident household, or commuter has an incentive to change their location, residence, or job. This means satisfying the constraints depicted in Figure 1 and ensuring commuters get their after-tax wage of  $S$ . An equilibrium specifies the model's 18 endogenous variables. The 18 equations of the model specified above are sufficient to solve for each of the 18 endogenous variables, conditional on values for each of the model's exogenous parameters.

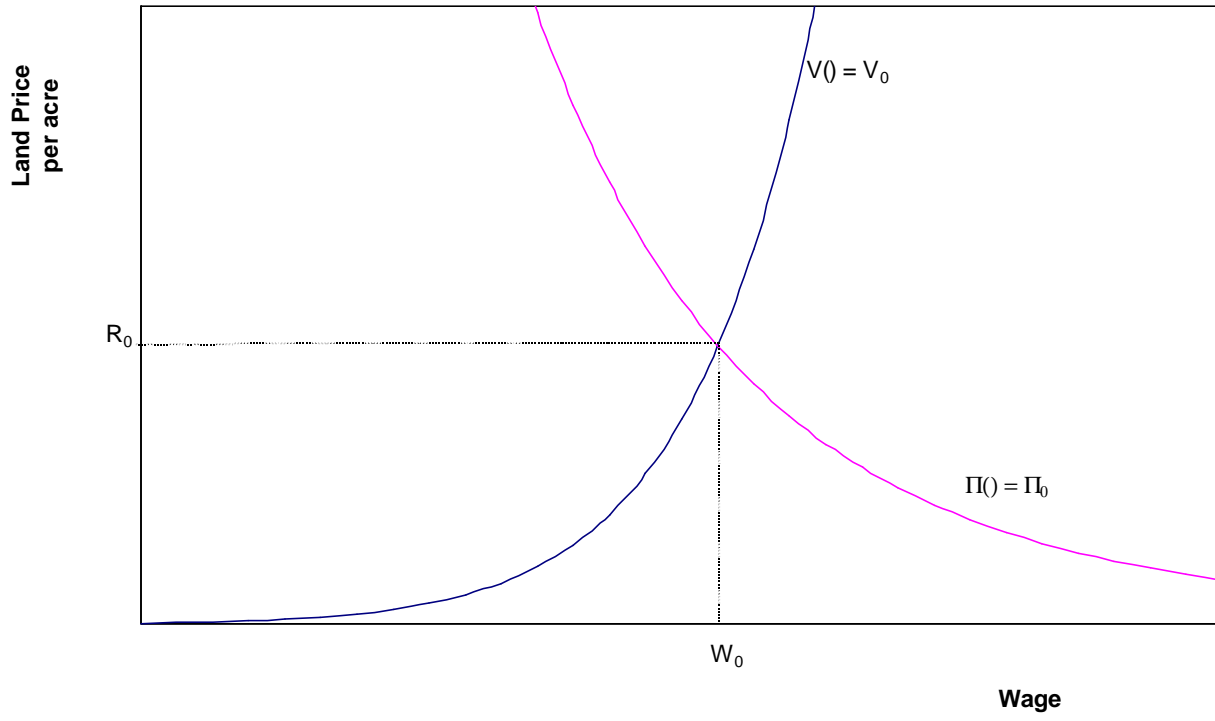
The model is solved iteratively. First, given preferences and technologies, world prices  $(r, 1, S)$  and the firms' and resident-workers' outside options  $(\Pi_0, V_0)$ , local tax rates  $\mathbf{t}$  and an assumed starting value for  $G (= G^{(0)})$ , Figure 1 depicts two equations in the two unknown endogenous city prices,  $W$  and  $R$ . Initially, the equilibrium values of wages and rents will be  $W = W^{(0)}$  and  $R = R^{(0)}$ , both conditional upon the assumed starting value of  $G = G^{(0)}$ .

Given  $W^{(0)}$  and  $R^{(0)}$ , the remainder of the model can then be solved for firms' input demands, resident workers' demands, and dependent residents' demands, respectively, again conditional upon  $G = G^{(0)}$ . Firms' and residents' demands for land and firms' demand for workers allow us to compute aggregate city output  $(X^{(0)})$ , aggregate resident employment  $(N^{(0)})$ , and the dependent population's share of total city population  $(\delta^{(0)})$ . Given conditional firms' and residents' demands, rents and wages, and now the dependent residents' share of city population, city own tax revenues  $(\mathfrak{R}^{(0)})$  can be calculated. Finally, we can now solve for a new starting value of  $G = G^{(1)}$ , and the solution process repeated.

An equilibrium is obtained when  $G^{(t-1)} = G^{(t)} = G$ ; that is, when a starting value of  $G$  creates a private economy and subsequent public goods resources just sufficient to pay for the original

starting level of  $G$ . Sufficient for an equilibrium level of  $G$  to be a locally stable equilibrium is for a small increase (decrease) in  $G$  from equilibrium to cost (save) more than any endogenous public goods resources generated (lost), *at given tax rates*, after the private economy's adjustments to that change in  $G$ . Simply put, for given tax rates increasing  $G$  cannot, in equilibrium, be a source of new wealth (i.e., a "money machine") for the city's current residents. All simulations reported here produced stable and unique equilibria.

Figure 1: Wage and Land Rent Equilibrium



**Figure 2: Wage and Land Price Equilibrium with Lower Taxes (cet. par.)**

