NBER WORKING PAPER SERIES

# THE NEW VIEW OF THE PROPERTY TAX: A REFORMULATION

Peter M. Mieszkowski

George R. Zodrow

Working Paper No. 1481

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 1984

Financial support from the National Science Foundation (Grant SES82-09210) is gratefully acknowledged. We would like to thank A. Friauf and J. Sutterfield for research assistance. The research reported here is part of the NBER's research program in Taxation and project in Government Budget. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

NBER Working Paper #1481
October 1984

# The New View of the Property Tax: A Reformulation

ABSTRACT

The "new view" of the property tax is reformulated within the context of a model with interjurisdictional competition, endogenous local public services, individuals who are segregated into homogeneous communities according to tastes for local public services, a simple form of land use zoning, and a political or constitutional constraint on the use of head taxes by local governments. Expressions for the "profits tax" and "excise tax" effects of the property tax are derived. The effects of a "consumption distortion" away from government services due to local reluctance to tax mobile capital are also examined.

Peter M. Mieszkowski
Department of Economics
Rice University
Houston, Texas 77251

George R. Zodrow
Department of Economics
Rice University
Houston, Texas 77251

# I. INTRODUCTION

There are two popular but highly contradictory theoretical views regarding the effects of the local property tax. The first is the "benefit view", developed by Hamilton (1975), Fischel (1975) and White (1975), which holds that interjurisdictional competition and factor and consumer mobility, coupled with homogeneous local jurisdictions with the appropriate zoning restrictions,[1] ensure that the property tax is a benefit tax -- a non-distortionary and non-redistributive user charge for local public services provided to individuals and businesses.

This view contrasts markedly with the "new view" of the property tax, which holds that the primary effect of nationwide use of the local property tax is to reduce the net return to capital, while tax differentials result in relatively less important effects on consumer prices and returns to imperfectly mobile factors of production.[2] In this analysis, the property tax results in many distortions, especially in capital allocation, and has an important redistributive component as the main burden is borne by capitalists. The new view was developed by Mieszkowski (1972) who, building on the work of Brown (1924) and Thompson (1965), utilized the Harberger (1962) fixed capital stock, perfectly competitive general equilibrium model of national tax incidence to analyze the property tax.

In an earlier article (Zodrow and Mieszkowski, 1983), we argued that the critical assumption underlying the benefit view result is that fiscal zoning is sufficiently precise that households and firms are not able to adjust their demand for capital. Interjurisdictional competition implies that benefit taxes are optimal from the viewpoint of the local government, and precise zoning converts the property tax to a benefit tax so that consumers of local public services cannot "free-ride" at the expense of non-resident or industrial capital owners. However, we noted that local head taxes are never observed while the precise zoning requirements described in the benefit view literature are seldom observed. Accordingly, we suggested that limitations on the use of precise zoning, coupled with local reliance on property tax finance, would imply that the effects of the property tax were accurately described by the new view.

We develop this suggestion formally in this paper. Our goal is to present a reformulation of the new view which takes into account some of the features of local use of the property tax stressed by proponents of the

benefit view; these features are ignored in the Mieszkowski (1972) new-view derivation based on the Harberger general equilibrium model of national tax incidence, which abstracts from local government behavior by taking public services and taxes as exogenous. Specifically, our approach differs from the original derivation in five important respects. First, we allow for independent local jurisdictions in the economy that compete along Cournot-Nash lines, as each local jurisdiction takes the tax and expenditure policies of other jurisdictions (and the national net return to capital) as fixed; thus local government tax and expenditure policies are endogenous in the model. Second, we explicitly include local public services in individual utility functions and allow individuals to differ in their tastes. Third, we take into account the composition of individual jurisdictions and assume, as predicted by Tiebout (1956) and benefit view proponents, that individuals are segregated into communities according to their tastes for public services; as in many of thc benefit view models, we assume that local jurisdictions are homogeneous. Fourth, we allow for a simple form of land use zoning in our model. Finally, we obtain explicit expressions for the "profits tax" and "excise tax" portions of the burden of the property tax,[3] and we identify the effects of a "consumption distortion" induced by local reluctance to subject mobile capital to property taxation. Within this more general context, we demonstrate that, except for the special case of perfect fiscal zoning noted above, the results of the new view of the property tax are quite robust; we also analyze the incidence effects of the endogeneity of local public service levels.

Our model is described in detail in the following section, while the incidence results are presented in Section III. An illustrative numerical example is presented in Section IV and the final section briefly summarizes the results.

## II. THE MODEL

We adopt the standard ncoclassical assumptions of a fixed national capital stock ($K_T$), full employment, perfectly competitive product and and factor markcts, and perfect mobility of capital across all jurisdictions. The economy is divided in N jurisdictions, each of which has the same fixed land area ($V_T$).[4] We assume that individuals are segregated into jurisdictions which are homogeneous according to tastes for public services;

there are $N_1$ jurisdictions composed exclusively of "high demanders" and $N_2$ jurisdictions composed exclusively of "low demanders," with $N = N_1 + N_2$. Each jurisdiction is assumed to have the same number of identical individuals -- each has the same utility function, supplies the same amount of labor inelastically,[5] and owns an equal share of the jurisdiction's land. Capital ownership is shared equally among all residents in the economy and, unlike land, capital need not be invested in the jurisdiction of residence. Since we are concerned primarily with the production-side effects of the property tax, we make the simplifying assumption on the demand side that all individuals have a Cobb-Douglas utility function defined over consumption of housing, local public services and the composite good. Public goods are modeled as equally-shared public purchases of the composite good and are treated as publicly-provided private goods (see Hamilton (1983) for a justification). Since the Cobb-Douglas utility function is homogeneous of degree one, the aggregate utility ($U_j$) of a typical jurisdiction j (the sum of residents' utilities) is given by

$$(1) \qquad U_j = \alpha \ln H_j + \beta_j \ln G_j + \gamma_j \ln C_j, \qquad j = 1,2,$$

where $\alpha+\beta_j+\gamma_j = 1$ and $H_j$, $G_j$ and $C_j$ are aggregate housing, public good and composite good consumption in j. The indirect utility function associated with (1), neglecting constant terms, is

$$(1)' \qquad U_j' = (\alpha+\gamma_j)\ln I_j - \alpha \ln q_j - \gamma_j \ln p + \beta_j \ln G_j,$$

where p is the price of composite good which is assumed to be identical across all jurisdictions, while $q_j$ is the price of housing and $I_j$ is aggregate net income in jurisdiction j. Since jurisdictions of type one are those composed of high demanders, $\beta_1 > \beta_2$ and $\gamma_1 < \gamma_2$. Note that we assume for simplicity that $\alpha$ does not vary across jurisdictions.

The production technology is the same in both types of jurisdictions. In each jurisdiction, the composite good is produced with a constant returns to scale production function using capital, labor and land. Housing is produced with a constant returns to scale production function using capital and land. Since public services are modeled as public purchases of the composite good, there is no separate public goods

technology.

Within this type of analytical framework, we have shown elsewhere (Zodrow and Mieszkowski, 1983) that if the individual local jurisdictions have head taxes at their disposal, they will use them exclusively and not rely on property tax finance; each local government fears that using the property tax will drive out mobile capital and lower land rents and so instead utilizes only head tax finance. Such a "head tax equilibrium", where all jurisdictions of both types finance all local services exclusively with head taxes, is the benchmark for our analysis; this initial equilibrium corresponds to the case of property taxation coupled with perfect fiscal zoning which induces each household (firm) to consume (use) the efficient amount of capital.

The level of public services in the initial equilibrium is chosen by the local government to maximize (1') and is financed by head taxes $Z_j$, while housing and composite good demands are determined by the maximization of (1') subject to an aggregate net income constraint. This yields

$$(2) \qquad pG_j = Z_j = \beta_j I_j/(\alpha+\gamma_j)$$

$$(3) \qquad pC_j = \gamma_j I_j/(\alpha+\gamma_j)$$

$$(4) \qquad q_j H_j = \alpha I_j/(\alpha+\gamma_j).$$

Our assumptions about factor ownership and equal-size jurisdictions with identical populations and production technologies, combined with the above demand functions, imply that composite good and housing production and all prices are identical in the two jurisdictions in the initial equilibrium. Identical factor prices imply that gross incomes $I_j^G = I_j + Z_j$; are also equal. Thus jurisdictions differ only in public and private demands for the composite good. The use of head tax finance corresponds to the Tiebout paradigm where binding zoning requirements convert property tax assessments into head tax levies.

Our method of relaxing the perfect zoning assumption is to assume that local zoning ordinances are limited to fixing residential and non-residential land use at the initial efficient levels and to introduce a constitutional or political restriction on the permitted level of head taxation; this level is determined by the value of $\phi$, an exogenous parameter which specifies that only $\phi Z_j$ can be collected as head taxes in each jurisdiction. Thus a

reduction in $\phi$ implies an equiproportionate reduction in head taxes in the two jurisdictions. Given $\phi$ (and p and r), each government sets $T_j$ to maximize $U_j'$, where $T_j = 1 + \tau_j$ and $\tau_j$ is and ad-valorem tax on the return to capital in jurisdiction j. The effects of the nationwide system of property taxes are obtained as the changes in all endogenous variables in response to an exogenous change in $\phi$.[6] The differential incidence expressions shown below are calculated at the initial head tax (zero property tax) equilibrium ($T_j = \phi = 1$); thus, they are only approximations for changes from finite levels of property taxation.[7]

The details of our model are as follows. For given values of $Z_1$, $Z_2$ and $\phi$ there are six endogenous varibles in our model, the two property tax rates ($T_1$ and $T_2$), housing prices ($q_1$ and $q_2$), the composite good price (p) and the after-tax rate of return on capital (r). The development of the six-equation equilibrium system is simplified if we follow a dual approach.[8] Our zoning assumption coupled with inelastically supplied labor imply that, in each jurisdiction, labor and non-residential land are a fixed composite factor, hereafter referred to simply as "labor" and denoted as L; residential land is similarly fixed, referred to as "land", and denoted as V.[9] Note that the quantities of the fixed factors do not vary across the two types of jurisdictions. We thus can construct restricted profit functions in each jurisdiction $\pi^{Xj}(p,rT_j,L)$ and $\pi^{Hj}(q_j,rT_j,V)$. Letting subscripts denote partial differentiation, with the r subscript denoting differentiation with respect to the gross price of capital $rT_j$, we have

$$(5) \quad \pi^{Xj}_p = L\pi^{Xj}_{Lp} = X_j$$

$$(6) \quad \pi^{Xj}_r = L\pi^{Xj}_{Lr} = -K_{Xj}$$

$$(7) \quad \pi^{Xj}_L = w_j$$

$$(8) \quad \pi^{Hj}_q = V\pi^{Hj}_{Vq} = H_j$$

$$(9) \quad \pi^{Hj}_r = V\pi^{Hj}_{Vr} = -K_{Hj}$$

$$(10) \quad \pi^{Hj}_V = s_j$$

where $w_j$ and $s_j$ are the returns to the fixed factors (the division of the return to $L_j$ between workers and non-residential land owners is arbitrary). The following definitions will be useful. The own-price capital

demand elasticity in the composite good sector, weighted by the amount of capital used, is

$$(11) \qquad \mu_{Xj} = -K_{Xj}[(rT_j/K_{Xj})\partial K_{Xj}/\partial(rT_j)] = r\pi_{rr}^{Xj} = -p\pi_{rp}^{Xj} = -p\pi_{pr}^{Xj} > 0.$$

Similarly, in the housing sector,

$$(12) \qquad \mu_{Hj} = -K_{Hj}[(rT_j/K_{Hj})\partial K_{Hj}/\partial(rT_j)] = r\pi_{rr}^{Hj} = -q_j\pi_{rq}^{Hj} = -q_j\pi_{qr}^{Hj} > 0.$$

The own-price supply elasticities in the two sectors are

$$(13) \qquad \eta_{Xj} = p\pi_{pp}^{Xj}/Xj = -r\pi_{rp}^{Xj}/Xj > 0$$

$$(14) \qquad \eta_{Hj} = q_j\pi_{qq}^{Hj}/H_j = -r\pi_{rq}^{Hj}/H_j > 0.$$

Two equations of the equilibrium system are provided by (4) for $j = 1,2$, where

$$(15) \qquad I_j = rK_T/N + w_jL + s_jV - \phi Z_j$$

and $K_T$ is the total capital stock.

A third equilibrium equation is implied by the fixed national capital stock constraint which, using (6) and (9) can be written as:

$$(16) \qquad K_T + N_1(\pi_r^{X1}+\pi_r^{H1}) + N_2(\pi_r^{X2}+\pi_r^{H2}) = 0.$$

The derivation of the fourth and fifth equations is more complex. The problem faced by each jurisdictional government is to choose the tax rate $T_j$ to maximize aggregate utility (1′) subject to the budget constraint:

$$(17) \qquad G_j = \phi Z_j - (T_j-1)\, r(\pi_r^{Xj}+\pi_r^{Hj}).$$

The change in net income with respect to changes in $T_j$ perceived by each government (i.e., holding p, r and $\phi$ constant) is

$$(18) \qquad \partial I_j/\partial T_j = H_j\partial q_j/\partial T_j - rK_j$$

where $K_j = K_{Xj} + K_{Hj}$. Thus, the first order condition for this optimization problem is

$$(19) \quad [(\alpha+\gamma_j)/I_j][q_j H_j \eta_{qj} - rK_j T_j] - \alpha\eta_{qj} + (\beta_j rK_j/pG_j)[T_j - (T_j-1)\eta_{Kj}] = 0,$$

where $\eta_{qj}$ is the perceived elasticity of housing prices with respect to property tax changes, and $\eta_{Kj}$ is the perceived elasticity of the capital stock with respect to property tax changes. Differentiating (4), holding $\phi$, p and r fixed, yields

$$(20) \quad \eta_{qj} = [(\alpha+\gamma_j)\eta_{Hj} - y_{Kj}]/[(\alpha+\gamma_j)\eta_{Hj} + \gamma_j],$$

where $y_{Kj} = (rK_T/N)/I_j^G$ is the capital share in gross income. Differentiating (6) and (9), holding p, $\phi$ and r constant, yields:

$$(21) \quad \eta_{Kj} = -(T_j/K_j)\partial K_j/\partial T_j = [\mu_X + \mu_H(1-\eta_{qj})]/K_j.$$

Substituting from (20) yields:

$$(21') \quad \eta_{Kj} = \frac{\mu_{Xj}[(\alpha+\gamma_j)\eta_{Hj}+\gamma_j] + \mu_{Hj}(\gamma_j + y_{Kj})}{K_j[(\alpha+\gamma_j)\eta_{Hj}+\gamma_j]} > 0.$$

Substituting from (4) into (19) and rearranging terms yields

$$(22) \quad \beta_j/pG_j - (\beta_j/pG_j)(T_j-1)\eta_{Kj}/T_j - (\alpha+\gamma_j)/I_j = 0.$$

The three terms of this first order condition indicate that, for any $\phi$, the government raises its property tax rate as long as the value of the marginal increase in revenue from the higher taxes (first term) outweighs the loss in revenue from the lower tax base (second term) and the loss in fixed factor income due capital out-migration. Note that differentiating (22) with respect to $T_j$, holding p, r and $\phi$ fixed, substituting from (20), (18) and from

$$(23) \quad \partial G_j/\partial T_j = y_{Kj}/\beta_j,$$

and evaluating at the initial equilibrium yields the second order condition for each government's optimization problem:

(24) $\sigma_j = (\alpha+\gamma_j)\{(\eta_{Hj}+1-\alpha)y_{Kj}/\beta_j+[(\alpha+\gamma_j)\eta_{Hj}+\gamma_j]\eta_{Kj}-\alpha\eta_{Hj}\} > 0.$

Finally, we choose the following price normalization

(25) $Np + N_1q_1 + N_2q_2 = 2N,$

where units are chosen so that $p = q_1 = q_2 = 1$ in the initial equilibrium. The six equation equilibrium system is thus described by (14) and (22) for j = 1,2, (16) and (25).

## III. DIFFERENTIAL INCIDENCE RESULTS

Totally differentiating the system of five equations described above yields the "equations of change" for the model -- the changes in the endogenous variables as a function of changes in the exogenous $\phi$ parameter. Our symmetry assumptions ensure that many quantities, including all housing market variables, gross income shares, capital stock variables and all derivatives of the profit functions, are identical in the initial equilibrium; to simplify the notation in the discussion below, the j subscripts are dropped for all such quantities. The system of differential equations for the model, calculated when $T_j = \phi=1$ is:

(26) $[(\alpha+\gamma_j)\eta_H-y_K]\tilde{T}_j+ [(\alpha+\gamma_j)\eta_H]\tilde{r} -[(\alpha+\gamma_j)\eta_H+\gamma_j]\tilde{q}_j = \beta_j\tilde{\phi}$

(27) $-[y_K/\beta_j+(\alpha+\gamma_j)\eta_{Kj}]\tilde{T}_j + \alpha\tilde{q}_j = \tilde{\phi}$

(28) $\sum_{j=1}^{2} [N_j(\mu_X+\mu_H)\tilde{T}_j-N_j\mu_H\tilde{q}_j] + N(\mu_X+\mu_H)\tilde{r} = 0,$

(29) $\tilde{p} + (N_1/N)\tilde{q}_1+ (N_2/N)\tilde{q}_2= 0,$

where the tilde denotes logarathmic differentiation. Solving this five equation system yields the differential incidence results, which are presented as elasticities of the endogenous variables with respect to a reduction in $\phi$; thus, $\varepsilon_{T1} = -(\phi/T_1)dT_1/d\phi$, etc.

The elasticities of the tax rates are

(30) $\varepsilon_{T1} = \sigma_2(\alpha+\gamma_1)(2N)[\mu_X(\eta_H+1-\alpha)+\mu_H(1-\alpha)]/D > 0$

(31) $\varepsilon_{T2} = \sigma_1(\alpha+\gamma_2)(2N)[\mu_X(\eta_H+1-\alpha)+\mu_H(1-\alpha)]/D > 0$

where, as shown in the appendix, D is the positive determinant of the coefficient matrix of the differential equation system. Thus, property tax rates in both jurisdictions must increase when the permitted level of head taxation ($\phi$) declines. Moreover, substituting from (24) for j=1,2 demonstrates that

(32) $\Omega = [\sigma_2(\alpha+\gamma_1) - \sigma_1(\alpha+\gamma_2)]/D > 0,$

so that

(33) $\varepsilon_{T1} - \varepsilon_{T2} = \Omega(2N)[\mu_X(\eta_H+1-\alpha)+\mu_H(1-\alpha)] > 0.$

Thus, property taxes rise more in jurisdictions of type one -- high-demander jurisdictions have higher property tax rates.

The price elasticity expressions presented below are each separated into two sets of terms. The first set reflects the "new-view" effects of local use of the property tax as specified by (30-31), and are described in terms of a "profits-tax effect" and some associated "excise-tax effects". The second set reflects the effects of the "consumption distortion" induced by the reduction in the permitted level of head taxation. This distortion arises for the following reason. In the initial head-tax equilibrium, the opportunity cost of government services is simply p, the price of the composite good. However when local governments use property tax finance, each government perceives a higher price as provision of public services has the additional cost of driving out mobile capital (as determined by $\eta_{Kj}$) and lowering local incomes.[10] Since government services are modeled simply as public purchases of the composite good, this consumption distortion has the effect of reducing total consumption of the composite good ($X_T = N_1X_1+N_2X_2$) and increasing total consumption of housing

($H_T = N_1H_1+N_2H_2$); specifically[11]

$$(34) \qquad \varepsilon_{XT} = -2\eta_X\mu_H(N_1\theta_1+N_2\theta_2) < 0$$

$$(35) \qquad \varepsilon_{HT} = 2\eta_H\mu_X(N_1\theta_1+N_2\theta_2) > 0,$$

where

$$\theta_1 = \sigma_2(\alpha+\gamma_1)\beta_1\eta_{K1}/D > 0$$

$$\theta_2 = \sigma_1(\alpha+\gamma_2)\beta_2\eta_{K2}/D > 0 .$$

The price changes induced by the reduction in $\phi$ are as follows. The change in the net return to capital is

$$(36) \qquad \varepsilon_r = -[(N_1/N)\varepsilon_{T1}+(N_2/N)\varepsilon_{T2}] - (\mu_X-\mu_H)(N_1\theta_1+N_2\theta_2).$$

The first term in (36) is unambiguously negative and, by itself, indicates that capital bears the full burden of property taxation in the economy; this "pure profits tax effect" occurs if

$$(37) \qquad K_T dr = -[(N_1 rK_1)dT_1+(N_2 rK_2)dT_2],$$

or if

$$(38) \qquad \varepsilon_r = -[(N_1/N)\varepsilon_{T1}+(N_2/N)\varepsilon_{T2}].$$

The second term in (36) reflects the effect of the consumption distortion, as the demand for capital falls (rises) in the composite good (housing) sector which reduces (increases) the net return to capital; the net effect depends on the sign of $(\mu_X-\mu_H)$ which is theoretically ambiguous. Throughout our exposition below, we assume that either $(\mu_X-\mu_H)\geq 0$ or, if not, the magnitude of the terms involving $(\mu_X-\mu_H)$ is sufficiently small that they do not change the signs of otherwise theoretically unambiguous expressions; this assumption is satisfied for all plausible parameter values.

For the particular price normalization (25) chosen, the change in the price of the composite good is determined solely by the effects of the consumption distortion, as

$$(39) \qquad \varepsilon_p = -(\mu_X+\mu_H)(N_1\theta_1+N_2\theta_2);$$

the reduction in composite good demand drives down its price. The changes in housing prices in the two jurisdictions are more complicated, as

$$(40) \qquad \varepsilon_{q1} = N_2\{\Omega\eta_H(\mu_X+\mu_H)+\lambda[(1-\alpha)(\mu_X+\mu_H)+\eta_H(\mu_X-\mu_H)]\} + N(\mu_X+\mu_H)\theta_1$$

$$(41) \qquad \varepsilon_{q2} = -N_1\{\Omega\eta_H(\mu_X+\mu_H)+\lambda[(1-\alpha)(\mu_X+\mu_H)+\eta_H(\mu_X-\mu_H)]\} + N(\mu_X+\mu_H)\theta_2,$$

where $\lambda$, defined in the appendix, is positive for all plausible parameter values. The first terms in (40) and (41) reflect one of the excise tax effects of the property tax differential. Note that these terms represent a pure redistribution of income between housing consumers in the two jurisdictions (multiplying the terms by $N_1$ and $N_2$, respectively, and adding yields zero) as higher housing prices in the high tax jurisdictions are offset by lower housing prices in the low tax jurisdictions. The second terms in (40) and (41) indicate that the increased housing consumption induced by the consumption distortion drives up housing prices in both jurisdictions.

The changes in the returns to labor are calculated by differentiating (7) and substituting from the tax and price elasticities above to yield

$$(42) \qquad y_L\varepsilon_{w1} = -N_2\{y_{KX}(2\Omega)[\mu_X(\eta_H+1-\alpha)+\mu_H(1-\alpha)]\}$$
$$-[y_L(\mu_X+\mu_H)+y_{KX}(2\mu_H)](N_1\theta_1+N_2\theta_2)$$

$$(43) \qquad y_L\varepsilon_{w2} = N_1\{y_{KX}(2\Omega)[\mu_X(\eta_H+1-\alpha)+\mu_H(1-\alpha)]\}$$
$$-[y_L(\mu_X+\mu_H)+y_{KX}(2\mu_H)](N_1\theta_1+N_2\theta_2),$$

where $y_L$ is the labor share of gross income and $y_{KX}$ is the composite good capital stock share of gross income. The first terms in (42) and (43) again represent an "excise tax effect" of the property tax differential which results in a pure redistribution of income; the lower wage payments made to the fixed factors in composite good production in the high tax jurisdictions are exactly offset by higher wages in the low tax jurisdictions. The second terms in (42) and (43) indicate that the consumption distortion away from the composite good lowers the returns to labor in both jurisdictions.

The last set of price changes in the model are the changes in land prices in the two jurisdictions, which are obtained by differentiating

(10) to yield

$$(44) \qquad y_V \varepsilon_{sj} = - y_{KH}(\varepsilon_r + \varepsilon_{Tj}) + (y_{KH} + y_{VH})\varepsilon_{qj},$$

where $y_V$ and $y_{KH}$ are the land and housing capital shares in gross income. Substituting into (44) from the tax and price elasticities above yields expressions which are quite cumbersome; these expressions can be summarized as

$$(45) \qquad y_V \varepsilon_{s1} = -N_2 A + B_1(\theta_1, \theta_2)$$

$$(46) \qquad y_V \varepsilon_{s2} = N_1 A + B_2(\theta_1, \theta_2),$$

where A, $B_1$ and $B_2$ are defined in the appendix. The sign of A is positive if, in the high tax jurisdictions, the negative effect on land prices of higher taxes (which drive out capital and lower the marginal productivity of land) outweighs the positive effect of higher housing prices. In this case, the excise tax effects of the property tax differential, the first terms in (45) and (46), indicate that lower land prices in the high tax jurisdictions are exactly offset by higher land prices in the low tax jurisdiction. In any case, these terms represent a pure redistribution of income between landowners in the two types of jurisdictions. Finally, since $B_1$ and $B_2$ are positive, the second terms in (45) and (46) indicate that in both jurisdictions the price of land, the immobile factor in housing production, increases due to the consumption distortion toward greater housing consumption.

## IV. A NUMERICAL EXAMPLE

For purposes of illustration, we present a simple numerical example in this section. Consider our model for the case where $\beta_1=0.10$, $\beta_2=0.05$, $\gamma_1=0.60$, $\gamma_2=0.65$, $N_1=N_2=1$ and the composite good (housing) production function is Cobb-Douglas with a capital share parameter of 0.3 (0.7). Suppose further that in the initial equilibrium $p=q_1=q_2=1$, and $K_X=K_H=0.304$, $L=1.70$, $V=1.0$ which implies $r=1$, $w=0.418$ and $s=0.131$. In this case, the relevant elasticities are $\mu_X=\eta_X=0.435$, $\mu_H=\eta_H=1.015$, and $\eta_{K1}=1.837$, $\eta_{K2}=1.819$.

The numerical values for the tax and price elasticities are shown below; when two numbers are listed and then added, the first corresponds to the profits tax or excise tax effects of the property tax differential and the second corresponds to the effects of the consumption distortion, as discussed in Section III. The elasticities are:

$$\varepsilon_{T1} = .194 \qquad \varepsilon_{T2} = .110 \qquad \varepsilon_{p} = -.0114$$

$$\varepsilon_{r} = -.152 + .005 = -.147$$

$$\varepsilon_{q1} = .0259 + .0178 = .0437$$

$$\varepsilon_{q2} = -.0259 + .0050 = -.0209$$

$$y_{L}\varepsilon_{w1} = -.00881 - .00892 = -.01773$$

$$y_{L}\varepsilon_{w2} = .00881 - .00892 = -.00011$$

$$y_{V}\varepsilon_{s1} = -.00103 + .00307 = .00204$$

$$y_{V}\varepsilon_{s2} = .00103 + .00017 = .00120.$$

The signs of all expressions are as described in the previous section. The return to capital falls due to the "profits tax" portion of the tax, and the excise tax effects cause higher housing prices and lower wages and land prices in the high tax jurisdictions with exactly offsetting effects in the low tax jurisdictions. The consumption distortion results in higher housing prices and higher land prices, as well as lower composite good prices and lower wages, in both types of jurisdictions.

Note that the consumption distortion component of $\varepsilon_{r}$ is quite small, so that the profits tax effect of the property tax differential on the return to capital is not mitigated to any significant extent. However, the consumption distortion effects are more important for the

other price changes; in particular, the consumption distortion effects dominate the excise tax effects for $\varepsilon_{w2}$ and $\varepsilon_{s1}$, so that wages fall in the low tax jurisdiction and land prices rise in the high tax jurisdiction.

## V. CONCLUSION

We have analyzed the effects of nationwide use of the property tax by independent local jurisdictions within the context of a model with (i) interjurisdictional competition, (ii) endogenous local public service levels which are included in individual utility functions, (iii) individuals who differ in their tastes for public services and are segregated by taste into homogeneous communities, (iv) a simple form of land use zoning, and (v) a political or constitutional constraint on local use of head taxes. Within the context of this more general model -- relative to the Mieszkowski (1972) analysis -- we obtained two sets of results. First, we presented a reformulated version of the "new view" of the incidence of the property tax; in particular, we derived expressions for the "profits tax" effect which lowers the return to capital by the amount of the tax, and the "excise tax" effects which cause pure redistributions of income between factor owners and consumers in the two types of local jurisdictions in the model. Second, we showed that local reluctance to impose a property tax on mobile capital results in a "consumption distortion" away from government services and derived the effects of this phenomenon on commodity and factor prices.

FOOTNOTES

1. Hamilton (1976) has extended the benefit view result to the case of non-homogeneous communities in a model where fiscal differentials are capitalized into house prices; we limit our analysis to the case of homogeneous communities.
2. Throughout the paper we consider only the effects of the capital portion of the property tax.
3. Our paper is thus a partial response to Aaron (1975, p. 42) who notes that "the theoretical foundations of the new view are incomplete." The profits tax and excise tax terminology follows Mieszkowski (1972).
4. Jurisdictions of different land areas could easily be introduced into the model as multiples of our constant size jurisdictions.
5. We make this assumption because allowing a variable labor supply would complicate the analysis considerably without changing the basic nature of the results since residents are immobile between jurisdictions in the sense that "high demanders" do not wish to move "low demander" jurisdictions and vice versa. For analyses of property taxation in models where labor is mobile between jurisdictions, see Brueckner (1981) and Starrett (1980).
6. This methodology follows Atkinson and Stern (1974).
7. For the methodology of relaxing the assumption of zero initial distorting taxes, see Ballentine and Eris (1975) and Vandendorpe and Friedlaender (1976). Also, Courant (1977) addresses this question within the property tax context.
8. See Diewert (1978) for a thorough discussion of duality in differential incidence analysis and proofs of assertions made below regarding restricted profit functions.
9. Our identical residents are assumed to own an equal share of both types of land.
10. See Zodrow and Mieszkowski (1984) for a detailed discussion of the question of the effects of property tax finance on local public service levels.
11. Expressions (34-35) are obtained by substituting from (5) and (8) into the definitions of $X_T$ and $H_T$, differentiating, and substituting from (30-31) as well as (36), (39), and (40-41) below.

## APPENDIX

The expressions for the D, $\lambda$, A, $B_1$ and $B_2$ parameters used in the text are provided in this appendix. The expression for D is obtained by evaluating the coefficient matrix of the differential equations (26-29) at the initial equilibrium; this yields

$$\begin{aligned}(A.1)\quad D= {} & N_1\sigma_2(\alpha+\gamma_1)\{\alpha\eta_H+(1-\alpha)(y_K/\beta_1+\eta_{K1})+\eta_H[y_K/\beta_1+\eta_{K1}(\alpha+\gamma_1)](\mu_X-\mu_H)\} \\ & + N_2\sigma_1(\alpha+\gamma_2)\{\alpha\eta_H+(1-\alpha)(y_K/\beta_2+\eta_{K2})+\eta_H[y_K/\beta_2+\eta_{K2}(\alpha+\gamma_2)](\mu_X-\mu_H)\} \\ & + N\,\sigma_1\sigma_2(\mu_X+\mu_H).\end{aligned}$$

We assume the system is stable, which imples $D>0$ (see Neary, 1978, or Atkinson and Stiglitz, 1980); note that all terms other than $(\mu_X-\mu_H)$. are unambiguously positive.

The expression for $\lambda$ is

$$\begin{aligned}(A.2)\quad \lambda = {} & \{\eta_H[y_K/\beta_2-y_K/\beta_1+\eta_{K2}(\alpha+\gamma_2)-\eta_{K1}(\alpha+\gamma_1)] \\ & +y_K[(\beta_1/\beta_2)\eta_{K1}-(\beta_2/\beta_1)\eta_{K2}]+(\beta_1-\beta_2)\eta_{K1}\eta_{K2}\}(\alpha+\gamma_1)(\alpha+\gamma_2)/D.\end{aligned}$$

The sign of $\lambda$ is ambiguous. However, the difference between the perceived capital supply elasticity parameters $\eta_{K1}$ and $\eta_{K2}$ is quite small for all plausible parameter values. Since, for $\eta_{K1} = \eta_{K2} = \eta_K$, $\lambda$ becomes

$$\begin{aligned}(A.2')\quad \lambda' = {} & \{(\eta_H y_K/\beta_1\beta_2)(\beta_1-\beta_2)+\eta_H\eta_K(\beta_1-\beta_2) \\ & + y_K\eta_K[(\beta_1/\beta_2)-(\beta_2/\beta_1)]+\eta_K^2(\beta_1-\beta_2)\}(\alpha+\gamma_1)(\alpha+\gamma_2)/D\end{aligned}$$

which is unambiguously positive, we assume that $\lambda>0$.

The expression for A is

$$\begin{aligned}(A.3)\quad A = {} & \Omega y_{KH}[2(\mu_X+\mu_H)(1-\alpha)+\eta_H(\mu_X-\mu_H)]-\Omega y_V\eta_H(\mu_X+\mu_H) \\ & -\lambda(y_{KH}+y_V)[(1-\alpha)(\mu_X+\mu_H)+\eta_H(\mu_X-\mu_H)].\end{aligned}$$

A is positive if, in the high tax jurisdiction, the effect on land prices of higher taxes which drive out capital and lower the marginal productivity of land (the first term in A.3) outweighs the effect of higher housing prices which increase the demand for land (the second and third terms of A.3).

Finally, the expressions for $B_1$ and $B_2$ are

$$(A.4) \quad B_1(\theta_1,\theta_2) = [Ny_V(\mu_X+\mu_H)+(N+N_2)y_{KH}\mu_X]\theta_1+N_2y_{KH}(\mu_X-\mu_H)\theta_2$$

$$(A.5) \quad B_2(\theta_1,\theta_2) = N_1y_{KH}(\mu_X-\mu_H)\theta_1+[Ny_V(\mu_X+\mu_H)+(N+N_2)y_{KH}\mu_X]\theta_2.$$

Barring implausibly large (in absolute value) negative values of $(\mu_X-\mu_H)$, both $B_1$ and $B_2$ are positive.

REFERENCES

Aaron, H.J., 1975, Who pays the property tax? (Brookings Institution, Washington, D.C.).

Atkinson, A.B. and N.H. Stern, 1974, Pigou, taxation and public goods, Review of Economic Studies 41, 119–128.

Brown, H. G., 1924, The economics of taxation (Holt, New York).

Brueckner, J.K., Labor mobility and the incidence of the residential property tax, Journal of Urban Economics 10, 173–182.

Courant, P.N., 1977, A general equilibrium model of heterogeneous property taxes, Journal of Public Economics 8, 313–327.

Diewert, W.E., 1978, Optional tax perturbations, Journal of Public Economics 10, 139–177.

Fischel, W.A., 1975, Fiscal and environmental considerations in the location of firms in suburban communities, in: E.S. Mills and W.E. Oates, eds., Fiscal zoning and land use controls (Lexington Books, Lexington, Mass.).

Hamilton, B.W., 1975, Zoning and property taxation in a system of local governments, Urban Studies 12, 205–211.

Hamilton, B.W., 1976, Capitalization of intrajurisdictional differences in local tax prices, American Economic Review 66, 743–753.

Hamilton, B.W., 1983, A review. Is the property tax a benefit tax? in: G.R. Zodrow, ed., Local provision of public services. The Tiebout model after twenty-five years (Academic Press, New York).

Harberger, A.C., 1962, The incidence of the corporate income tax, Journal of Political Economy 70, 215–240.

Mieszkowski, P.M., 1972, The property tax. An excise tax or a profits tax?, Journal of Public Economics 1, 73-96.

Starrett, D.A., 1980, On the method of taxation and the provision of local public goods, American Economic Review 70, 380-392.

Thomson, P., 1965, The property tax and the rate of interest, in: G.C.S. Benson, S. Benson, H. McClelland and P. Thomson, The American property tax (The Lincoln School of Public Finance, Claremont, Cal.).

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

Vandendorpe, A.L. and A.F. Friedlaender, 1975, Differential incidence in the presence of initial distorting taxes, Journal of Public Economics 6, 205-229.

White, M.J., 1975, Firm location in a zoned metropolitan area, in: E.S. Mills and W.E. Oates, eds., Fiscal zoning and land use controls (Lexington Books, Lexington, Mass.).

Zodrow, G.R. and P.M. Mieszkowski, 1983, The incidence of the property tax. The benefit view vs. the new view, in: G.R. Zodrow, ed., Local provision of public services. The Tiebout model after twenty-five years (Academic Press, New York).

Zodrow, G.R. and P.M. Mieszkowski, 1984, Pigou, Tiebout, property taxation and the under-provision of local public goods, Rice University working paper.