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THE PROPERTY TAX: AN EXCISE TAX OR A PROFITS TAX? [1]

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1. Introduction

A widely accepted proposition of incidence theory is that the burden of a local property tax on reproducible capital is shifted to consumers and is equivalent to an excise tax. This result dates back to the work of Marshall (1897), Pierson (1902), Edgeworth (1925), more recently to the work of Simon (1943), and is used repeatedly in empirical work, Musgrave et al. (1951), Gillespie (1965), and in the literature on housing and urban problems, Netzer (1966, 1968). Netzer has expressed property taxes on the housing stock in the nation as a whole as an excise tax on housing services. Also in the national accounts prepared by the U.S. Department of Commerce, property taxes are lumped together with sales and manufacturers' excise taxes in the category, indirect taxes.

While the proposition that the property tax is an excise tax represents conventional wisdom there are two opposing points of view. One is that the property tax is very similar, if not fully equivalent, in its distributive effects to taxes on profits. This view of the effects of the property tax was first developed by Brown (1924) in a well-known, though neglected section of his book, *The economics of taxation,* and has been restated by Thompson (1965). The second, somewhat different proposition is that a property tax on improvements (reproducible capital) is shifted through a reduction of site rents onto owners of land. This argument, first found in Marshall (1890), has also been recently

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presented by Richman (1967, 1968) [2]. The essence of Richman's argument is that a property tax in a particular city will lead to a less intense use of land there and will decrease land values. It is possible to argue that land rents are determined as a residual, and when a property tax is imposed on capital, developers will bid less for land, as their normal costs are increased by the amount of the tax. Also there is the related, more general, argument made by Rolph (1954) and Rolph and Break (1961) that partial taxes, excise and property, will be borne in large part by imperfectly mobile factors of production.

The main aim of this paper is to attempt to reconcile these opposing views on the effects of the property tax and to demonstrate that there is some truth to each of the three general arguments presented above. Although I attempt to be as eclectic as possible the paper is based on a number of stylized assumptions and certain effects are emphasized at the exclusion of other considerations.

In particular I attempt to demonstrate that excise tax effects will result from taxes imposed at varying rates on different types of property, or at varying rates in different regions or cities. Also there is relatively little conflict between the view that property taxes are excises and the proposition that the basic effect on the property tax is to decrease the yield from real capital *if it is properly recognized that the global (nation wide) effects of the tax are quite different than the partial effects for a single city, or groups of cities.*

From a national perspective the basic effect of the imposition of property taxes by thousands of local governments is to decrease the yield on reproducible capital. Relatively high tax rates in certain cities increase the prices of goods and services produced in these localities. However these price increases will be tempered, even swamped, by decreases in the value of land and decreases in the returns to other imperfectly mobile factors of production. Nevertheless, the discentive effects of property taxes, often stressed by the critics of property taxes, are very real. Unless increases in the property tax rates in a particular city are accompanied by improvements in the quality of public services, residents will have an incentive to move, the size and quality of the housing stock will deteriorate, and the location of industrial activities in high tax jurisdictions will be discouraged.

[2] Marshall argued that a general property tax imposed in all communities would be shifted to consumers. On the other hand he believed that a partial tax, imposed in a single community, if not accompanied by improvements in public services, would fall on land owners as residents would move to escape the tax.

Throughout the paper we limit ourselves to the consideration of taxes on reproducible, shiftable, capital. Thus we exclude from consideration the question of whether taxes on site rents are borne by the owners of land. As Simon has shown in his famous review of the classical literature this issue hinges on the formation of urban land values and whether rent differentials, arising from locational advantages, are constant in *absolute* magnitude or whether rent differentials observed under various tax regimes will be a constant *proportion* of a base value. Despite the insights gained by the classical writers, Pierson and Edgeworth, the incidence of taxes on urban land rents remains an unsettled question. It seems to me that the key issue is whether the supply of land, which is subject to tax, is variable in supply. For the case of a developed city it is unlikely that a land tax will have much of an impact on the supply of land in urban use, and a land tax will be borne by the owners of land. On the other hand if the price of urban land at the outskirts of a city is closely related to its opportunity cost in agriculture and the demand for urban land is price elastic, taxes on urban land will change the quantity and before-tax price of land. [3]

In addition to assuming that the supply of land is fixed and/or limiting the discussion to taxes on improvements we make the following assumptions and simplifications: The *total* supplies of capital and labor are assumed to be fixed; Product and factor markets are perfectly competitive, and factors receive the value of their marginal products. Capital is assumed to be perfectly mobile (shiftable) between industries and different regions, so in the absence of differential risk the after-tax rate of return on all capital in the economy are equalized. Also the value of capital in any use will be equal to its reproduction costs. Property taxes are not capitalized.

Throughout most of the analysis we shall abstract from the effects of the expenditure side of the budget. The only justification of this simplification is convenience, as the level and quality of public expenditures influence housing values and locational decisions. However, if we

[3] This question is complex and there are a wide range of possible outcomes. For example, if the rent on marginal urban land is equal to a fixed agricultural rent, a land tax on urban land rents will increase the cost of the marginal land by the amount of the tax, and the size of the city will decrease. If urban land rents are determined primarily by access to a central work place it is possible, depending on the nature of the demand for land services, that land rents at points close to the centre of the city will fall even when the total cost of land services increases in the outskirts. This is due to the decrease in the total land area of the city, which decreases the relative advantage of the central areas. Of course the effects of the higher density of development may outweigh this effect.

were to consider the expenditure side we would have to specify the value placed on a particular bundle of services by different groups for varying rates of tax and to recognize that varying tax bases between communities lead to different levels of public services for the same tax rate. To avoid these complications we make the conventional simplification of taking the budget as given, essentially ignore it, and attempt to determine the change in factor and commodity prices that rest from a particular method of finance and compare these distributive effects with those derived for alternative tax regimes.

Given the above assumptions it follows that when all cities in the nation impose the same rate of property tax on all types of reproducible capital the burden of the tax falls on the owners of capital. Under marginal productivity factor pricing any attempt to shift the tax will be frustrated. For example a rise in commodity prices relative to wages results in a decrease in real wage below the value of the marginal product of labor and this will result in an increase in the demand for labor that will restore the real wage to its original level. Also as capital accumulation is assumed to be independent of tax changes the before-tax rentals on capital goods and the reproduction cost of capital goods are unaffected by the imposition of the tax. Asset prices will remain unchanged and the rate of return (rate of interest) will fall in proportion to the size of the property tax.

Contrary to the conventional wisdom the imposition of a general property tax does *not* increase the price of housing services. Although owner occupants have to pay a property tax the price of rental housing is not increased. The cost of housing for the owner-occupant also remains unchanged, as the opportunity cost of capital falls by the amount of the tax, leaving total housing costs unchanged. Changes in the relative income positions of different groups are due solely to the different amounts of wealth that they own. A renter who does not own any wealth will not bear any of the burden of the property tax. An individual who owns a $20,000 house and another individual who owns $20,000 worth of manufacturing equipment will both bear the same tax burden.

Furthermore for the special case under consideration the property tax is *not* a benefit tax. Households pay taxes only in their role of owners of capital. When an initial equilibrium is disturbed by a change in preferences and all communities increase public expenditures, and finance these expenditures by increasing the property tax rate by the same amount, the additional tax burden will fall on the owners of

capital. The overall marginal productivity of capital is not changed by an equal increase in tax rates in all communities. In the extreme case where all capital is owned by a single individual and all towns are composed of renters the benefits of the higher public expenditures will be enjoyed at the expense of the capitalist.

2. The excise tax effects of property taxes

The above results are highly stylized by the assumption that all towns tax all capital at the same rate. In fact, thousands of local governments and special districts impose property taxes at different rates with different coverage, and with varying assessment practices.[4]

Tax rate differentials between communities result in excise tax effects. These effects are the result of the perfect mobility of capital which equalizes the after-tax rate of return in all communities. A town, which because of a higher than average propensity, or need, to spend on public goods and services, imposes a relatively high rate of property tax on housing impose a relatively high property tax rate on industrial capital, the cost of capital to these industries will rise and, depending on the competitive position of the industries in the high tax communities vis-a-vis firms in other areas, the price of the products of the heavily taxed industries will rise, and/or wages and the returns on land will have to fall so that the industries in the high tax town can remain competitive.

In order to highlight the excise tax effects of property tax differentials I shall (in this section of the paper) make a number of further simplifying assumptions. First that there are no 'economies of scale' associated with high density industrial and residential development, and transportation costs are negligible. Capital and workers are perfectly mobile between communities so that after-tax rates of return on capital and wage rates are equal in all communities.

Although there is little relation between place of work and place of residence, different households prefer, for a given set of housing prices, different residential locations (cities). If relative housing prices change some of the households will change their place of residence. I also assume that each town is surrounded by farm land and that the supply of land from agriculture to urban use is perfectly elastic at the opportu-

[4] Beck (1963) analyzed the effective property tax rate for about one hundred communities in Northeastern New Jersey and found effective tax rates varying from less than 1% to over 7%.

nity cost of the land in agriculture. This last assumption helps to insure that tax induced changes in residential locations will not affect land rents and land values. Adjustments in the relative size of various cities will take place through changes in the amount of land taken out of agriculture. Finally it is assumed that industries are specific to particular towns. This assumption allows us to ignore the possibility of wholesale relocation of industries between towns and to concentrate on the excise tax effects of property taxes imposed on industrial commodities which each town exports to the national market.[5]

In addition to industrial, or export goods, we distinguish 'home goods' such as residential real-estate, trade and services which are produced and *consumed* locally. We begin with the case where different cities levy a varying rate of tax on capital used in the production of 'home goods', i.e. residential capital, trade and services, but each city taxes industrial capital used in the production of export goods at the same rate and the common rate of tax on industrial capital is equal to the *average* rate of tax on residential capital (home goods) in the economy as a whole.

The average rate of tax on residential capital for the nation as a whole is the tax in each community weighted by the amount of capital subject to tax. For example in the symmetrical situation, there are three towns, A, B, C, and town A taxes 1,000 units of residential capital at a rate of 2%, B has a 3% rate of tax and 10,000 units of capital and C, the high tax town has a tax rate of 4% and 1,000 units of capital. The simple, and weighted mean of the tax rate is 3%, and by assumption this is the common rate of tax imposed on industrial capital. Suppose that before the imposition of the property tax system the before-tax rate of return on all capital was 10%.

After the imposition of taxes residents of high tax communities will

[5] Changes in industrial location of industries are sluggish as industrial capital, especially structures, have long-lives. The immobility of capital raises the possibility that an increase in the property tax, *by a particular city*, on existing industrial capital will be capitalized which is contrary to the argument that the tax-induced increases in the cost of capital services will increase the cost of commodities produced in high tax jurisdictions. If different components of a firm's capital stock come up for replacement at different points in time, it may never pay to move as there will always be a large amount of complementary capital which has a useful economic life. However the choice of technique for the process under replacement will be based on a cost of capital calculation that reflects the higher property tax. Consequently as capital is replaced over time bit by bit the after-tax rate of return on capital will be restored to its previous level. These assumptions about the nature of depreciation and replacement help make the assumption of location specific industries a little more realistic.

decrease their demand for residential capital and some households will shift their residential capital to low tax areas. The tax-induced change in the allocation of residential capital may take place at an unchanged rate of return on capital. This will depend on whether the tax induced decrease in the demand for capital in high-tax towns is just offset by an increase in the demand for capital in low-tax towns. When the before-tax rate of return on capital remains unchanged after-tax rates of return on capital fall by the average rate of tax, i.e. from 10% to 7%. On the other hand, if the capital which shifts out of high tax communities cannot be absorbed in low-tax areas at an unchanged before-tax rate of return, the overall tax rate will fall. Suppose this occurred and the before-tax rate of return on capital fell from 10% to 9.5%. The burden on owners of capital will be larger than the average-tax rate of 3%. Consumers of industrial commodities and housing services will benefit from the decrease in real profits that does not accrue to government.

Regardless of whether the overall before-tax of return is decreased, increased, or unchanged by the tax, and we shall assume for simplicity that it remains unchanged, there are two basic effects of a system of property taxes imposed at varying rates in different communities. The first is to decrease the after tax return on capital by an amount that approximates the average rate of property tax in the economy. The second effect is to increase the cost of the services of capital in high areas and to decrease its cost in low-tax communities, for capital markets will not be in equilibrium unless the after-tax rate of return on capital is the same in all communities.

In our example community C, the high tax town, imposes a tax rate of 4%, while the national average is 3%, and while the global effect of the property tax system is to decrease the after tax return on capital from 10% to 7%, the required rate in community C increases from 10% to 11%. The eleven percent is made up of an interest rate of 7% plus a property tax of 4%. Consequently, relative to the situation where *no* community imposes property taxes the cost of capital has increased by a percentage point in community C. If capital is the only input in the production of housing services, the price of these services (rents) in C will go up by 10%. In community A, whose tax rate is 1 percentage point below the national average of 3%, the cost of housing will go down by 10% relative to the zero tax situation.

The existence of negative as well as positive excise tax effects resulting from property taxes is important for empirical work which allocates tax burdens to groups classified by income level. Ideally, one should

work with income distributions for each separate taxing jurisdiction. But if this is not feasible and when the correlation between the level and distribution of income in various communities and the level of property tax is weak it will not be inaccurate to ignore the excise tax effects and to treat the property tax as a profits tax. For if the shape of the income distribution and mean income levels are the same in low tax towns as in high tax towns excise tax effects at the global level will cancel for each group at a particular level of income.

To this point we have abstracted from changes in relative prices in the industrial sector by assumption that all cities tax industrial capital at the same rate, which is equal to the average tax on residential capital.

As in the case of home goods an above-average rate of tax on a particular export commodity, which by assumption is specific to a given town, will increase the cost of capital to that industry. When there is little or no correlation between the production parameters of specific industries (the relative factor intensities and the relative sizes of the elasticities of substitution) and the tax rates imposed on different industries, the capital released from the industries located in high tax towns will be absorbed in industries subject to low rates of tax without an appreciable change in the *average* before-tax rate of return on capital. On the other hand if high tax areas produce predominately capital (labor) intensive commodities and the elasticities of substitution are relatively high (low) in these industries the average rate of return on industrial capital will fall (increase).

As in the analysis of taxes on home goods it is important to measure the excise tax effects of property taxes on industrial capital relative to the mean rate of tax on this type of capital. If the average property tax rate on industrial capital is 3% and the shoe industry is taxed at a rate of 4%, the price of capital to the shoe industry will be 1 percentage point higher. If the average before-tax rate of return is 10% and the share of capital is 0.25, the price of shoes will increase by 2.5%. The relative prices of commodities produced by industries, subject to tax rates below the mean rate for industrial sector, will fall and as in the taxation of residential capital excises taxes tend to cancel, with some commodities increasing in price and others decreasing in price. In empirical work these excise tax effects are important when commodities taxed at below average rates are disproportionately important in the consumption patterns of specific income groups.

We have discussed separately the excise tax effects of property taxes

on residential real estate and on industrial property. Assumptions were made to minimize the possible changes in overall rates of return on capital within each of the two broad sectors. In fact, capital is mobile between industry and residential real estate and the possibility of tax differentials between broad industry groups must be accounted for. Housing services, in the aggregate, may be taxed more heavily than industrial capital or vice-versa. If this is true the price of housing in general will rise relative to the price of industrial goods; there will be a reallocation of resources; and since housing is very capital-intensive the price of capital will fall relative to the price of labor. Consumers of housing services and owners of capital suffer a loss in real income while consumers of other goods experience an increase in real income as a result of a decrease in the price of commodities other than housing services.[6]

3. The immobility of labor, the capitalization of property taxes and their effects on land values

The major qualification to the result that local tax differentials increase or decrease the price of locally produced goods and services by the changes in the cost of capital services is the possible decrease in the returns to imperfectly mobile factors of production.

In this section we retain the assumption of perfect mobility of capital, allow for the imperfect mobility of labor and assume that the supply of land in each taxing jurisdiction is fixed. Also our analysis is

[6] In an earlier paper (Mieszkowski, 1970, p. 1110) I sketched an example which was designed to bring out Brown's major insight on the effects of property tax. Brown took exception to the view that a property (profits) tax on residential real estate is shifted to the consumer and argued that a tax on housing would shift capital out of housing and would be a tax on capital in the economy as a whole. Brown also pointed out that the small size of a taxed sector is not a sufficient reason for ignoring general equilibrium adjustments.

In our example, we assume an economy consisting of three groups, A, B, C. A property tax is imposed on apartment dwellings, a service consumed only by group A. Group C owns all of the capital, and originally 1% of the total capital stock is used as apartment buildings. With appropriate assumptions it is possible to show that the imposition of a tax on apartment buildings will decrease the after-tax rate of return on *all* capital by 1%. This means that total profits have decreased by the amount of the tax. Simultaneously the price of apartment units will increase by the amount of the tax. This means that in addition to the taxes collected by government the consumers of products other than the commodity subject to tax gain at the expense of capitalists. Brown's insistence that a tax on housing falls on the earnings of all capital through the shift of capital out of the capital-intensive housing sector can be at best partially correct when there exist substantial differences in the spending patterns among various income groups.

partial in that we concentrate on the effects of a tax imposition on the prices of commodities, land and labor – in *one* particular town. Thus we ignore general equilibrium adjustments and prices changes which occur in the no-tax (low-tax) communities. While a formal treatment of these effects would considerably complicate the analysis the general effects are fairly straightforward.

To this point we have, through appropriate assumptions, ruled out changes in factor prices. Changes in land rents and wages which result from tax differentials mean that changes in relative commodity prices will be moderated. In high-tax towns factor prices will fall and the increases in the cost of capital will lead to more moderate increases in commodity prices. On the other hand, increases in factor prices in low-tax towns will temper the negative excise tax effects in these communities.

The partial analysis which deals with factor price effects not only allows us to gain some insight on the overall (global) impact of the tax but also enables us to focus on what happens in a community when it increases its rate of property tax relative to the rate prevailing in other cities. However what needs to be emphasized is that the introduction of changes in factor prices is principally a qualification of the previous result that tax-rate differentials lead to excise tax effects (changes in commodity prices). The result that the global effect of a property tax system is to depress the earnings on capital by the average rate of tax in the economy remains unaffected by the consideration of changes in the returns to immobile factors of production.

The simplest view of the effects of tax rate differentials on the returns to immobile factors of production is that they will be fully capitalized in the value of land which is an immobile factor of production. Even if capital is perfectly shiftable the property tax may be fully capitalized in the value of land. For example if the present value of property tax in town A on a house which cost $20,000 to produce is $1,000 larger than in town B it is expected that a lot in A will sell for $1,000 less than an identical lot in B.[7] Similarly a potential developer of an apartment house or some other activity will consider property taxes as costs and will substract them in bidding for prospective development sites.

This simple line of reasoning leaves out two interrelated considerations. First the ratio of improvements to land can be varied in both

[7]Footnote see page 83.

residential and industrial activities. As is well known from the work on urban structure, (Mills, 1967; Muth, 1969) high land rents close to the central business district resulting from low transportation costs to work places will lead to high density apartment developments and the rental of these units by households who derive little utility from the consumption of land space. On the other hand families with children will incur higher transportation costs to 'consume' large lots in the suburbs where land is cheaper. If a central city increases its property tax rate relative to suburban tax rates there will be a shift in residential and industrial capital to the suburbs. However the fall in land rents will be buffered by increases in the amount of land used by household who chose to remain in the central city and by industry that will substitute cheaper land for higher-cost capital. Although the price of land will fall the decrease in before-tax rents may significantly smaller than the additional tax on improvements.

Second, a good part of tax burden on improvements may fall on labor which may be imperfectly mobile. Taxes on industrial capital by decreasing output decrease the demand for labor and workers may have to take a cut in wages to remain fully employed.

In order to deal simultaneously with changes in land prices and wages we present a conventional production function approach to the determination of factor prices where land is treated as an ordinary factor of production. In this formulation all sites within a city are identical, a central business district (CBD) does not exist, and in equilibrium the

[7] One of the unrealistic aspects of the assumption that rent on urban land is determined by the opportunity cost of land in agriculture is that in most communities agriculture is not a viable alternative as undeveloped land consists of a number of small scattered plots. The value of urban land will be determined strictly by urban uses and taxes will play a role in the determination of the value of undeveloped urban land. In this connection it is important to note the work of Oates (1970) and Heinberg and Oates (1970) on the capitalization of property taxes. For a sample of cities in New Jersey and Massachusetts these studies find that the average values of owner-occupied houses in different towns are sensitive to expenditures on schools and varying tax burdens, and largely offset one another. For a given level of expenditures an increase of future tax payments of $1 (on a present value basis) will decrease the value of housing by exactly that amount. While there is some question whether the authors have "sorted out" various interdependences arising from the need of imposing higher taxes in poorer towns, these results suggest that the owners of capital bear the differential burden of property taxes. The fact that the tax is fully capitalized for owner-occupied housing implies that the implicit rents on these houses are determined independently of taxes (though they depend on the level of expenditures) and suggests that the tax burden of a property on rental housing falls on the landlord. If there is new construction in each town these results support the proposition that landowners bear the tax differential on improvements in addition to the taxes imposed on the value of land.

rent on land in all activities, high-rise residential, single-family residential, commercial and industrial will be the same. The size of buildings, per unit of land space, will depend on whether marginal cost of floor space increases with the size of the building, and on the return to the complementary services of land, such as parking space, recreational uses of land in apartment house developments and so on. The marginal revenue product of capital on a given plot of land is expected to fall as the size of the building is increased.

To make things as simple as possible all activities of a city are aggregated into a single output, X, which is produced with inputs of labor, L, capital, K, and land, R.[8]

The model is a system of six equations in six unknowns, L, K, X, P_X, w, and r, and an exogenous tax expressed as a per-unit tax on capital, T. The supply of land, R, is taken as fixed. The six equations are as follows:

$$X = f_1(L, K, R) \quad \text{, supply of } X \tag{1}$$
$$X = f_2(P_X) \quad \text{, demand for } X \tag{2}$$
$$K = f_3(w, r, T, X) \quad \text{, demand for } K \tag{3}$$
$$L = f_4(w, r, T, X) \quad \text{, demand for } L \tag{4}$$
$$L = f_5(w) \quad \text{, supply of } L \tag{5}$$
$$P_X X = wL + rR + (P_K + T)K \quad \text{, price relation.} \tag{6}$$

Equation 1 is a linear homogeneous production function which relates the output of X to the three factor inputs. Relation 2 is the demand relation which makes the demand for locally produced commodities a function of the price of local commodities, P_X. With this very simple demand formulation I ignore the income effects arising from changes in the population (labor force). Equations 3 and 4 are two of the three factor demand relations for labor, land and capital. Only two of the three equations are independent. These factor demand equations are based on cost minimizing considerations. For a given set of after-tax factor prices and for tax rate, T, the demand for capital labor, and land depends on level of output. When relative factor price change factor substitutions will occur and at each level of output factor proportions will change. Hence changes in the demand for factors will

[8] The aggregation of home goods and industrial activities, into a single output omits an important feature, the possible differential change in the prices of the two broad commodity classes, home goods and exports. However, little is lost through the aggregation in understanding the effect of property taxes on factor prices, and the effects of different technologies on these changes.

occur as the result of output effects and factor substitution effects. As the after-tax return on capital, p_K, is given by national conditions and is taken as the numeraire, it has not included in the factor demand equations. The cost of capital changes only as a result of changes in the rate of property tax.

Equation 5, is a simple supply of labor equation that makes the supply of labor a function of the local wage rate (the wage rate in other communities is taken as given). For simplicity the effect of changes in the prices of home goods (housing etc.) on the supply of labor is ignored.

Equation 6 is a price relation, or total revenue function, that relates the price of the output to the prices of the factors.

In order to investigate the effects of changes in the tax rate, T, on the returns to labor and land, and on the price of X the system of equations 1–6, is differentiated totally with respect to T and a solution is obtained for dw/dT and dr/dT. As this differentiation is straightforward it is not presented in any detail.[9] The differentiation of the factor demand equations may be the only unfamiliar part of the exercise.

The differentiation of the demand for capital equation, relation 3, yields after some rearrangement

$$\frac{dK}{K} = a_{KL}\,dw + a_{KR}\,dr + a_{KK}\,dT + \frac{dX}{X}. \qquad (3')$$

The a_{ij}'s are the elasticities of demand for factor i with respect to a change in the price of factor j. As defined by Allen (1950) a_{ij} is the partial elasticity of substitution between factor i and factor j weighted by the proportion of factor j in total cost: i.e. a_{KL} is $f_L e_{KL}$ where e_{KL} is the partial elasticity of substitution between capital and labor. Allen showed that $a_{ii} < 0$ and that $a_{iL} + a_{iK} + a_{iR} = 0$ for $i = L, K, R$. He also demonstrated that *either* all three partial elasticities of substitution a_{ij}, $i = j$, are positive *or* that one of the three partial elasticities is negative

[9] In carrying out the differentiation we make use of the convention that commodity and factor prices are originally equal to 1. Also because of the choice of capital as the numeraire, $dp_K = 0$. We make use of marginal productivity conditions and the assumption of constant returns to scale. For example in differentiating equation 1 we have $dX = f_{1L}\,dL + f_{1K} + f_{1R}\,dR$. Since factors are paid the value of their marginal products we can replace the partial derivatives f_{1L}, f_{1K} and f_{1R} with w, $pK + T$ and r, and divide both sides of the expression by X to obtain $dX/X = f_L(dL/L) + f_K(dK/K) + f_R(dR/R)$ where f_L, f_K, f_R are the original shares of bor, capital and land respectively. In differentiating the commodity demand and supply of labor relations we transform the partial derivatives to elasticities.

and the other two positive. I shall assume, for simplicity, that all three of these partial elasticities are positive.

Upon differentiation the solution for dw/dT and dr/dT are as follows:[10]

$$\frac{dw}{dT} = \frac{(f_K E_X - f_K(a_{KK} - a_{RK}))(a_{LR} - a_{RR}) + (a_{LK} - a_{RK})(f_K(a_{KR} - a_{RR}) - E_X f_R)}{D} \tag{7}$$

$$\frac{dr}{dT} = \frac{-(f_K E_X - f_K(a_{KK} - a_{RK}))(a_{LL} - a_{RL} - E_L) + (a_{RK} - a_{LK})(f_K(a_{KL} - a_{RL}) + f_L E_L - E_X f_L)}{D}, \tag{8}$$

[10] The differentiation of equations 1–6 yields,

$$\frac{dX}{X} = f_L \frac{dL}{L} + f_K \frac{dK}{K} + f_R \frac{dR}{R}, \tag{1'}$$

$$\frac{dX}{X} = E_X dP_X, \tag{2'}$$

$$\frac{dK}{K} = a_{KL}\, dw + a_{KR}\, dr + a_{KK}\, dT + \frac{dX}{X}, \tag{3'}$$

$$\frac{dL}{L} = a_{LL}\, dw + a_{LK}\, dT + a_{LR}\, dr + \frac{dX}{X}, \tag{4'}$$

$$\frac{dL}{L} = E_L\, dw, \tag{5'}$$

$$dP_X = f_L\, dw + f_R\, dr + f_K\, dT. \tag{6'}$$

In order to eliminate the term dX/X from equation (3') and (4') and to introduce explicitly the partial elasticities of subtitution for land we make use of the relation for the demand for land

$$\frac{dR}{R} = a_{RL}\, dw + a_{RR}\, dr + a_{RK}\, dT + \frac{dX}{X} = 0. \tag{7'}$$

Subtracting (7') from (3') and (4') and making the appropriate substitution in (1') we obtain two equations in two unknowns dw/dT and dr/dT.

$$\begin{aligned}&(f_K(a_{KL} - a_{RL}) + f_L E_L - E_x f_L)\frac{dw}{dT} + (f_K(a_{KR} - a_{RR} - E_x f_R)\frac{dr}{dT},\\ &= (f_K E_X - f_K(a_{KK} - a_{RK})\end{aligned} \tag{1''}$$

and

$$(a_{LL} - a_{RL} - E_L)\frac{dw}{dT} + (a_{LR} - a_{RR})\frac{dr}{dT} = (a_{RK} - a_{LK}). \tag{4''}$$

Solving these two equations for dw/dT and dr/dT we obtain relations (7) and (8) presented in the text above.

where the denominator D is equal to

$$D = (f_K(a_{KL} - a_{RL}) + f_L E_L - E_X f_L)(a_{LR} - a_{RR}) -$$
$$(a_{LL} - a_{RL} - E_L)(f_K(a_{KR} - a_{RR}) - E_X f_R),$$

and where f_K, f_L, f_R are the original shares of capital, labor and land respectively, E_L is the elasticity of supply of labor, E_X is the price elasticity of demand for X. The presumptive signs of E_L and E_X are positive and negative respectively and it is easy to show that the sign of D is unambiguously positive.[11]

The main qualitative result implied by this model is that changes in the tax rate, T, can lead to a very wide range of changes in the returns to the imperfectly mobile factors, labor and land. It is even possible (though not probable) especially for land, that a tax on improvements will increase the returns to labor and land relative to the fixed after-tax return to capital. The imposition of property tax increases the cost of the services of capital and this change in relative factor prices results in a substitution of labor and land for land. While the demand for labor and land will be increased at each level of output, the level of economic activity in the city will be decreased by the property tax. The output effect decreases the demand for land and labor for any set of factor prices. Consequently the effect of the tax on the returns to labor and land is ambiguous in sign and in magnitude. When the output effect dominates the factor substitution effect, i.e. when $f_K E_X$ exceeds $f_K(a_{KK} - a_{RK})$ as it probably will, the returns to labor and land fall relative to the after-tax return on capital. Nevertheless any decrease in the return to these immobile factors will be quite modest if the demand for these factors is sustained by the substitution of labor and land for capital. Of course the more elastic is local demand to price increases the more powerful will be the output effect. The change in the relative changes in the returns to land and labor depend in part on the supply

[11] Recall that I have assumed that a_{ij}, $i = j > 0$ so $(a_{LR} - a_{RR})$ and $(a_{KR} - a_{RR})$ are unambiguously positive. Also for the special case when land is used in fixed proportions with capital and labor, i.e. $a_{Ri} = 0$ expressions (7) and (8) simplify to $dw/dT = (a_{LK}(-E_X)f_R)/D' > 0$

$$\frac{dr}{dT} = \frac{-(f_K E_X - f_K a_{KK})(a_{LL} - E_L) - a_{LK}(f_K a_{KL} + f_L E_L - E_X f_L)}{D'},$$

where $D' = (a_{LL} - E_L)E_X f_R$.

response of labor to changes in the wage rate.

When land and labor are both perfectly immobile the change in the relative prices of labor and land depend on the relative responses in the demands for these two factors to changes in their prices and to the change in the cost of capital. If the factor substitution possibilities are greater for labor than for land, the price of labor will increase relative to the price of land. If as expected $(a_{LK} - a_{RK})$ is positive the second term of the numerator of the expression for dw/dT (equation 7) is unambiguously positive. When in addition $(a_{KL} - a_{RL})$ is positive the second term in the numerator of equation 8 is unambiguously negative.

As factor substitution terms appear in both the numerators and denominators of expressions 7 and 8 it is uncertain what effect the magnitude of these parameters will have on the absolute value of dw/dT and dr/dT. On the other hand the effects of these parameters on relative magnitudes of dw/dT and dr/dT are easier to interpret.

By rewriting equation (4'') in footnote 10 dr/dT can be expressed in terms of dw/dT

$$\frac{dr}{dT} = \left(\frac{a_{LL} - a_{RL} - E_L}{a_{LR} - a_{RR}}\right) \frac{dw}{dT} + \left(\frac{a_{RK} - a_{LK}}{a_{LR} - a_{RR}}\right) . \tag{9}$$

Assuming $a_{RK} - a_{LK}$ to be negative it follows from equation (9) that when dw/dT is negative the fall in r relative to w will be less the more responsive is the demand for land to changes in the price of land. When dw is positive it is unclear, because of the constant term, whether it will be to the benefit of landowners (relative to workers) for $(a_{LR} - a_{RR})$ to be as small as possible. Nevertheless it is quite likely that the less elastic the demand for land with respect to its price the larger will be the increase in the return on land relative to the increase in wages. There is a straightforward interpretation to these results. If wages fall as a result of a tax-induced decrease in economic activity, the fall will be cushioned by the possibility of substituting labor for land and capital. If the factor substitution possibilities are smaller for land than for labor, the price of land will fall more. On the other hand when the demand for labor and land both rise, the return to labor will increase relatively less as the demand for this factor is more elastic with respect to changes in its price.

The close connection between the price of land and the wage rate also serves to explain the curious result that the price of land does not

necessarily fall more when the supply of labor is more responsive to wage rate changes.

As E_L, the elasticity of supply of labor with respect to wage rate change appears only in the denominator in the expression for dw/dT the wage rate will necessarily fall less when the supply of labor to the city is more elastic. However, it does not follow from (9) that an increase in E_L, which leads to a decrease in dw/dT, will necessarily increase (decrease) the magnitude of dr/dT. It is expected that a smaller decrease in the wage rate due to mobility of labor (assuming dw/dT negative) will depress the demand for X and will decrease land prices. Working counter to this effect is the increased demand for land as a result of the smaller fall in wages. The possibility the land prices will fall less, not more, when labor supply is more elastic should be considered as a curiosum as it depends on a high partial elasticity of substitution between labor and land relative to price elasticity of demand for X. Also the model under consideration leaves out the interaction between the demand of certain components of X (the home goods sector in X) and income and population in X.

A narrowing of the possible range for dw/dT, and dr/dT depends on estimation of the parameters in expressions (7) and (8). However, even without hard estimates reasonable restrictions can be placed on the likely range in the change in wages and land rents. For most cities the share of land rents in the total value of output is unlikely to exceed 5%.[1 2] The share of labor is around 70% and the share of capital 25%. The small share of land relative to labor and capital means land rents may fall dramatically and still not absorb the full burden of the tax on capital. The change in the price of X is related to the tax and changes in factor price by the relation

$$dp_X = f_K\,dT + f_L\,dw + f_R\,dr\,. \tag{10}$$

[1 2] The overall share of wages in national income is about 70%. This leaves 30% to be divided between real capital and land. The balance sheets in statistics of Income Corporation Income Tax Returns (1966) show that for all corporations the value of land relative to the value of depreciable assets is about 13:1. For corporations in the real estate industry; an industry in which large inventories of land are held for development purposes, this ratio is about 3:1. From Netzer (1966) tables 2–7 we calculate the ratio of residential structures to private residential land to be about 7:1. On the basis of these data it seems safe to conclude that average capital rentals are at least five times the level of land rents.

Suppose that dT is 10%. For $f_K = 0.25$, the price of X will increase by 2.5% when $dw = dr = 0$. Even if $dr/dT = 2$ so that land rents fall by 20% for a 10% increase in taxes, commodity prices will increase by 1.5% as the share of land rents in total costs is only 0.05. When there is no possibility of substituting land for labor or capital ($a_{LR} = a_{KR} = a_{RR} = 0$), then dw is positive so in order to remain fully employed land will have to absorb not only the tax but also the increase in wage costs which results from the substitution of labor for capital.

We have experimented with various values for E_X and E_L and the production parameters and have found that even for low values of partial elasticities of substitution of land for labor and land for capital the value of dr/dT does not exceed 2. For example when $E_X = -1$, $E_L = 1$ and the partial elasticities envolving capital and labor are taken to be 1 while those involving land are assumed to be 0.1 the value of $dw/dT = 0.02$ and $dr/dT = -1.5$.

These numerical experiments suggest that when the demand for land is unresponsive to factor prices changes the wage rate will change very little, especially for moderate responses in the supply of labor. This will be true for a wide range of values for the partial elasticity of substitution between labor and capital. For low elasticities of substitution between land and labor and between land and capital, say in the range 0.05 to 0.1, the price of land will fall substantially. For example, a 10% tax on capital earnings may well decrease land rents by 20% of their original value but because of the small share of land rents in total costs this decrease in the land rents will not offset the tax levy and prices will rise. It is highly unlikely that land will bear more than 40% of the total tax burden and quite likely that consumers will bear 75% or more of the burden in the form of higher prices.

4. A simple model of a central business district

By treating land supply as another factor of production in a neoclassical production process and by making all sites within a city identical we have not allowed for economies of agglomeration that result in the formation of a central business district (CBD). In this section we analyse the effects of property taxes in a model where a fixed amount of land serves as a 'base' for buildings of indefinite height. In this model, unlike the previous formulation, the fall in land rents may exceed the taxes collected on improvements.

The demand for floor space at the CBD is a function of price, i.e. $X = f(p_X)$. The marginal cost of a unit of floor space (building an additional floor) is assumed to rise and average costs at any given level of output lie below marginal costs. If developers operating in the CBD take the price of output as given, equilibrium will be reached when marginal variable cost is equal to price (average revenue). For simplicitly we assume that only variable cost to be the cost of capital services. The difference between average revenue (price) and average cost multiplied by the level of output will be quasi rents that accrue to owners of land.[13] The imposition of a property tax in a city shifts the marginal cost schedule upwards, increases the price of CBD services and leads to a decrease in output and land rents.

The demand for floor space at the CBD is equal to

$$X = f(P_X)\,, \tag{11}$$

marginal cost (equal to price) is given by

$$P_X = g(X)p_K\,, \tag{12}$$

where p_K is the cost of capital.

The marginal cost of output which is equal to price is a function of the level of output and the cost of capital. For a change in p_K the change in the price of X is equal to

$$\frac{\mathrm{d}p_X}{p_X} = \frac{\mathrm{d}p_K}{p_K} + e_s \frac{\mathrm{d}X}{X}\,, \tag{13}$$

where e_s is the elasticity of the marginal cost curve with respect to changes in output. Differentiating the demand relation we obtain

$$\frac{\mathrm{d}X}{X} = E_X \frac{\mathrm{d}p_X}{p_X}\,. \tag{14}$$

[13] A variant to this model is the case where all the ownership of land is very concentrated relative to its supply so that developers recognize the effect the size of their buildings will have on the price of floor space in this location and will set output at the level where marginal revenue) are equal. As long as there exists competitive bidding for the land all of the "monopoly profits" will accrue to land owners. For purposes of determining the effect of taxes on land rents the qualitative result for the "monopoly" model are essentially the same as for the competitive model.

From (13) and (14) it follows

$$\frac{dX}{X} = \frac{E_X(dp_K/p_K)}{1-e_sE_X} . \tag{15}$$

We assume that e_s is small relative to E_X. When $E_X = -1$ and $e_s = 0.1$ the fall in output will be 9% when capital cost are increased by 10%. When E_X is raised to -5, output will fall by 33% when the cost of capital is increased by 10%. In order to simplify the relation between the level of land rents and the level of output we assume that *total* variable costs are given by the quadratic function

$$(cX + mX^2)p_K . \tag{16}$$

Land rents are equal to the difference between price (marginal cost) and average cost multiplied by the level of output. For the quadratic total cost function this difference is equal to $(c + 2mX - (c + mX))\, Xp_K$ which reduces to

$$R \text{ (land rents)} = mX^2\, p_K . \tag{17}$$

Taking the cost of capital to be equal to 1 when the rate of property tax is zero the ratio of land rents with the tax to the level of land rents in the absence of tax is equal to

$$\frac{R_1}{R_0} = (1+t)\left(\frac{X_1}{X_0}\right)^2 . \tag{18}$$

Approximating the ratio of X_1/X_0 by means of equation (15) and taking t equal to 0.1 the ratio R_1/R_0 for $E_X = -5$ is equal to (1.1) (0.66) = 0.48. Land rents fall by more than 50% of their original value. For E_X equal to -1 the fall in land rents is about a little less than 10%, i.e. $R_1/R_0 = 0.91$.

The decrease in land rents relative to the level of tax collections on the improvements depends on the value of land relative to the value of improvements. Assume that before the tax was imposed the ratio of capital rentals was 4:1 – and 100 units of capital were employed in the CBD. Capital is measured so that the after-tax return on capital is equal to 1. For $E_X = -0.5$ the imposition of a 10% tax will reduce the

amount of capital to 66 units, tax collection will equal 6.6 units and land rents will fall from 25 units to 12. For a ratio of improvements to land of 10:1 land rents will fall by 75% of tax collections.

For smaller values of the price elasticity of demand the fall in land rents will be much less dramatic. When E_X is equal to -1 tax collections will be equal to 9 units and land rents will fall by 9% of their original value when the capital to land ratio is 10:1. When the capital to land ratio is 4:1 the fall in land rents will be 25% of tax collections.

The simultaneous increase in prices and fall in land rents illustrates the need of dealing with both excise tax effects of local taxes and their effect on factor prices. In this model purchasers of the taxed commodities will pay prices that "include" the property tax and land prices may also fall by substantial amounts. There are two possible interpretations to the fall in land values. One is that it reflects a transfer of income from the owners of CBD land to the owners of suburban land where CBD activities have relocated. However if the CBD has some unique features that favor the concentration of economic activity at this site the imposition of the tax in the central city may lead to an overall fall in land values. The overall fall in land values reflects the dead weight loss associated with the dispersal of the CBD.

There are several reasons for doubting that land rents will fall by amounts which approach the level of tax collections on improvements. First dramatic changes in rents depend on very elastic demand for floor space at the CBD. Second by ignoring complementary labor inputs in the provision of floor space at the CBD we exaggerate the increase in prices that result from an increase in the cost of capital. Finally it is unlikely that the value of land will be greater than 10% of the value of improvements.

5. The benefits of public expenditures and the differential incidence of the property tax

On balance the introduction of the benefit side of the budget significantly complicates any analysis of the budgetary policies of local governments. A general way of introducing public expenditures is to write the demand for home goods X_H as a function of their price p_H and the level of public expenditures g. An increase in the property tax rate by increasing the cost of capital will increase the price of home goods. However, if the marginal utility of public goods is high consumers will be willing to pay the additional cost and the overall effect of a budget

expansion will be to increase the demand for home goods. The demand for industrial goods, largely external, will fall as a result of the budget expansion unless the public expenditure decreases production costs, to compensate for the tax increase, and/or increase the supply of labor.

If town officials do their job well and choose the level and composition of public expenditures in accordance with the preferences of the electorate and attempt to "maximize the value of the town" the results on budget incidence may be simpler and more straightforward than the separate analysis of taxes. Demand for home goods will be less responsive to budget changes and so will the supply of labor and the cost of producing industrial goods.

The introduction of the benefit-side in no way alters our basic conclusion that the property tax system for the nation as a whole depresses the return on capital and changes the cost of capital to higher-tax communities and decreases the cost of capital to low-tax communities. However, it may be highly misleading in empirical work to classify cities into high-tax cities and low-tax cities and to make empirical judgments on the decrease or increase in land rents and wages on a city by city basis, solely on the basis of tax differentials. Endowments of capital per households vary between cities and do the relative amounts of income redistribution which occur in each jurisdiction. A consideration of the separate effects of taxes independently of expenditures is meaningful only with reference to an alternative source of tax finance.

6. Concluding remarks

The principal conclusion of this paper is that the *system* of property taxes imposed by local governments decreases the overall return to capital by the average rate of tax in the nation as a whole, and changes the supply price of capital to different cities according to relationship of the specific rates relative to the mean rate of property tax. Cities with relatively high tax rate will pay for the services of capital, low tax rates result in a lower cost of capital.

Changes in the cost of capital lead to a reallocation of residential and industrial activities which in turn influence site values and the returns to other imperfectly mobile factors of production. The analysis of this paper suggests that changes in wage rates will be small in magnitude as labor is partially mobile and labor can be substituted for capital. Changes in land values are likely to be substantial but because of the

low share of land rents in total costs are quite unlikely to approach increase sufficiently to offset the tax. Commodity prices will rise and I venture to guess that at least 75% of the burden of the tax differential falls on consumers, when capital is perfectly shiftable. In cities where the level of new construction is negligible tax increases will lead to a downward re-evaluation of the existing capital stock.[14]

[14] When rate of capital accumulation is sensitive to the rate return on capital (we have assumed the stock of capital to be fixed throughout the paper) price of capital intensive goods would rise relative to other commodities. The change in the price of housing is equal to $f_K dp_K + f_L dp_L$, where f_K and f_L are the shares of capital and labor respectively in the production of housing and dp_K, and dp_L are the changes in the cost of capital and labor respectively. Suppose the supply of capital is perfectly elastic with respect to the rate of return so a 2% general property tax will, in the long-run, increase the before-tax rate of return on capital by 25%. If capital is the only input in the provision of housing services, i.e. $dp_L = 0$ the price of housing increases by 25% relative to the "typical" (mean capital intensity) commodity. Of course the other basic effect of a decrease in the stock of capital is to decrease wages relative to what they would be in the case where capital is perfectly inelastic in supply.

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