Capitalization of Federal Taxes, the Relative Price of Housing,
and Urban Form: Density and Sorting Effects

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Abstract

We investigate the impact of the tax treatment of owner-occupied housing on urban form in an economy in which high and low income households choose among city and suburban communities. Because housing tax policies differentially affect the relative, after-tax price of housing for high and low income households, and because the extent of capitalization of housing tax policies can differ across city and suburban communities, our analysis finds that housing tax policies can affect not only the density of the metropolitan area, but also can influence where rich and poor households choose to live.

The impact of housing tax policies differs depending upon the extent to which the subsidy is capitalized into city land prices and whether a land use constraint such as suburban large lot zoning exists to make poorer households less mobile. If the rich and poor both are fully mobile, increasing a subsidy to home ownership that is positively correlated with the income of the owner leads to the decentralization of both rich and poor; the greater the extent of capitalization, the larger the decentralization impact. In the presence of binding large lot zoning in the suburbs, the rich have a greater incentive to decentralize while the poor are constrained to the city. Thus, it is only when the mobility of the poor is restricted that housing tax policy of the type we have in the U.S. could have helped exacerbate the intense residential sorting by income that we see in many parts of the country.

Finally, it is noteworthy that our analysis of community choice is not driven by different preferences for city or suburb that may be associated with the income elasticity of housing demand. Rather, our conclusions arise from changes in relative after-tax housing prices faced by poor and rich households. Determining the empirical relevance of prices versus preferences in this matter should be an urgent task for future research.

1. INTRODUCTION

This paper analyzes how current housing tax policy, which provides benefits to home owners that increase with income, can influence urban form. Mills (1987) and others have shown that the favorable tax status of owner-occupied housing has resulted in more housing investment than otherwise would have occurred. We would expect that because land is an input to housing, this increased housing investment would also result in lower population densities. With the exception of Blackley and Follain (1983), however, analyses of the patterns of metropolitan development generally have not seriously considered the impact of the tax treatment of housing.[1] In this paper, we focus on the differential impacts that the tax treatment of housing can have on the consumption of land and on the location choices of high versus low income households.

There are two reasons why the tax treatment of housing can affect patterns of metropolitan development beyond simply reducing density. First, current housing tax policy has greater direct effects on the after-tax relative price of housing for high income households, thereby providing incentives with respect to housing and location choices that differ from those for low income households. Second, differing supply conditions across communities are likely to yield different capitalization of housing-related tax incentives that also can influence after-tax relative prices across locations. For example, there should be a different supply response, and hence different capitalization, in communities with limited undeveloped land versus communities on the urban fringe that have plentiful supplies of open land. In addition, the supply of housing

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[1]For example, in their widely cited review of the causes of suburbanization, Mieszkowski and Mills (1993) consider the impacts of transportation policies and the like, but not housing-related tax expenditures.

available to high income households will also depend on the housing decisions of low income residents, so that the extent to which housing tax benefits are capitalized into the market price of housing itself will depend on the distribution of high and low income households across communities.

These two features are incorporated in a model that is used to analyze the impact of housing related-tax incentives on the housing consumption and community choices of high and low income households who hold idiosyncratic preferences for cities (bounded, supply-constrained communities) and suburbs (unbounded, supply-unconstrained communities). A key feature of our analysis of community choice is that households' choices are not driven by different preferences between high and low income households, but by the effects of policy on after-tax housing prices. The impact of the tax treatment of housing is examined under two regimes: one with no land-market constraints and one with a binding, large lot zoning requirement in the suburbs that restricts the mobility of the poor.

When no binding zoning rules exist so that rich and poor households are equally mobile within the metropolitan area, lowering the relative price of housing for high income households unambiguously creates an incentive for both low income and high income residents to leave the city. The magnitude of the incentive to decentralize is positively related to the extent of the capitalization of the subsidy. Because the factors determining the extent of capitalization are likely to differ across metropolitan areas, the decentralization impacts are likely to differ as well.

In the presence of a binding, suburban zoning constraint that limits the ability of the poor to purchase a lot in the suburbs, tax policy that subsidizes the rich increases the degree of spatial sorting by income in the metropolitan area. More specifically, if large lot zoning in the suburbs

confines poorer households to the central city, then a proportional subsidy that reduces the relative price of housing for high income households will result in greater decentralization of the rich and a greater separation of high versus low income households than otherwise would occur. Thus, it is only in the presence of some factor such as a binding large lot-type zoning constraint that restricts the mobility of the poor that a proportional subsidy to owners can generate residential sorting by income of the type we see in the United States.[2]

The practical relevance of these theoretical conclusions derives partially from their implications that policy influencing the spatial pattern of relative land prices, not just preferences for lower density lifestyles combined with rising incomes and better transportation systems, may have helped shape urban form in the U.S.[3] In addition, our findings have potentially important implications for the emerging debate surrounding Smart Growth initiatives. If enacted, some of those initiatives clearly will affect the relative price of land across communities within individual metropolitan areas. And, our results indicate that the spatial pattern of development and the degree of residential sorting by income can be influenced by policy affecting relative land prices across space.

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[2]Conceptually, policy need not be the only factor that could confine the poor to the central city. If the poor systematically had a preference for city life, the same outcome would result. However, we specifically do not want preferences playing such a role in our model so that we can focus on relative price effects. And, we think zoning policy is a potentially relevant way in which the mobility of the poor might be restricted.

[3]The incentives identified here also may be related to communities' decisions to enact zoning restrictions. Voith (2000) show that community behavior also may be influenced by housing tax policy. He demonstrates that, under plausible conditions, housing subsidies like those in the US may encourage high income communities to enact exclusionary zoning.

2. THE MAGNITUDE AND DISTRIBUTION OF THE TAX SUBSIDY TO OWNER-OCCUPIED HOUSING

It is well known that owner-occupied housing is favored by the current tax system because its occupants can deduct certain expenses without having to declare any income on the asset. Specifically, mortgage interest and local property taxes are deductible from taxable income for those who itemize, while no owner occupant has to include the rental value of the home as part of taxable income. A standard user cost equation that takes into account these features is expressed in equation (1)

(1) $R_H = (1-\tau_{ded})\alpha i + (1-\tau_{ded})\tau_p + (1-\tau_{int})(1-\alpha)r + M + \delta - \Pi^H$.

The left-hand side variable, R_H, is the implicit rent per dollar of housing value the owner pays herself. In equilibrium, it must equal the cost of owner occupancy per dollar of housing value. These costs include: (a) the after-tax cost of mortgage interest, $(1-\tau_{ded})\alpha i$, where α is the loan-to-value ratio on the house, i is the mortgage interest rate, and τ_{ded} is the owner-occupier's marginal tax rate which equals her marginal rate (denoted τ_{int}) if she itemizes and equals zero otherwise; (b) the after-tax cost of property tax payments, $(1-\tau_{ded})\tau_p$, with τ_p the effective property tax rate; (c) the after-tax opportunity cost of investing equity in the house rather than in some other investment at rate of return, r; this is given by $(1-\tau_{int})(1-\alpha)r$ and is a cost to all owners, whether they itemize or not[4]; (d) annual maintenance costs per unit of housing which are given by M; (e) the cost of true economic depreciation per unit of house which is assumed to occur at rate δ; and

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[4]This notation assumes the opportunity cost of investing equity in the home is foregoing taxable returns.

(f) any annual appreciation in the house value, Π^H, which reduces the carry cost.[5]

The subsidy per dollar of owner-occupied housing can be estimated by comparing this user cost of owner occupancy under the current code to that under a hypothetical code that does not favor owner-occupied housing. One reasonable alternative is a tax code that treats the home owner like a landlord so that owner-occupied housing is not treated differently from rental housing (or from most other assets for that matter). Since the home owner effectively rents the house to herself, neutral tax treatment requires taxing the implicit rental income on one's home. However, if treated like a landlord, owner occupiers also would be able to deduct maintenance and depreciation expenses in addition to the mortgage interest and local property tax costs presently allowed. Making these changes (and assuming accrual taxation of capital gains for clarity of exposition) yields the follow new equilibrium rent, R_H', per dollar of housing value

(2) $R_H' = (1-\tau)\alpha i + (1-\tau)\tau_p + (1-\tau)(1-\alpha)r + \tau R_H' + (1-\tau)M + (1-\tau)\delta - (1-\tau)\Pi^H$.

where $\tau R_H'$ is the tax due on imputed rent and all other terms are as defined above.

The difference in user costs under the two tax regimes, $R_H' - R_H$, represents the subsidy to owner occupancy per dollar of housing value under the current code and is captured below in equation (3)

(3) $R_H' - R_H = \tau_{ded}\alpha i + \tau_{ded}(\tau_p) + \tau_{int}(1-\alpha)r$.

This equation measures the change in user costs, or implicit rent for owner-occupiers, that would result if the current tax system were modified so that one dollar of investment in owner-occupied

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[5]This specification treats capital gains on housing as untaxed and realized every year. Given that there now is a $250,000 capital gains exclusion ($500,000 for married couples filing jointly) that can be applied every other year, this is likely to be the case.

housing was not favored over other assets.[6] Thus, the tax subsidy to owner-occupied housing can

be decomposed into three factors: (a) the tax value of home mortgage interest deductions

$(\tau_{ded}*\alpha*i)$; (b) the tax value of local property tax deductions $(\tau_{ded}*\tau_p)$; and (c) the tax that would

have been paid on the equity invested in the home had it been invested elsewhere $(\tau_{int}*(1-\alpha)*r)$.[7]

Gyourko and Sinai (2001) estimate each component of equation (3), and conclude that the

total value of the tax subsidy in 1989 was over $160 billion. They also show that the subsidy is

highly skewed along income lines with upper income owners receiving a disproportionate share

of the total subsidy. That the net impact of the tax treatment of housing is to provide greater

benefits for households with greater income and wealth is not surprising and accords with other

research in this area. For example, Auten and Reschovsky (1998) have estimated that the tax

expenditures associated with mortgage interest and local property tax deductions alone amount to

$72.1 billion in fiscal year 1999. Less than one quarter of all filers and less than 40 percent of all

home owners have sufficient income, house value, and leverage to warrant itemizing in lieu of

taking the standard deduction.[8]   There is no doubt that non-itemizers tend to have lower

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[6]This characterization ignores second-order affects associated with changes in house values that may result from a change in housing tax policy. This is done for simplicity only, so that the underpinnings of what creates the subsidy can be readily identified. Capitalization and its implications will have prominent roles in the model presented below.

[7]We do not intend to imply that the mortgage interest or local property tax deductions themselves create subsidies to owner occupiers. The subsidy arises from the non-taxation of imputed rent in conjunction with those deductions. However, mathematically the subsidy can be represented by the three terms in equation (3).

[8]The *Statistics of Income Bulletin* (Internal Revenue Service, Washington D.C.:Fall 1995) reports that 23.2 percent of all filers used the mortgage interest deduction. Although the IRS does not tabulate data separately for owners and renters, if we assume that 65 percent of all filers are home owners, then the fact that 23.2 percent of all filers use the deduction suggests that roughly 36 percent of all owners use the standard deduction.

incomes.[9] In addition, even though all home owners profit from the non-taxation of imputed rent, this aspect of the housing subsidy also is differentially valued by high and low income households. Because high income households face higher marginal tax rates, the non-taxation of imputed rents effectively lowers the after-tax price of housing more for high income households than for low income households.[10]

In sum, the tax benefits to owner-occupied housing clearly are skewed toward higher income households that tend to be in more valuable homes. The remainder of the paper examines how this can affect the density and residential make-up of a metropolitan area.

3. A MODEL OF THE IMPACTS OF RELATIVE HOUSE PRICE CHANGES IN A METROPOLITAN AREA WITH BOUNDED AND UNBOUNDED COMMUNITIES

The structure of our model is characterized by the following features: (a) a metropolitan area in which there is a city with a fixed boundary and a suburban community that always can expand on the margin; (b) two types of workers, high and low income; (c) a housing subsidy which only high income households receive; and (d) a system of preferences in which households of a given type have identical preferences over housing services and non-housing services, but

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[9]Cecchetti and Rupert (1996) report that over 70 percent of the tax expenditures associated with the mortgage interest deduction accrue to households with annual earnings in excess of $75,000.

[10]Gyourko and Sinai (2001) and Auten and Reschovsky (1998) estimate this component of the tax subsidy to home ownership to be about $100 billion on an annual basis. In addition, Poterba (1991) estimates that tax code-related benefits to owner-occupied housing lower high tax bracket owners' user costs by as much as 15 percent.

can differ in terms of an idiosyncratic preference for city versus suburban location.   *3.1*

Characterization of the Metropolitan Area

There is a single metropolitan area consisting of two jurisdictions indexed by $j = (c,s)$, with c denoting the central city and s denoting the suburban jurisdiction. The central city boundary is exogenously given and cannot be changed so that the central city's land area, $\overline{L}_c$, is fixed. We refer to the central city as being a bounded community with its land in perfectly inelastic supply. In contrast, unimproved land in the suburban region, L_s, is assumed to be perfectly elastically supplied. Hence, the suburbs are the unbounded community.[11] Because there is a potentially infinite supply of land to the suburban community, its price, r_s, is fixed at the value of its alternative use–agriculture. City land price, r_c, adjusts to allocate the scarce resource, city land.[12]

In addition, two types of workers indexed by $i=(h,l)$, with h denoting high income and l denoting low income, live in the metropolitan area. Each group is fixed in size, N^i, with high income workers earning wage w^h and low income workers earning wage w^l.[13] The distribution of these two groups across the metropolitan area depends on systematic and idiosyncratic preferences, equilibrium prices, and housing subsidies.*3.2 Characterization of the Housing*

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[11]While the central city always is the bounded community and the suburb the unbounded community in our lexicon, the results derived below generally apply to communities with low versus high supply elasticities.

[12]We wish to abstract from income effects in order to focus squarely on relative price changes. Hence, we effectively assume that land rents are distributed uniformly across households.

[13]The metropolitan area is assumed to be an integrated labor market and all locations are equally accessible to employment so that there are no commuting-related rent or wage gradients. In addition, fixing the population size effectively allows us to abstract from the decisions of firms and from the role of non-residential land.

Subsidy

The various tax code-related benefits to owner occupancy described above can lower the after-tax price of owner-occupied housing. We specify them as a subsidy, τ^i, defined as the fraction of the price of housing services paid by the government. For simplicity, we assume that the tax code-related benefits are attractive only to high income workers.[14]

For low income households, $\tau^l=0$, so that the after-tax price of housing services (r_{ja}^l) equals the observed market price of those services r_j. Because the after-tax price equals the market price for low income households, we drop the superscript on after-tax rents for the remainder of the discussion. For high income households, the after-tax price of housing services is given by equations (1) and (2),

$$r_{ja} = (1-\tau^h)r_j \quad \text{where } 0 < \tau^h < 1, \quad j = c,s. \tag{4}, (5)$$

Note that the after-tax price of housing for high income individuals depends not only on the direct effect of τ, but also on the effect of τ on equilibrium prices. At one extreme, τ could be perfectly capitalized into market prices such that after-tax prices were unchanged by the subsidy; at the other extreme, there could be no capitalization and r_j would be unaffected by τ while r_{ja} would fall by the full amount of τ. *3.3 Preferences*

Individuals consume a market good, X (whose price is the numeraire), and housing services, H_j. An individual consumer, k, maximizes utility by choosing residential location and optimal quantities of X and H_j given r_j, τ^i, and w^i, household income. More formally,

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[14]This is an obvious simplification because all owner occupiers, including those who do not itemize, benefit from the non-taxation of imputed rent. The basic results hold if a continuous subsidy measure is used, as long as the tax benefits are positively correlated with income. However, our simplification makes the algebra much less cumbersome.

$$\text{Max } U^{ik} (X, H_j) \quad \text{Subject to:} \quad X + (1-\tau^i)r_j H_j = w^i. \tag{6}$$

Individuals of a given type are assumed to have identical preferences over X, and H_j, but they differ in their preferences for city or suburban location. This idiosyncratic location preference reflects heterogeneous tastes regarding the desirability of face to face interaction and public spaces in cities versus the availability of open space and privacy in suburban communities.[15] The utility function is defined such that the indirect utility function, V^{ik}, takes the following form

$$\text{High income:} \quad V^{hk} = V(r_{ja}, w^h) + \varepsilon_j^{hk}$$

$$\text{Low income:} \quad V^{lk} = V(r_j, w^l_j) + \varepsilon_j^{lk}, \tag{7}$$

where $V(.)$ is the systematic component of utility and ε_j^{ik} is the increment to indirect utility associated with the choice of location j. We further define $\varepsilon^{ik} = \varepsilon_s^{ik} - \varepsilon_c^{ik}$ to be the relative idiosyncratic preference for locations c and s.

3.4 Location Choice

Because all consumers have identical tastes except for idiosyncratic preferences for city or suburban living, the marginal consumer is defined (separately for rich and poor individuals) by that ε^k, ε^{i*}, satisfying $\varepsilon^{i*} = V_c^i - V_s^i$. More formally, for each worker type the marginal consumer is defined such that

$$\varepsilon^{h*} = V(r_{ca}, w^h) - V(r_{sa}, w^h) \tag{8}$$

$$\varepsilon^{l*} = V(r_c, w^l) - V(r_s, w^l). \tag{9}$$

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[15]These taste differentials may reflect basic differences across consumers, or they may represent differences in tastes over the life-cycle of the consumer. That said, our model abstracts from life-cycle considerations in community choice.

Since $r_c \geq r_s$, $\varepsilon^{i*} \leq 0$ or no households would choose to live in the city.[16]

By specifying a distribution, Ψ^i, for ε^{ik}, the number of rich or poor households choosing

city residences, N_c^i, can be determined as a function of relative rents in the city and suburbs.[17]

Thus, the numbers of rich and poor households choosing to live in the city are given by:

$$N_c^i = \Psi^i(\varepsilon^{i*}), \text{ for } i = h, l. \tag{10}, (11)$$

Note that if indifference requires a very negative ε^{i*}, few people will choose a city residence.

Essentially, city rents are relatively high if ε^{i*} is strongly negative. However, as ε^{i*} increases

toward zero, the number of people choosing city residences increases.

Finally, because the number of high and low skill individuals is fixed,

$$N_s^i = N^i - N_c^i, \quad i = h, l. \tag{12}, (13)$$

3.5 Housing Demand

Given an indirect utility function, Roy's identity provides the demand for housing by each

household. Conditional on the choice of jurisdiction, individual housing demand is a function of

r_{ja} and w^h for high-skill households, and r_j and w^l for low-skill households as shown in equations

(14)-(17).

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[16]Because suburban rent is fixed at the value of its alternative use, city rents are always greater than or equal to suburban rents. As pointed out by an anonymous referee, this implicitly presumes that city land could be turned back into farm land. Thus, the systematic component of utility in the city is always less than or equal to the systematic component of suburban utility. Stated differently, households choosing to live in the city must have an idiosyncratic preference for the city, and hence $\varepsilon^{i*} \leq 0$.

[17]Note that increasing wealth is presumed not to change one's intrinsic preference for a city versus suburban location. Thus, when subsidies increase, they do not favor city or suburbs. Similarly, w^i does not affect the population distribution because wages for individuals of a given type within the single metropolitan area labor market are assumed to be the same in both jurisdictions.

$$H_j^h = H^h(r_{ja}, w^h), \quad \text{for j=c,s;} \tag{14), (15}$$

$$H_j^l = H^l (r_j , w^l), \quad \text{for j=c,s} \tag{16), (17}$$

3.6 Aggregate Demand and Supply of Land

Land consumption is assumed to be proportional to the demand for housing services. Assuming purely for convenience that the proportionality factor equals one, land consumption, which cannot exceed $\overline{L}_c$ in the city, is given by

$$\overline{L}_c = H_c^h N_c^h + H_c^l N_c^l. \tag{18}$$

Suburban land, which is not exogenously given, is defined by

$$L_s = H_s^h N_s^h + H_s^l N_s^l. \tag{19}$$

While the assumption of proportionality is a useful one because it simplifies the algebra in the comparative static analysis below by doing away with the need to explicitly model the production of housing with capital and land, it obviously is not realistic. Hence, its potential impact on the results needs to be examined up front. Clearly, if land prices were to increase, capital could be substituted for land in the production of housing services. That is, more people could be accommodated in the rising land price area by increasing the use of capital (i.e., by building up). By assuming proportionality, we abstract from this margin for substitution. However, all our key comparative static results hold as long as there are diminishing returns to using capital in the production of housing. Because land is a fixed factor in the city, the unit cost of housing will rise with an increasing number of households in the city, even as capital is substituted for land. Rents in the city still adjust to allocate the scarce resource.[18] This highlights that the bounded-

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[18]This does imply that, when population falls in the city, the remaining city residents consume more city housing services. Implicitly, we are assuming that the housing stock adjusts

unbounded distinction between communities in the metropolitan area is much more important to the model than is our simplified housing supply side.

4. COMPARATIVE STATICS

4.1 *Case 1: No Lot-Size Constraints*

The first case considered is one in which no land-use constraints of any type are present. With w^i exogenously fixed, equations (4), (5), (8)-(19) form a system of fourteen equations (six of which are identities) in fourteen variables r_c, r_{ca}, r_{sa}, ε^{h*}, ε^{l*}, N_c^h, N_c^l, N_s^h, N_s^l, H_c^h, H_c^l, H_s^h, H_s^l, and L_s. Note that r_s does not adjust in this case because agricultural land is perfectly elastically supplied. To examine the effects of changing a tax subsidy to owner-occupied housing that is positively correlated with income on the location choices and housing consumption of high- and low-income workers, we totally differentiate these equations and solve for $dr_c/d\tau$, $dN_c^h/d\tau$, $dN_c^l/d\tau$, $dH_c^h/d\tau$, $dH_s^h/d\tau$, $dH_c^l/d\tau$, and $dL_s/d\tau$. (Total differentials are shown as equations A1-A14 in the appendix.)

4.1.1 Rents

First, consider the effects of a change in subsidy on the price of housing services in the city, which is given by:

$$\frac{dr_c}{d\tau} = \frac{\{-H_c^h \psi_{\varepsilon^{h*}}^h (V_{r_{sa}}^h r_s - V_{r_{ca}}^h r_c) + N_c^h H_{c_{r_{ca}}}^h r_c\}}{H_c^h \psi_{\varepsilon^{h*}}^h V_{r_{ca}}^h (1-\tau) + N_c^h H_{c_{r_{ca}}}^h (1-\tau) + H_c^l \psi_{\varepsilon^{l*}}^l V_{r_c}^l + N_c^l H_{c_{r_c}}^l} > 0 \tag{20}$$

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in terms of size of housing to match demand. This also is unrealistic in the short run, as housing that does not match consumer demands often is left vacant. It is noteworthy that this sort of fixity of city housing stock only reinforces the results below associated with sorting by income.

In the denominator, the first and third terms are negative because the demand for housing by each income type falls as price increases (i.e., $\partial H_c^l / \partial r_c < 0$ and $\partial H_c^h / \partial r_{ca} < 0$) and because the number of people choosing city residences increases with ε^{h*} (i.e., $\partial \Psi^h / \partial \varepsilon^h > 0$). The second and fourth terms are also negative because utility decreases as after-tax rents increase (i.e., $\partial V^h / \partial r_{ca} < 0$ and $\partial V^l / \partial r_c < 0$). Thus, the denominator clearly is negative.

Signing the numerator requires a bit more analysis. The second term of the numerator is always negative because demand curves slope down. However, the sign of the first term depends on the sign of the quantity $(V_{r_{sa}}^h r_s - V_{r_{ca}}^h r_c)$. Invoking Euler's theorem for functions that are

homogeneous of degree zero (which is the case for the indirect utility function), it is straightforward to show that this term equals zero.[19] Thus, the numerator and denominator of equation (20) both are negative and the derivative is unambiguously positive. This result is not surprising economically since an increase in housing subsidies increases the overall demand for housing. This, in turn, increases city prices because housing in this part of the metropolitan area is inelastically supplied.

The important aspect of equation (20) is that it illustrates the extent to which tax subsidies for housing are capitalized into market prices. As such, there are two aspects of the equation that warrant further discussion. The first is that the degree of capitalization will be lower when there are larger numbers of low income households living in the city. Capitalization also will be lower

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[19]Utilizing the fact that the indirect utility functions are homogenous of degree zero, Euler's Theorem then implies that $V_{r_{ca}}^h r_{ca} + V_{w^h}^h w^h - V_{r_{sa}}^h r_{sa} - V_{w^h}^h w^h = 0$. Substituting in for $r_{ca} = (1-\tau)r_c$ and $r_{sa} = (1-\tau)r_{sa}$ from equations (4)-(5) and rearranging yields the quantity $(V_{r_{sa}}^h r_s - V_{r_{ca}}^h r_c) = 0$.

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if these households's city housing consumption is highly sensitive to price. To see this more

clearly, note that the last two terms in the denominator represent the responses of low income

households to changes in prices, and the larger these terms are, the less capitalization of subsidies

into market prices. The economic intuition for this is that low income residents are the suppliers

of land to the high income households receiving the subsidies. And, the more elastic that supply,

the lower the capitalization of the subsidies to the rich owners.

A second feature to be noted is that housing subsidies are never completely capitalized

into market prices even if there are no low income households in the central city in which land

supply is fixed. Incomplete capitalization arises from the fact that high income households can

opt for a suburban residence where subsidies always lower after-tax market prices (because

housing there is in perfectly elastic supply). This can be seen more formally by noting that

complete capitalization would leave after-tax prices unchanged so that $dr_{ca}/d\tau = (1-\tau)dr_c/d\tau - r_c =$

0, or $dr_c/d\tau = r_c/(1-\tau)$. Manipulation of (20) reveals that $dr_c/d\tau < r_c/(1-\tau)$ even when there are no

low income households in the city.[20] These findings with respect to capitalization will be

important for our analysis below of the impact of housing subsidies on the community choices of

high and low income households. *4.1.2 Number of Households Choosing City Residences*

Increases in subsidies always reduce the number of low income households choosing to live in the

city as is evident by

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[20]Note that if there are no low income households in the city, the last two terms in the
denominator of (20) drop out. The remaining expression can be manipulated to yield

$$\frac{dr_c}{d\tau} = \frac{r_c}{(1-\tau)} - \frac{H_c^h \psi_{\varepsilon^{I*}} V_{r_{sa}} r_s}{(1-\tau)(H_c^h \psi_{\varepsilon^{I*}} V_{r_{ca}} + N_c^h H_{r_{ca}}^h)}.$$ Note that the second term of this equation is

positive so that $\dfrac{dr_c}{d\tau} < \dfrac{r_c}{(1-\tau)}$. Thus, the subsidy is not fully capitalized.

$$\frac{dN_c^l}{d\tau} = \psi_{\varepsilon^{l*}}^l V_{r_c}^l \frac{dr_c}{d\tau} < 0 \, . \tag{21}$$

As subsidies rise, rents in the city increase, so fewer low income households, who pay the full market price, choose to live in the city.

The rich also decentralize as indicated by the comparative static result in equation (22):

$$\frac{dN_c^h}{d\tau} = \psi_{\varepsilon^{h*}}^h (V_{r_{ca}}^h (1-\tau) \frac{dr_c}{d\tau} + (V_{r_{sa}}^h r_s - V_{r_{ca}}^h r_c)) \tag{22}$$

A quick inspection of relevant terms show the inequality is unambiguously negative. That is, the derivative with respect to the cumulative distribution function is positive by definition, utility is decreasing in city rents (i.e., $\partial V^h / \partial r_{ca} < 0$), $dr_c/d\tau > 0$ from equation (20), and the quantity $(V_{r_{sa}}^h r_s - V_{r_{ca}}^h r_c) = 0$ from above.

The extent to which the subsidy causes both high and low income households to move depends crucially on the degree of capitalization, all else constant. If the subsidy is highly capitalized, it has greater decentralization effects, suggesting that the impacts could differ across metropolitan areas. Building upon the discussion in the previous section, those areas with central cities populated by a large number of low income households well tend to have lesser capitalization, thereby reducing the incentive for decentralization especially if the low income households' housing consumption and community choices are highly price elastic. On the other hand, central cities containing primarily high income households will tend towards greater

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capitalization, and hence the subsidy will provide a greater incentive for decentralization.[21]

In sum, a proportional subsidy to owner occupiers that increases with income fosters decentralization of both household types if richer and poorer owners are fully mobile. Under these conditions, housing tax policy is not a candidate to explain the intense degree of residential sorting by income that we see in many metropolitan areas across the United States.

4.1.3 Household Land Consumption Household land consumption depends on the after-tax rent for high income households and market rents for low income households. For high income households, the effect of subsidies on city land consumption is given by

$$\frac{dH_c^h}{d\tau} = H_{c r_{ca}}^h \frac{dr_{ca}}{d\tau} \geq 0.$$

(23)

As discussed in section 4.1.1, the subsidy cannot be fully capitalized, so subsidies must lower after-tax rents in the city for high income households. Thus, housing consumption by high income households rises with an increase in subsidy.

In the suburbs, because land is elastically supplied, there is no capitalization and, as is evident from equation (A4) in the appendix, $dr_{sa} / d\tau = -r_s < 0$. Thus,

$$\frac{dH_s^h}{d\tau} = H_{s r_c}^h \frac{dr_{sa}}{d\tau} > 0.$$

(24)

Increased subsidies lower after-tax suburban prices and increase suburban land consumption by

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[21]Capitalization is not the only factor determining the extent of decentralization. This also depends importantly on the distribution of idiosyncratic preferences. They help determine how responsive a household's community choice is to price.

high income households.

Since low income households do not receive any subsidy and market rents in the city increase with subsidies, increased subsidies must lower low income household land consumption in the city as shown in equation (25)

$$\frac{dH_c^l}{d\tau} = H_{c_{r_c}}^l \frac{dr_c}{d\tau} < 0 \tag{25}$$

Finally, because subsidies do not affect suburban market rents, $dH_s^l / d\tau = 0$. *4.1.4 Aggregate Land Consumption*

Aggregate land consumption in the city is fixed at $\overline{L}_c$, and therefore is unaffected by subsidies.[22] The effects of subsidies on the amount of suburban land consumed is given by subsidies on the amount of suburban land consumed is given by:

$$\frac{dL_s}{d\tau} = H_s^h \frac{dN_s^h}{d\tau} + N_s^h \frac{dH_s^h}{d\tau} + H_s^l \frac{dN_s^l}{d\tau} \tag{26}$$

Suburban land consumption rises unambiguously because both the rich and poor are incented to move to the suburbs in the face of an increased subsidy.

4.1.5 Summary

With no constraints in the land market, introducing a subsidy to ownership that is positively correlated with income has the following impacts. First, it unambiguously increases

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[22]We assume that there always are enough households who wish to live in the city at rents equal to their alternative use (r_s) so that all available city land is occupied.

market rents in the city. Second, low income households that do not benefit from the housing subsidy program and therefore confront higher market rents in the city have an incentive to decentralize to the suburbs. The fact that low income households in the city face higher prices or move to the suburbs implies that the subsidy lowers the average welfare of low income households. More specifically, the welfare of low income households already living in the suburbs is unaffected since they confront no change in price. However, low income households moving to the suburbs receive lower utility in the suburbs than their utility would have been in the city prior to the subsidy increase. Third, high income households also have an incentive to suburbanize on the margin, so that the tax policy does not necessarily lead to increased residential sorting by income when both rich and poor owners are fully mobile. Fourth, aggregate land consumption in the suburbs increases unambiguously. On a per household basis, an increase in the subsidy clearly leads a rich household to consume more land in the city and the suburbs. For the typical low income household, land consumption clearly falls in the city and is unchanged in the suburbs.

Finally, it is noteworthy that the impacts described by this model are symmetric. If low income households received the subsidy rather than high income households, low income households' choices would be affected in the same way that high income households would be if they received the subsidy. That is, if a special tax credit was instituted that was available only to low income households, we would expect to see motivations to suburbanize analogous to those described above (with the income labels changed). Thus, in our model it is the effect of the subsidy on the relative price of housing that drives behavior, not the incomes of the owners *per se*.

4.2 Case 2: Lot-Size Constraints

The second case introduces a common suburban land-use restriction in the form of a minimum lot-size requirement for residential development. To help simplify the analysis, it is assumed that lot-size constraints exist such that no low income people choose to live in the suburbs, but the constraints are not binding for high income workers.[23] In other words, high income workers earn sufficiently high wages that they always choose lots at least as large as the constraint whenever they choose a suburban site. Low income workers, on the other hand, have sufficiently low wages that they never choose to purchase a lot as large as the minimum in the suburbs.[24]

The new comparative static result for city rents is given in equation (27):

$$\frac{dr_c}{d\tau} = \frac{-H_c^h \psi_{\varepsilon^{h*}}^h (V_{r_{sa}}^h r_s - V_{r_{ca}}^h r_c) + N_c^h H_{c_{r_{ca}}}^h r_c}{H_c^h \psi_{\varepsilon^{h*}}^h V_{r_{ca}}^h (1-\tau) + N_c^h H_{c_{r_{ca}}}^h (1-\tau) + N_c^l H_{c_{r_c}}^l} > 0 \qquad (27)$$

Equation (27) is the same as (20) except that it does not include the term representing low income households' community choice response to a change in city prices. Although it is not possible to directly compare the magnitudes of the rent impact under the two cases because they represent

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    [24]These simplifying assumptions imply the following modifications to the comparative statics analyzed in Case 1. Equation (A6) is no longer relevant, since low income workers never choose to live in the suburbs, and equations (A7) and (A8) simplify to $H_c^h dN_c^h + N_c^h dH_c^h = -N_c^l dH_c^l$ and $dL_s = H_s^h dN_s^h + N_s^h dH_s^h$, respectively.

different equilibria, one is tempted to argue that the impact on rents is greater in the constrained case because low income households cannot move away from the city and, hence, have only one margin on which to adjust their consumption of city land. This would imply that land would be less elastically supplied to high income households who received the increased subsidy, and hence a greater share of the subsidy would be capitalized. This is not the complete story, however, because there also may be more low income households in the city. Consequently, the aggregate response due to households lowering housing demand in response to increasing market prices could exceed the aggregate response in the unconstrained case in which low income households can adjust both by moving and by reducing housing consumption.

That said, given an existing set of land use restrictions and a corresponding distribution of low income households, increasing subsidies would result in greater capitalization of the subsidy than would occur conditional on the same distribution of low income households whose future mobility was unconstrained. Subsidy changes generally take place in the context of land use policies that are long-standing, rather than in the context of shifting from constrained to unconstrained regimes. Therefore, empirically we would expect to see greater capitalization of subsidy changes in areas in which land use policies restrict the mobility of low income households. Further following the logic outlined in the previous section, housing subsidies to higher income people are more likely to foster the separation of the rich into suburban neighborhoods and poor in city neighborhoods when a land use constraint such as binding large lot zoning exists.

5. DISCUSSION AND CONCLUSION

Our analysis has shown that a public policy subsidizing home ownership differentially

along income lines can affect the density of the metropolitan area, as well as influence where rich and poor households choose to live. We have shown that these impacts can depend importantly on the extent of capitalization and on whether binding land use constraints exist that restrict the mobility of the poor. If rich and poor households are fully mobile, increasing the subsidy leads to decentralization of the poor and the rich; the greater the capitalization of the subsidy in the city, the greater the incentive for decentralization. In this case, housing tax policy is unable to account for the intense residential sorting by income that we see in most metropolitan areas in the United States.

The implications for residential sorting, however, are different when a constraint such as large lot suburban zoning exists. The rich still have an incentive to decentralize on the margin. And, with the poor stuck in the city due to the large lot zoning limitation, residential sorting by income is likely to be greater because of the subsidy policy as long as there is some elasticity to the demand curve for residential land.

Determining the empirical relevance of this case should be an important issue for future research, as it suggests that policy, not just preferences for less density, could have played a role in shaping America's urban form. Pinning down the influence that price and preference have had not only would be interesting in its own right, but certainly would help inform the current debate surrounding urban sprawl and it costs and benefits. Careful measurement of the subsidies themselves, along with estimates of key demand and supply schedule parameters are needed to determine if policy could have influenced our urban form in a meaningful way. Another useful extension of the model would be to incorporate local amenities that are at least partially determined by the makeup of the local population. Endogenous local amenities could affect

prices in a way that encourages even more sorting by income than in our second model. However, we leave that work for the future.

References

1. Gerald Auten and Andrew Reschovsky. "The New Exclusion for Capital Gains on Principal Residences," U.S. Treasury Department, mimeo (December 1998).

2. Dixie Blackley and James R. Follain, "Inflation, Tax Advantages to Homeownership and the Locational Choices of Households," *Regional Science and Urban Economics*, Vol. 13 (1983), pp. 505-16.

3. Stephen Cecchetti and Peter Rubert, "Mortgage Interest Deductibility and Housing Prices," *Economic Comentary*, Federal Reserve Bank of Cleveland, 1996.

4. Joseph Gyourko and Todd Sinai, "The Spatial Distribution of Housing-Related Tax Benefits in the United States", NBER Working Paper #xxxx, March 2001.

5. Peter Mieszkowski and Edwin Mills, "The Causes of Metropolitan Suburbanization," *Journal of Economic Perspectives*, Vol. 7, no. 3 (Summer 1993): 135-147.

6. Edwin Mills, "Dividing Up the Investment Pie: Have We Overinvested in Housing?" *Business Review*, Federal Reserve Bank of Philadelphia, March-April, 1987.

7. James Poterba, "House Price Dynamics: The Role of Tax Policy and Demography," *Brookings Papers on Economic Activity*, 1991, 2, 143-203.

8. Richard Voith, "Zoning and the Tax Treatment of Housing," *Brookings-Wharton Papers on Urban Affairs*, (2000) The Brookings Institution.

Appendix

The total differentials used in the comparative static analysis are

$$d\varepsilon^{h*} = v^h_{r_{ca}} dr_{ca} - v^h_{r_{sa}} dr_{sa} \tag{A1}$$

$$d\varepsilon^{l*} = v^l_{r_c} dr_c \tag{A2}$$

$$dr_{ca} = (1 - \tau)dr_c - r_c d\tau \tag{A3}$$

$$dr_{sa} = -r_s d\tau \tag{A4}$$

$$dN^h_c = \psi^h_{\varepsilon^{h*}} d\varepsilon^{h*} \tag{A5}$$

$$dN^l_c = \psi^l_{\varepsilon^{l*}} d\varepsilon^{l*} \tag{A6}$$

$$dH^h_c = H^h_{r_{ca}} dr_{ca} \tag{A7}$$

$$dH^l_c = H^l_{r_c} dr_c \tag{A8}$$

$$dH^h_s = H^h_{r_{sa}} dr_{sa} \tag{A9}$$

$$dH^l_s = H^l_{r_s} dr_s = 0 \tag{A10}$$

$$H^h_c dN^h_c + N^h_c dH^h_c = -H^l_c dN^l_c - N^l_c dH^l_c \tag{A11}$$

$$dL_s = H^h_s dN^h_s + N^h_s dH^h_s + H^l_s dN^l_s + N^l_s dH^l_s \tag{A12}$$

$$dN^h_c = -dN^h_s \tag{A13}$$

$$dN^l_c = -dN^l_s \tag{A14}$$