Should We Be Taxed Out of Our Homes?

The Optimal Taxation of Housing Consumption

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Abstract: Optimal tax theory suggests that it is more efficient to tax housing as a consumption good than other forms of consumption as it is a complement to leisure and is produced more intensively from land, an inelastic factor, than other goods. This tax rate appears to be at least 50 percent higher than other forms of consumption, justifying high rates of property taxation, particularly in areas with inelastic housing supply. It may be efficient to offer a lump sum transfer to households who choose to live close to high-paying jobs, justifying infra-marginal subsidies to housing units in some high-price areas. Proximity to amenities may also influence optimal tax rates depending on whether they are substitutes or complements to labor supply or housing consumption.

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I. Introduction

Economists have considered various justifications for why housing should receive special treatment in tax and transfer systems. Most of these explanations involve its role as a form capital (Gervais, 2002) or to externalities around homeownership (e.g. Glaeser and Shapiro, 2003). However, little attention has been paid to housing as a consumption good.[1] This is important as housing consumption may be deeply related to labor supply, since much leisure and most household production occurs in and around the home. The quantity of housing consumed may prove to be a substitute for taxable, market-oriented activities. In this case, taxing housing consumption more heavily than other commodities may provide first-order benefits (with only second-order costs), based on insights provided Corlett and Hague (1953) on leisure, and Sandmo (1990) and Kleven et al. (2002) on household production.

Another consideration is that much of the value of housing stems from the land it is on. Land is supplied inelastically, although it may be allocated across various uses. In most urban areas, land is allocated primarily to residential purposes. It seems reasonable to assume that most residential land of value is supplied inelastically. Thus, it has been famously argued that it more efficient to tax land than other factors, such as labor or savings (George 1879). Most other goods in the economy derive very little value from land. If land is not taxed separately from the rest of a property --- as is the usual case --- it can be efficient to tax housing more heavily than other goods. There is also reason to believe that land ownership is distributed unequally, especially by value, making it equitable to tax.

These arguments support taxing the amount of housing consumed heavily. A major complication arises from the fact that we typically only observe housing expenditures (at best), and that housing is very heterogeneous. In particular, the amount of housing consumed is hard to observe because the price of housing per unit varies by location. The per-unit price of housing is likely to be higher in areas that are close to high-paying jobs, or with a high density of services that substitute for home production. Commuting and other travel involves untaxed time, and may involve negative externalities due to pollution in congestion. In other words,

[1] The only paper I am aware of is Aura and Davidoff (2012), who develop a considerably different model without housing production. This model is not developed to produce quantifiable results.

well-located housing is a complement to production, and possibly public goods (Hochman, 1982). In these cases, it may be sensible to subsidize housing in dense areas where prices per unit are high.

This insight expands on work by Wildasin (1985), who finds that taxes on labor reduce the value of time, and thus induce inefficient levels of commuting. Brueckner (2002) finds that taxes in property reduces building densities in central, high price areas, further compounding problems of sprawl. Albouy (2009) argues that taxes on earnings discourage workers from locating in high-wage areas with high productivity, while encouraging them to work in low-wage areas with high quality of life, generally reducing urban populations.

Housing is a complex good to study, as it is durable, and has a dual nature as both a consumption and investment good A renter household effectively purchases housing services from a landlord, who owns the housing capital and must declare the capital income for taxes. An owner-occupier effectively rents to himself in a transaction that is not recognized by most tax authorities. This makes it harder to determine what a homeowner spends on housing, as a rental equivalent, which in principle should equal the user cost. The focus on this paper is on housing as a consumption good rather than as an investment good, i.e., as renters would, without ignoring benefits the tax code provides to owner-occupiers. It also abstracts from issues related to home-ownership.

The stock of housing capital consists of both land and structure, which is produced from labor and materials. In its purest form, land represents only the location itself, and does not deteriorate physically, unlike the structures upon it. In principle, taxes can be levied at separate rates on land and structure. As mentioned earlier, taxes on land are far less distortionary and should in principle have no incidence on the consumer, so long as they are uniform across residential and non-residential uses. Taxes on structure, on the other hand, will typically raise the price consumers pay for it, especially if the tax is local. This increase will be distortionary if this price does not come with associated benefits (Zodrow 2001). The focus here is primarily on the consumption of housing services itself through the structures people inhabit, although its cost depends on the availability of land. Eventually, we need to consider what happens if taxes on housing causes land to be used for other uses, such as commercial or agricultural.

It is surprising that the optimal taxation of housing as a commodity has not received more attention as it is the most important single item in a household budget (20 percent of

expenditures in 2011) and receives very particular treatment in public finances. In the United States, new homes and home improvements are not subject to sales taxes, while property taxes are a major source of local revenue. Income on rental properties is subject to income taxes, while implicit rental from owner-occupied units is free of taxation, creating tax advantages with deductible mortgage interest. Capital gains are also lightly treated.[2] With all of the tax effects considered, this tends to make housing relatively cheaper than other commodities for owner-occupiers and relatively more expensive for renters (Albouy and Hanson, 2014).

Numerous public programs provide in-kind transfers of housing to poorer households in the form of public housing or housing-assistance vouchers. Rosen (1985) considers whether policies that subsidize higher -quality housing may have external benefits from increase beautification and lower crime, fires and delinquency. Cremer and Gahvari (1998) consider a model with two types of housing, where the consumption of high quality housing acts a signal of high skill. This is important in the context of Atkinson and Stiglitz (1976) who provide the canonical argument that when consumption and leisure are weakly separable, commodity taxation becomes irrelevant. These results break down when preferences are heterogenous, leisure is not separable from consumption, or there are pure profits in the economy – issues to be considered here. [3]

[2]The purchase of materials for home improvements is taxed, but labor that is put into home improvements is not taxed. Mortgage interest costs on up to $1 million of debt on primary and secondary homes are deductible from taxable income. Homeowners can also deduct up to $100,000 in home equity secured debt, effectively pushing the lending cap to $1.1 million. Capital gains from home sales of up to $500,000 for married couples, and $250,000 for singles, are excluded from taxable income. The Office of Management and Budget projects that these benefits to home owners will result in foregone tax revenues – or "tax expenditures" – for the 2014 fiscal year of over $200 billion, equal to 14 percent of federal income tax revenues. ("Analytical Perspectives, Budget of the United States Government, Fiscal Year 2013" estimates of the foregone revenue from 2014 tax collection.) See Burman and Phaup (2012) for a discussion of how much additional revenue would actually be collected if these and other tax expenditures were eliminated. They point out that revenue depends on the behavioral response of tax payers and the interaction with other aspects of the tax code (rates, itemization, and other deductions).

[3] Boskin (1975) concludes that the tax system is highly favorable towards household labor.

II. Theoretical Basics

An Economic Framework for Housing as a Taxable Commodity

I model housing here in a static setting, as in Albouy (2009), over numerous locations. Let *x* be a good that is traded across locations and has a price of 1. Let *y* be housing, which cannot be traded across cities. The third good consumed is leisure, denoted by *h*. Each household lives in a single residential locations, indexed with *j*, offer differing levels of amenities, represented by Q^j , and have a price of housing p^j=*1,…J*. Wage w_i^k levels also vary by worker type i, and workplace location, indexed with *k = 1,…K*, with the time cost of commuting given by f^{jk}. Each worker's labor is supplied to a single location. Households receive a non-labor income of R_i. We take leisure to be an untaxed good, as is standard in such problems,, and impose taxes on the numeraire and housing as ad valorem at rates of t_x and t_y.

Note that above we formulated a single tax rate on housing, although in principle, we could levy separate taxes. The use of an ad valorem rate is important if there are more housing prices than there are tax rates. Whether or not housing should be subjected to uniform rates is related to a well-studied problem in optimal commodity taxation. Federally, housing is subject to the same tax code, while locally it varies from differences in local property taxes.

Households have one unit of time to split between work, $\tilde{h}$, leisure, and commuting. If we take residences and workplaces as given, the household budget and time constraints are

$$(1 + t_x)x + p^j(1 + t_y)y \leq w_i^k\tilde{h} + R_i,\ h + \tilde{h} = 1 - f^{jk}$$

Substituting in the time constraint to eliminate work gives the budget constraint in terms of all three goods, which are purchased out of the household's endowment of time, net of commuting, plus non-labor income:

$$(1 + t_x)x + p^j(1 + t_y)y + w_i^k h \leq w_i^k(1 - f^{jk}) + R_i$$

Taxes on income may modeled by uniformly changing taxes on the two commodities. Households have preferences represented by the utility function $Ui(x,y,h;Q^j)$. The indirect utility function is then

$$V_i\left[1 + t_x, p^j(1 + t_y), R_i, w_i^k, f^{jk}; Q^j\right]$$

The production side of the economy involving labor, that of tradable goods, is modeled

by workplace *k*, which may coincide with residence *j*. Assume that labor is the only input in the production of the traded good, and that labor of different kinds is perfectly substitutable. The effective amount of labor provided by worker *i* is proportional to their labor inputs, n_i, and innate productivity, ϑ_i, so that aggregate production in location *k* is $X^k = A_X^k \sum_{i \in I^k} \theta_i n_i$, where I^k is the set of workers in workplace *k*, and A_X^k is the local level of trade-productivity. The gross wage of the worker is then $w_i^k = \theta_i A_X^k$, the product of personal and local productivity. The effective labor supply employed in location *k* is denoted $H^k = \sum_{i \in I^k} \theta_i \tilde{h}_i$.

There are *J* kinds of housing, and accordingly *J* production sectors for it. I assume that housing is produced from local land L^j, which is fixed in a location, and from capital K^j, which is mobile across locations. The production technology for local housing supply is given by $Y^j = A_Y^j G(L^j, K^j)$, where A_Y^j is local housing-productivity, and *G* is subject to constant returns to scale. Since land is fixed, the production function may be expressed intensively: $G\left(L^j, K^j\right) = L^j G\left(1, k^j\right) \equiv L^j g\left(k^j\right), k^j \equiv K^j / L^j$. The price of land is r^j, which may be thought of as profits in the housing sector so long as the supply of land is fixed.[4]

There are two possible assumptions for the supply of capital: it may be fixed at the national level, so that $\sum_j K^j = K^{TOT} > 0$, or it may be produced difrectly from the tradable good, so that its price, p_K, is constant at 1. The latter assumption is largely consistent with the "old view" of property taxation, while the former is consistent with the so-called "new view." The new view assumes that the stock of housing capital is fixed, while the old view, as it modeled here, recognizes that housing production has an opportunity cost in terms of leisure or non-housing consumption, which is arguably more accurate. In principle, it would be desirable to include both capital and land in tradable production, and local labor in housing production, but these assumptions are largely reasonable and help keep the model tractable.

To specify the condition for non-labor income suppose each household has a share ρ_{ij} of land in location *j*, and share κ_i of mobile capital, when the overall supply is fixed (otherwise set

[4] Alternatively, we could specify that land has a social opportunity cost of $\bar{r}^j$, which could be used to produce the numeraire good directly. Or households could benefit directly from the amount of land, either locally or totally, not used for housing.

$\kappa_i = 0$). Then non-labor income is $R_i = \sum_j \rho_{ij} r^j L^j$ $(+\kappa_i p_K K^{TOT})$.[5] Market clearing requires that that the housing consumed in by households is equal to the aggregate supply. $\sum_{i \in I_j} N_i^j y_i^j \leq Y^j$ for each j. For the traded good, assume that the (federal) government collects revenue in it, so that in the case where capital is produced, $\sum_{i=j}^{J} \sum_{i \in I_j} N_i^j x_i^j + \sum_{i=j}^{J} K^j + G \leq \sum_{i=j}^{J} X^j$. The federal government budget constraint assumes that taxes only apply to final goods purchases:

$$G \leq \sum_{i=j}^{J} t_X (X^j - K^j) + \sum_{i=j}^{J} t_Y p^j Y^j = \sum_{i=j}^{J} \sum_{i \in I_j} t_X N_i^j x_i^j + \sum_{i=j}^{J} \sum_{i \in I_j} t_Y N_i^j p^j y_i^j$$

For now, the tax on the commodity and on housing is represented as uniform. It is also possible to model a local tax on consumption of a much simpler form for a single government

$$G^j \leq \sum_{i \in I_j} t_X^j N_i^j x_i^j + \sum_{i \in I_j} t_Y^j N_i^j p^j y_i^j$$

An optimal tax problem in this situation differs from a conventional one in several ways. First, there are *J* different prices for housing, although households consume it only one location, implying non-convex preferences. If we consider a uniform federal tax on housing, the government does not independently control every price, which results in difficult mathematics. The effective price of leisure also varies according to the different opportunity costs through wages across workplaces, although that price is determined by the exogenous productivity. Furthermore, our analysis has two untaxed goods: both leisure and land. In the case below, we will consider what happens if land can be taxed at the inclusive rate of t_L.

The existing problem set up above is more complex than typical work on optimal tax theory. It appears that the general problem has not been solved, and will require further analysis, even though the model specified above is complete. There are various dimensions to consider. (i) using one residential location and several (ii), fixed or variable producer prices, (iii) residential mobility or immobility, (iv) commuting outside the residential area to a workplace $k \neq j$., (v)

[5] For greater realism in the old view, we could assume that there is a preexisting value of capital, like in the new view, providing a source of capital income. On the margin, capital is produced out of labor and thus retains its opportunity cost. In markets with a declining demand for the housing stock (see Glaeser and Gyourko, 2006), this opportunity cost may be greater than the marginal value of housing, making the new view more appropriate for such areas.

having a single or multiple tax on housing, (vi), providing local public goods by having G affect Q, and (vii), considering households heterogeneous in their skills and tastes. I begin by taking insights from the existing literature, expanding on them in the context of housing.

One Household Type, One Location, Three Goods, and Two Taxes

I begin with a non-spatial economy, with one location and one household type which may be thought to apply to the national economy and the housing stock as a whole. This model involves three final goods, two commodity taxes, and possibly a tax on the one kind of land. The technology postulated above allows us to simplify in two important ways (1) housing capital and leisure are perfect substitutes, and (2) land as a fixed factor receives all of the pure profits in the economy. These two simplifications allow me to use the optimal tax framework developed in Auerbach (1985), which I develop to intuitively include housing supply . The key result involves the determination of the relative tax rates in terms of demand and supply elasticities in the economy.

$$\frac{t_y}{t_x} = \frac{\varepsilon_{xh} + \varepsilon_{xy} + \varepsilon_{yx}}{\varepsilon_{yh} + \varepsilon_{xy} + \varepsilon_{yx}} \left[\frac{\eta_s - \varepsilon_{yy}(1 - t_L)(1 + t_y)}{\eta_s - \varepsilon_{xy}(1 - t_L)(1 + t_y)} \right]$$

Here ε_{xh} is the compensated price elasticity of x with respect to the price of h, etc, and η_s is the elasticity of housing supply. The first ratio on the right-hand side, which is all that matters when the supply of housing is perfectly inelastic, presents the classic Corlett-Hague result. Namely, it is efficient to tax housing more heavily than other consumption, if it is a closer complement to leisure. Mathematically this is true if $\varepsilon_{yh} < \varepsilon_{xh}$, in other words if a compensated increase in wages increases commodity-consumption more than housing.

When housing supply is not perfectly elastic, land receives a pure profit or rent, which is most efficient to tax. This causes the (newly developed) term in brackets to become relevant unless the profits that go to land are taxed at 100, i.e. if $t_L = 1$. Otherwise, the model implies that housing should be taxed more heavily than other consumption if the quantity of housing consumed is more responsive to changes in housing prices than non-housing consumption, i.e., if

$\varepsilon_{yy} < \varepsilon_{xy}$ This is almost certainly the case. When housing supply is more inelastic, the profits that go to land owners is greater, making this term increasing important. [6]

This model should be expanded to incorporate heterogeneous preferences and abilities. The first concern here is that housing appears to be a necessity, so that the share of expenditures spent on housing declines with household income. Society may then put a greater valuation on the consumption of housing as it is disproportionately consumed by the poor, or households with small children. If so, this would lower the the optimal tax on housing with the limited set of tax instruments considered.

With additional tax instruments, most of these additional considerations may be dealt with independently of the tax on housing. Redistributive concerns can be met with using non-linear taxation of income (or all consumption/expenditures). [7] Households with children may be dealt with through tagging, directly by making allowances for dependents and or indirectly through education benefits. Those considerations aside, it is difficult to argue that consuming housing has greater social value than other forms of consumption except when consumption levels are so low that homelessness becomes a possibility. The social ills and negative externalities associated with homelessness could justify putting a subsidy on housing at very low levels of consumption, switching to a tax at higher levels of consumption.

Government Tax Problem with Mobile Workers

The problem above neglects problems associated with spatial differences in housing prices and household mobility. Because labor is taxed, workers are discouraged from working in high wage areas, which on average are areas where the price of housing is high. In that case, high taxes on housing may further discourage workers from working in high wage areas.

To show this, we need a model of worker mobility. The Albouy (2009) model assumes that workers are fully mobile and live and work in the same area. In this case, wage differentials compensate workers for price differentials, except for the quality-of-life benefits those entail.

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[6] This optimal tax result neatly integrates rather complex formulae from Dasgupta and Stilgitz (1971) with more intuitive thoughts about land taxes in the more general literature.

[7] Conditional on income, high levels of housing consumption may indicate higher levels of wealth or future income, making it reason to tax a household more, rather than less. This is especially true for owned housing.

The model ignores any impact amenities may have on labor supply. Such labor supply effects have no first-order effects on household welfare, since they value labor and leisure equally in the margin. Yet they may have important

To model these effects, we assume that labor is already taxed, and housing receives a possible discount or penalty relative to that tax. Define the marginal tax rate on labor $\tau = t_X/(1+t_X)$ in terms of commodity tax on the traded good. Then we define a deduction level so that $(1-\delta)\tau = t_Y/(1+t_Y)$.

$$\delta = 1 - \frac{t_Y(1+t_X)}{t_X(1+t_Y)} = \frac{t_X - t_Y}{t_X(1+t_Y)}$$

This formulation has more practical value for dealing the federal tax code, which gives housing a reduction through greater deductions in the income tax.

With mobile workers, and the production sector given, we can relate prices, wages, and amenities to the following formulae, using the hat-notation to denote log differences (i.e.$\hat{x} = dx/x$) away from the national average.

$$\hat{Q}^j = (1-\delta\tau)s_y\hat{p}^j - (1-\tau)s_w\hat{w}^j,\ \hat{w}^j = \hat{A}_X^j, \hat{p}^j = \phi\hat{r}^j - \hat{A}_Y^j$$

where s_y is the expenditure share of housing, s_w the income share of wages, and ϕ is the cost share of land in housing production. High quality of life is reflected in high housing costs relative to after-tax income. High nominal wages reflects high trade-productivity. Solving

$$\hat{w}^j = \hat{A}_X^j, \hat{p}^j = \frac{\hat{Q}^j + (1-\tau)s_w\hat{A}_X^j}{(1-\delta\tau)s_y}, \hat{r}^j = \frac{\hat{Q}^j + (1-\tau)s_w\hat{A}_X^j + (1-\delta\tau)s_y\hat{A}_Y^j}{\phi(1-\delta\tau)s_y}$$

High housing prices reflect high quality of life or local productivity. Land values also incorporate the local productivity of the housing sector. According to this model, increases in the subsidy to housings crease the the dispersion of land and housing prices, but it will not affect the dispersion in the net payments to housing. The subsidy may still affect the average price nationally, as in the case with the single region discussed above. It does increase the producer price the supplier of housing receives, not only raising land values, but attracting higher levels of housing capital as well.

The deadweight-loss of taxation is proportional to differences in federal tax payments over space. Assuming the tax rates are uniform across space, revenue constraints will constrain one degree of freedom over them:

$$var\left(\tau s_w \widehat{w}^j - \delta\tau s_y \hat{p}^j\right) = \tau^2 (s_w)^2 var\left(\widehat{w}^j\right) + \delta^2\tau^2 \left(s_y\right)^2 var\left(\hat{p}^j\right) - 2\delta\tau^2 s_w s_y cov\left(\widehat{w}^j, \hat{p}^j\right)$$

To solve for the other dimension, take the derivative with respect to δ and setting it to zero. The optimal deduction level depends largely on the extent to which wages and prices are correlated.

$$\delta^* = \frac{s_w cov\left(\widehat{w}^j, \hat{p}^j\right)}{s_y var(\hat{p}^j)}$$

If productivity determines price differences, then wages and prices will be positively correlated and the optimal deduction rate will be negative. *I*f quality of life determines price differences, wages and prices will be uncorrelated, and the optimal deduction will be zero.[8]

Amenities that are Complements to Leisure

A more complex situation arises if the amenities in question are a complement or a substitute for leisure. The amenities that may be a complement to leisure, such as recreational facilities, can be indirectly taxed through housing prices. Amenities that are substitutes for leisure, such as a large variety of nearby food preparers offering delivery, would imply the opposite. In other words, residents close to the beaches of Honolulu may deserve a different tax treatment than residents in New York, which if full of locations complementary to substitutes for home production and shopping opportunities. There is also a question of whether certain amenities may encourage or discourage the consumption of housing, which will have fiscal externalities if it receives special tax treatment.

To model this possibility, we need to consider possible labor supply responses with amenities, and the fiscal externalities associated with them, while acknowledging that they will not have any first order effects on utility and mobility. If a worker moves to city j, the fiscal externality associated with them will be

[8] In a more general setting with land in traded production, quality of life may lower wages, resulting in an optimal deduction that is negative. In that case, a surcharge is put on housing as lower wages are used to effectively purchase amenities.

$$\frac{d\tau}{m} = \tau s_w(\hat{w}^j - \omega\hat{h}^j) - \delta\tau s_y(\hat{p}^j + \hat{y}^j)$$

where $\omega = h/\bar{h}$ is the ratio of non-work time to work time. Assuming households are mobile, we can model the behavioral responses as

$$\hat{h}^j = \varepsilon_{hh}\hat{w}^j + \varepsilon_{hy}\hat{p}^j + \sum_l \varepsilon_{hQl}\hat{q}_l^j$$

$$\hat{y}^j = \varepsilon_{yh}\hat{w}^j + \varepsilon_{yy}\hat{p}^j + \sum_l \varepsilon_{yQl}\hat{q}_l^j$$

where ε_{hQl} is the elasticity of leisure with respect to the individual amenity *l*. Thus, it may be efficient to adjust taxes by location according to their proximity to individual amenities.

Resolving Spatial and Non Spatial Considerations.

The two above results create what appears to be a conflicting problem for the taxation of housing. Spatial considerations aside, it is efficient to tax housing as it is a complement to leisure and is tied to land consumption. Taking into account spatial consideration, high price areas are generally high-wage areas. Thus high taxes on housing will exacerbate the distortion caused by labor taxes which discourages them from locating in the most productive, high-wage areas.

One possible resolution to this problem is tax households on the quantity of housing they consume, rather than on the total expenditures on housing, as is commonly done. This would require developing a set of local housing price indices to divide housing expenditures, producing a standardized measure of housing consumption. A tax exemption for housing could even be applied based on what might be considered the appropriate standardized units of housing consumption based on the number of filers, dependents, and reported income. Further analysis will hopefully reveal whether or not such a policy is truly feasible or desirable.

Locally the property tax may already act in a similar manner in so far as they are used to confer valuable benefits to households and are levied independently in very small geographic areas. The benefits that are conferred are much more closely related to the characteristics of a household, particularly its age composition, than to the actual quantity of housing consumed. If on the margin those benefits are valued dollar for dollar by the typical household, as if they were rebated, then taxes levied on property values discourage the consumption of housing on the

margin. Those taxes will still distort the location choices in so far as the geographic coverage of the taxing authority is large.

III. Empirical Evidence on Housing as a Complement to Leisure

Below I consider the evidence on whether housing is truly a complement to leisure and household production. There does not appear to be much empirical research on this topic in the existing literature. Jacob and Ludwig (2012) estimate that in-kind transfers of housing do reduce labor, but it is unclear whether or not these would dominate income effects from cash transfers. Numerous activities appear to be associated with housing, although it is difficult to ascertain from existing data how housing directly affects activities. What we would like to know is if changes in housing prices would affect these activities more than changes in non-housing prices through substitution (rather than income) effects. For that, I consider data on how labor supply varies across areas according to local prices and commuting times.

Time-Use Evidence

The American Time Use Survey has several categories for where activities take place. Table 1 splits this time use up between four locations: the home, the workplace, vehicles, and outside places. With the focus here on housing, I include homes of those other than the respondent as "home" as well. The location of activities such as sleeping, personal grooming, and "personal activities" are not reported, although most of this occurs in one's home. If we count sleeping at home, households spend roughly two thirds of their time at home, with over one third awake. 5 percent is in vehicles, 14 percent at work and 7 percent outside of all of these places.

At home, people spend much of their time in what appear to be pure leisure activities, with roughly half the time spent watching television and listening to radio, playing games and engaging in hobbies, and relaxing, thinking and reading. Over 20 percent of time is spent on household activities such as maintenance, housework, and food preparation and clean up. Roughly 4 percent of the reported time is for taking care of other household members, so that what might be considered "home production" is roughly 25 percent. Slightly under 5 percent is related to market production, with 4.4 percent of time for work and work-related activities.

TABLE 1: TIME USE AT HOME, IN VEHICLES, OUTSIDE THE HOME, AND IN THE WORKPLACE

	Own Home or Others'	Vehicle or Similar	Outside Home Work or Vehicle	Work or School place	Not Disclosed
Panel A: Fraction of day spent in place					
Entire sample	34.2%	5.1%	7.2%	14.0%	39.5%
Renters only	32.9%	4.9%	7.0%	14.6%	40.6%
Panel B: Fraction of time in place spent in each activity.					
Television, Radio	34.1%	0.3%	1.2%		
Maintenance, and other Household Activities	7.0%		2.9%		
Housework	7.0%		0.6%		
Relaxing, Thinking, Reading, etc.	6.8%		1.6%	0.9%	
Food Preparation and Clean-up	6.7%				
Socializing and Communicating	6.1%		6.6%	0.6%	
Games, hobbies	5.3%	0.3%	1.1%		
Caring for and Helping Household Members	4.3%		3.7%	0.6%	
Traveling to Purchases, Eating & Drinking		9.1%	1.4%		
Traveling to Work or Educ		24.2%			
Other Traveling		60.9%			
Consumer Purchases			20.2%		
Eating and Drinking	9.1%	0.3%	13.9%	3.8%	
Sports, Exercise, and Recreation	0.8%	0.4%	13.9%	0.8%	
Socializing and Communicating	6.1%	0.3%	6.6%	0.6%	
Religious and Spiritual Activities	0.4%		6.4%		
Volunteer Activities	0.4%		4.8%	0.5%	
Arts and Entertainment Attendance			4.6%		
Professional and Personal Care Services			4.1%		
Work and Work-Related Activities	4.4%	2.2%	4.5%	82.9%	
Education	1.7%		1.9%	8.2%	
Sleeping					91.5%
Washing, dressing and grooming oneself					7.2%

Data from the American Time Use Survey, pooling 2011 to 2013. Includes those of ages 18 to 59. Numbers of 0.2% or less omitted for readability. Outside home, work, or vehicle includes the outdoors, restaurants, bars, places of worship, stores, malls, libraries, banks, gyms, post office and "other place". Fraction of the entire day spent doing an activity in a place may be obtained by multiplying the entry in Panel B with the appropriate number in Panel B.

At the workplace, individuals spend most of their time working, while at school they are devoted to educational activities. The second most important is eating and drinking, taking only 4 percent of time. Thus, it seems that whatever will induce individuals to be at the workplace, would also induce them to work. When in a vehicle, only a quarter of the time is spent traveling to work. This is consistent with West and Williams (2007) finding that gasoline is a complement to leisure. Nine percent, is devoted to travel for making purchases, eating and drinking. Much of the rest involves travel for leisure, socializing and transporting friends and relatives.

When in other outside places -- specifically outside of residences, workplaces, and vehicles -- individuals spend one fifth of their time making consumer purchases. They also spend considerable time doing eating and drinking, much of it at restaurants and bars. A good deal of activity is less market oriented like sports, exercise and recreational activities, as well as religious and spiritual activities. A fair amount of time is spent volunteering, which may have considerable external benefits.

On the whole, the evidence suggests that outside of the workplace, time outside of residences is much more oriented towards market-based taxable activities, than activities inside of residences, much of which is related to pure leisure activities or home production. Much of this home production, through maintenance, cleaning, gardening, and cooking, is connected with housing itself.[9] This evidence cannot tell us, however, how much increasing housing consumption, or lowering the price of housing, would change how households allocate time between work and leisure activities.

Spatial Evidence

For optimal taxation, what matters is not so much how time is allocated where, but how time use responds to differences in relative prices. To examine how time use depends on housing prices, I examine Census data across 2071 Public-Use Microdata Areas using data from Albouy and Lue (forthcoming). This data includes indices of local prices by place of residence, wages by typical place of work, and commuting costs between residences and places of work. It also contains measures of the average level of labor skill and housing quality, based on location invariant characteristics, e.g., the education and experience of workers, and the age and number of room in

[9] It is worth noting that home owners are more likely to be engaged in these activities than renters.

a house. It also includes amenity data on natural features related to climate and geography, as well as artificial features, such as arts and culture and the number of eating and drinking establishments per capita. The Census data also contains considerable data at the individual level on individual and household characteristics, such as race and the number of children.

I consider enhancing the model proposed by Turnbull, who models the consumption of housing, non-housing goods, and leisure in a standard monocentric city model, where workers commute to a central business district for production purposes. The most important implication of this model for purposes here is that if time devoted to work falls with an increase in commute time, then we may infer that leisure and housing are complements. It also suggests that we should control for wage level differences. One issue with implementing the model, is that it does not account for various unobserved amenities, which may affect prices as well. For that reason, I include both indices of housing costs, as well as commuting costs. If leisure and housing are complements, then time spent at work should increase with housing prices, and decrease with commuting costs. (This section will be developed later). Note that higher increases in the price of housing services reduce the value of labor income by eroding the real wage. Without complementarity, labor supply should actually fall with higher housing costs.

To handle complications associated with commuting, I consider the decision to work on both the extensive margin, whether to work, as well as the intensive margin, how many hours to work. Housing prices may be expected to affect both of those decisions, especially in households with several working-age adults. Furthermore, to contextualize the data further, I control for metropolitan area indicators in the even-numbered columns of table 2, so that only variation within metro areas is considered.

The cross-sectional evidence in Table 2 finds a small but positive association between housing costs and labor supply both in the extensive and intensive margins. Higher commuting times is also associated with lower labor supply on both margins, further reinforcing the findings. These effects are robust to the inclusion of the metro area fixed effects.

The other interesting findings are that most of the natural amenities are associated with lower levels of labor supply. Yet, being close to numerous restaurants and bars is positively associated with labor supply. These results are consistent with the hypothesis that market-oriented amenities are substitutes for leisure, while nature-oriented amenities are complements to

TABLE 2: LABOR FORCE PARTICIPATION, WORK HOURS, AND LOCAL CHARACTERISTICS

Dependent Variable	Works over 20 hours		Annual hours if work	
	Across PUMAs (1)	Across PUMAs MSE FE (2)	Across PUMAs (3)	Across PUMAs MSE FE (4)
PUMA-Level variables				
Housing-cost Index	0.051	0.041	48.065	51.824
	(0.008)	(0.010)	(10.322)	(10.180)
Wage-level Index	0.072	0.15	-139.189	-12.526
	(0.018)	(0.028)	(26.551)	(30.993)
Commuting-cost Index	-0.039	-0.024	-24.837	-30.354
	(0.006)	(0.006)	(7.007)	(6.976)
Worker-Skill Index	0.155	0.108	101.915	41.226
	(0.012)	(0.014)	(13.947)	(13.689)
Housing-Quality Index	-0.202	-0.204	22.202	45.314
	(0.018)	(0.020)	(20.172)	(20.383)
Eating Establishments per 1000	0.009	0.004	-10.548	-7.493
	(0.002)	(0.002)	(3.116)	(3.362)
Cold (1000s heating degree days)	-0.010	-0.007	-2.318	-2.115
	(0.001)	(0.002)	(1.044)	(3.140)
Heat (1000s cooling degree days)	-0.016	-0.007	-21.625	-8.114
	(0.002)	(0.005)	(2.234)	(6.730)
Sunshine (percent possible)	-0.036	0.009	-20.245	210.375
	(0.013)	(0.041)	(18.572)	(72.632)
Coastal Proximity (inverse distance)	-0.026	-0.024	0.551	14.126
	(0.007)	(0.007)	(10.470)	(9.608)
Hilliness (average slope)	-0.595	-0.343	-565.968	-112.155
	(0.042)	(0.054)	(50.329)	(61.292)
Individual demographic controls	X	X	X	X
Neighborhood demog. Controls	X	X	X	X
Metro Area Fixed Effects		X		X
R-squared	0.129	0.131	0.112	0.114
Sample size	6,293,262	6,293,262	4,732,972	4,732,972
Mean of dependent variable	0.7591	0.7591	2143.013	2143.013

Standard errors in parentheses clustered at the MSA level. All of these regressions control for extensive demographic variables related to education, experience, race, immigrant and veteran status, English language ability, number of children, each interacted with gender.

it. Economically, these effects are generally small but interesting. For example a two standard-deviation point increase in the proximity to the coast (an inverse distance of 0.28), i.e., being by the beach, is associated with a 0.7 percentage point decline in the participation rate. A two standard-deviation increase in the number of restaurants and bars is associated with a 0.2 to 0.4 percentage point increase in participation.

The difficulty in interpreting these estimates is that households may be sorting across locations according to unobserved characteristics related to their propensity to work. Most importantly, households less attached to the labor market may find long commutes less arduous, or seek out lower-price areas. The estimates may then not represent the causal effect of high housing prices on labor supply. One reassuring result from the table is that the estimated compensated elasticity of labor supply on the intensive margin is positive, with a value of 0.15 in the fixed effect specification, a number rather close to the existing literature.

IV. Estimating optimal tax rates

Estimating optimal tax rates requires knowledge of several price elasticities, as well as various means and moments about expenditure shares and earnings.

I begin by considering the optimal tax rates on housing consumption relative to non-housing consumption. To do this, I posit rounded values for various economic parameters based primarily on evidence from the literature. First I posit that the income share from labor is $s_w = 0.75$ while the expenditure share on housing is $s_y = 0.33$. According to Table 1, of the time not spent sleeping, grooming, or engaging in personal activities, roughly one quarter is devoted to work, while another three quarters is devoted to leisure, implying that $\omega = h/\bar{h} = 3$.

The system of nine compensated demand elasticities requires three independent estimates. For the own-price elasticity of leisure I use $\varepsilon_{hh} = -0.067$, which is minus one-third the own-price elasticity of compensated labor demand of 0.2, a standard value from that literature. For the own-price compensated elasticity of housing demand I take $\varepsilon_{yy} = -0.50$ from Albouy, Ehrlich and Liu (2015). And for the elasticity of leisure with respect to housing prices I

take $\varepsilon_{hy} = -0.033$ based on what appears to be roughly a 10 percent increase in labor supply (a 3 .3 percent reduction in leisure), on both intensive and extensive margins. [10]

Using the requirements that compensated demand is homogenous of degree zero in prices and obeys Slutsky symmetry, this results in the following table of compensated elasticities.

ε_{ij}	j=h	x	y
i=h	-0.067	0.100	-0.033
x	0.1125	-0.304	0.192
y	-0.075	0.575	-0.500

The tax formula also requires an elasticity of housing supply. These elasticities may vary across cities, but for the purposes here we consider a singular value of η = 2.4 from Albouy and Stuart (2014).

Putting these elasticities into the optimal tax formula above (assuming t_y is small) yields the interesting finding that housing should be taxed two thirds more heavily than non-housing consumption.

$$\frac{t_y}{t_x} = (1.27)[1.31] = 1.66$$

The term in round parentheses is from the complementarity with of leisure, implying a 27 percent increase; the term in brackets comes from the inelastic land supply. Thus if the marginal tax rate on effective consumption is on average 24 percent – incorporating income, sales and payroll taxes at the federal and state level – the optimal tax on housing would then be 40 percent, 16 percentage points higher. This number will vary depending on the nature of the behavioral responses. In markets where the housing supply is inelastic, such as in coastal areas, the tax

[10] The elasticity of labor with respect to the price of housing may be calculated by adding the intensive and extensive elasticities taken from Table 2. $\varepsilon\_hy = -(1/\omega)(0.05/0.75 + 50/2000) = -(0.334)(0.192) = -0.31$

should be higher. Thus, limitations on property in taxes in areas such as California, through Propsoistion 13, may be particularly inefficient.

This additional tax on housing may not be incredibly different from typical local taxes on property if they are taken as a proportion of housing's user cost. Owner-occupied houses, however, are subject to various tax advantages which make the effective tax rate on them without property taxes extremely low. With all taxes taken into account, the effective tax rate of housing is roughly 17 percentage points below that of other housing consumption.

Now I consider the very different problem of how to subsidize housing purchases by place in order to minimize the deadweight loss due to mobile labor trying to escape federal taxation in high-wage areas. Across metropolitan areas in the United States, wages and housing costs are positively correlated with $cov(\hat{w}^j, \hat{p}^j) = 0.0135$. Taking the variance of prices as $var(\hat{p}^j) = 0.047$, and substituting this into the above formula implies $\delta^* = 0.60$.

This value is only half close to the effective value observed for home owners that claim a deduction once we account for payroll taxes. However, the abstract model does not account for non-housing costs of living.

We can also adjust the tax differential equation for behavioral changes in leisure and housing consumption. Using the formulae provided above we would find that

$$\hat{h}^j = -0.067\hat{w}^j - 0.033\hat{p}^j + \sum\nolimits_l \varepsilon_{hQl}\hat{q}_l^j$$

$$\hat{y}^j = -0.075\hat{w}^j - 0.500\hat{p}^j + \sum\nolimits_l \varepsilon_{yQl}\hat{q}_l^j$$

Relative to the main price effects, these effects appear to be largely second order. They do suggest that main tax effect representing the fiscal losses from taxing wages is larger than without these adjustments. Workers in high-wage areas work more, as do those in high-price areas, granting an even larger fiscal spillover. Meanwhile, tax effect effects suggest the benefits to the housing deduction are considerably smaller: households in high-price and also high-wage areas consume less housing than similar households.

Conclusion

The above analysis suggest that both the complementarity of housing with leisure, and its production from land merit housing a higher tax than other goods. Arguments that housing deserves lower taxation because it is a necessity may be countered that such issues are dealt with better through progressive non-linear taxation. While housing may be associated with greater need, such as children, most of these needs are observable and may be dealt with directly in the tax code through exemptions. On the margin, a fourth or fifth bedroom for a typical family does not appear to be a more deserving "basic need" than other forms of consumption. Thus, An optimal tax that is two-thirds greater for housing, may not seem unreasonable, especially in areas with inelastic housing supply. Much of the incidence will likely be on landowners rather than consumers, likely enhancing its equity.

This paper does point out an additional problem. While housing as a pure consumption good is a substitute for labor, in terms of location it may be a complement to labor. In that case, it may be efficient to subsidize workers for living close to high-wage areas. This is only a second-best policy, as it would be more efficient to not penalize workers for taking a job in a high wage area to begin with.

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