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Equity and Efficiency Effects of Land Value Taxation

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Abstract

It is a well-known result in economics that land value taxation is efficient since it does not distort the supply of the tax base. Considering only efficiency, land value should thus be fully taxed. Using optimal taxation theory with heterogeneous households, we show that it may be optimal not to tax land value fully for distributional reasons. The decisive variable is the covariance of land value held by households and their social welfare weight. Empirical data from the US and France, however, indicates that ownership of land value (in absolute terms) is negatively correlated to the social welfare weight. Middle income households would pay relatively more land value taxes than high income households, but less in absolute terms. With reasonable revenue recycling, land value taxation would thus reduce the net tax burden of low and middle income earners, because they would benefit more from the recycling than they pay in additional taxes.

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1 Introduction

Land value taxation is neutral (Tideman, 1982; Oates and Schwab, 2009), meaning that a *compensated* land value tax does not distort the tax base. This makes it is preferable to distortionary taxes like capital and labor income taxes from the point of view of economic efficiency. For this reason, it has been advocated by eminent economists including Adam Smith, David Ricardo and James Mirrlees (Mirrlees et al., 2011). In practice, however, very few countries use land value taxes and if they do, they apply low rates (Fernandez Milan et al., 2016). Recent research on land and economic rents[1] has given even more relevance to the idea of land value taxation. Piketty (2014) describes an increasing capital/income ratio due mainly to a rapid accumulation of housing wealth. Knoll et al. (2017) explain the increase in housing wealth by a strong surge in land prices. Jointly, the results by Piketty (2014) and Knoll et al. (2017) point to an increasing empirical relevance of land value taxes.

The discrepancy between the theoretical appeal of land value taxation and its lack of use has several reasons. Clearly, the political economy of introducing land value taxes is one important reason (Hughes et al., 2020). Distributional concerns, however, also play an important role. Data provided by Garbinti et al. (2021) and Bricker et al. (2017) shows that housing wealth increases in absolute terms with wealth but decreases in relative terms. This points to the potential that a land value tax might be regressive. Stiglitz (2015) by contrast highlights the role of economic rents in increasing inequality. Land value taxation could thus also reduce inequality.

In this paper we provide the first analysis of the efficiency and equity effects of land value taxation in an optimal taxation framework. We take into account that households are heterogeneous in wealth and also in their asset portfolios. The difference in asset portfolios means that the share of land in total wealth may vary systematically across households of different wealth. As a result, a land value tax may be more or less progressive. We find that the optimal level of land value taxation is determined by the marginal cost of public funds (MCF) and the covariance of land value held by households and their social welfare weight. Taxing land value away completely is optimal, unless the MCF is smaller than one or land value is concentrated among households with a low income level. Optimal land value taxation thus depends both on the wealth inequality and on the portfolio composition.

In an economy where low income households invest a high share of their assets in land (for their primary residence or for subsistence agriculture for example), it might be best to abstain from full land value taxation for equity reasons. Higher land value taxes, however, also allow for a lower level of other taxes. It could thus be optimal for low income households to have full land value taxation, even if they own a higher proportion of their wealth in the form of land than high income households.

There is little literature on the interaction of equity and efficiency effects of land value taxation. Franks et al. (2018) use a numerical model to consider heterogeneous households and land value taxes. Kumhof et al. (2021) estimate the effect of introducing land value taxes in a model calibrated to the US economy and find that it would generate large welfare gains. While Kumhof et al. (2021) has workers, capitalists and landlords, our model features households which differ by labor productivity as well as land and capital ownership. In addition, households have different levels of wealth.

Koethenbuerger and Poutvaara (2009) analyze land value taxation in a dynamic model, but the basic efficiency argument remains: Full land value taxation is the most efficient form

[1] Economic rents are defined as “those payments to a factor of production that are in excess of the minimum payment necessary to have it supplied” (Varian, 2006).

of taxation, it maximizes utility in equilibrium. It may, however, not be welfare maximizing to tax land value fully as the old generation at the time of the introduction of the tax might suffer a significant loss of income. This case can be seen as a special case of our model, where a large part of the population has "zero productivity" due to old age but owns considerable land value. Like Koethenbuerger and Poutvaara (2009) we find that in such a setting it could be optimal not to tax land value fully, for example by (partially) exempting old land owners.

Edenhofer et al. (2015) also consider distributional aspects in a model of rent taxation and overlapping generations. While they do not explicitly model an equity-efficiency trade-off, they show the importance of targeting the rent taxation revenue at the least wealthy part of the population. The literature on land value taxation typically addresses distributional effects only for a switch from property to land value taxes (Plummer et al., 2010). A property tax is applied to both land value and the value of buildings. Taxing buildings is less efficient than taxing land value as it disincentivizes investments in buildings.

To analyze the trade-off between equity and efficiency of land value taxation we employ a framework of optimal taxation with households of heterogeneous labor productivity. It thus builds on the approach of Mirrlees (1971). For the formulation of the tax rules for labor income and land value we employ a formulation for the marginal cost of public funds suggested by Jacobs and de Mooij (2015) and use the definition for the marginal value of income suggested by Diamond (1975). The application of optimal taxation theory to land value taxes appears to be new.

The literature reviewed in Medda (2012) considers land value capture as a means of financing infrastructure investments. This means that land value increases from a given investment are used to finance the investment. This paper by contrast considers the entire land value (and not only increases) as a legitimate basis of taxation. In addition to the efficiency and distribution benefits analyzed here, it may even be the only tax necessary (Arnott and Stiglitz, 1979).

Schwerhoff et al. (2020) analyze which types of economic rents exist and what the optimal government response to each type is. The study finds that most economic rents are created intentionally (for rent extraction) and should be addressed by competition policy (possibly including fines and taxes). Land rents, by contrast, reflect the natural scarcity of land.[2] Welfare maximization would thus require taxation. In an empirical study, Kalkuhl et al. (2018) find that a linear land tax would be regressive in developing economies, because close to 100% of low income households own land for subsistence farming. In this context, a land value tax could be made progressive by exempting a small amount of land from taxation for each household.

We present our model in Section 2 and derive the optimal policy rules in Section 3. We then use the policy rules to study the level of land value taxation in a number of special cases in Section 4. Section 5 considers a variant of the model with lump-sum transfers. In Section 6 we use empirical data from France and the US to obtain an indication of how land rents are distributed among households. In Section 7, we discuss possible practical obstacles to the introduction of land value taxes with the aim of showing that these obstacles can be addressed with reasonable efforts. We conclude in Section 8.

[2]Urban land, the most valuable type of land, is not limited directly by the availability of land, but by zoning. Zoning itself, however, is motivated by conserving sufficient land for agriculture and conservation. Land rents thus reflect the natural scarcity of land at least indirectly.

2 Model

We model a static economy with heterogenous households. Households supply labor and consume a homogeneous good. The government maximizes social welfare by setting labor income taxes and land rent taxes (which are equivalent to land value taxes). We assume constant returns to scale and that labor types are perfectly substitutable. Following Diamond and Mirrlees (1971), the optimal tax rules we obtain in partial equilibrium with fixed prices thus generalize to general equilibrium.

2.1 Land value and land rents

While the literature usually discusses land value taxation, we consider land rent taxation in the model. Based on Oates and Schwab (2009) we briefly explain why the two concepts are equivalent. The value v of a piece of land, which generates economic rents a and is subject to land value taxation τ_v, is given by

$$v = \sum_{t=1}^{\infty} \frac{a - \tau_v v}{(1+r)^t} = \frac{1}{r}(a - \tau_v v) \ . \tag{1}$$

The value of the land can thus be written as

$$v = \frac{a}{r + \tau_v} \ . \tag{2}$$

The value of the land thus decreases with the level of land value taxation. Increasing land value taxes reduces the tax base so that the tax revenue does not increase linearly in the tax rate. In principle, land value taxation can exceed 100% of the land value, because the tax reduces the land value below the land rent of a single year, so that the land rent is able to pay for a tax bill exceeding the land value.

We can determine the level of land rent taxation τ_a which corresponds to a given level of land value taxes. If τ_a and τ_v are to generate the same level of income we need to have $\tau_v v = \tau_a a$. Substituting in equation (2) we obtain

$$\tau_a = \frac{\tau_v}{r + \tau_v} \ . \tag{3}$$

There is thus a one-to-one correspondence between land value taxation and land rent taxation.

Land value taxation and land rent taxation are therefore equivalent. Land rent taxation, however, is easier to handle. Note for example that land value taxation can take arbitrarily high values. A land rent tax of 100%, or $\tau_a = 1$, corresponds to a land value tax of infinity. In the introduction we referred to land value taxation as this is the more common term in the literature. Since land rent taxation is more straightforward mathematically, we will use it in the model.

2.2 Model assumptions

We assume that households have three types of income, from labor, capital and land. With respect to labor the model follows a standard Mirrlees (1971) approach. With respect to land we assume that households own a certain amount of land and do not trade land. Given that the land value is the net present value of the land rent, a land rent tax is capitalized instantaneously. As a result, there is no incentive to trade land so that not considering land trade causes no loss of generality. With respect to capital, we assume that it is not taxed. This simplification allows us to analyze the effects of land value taxes in a static model.

We consider only linear taxes on both labor and land rents[3]. The main reason is that with this assumption, we obtain simple and intuitive tax rules. Even if we would allow for a non-linear income tax, the result of Atkinson and Stiglitz (1976), that the optimal indirect tax is zero, would not extend to land rent taxes. The reason is that the supply of land, unlike consumption, is inelastic. Allowing for non-linear land rent taxes would introduce an incentive to trade land, because the net-of-tax value of a given piece of land would differ between households. The non-linearity would thus introduce distortions. An extension of the model to non-linear labor income taxes is possible but would not yield much additional insights.

A tax that doesn't distort the tax base seems to be strongly counter-intuitive. Yet Oates and Schwab (2009), distinguished tax economists, find that "a land value tax does not distort economic choices, as do most taxes." It is important to distinguish between a unit tax and a value tax. A unit tax on land, which taxes by area, would make it unprofitable to hold land with low value. The low value land would be removed from economic use and the tax base would thus be distorted. A value tax (or rent tax) would tax would be proportional to the value. As long as the tax is below 100%, there would still be a residual value, even for very low value land. It would thus be profitable to keep even land with a low value. As a consequence, a land value tax would not distort the supply of land.

The model could be extended in several directions. Overlapping generations models as in Edenhofer et al. (2015) would allow considering additional equity and efficiency effects. A dynamic version could be developed in order to determine the optimal level of capital taxes. Market frictions could be introduced, for example in the market for renting apartments. However, we choose to keep the assumptions close to those of the optimal taxation literature in order to establish the basic equity efficiency trade-off involved in land rent taxation as a first step.

2.3 Households

There is a total mass of individuals equal to 1. Individuals are indexed by parameter $n \in \mathcal{N} = [0, 1]$. The individual's earning ability is denoted as f_n. The wage rate per efficiency unit of skill is constant and normalized to unity. All individual-specific variables are indexed with subscript n.

Individuals supply labor l_n and receive capital income k_n as well as land rents a_n. We assume a small open economy where the respective factor prices are not affected by decisions in the economy. We chose the units of the production factors in such a way that prices equal one.

Individuals derive utility from consumption c_n and disutility from supplying labor. The utility function is strictly quasi-concave and identical across individuals:

$$u_n = u(c_n, l_n), \quad u_c, -u_l > 0, \quad u_{cc}, u_{ll} < 0, \quad \forall n \; . \tag{4}$$

Taxes on income source j are given by τ_j. Although it is not modeled here explicitly, capital supply is elastic and the optimal capital tax is often found to be zero. Based on this literature and because capital taxes are not the focus of this paper we set capital taxes to

[3]In Section 5 we consider a version of the model where households receive lump-sum transfers in addition.

zero by assumption. Consumption is thus given as total net income,

$$c_n = (1 - \tau_l) f_n l_n + k_n + (1 - \tau_a) a_n \; . \tag{5}$$

We denote labor income of individual n as $z_n = f_n l_n$. The price for the final good is normalized to 1. Maximizing utility with respect to the budget constraint yields the first order condition of the household,

$$-\frac{u_l}{u_c} = (1 - \tau_l) f_n, \quad \forall n \; . \tag{6}$$

The private marginal utility of income of the household, λ_n is given by

$$\lambda_n = u_c = -\frac{u_l}{(1 - \tau_l) f_n} \; . \tag{7}$$

The indirect utility function is designated by $v_n \equiv v(\tau_l, \tau_a) \equiv u(\hat{c}_n, \hat{l}_n), \forall n$, where hats denote optimized consumption and labor supply. Application of Roy's identity produces the following derivatives of the indirect utility function: $\frac{\partial v_n}{\partial \tau_l} = -\lambda_n f_n l_n$, and $\frac{\partial v_n}{\partial \tau_a} = -\lambda_n a_n$.

2.4 Government

The government maximizes a Bergson-Samuelson social welfare function, which is a sum of concave transformations of utility levels,

$$\int_{\mathcal{N}} \Psi(u_n) dn, \quad \Psi'(u_n) > 0, \quad \Psi''(u_n) \leq 0 \; . \tag{8}$$

The government needs to finance a fixed budget G,

$$G = \int_{\mathcal{N}} (\tau_l l_n + \tau_a a_n) dn \; . \tag{9}$$

Since the population has mass 1, this formulation of the government budget reflects both the total government budget and the budget per person.

Rent taxation is limited by 100%,

$$\tau_a \leq 1 \; . \tag{10}$$

As households cannot be forced to own land, this condition ensures that households do not refuse to own land.

3 Optimal tax rules

In this section we will derive the optimal policy rules for land value taxation in a general formulation. In Section 4 we will proceed to some more specific examples, where we can give an estimation of the level of land rent taxes.

The Lagrangian for maximizing social welfare is given by:

$$\max_{\tau_l, \tau_a} \mathcal{L} = \int_{\mathcal{N}} \Psi(v_n(\tau_l, \tau_a)) dn + \eta \left(\int_{\mathcal{N}} (\tau_l f_n l_n + \tau_a a_n) dn - G \right) + \mu(1 - \tau_a) \; . \tag{11}$$

The Lagrange multiplier η denotes the marginal social value of public resources and the Lagrange multiplier μ denotes the value of relaxing the upper limit on land rent taxation.

The first-order conditions for an optimal allocation are given by:

$$
\begin{aligned}
\frac{\partial \mathcal{L}}{\partial \tau_l} = \int_{\mathcal{N}} \left(-\Psi' \lambda_n f_n l_n + \eta \left(f_n l_n + \tau_l f_n \frac{\partial l_n}{\partial \tau_l} \right) \right) dn &= 0 \,, && (12) \\
\frac{\partial \mathcal{L}}{\partial \tau_a} = \int_{\mathcal{N}} \left(-\Psi' \lambda_n a_n + \eta \left(\tau_l f_n \frac{\partial l_n}{\partial \tau_a} + a_n \right) \right) dn - \mu &= 0 \,, && (13) \\
\mu(1-\tau_a) &= 0 && (14) \\
\int_{\mathcal{N}} (\tau_l f_n l_n + \tau_a a_n) dn - G &= 0 \,. && (15)
\end{aligned}
$$

For the derivation of the household utility functions, we used the indirect utility functions and employed Roy's identity.

In the following we will employ the Slutsky equations for labor supply: $\frac{\partial l_n}{\partial \tau_l} = \frac{\partial l_n^*}{\partial \tau_l} - f_n l_n \frac{\partial l_n}{\partial T}$ and $\frac{\partial l_n}{\partial \tau_a} = \frac{\partial l_n^*}{\partial \tau_a} - a_n \frac{\partial l_n}{\partial T}$. T is a hypothetical transfer received by households used to represent the wealth effect of the Slutsky decomposition. l_n^* is the compensated labor demand function.

3.1 Definitions

Jacobs and de Mooij (2015) suggest a new definition for the marginal cost of public funds. It is based on a definition of the social marginal value of transferring a marginal unit of income to individual n from Diamond (1975), which includes the indirect effects of the transfer. We follow the new definition and adjust it to our model.

Definition 1 The social marginal value of transferring a marginal unit of income to individual n is:

$$
\lambda_n^* = \Psi' \lambda_n + \eta \tau_l f_n \frac{\partial l_n}{\partial T} \,. \tag{16}
$$

λ_n^* gives the net increase in social welfare (measured in social utils) of transferring a marginal unit of resources to person n. The component $\Psi' \lambda_n$ is the increase in social welfare when individual n receives a marginal unit of income. The component $\eta \tau_l n \frac{\partial l_n}{\partial T}$ reflects the lost tax revenue resulting from a decreased labor supply following the transfer receipt of individual n.

With this definition the marginal cost of public funds can be defined in the following way.

Definition 2 The marginal cost of public funds is:

$$
MCF = \frac{\eta}{\bar{\lambda}^*} \,, \tag{17}
$$

where $\bar{\lambda}^* = \int_{\mathcal{N}} \lambda_n^* dn$.

As in the standard definition of the MCF, it is thus the ratio between social marginal value of one unit of public income and the average of the social marginal value of one unit of private income. The only change is in the definition of the latter.

In order to express the optimal tax rules, we employ the Feldstein (1972) distributional characteristics of the income tax and the land rent tax.

Definition 3 The distributional characteristics of labor income ξ_l and land rent income

ξ_a are:

$$\xi_l \equiv -\frac{\int_{\mathcal{N}} \lambda_n^* z_n dn - \int_{\mathcal{N}} \lambda_n^* dn \int_{\mathcal{N}} z_n dn}{\int_{\mathcal{N}} \lambda_n^* dn \int_{\mathcal{N}} z_n dn} = -\frac{cov[\lambda_n^*, z_n]}{\bar{\lambda}^* \bar{z}}, \quad (18)$$

$$\xi_a \equiv -\frac{\int_{\mathcal{N}} \lambda_n^* a_n dn - \int_{\mathcal{N}} \lambda_n^* dn \int_{\mathcal{N}} a_n dn}{\int_{\mathcal{N}} \lambda_n^* dn \int_{\mathcal{N}} a_n dn} = -\frac{cov[\lambda_n^*, a_n]}{\bar{\lambda}^* \bar{a}}, \quad (19)$$

where $\bar{z} \equiv \int_{\mathcal{N}} z_n dn$ and $\bar{a} \equiv \int_{\mathcal{N}} a_n dn$.

ξ_l corresponds to (minus) the normalized covariance of earnings of individual n, z_n, and the net social welfare weight λ_n^* of individual n. It measures the marginal gain in social welfare, expressed as a fraction of taxed labor income, of marginally increasing revenue with the labor tax. In models where the households differ only by their labor productivity, ξ_l has to be positive. This is not the case here as individuals have income from assets. ξ_a is minus the normalized covariance of land rents a_n, and the net social welfare weight λ_n^*. It gives the marginal gain in social welfare, expressed as a fraction of land rents, of marginally raising revenue with the land rent tax.

As the last step we define the compensated elasticities of labor supply with respect to the two types of taxes.

Definition 4 The compensated elasticities of labor supply with respect to the labor tax and the land rent tax are defined as: $\varepsilon_{l\tau_l} \equiv \frac{\partial l_n^*}{\partial t}\frac{1-\tau_l}{l_n} < 0$ and $\varepsilon_{l\tau_a} \equiv \frac{\partial l_n^*}{\partial \tau_a}\frac{1-\tau_a}{a_n} = 0$.

3.2 Results

Using the definitions, we can express the optimal tax rules for labor and land rent taxes in a concise way.

Proposition 1 *The policy rules for the optimal labor and land rent tax are given by:*

$$1 - \frac{1}{MCF} + \frac{\xi_l}{MCF} = \frac{\tau_l}{1-\tau_l}(-\overline{\varepsilon_{l\tau_l}}), \quad (20)$$

$$1 - \frac{1}{MCF} + \frac{\xi_a}{MCF} - \mu\frac{1}{\eta\bar{a}} = 0, \quad (21)$$

$$\mu(1-\tau_a) = 0, \quad (22)$$

where $\overline{\varepsilon_{l\tau_l}} = \frac{\int_{\mathcal{N}} \varepsilon_{l\tau_l} f_n l_n dn}{\int_{\mathcal{N}} f_n n l_n dn}$ *is the income weighted average of the labor supply elasticity.*

Proof. Substituting the Slutsky equations and the distributional characteristic (18) into the first-order condition for the labor tax in equation (12), using the definitions for the labor elasticity and rearranging yields (20). Substituting the Slutsky equations and the distributional characteristic (19) into the first-order condition for the labor tax in equation (13) and rearranging yields (21). In this transformation we use that $\varepsilon_{l\tau_a} = 0$. The reason is that $\varepsilon_{l\tau_a}$ is the *compensated* elasticity, meaning that it only reflects the substitution effect of land rent taxation on labor supply. The taxation of the land rent, however, does not affect prices, so that compensated households do not adjust their consumption choice. For a step-by-step proof, please refer to Appendix A.1. □

The importance of this result is that in general, the optimal rent tax is neither equal to zero (as found in practice in many cases) nor necessarily equal to one (as claimed by some advocates of land value taxation). The reason is that households have different welfare weights to the social planner. Taxing away the assets of a household with high welfare weight (that is a household with a low asset endowment) is not optimal. The government thus has to determine the optimal equity-efficiency trade-off of land rent taxation.

In both policy rules, the part $1-\frac{1}{MCF}$ is a revenue raising term, referred to as the Ramsey term. The terms $\frac{\xi_l}{MCF}$ and $\frac{\xi_a}{MCF}$ reflect the distributional concern of the government. The optimal level of a tax which redistributes from high to low income earners is higher than it would be without distributional preferences. The term $\frac{\tau_l}{1-\tau_l}(-\overline{\varepsilon_{l\tau_l}})$ reflects the deadweight loss of taxation. It is relevant only for labor taxation because the land supply is fixed.

Solving the policy rules for the marginal cost of public funds allows further insights into the optimal tax levels.

$$MCF = \frac{1-\xi_l}{1-\frac{\tau_l}{1-\tau_l}(-\overline{\varepsilon_{l\tau_l}})}, \tag{23}$$

$$MCF = \frac{1-\xi_a}{1-\frac{\mu}{\eta\bar{a}}}. \tag{24}$$

The part for the labor tax in equation (23) is completely standard. The MCF increases in the deadweight loss of the tax and it decreases in distributional benefits.

The rule for the land rent tax in equation (24) allows conclusions on the optimal tax level for land rents. Recall that ξ_a is minus the normalized covariance of land rents a_n, and the net social welfare weight λ_n^*. Individuals with a high income have a low social welfare weight for two reasons. First, the marginal welfare gain of adding utility to these households is low. Second, reducing the income of high income earners causes them to supply more labor so that the government earns more labor income taxes. Therefore, if households with high labor income also have high land rent income on average, we have $\xi_a > 0$. Knowing that $\xi_a > 0$ is an empirically relevant case, we proceed in Section 4 to study the optimal tax level in this case.

Notice that in a tax system with labor income and land value taxes, it is conceivable that labor income taxes are negative, that is, a subsidy. To see this, consider the situation where land rents are more than sufficient to pay for government expenses, $G < \int_{\mathcal{N}} a_n dn$. If this is the case and land value is more concentrated than labor income, the government could set a high land rent tax and return excess revenues in the form of labor subsidies.

4 The level of land rent taxes

Proposition 1 characterizes the welfare maximizing combination of linear labor taxes and land rent taxes. By considering certain special cases, we can narrow down the optimal level of land rent taxes more precisely. Recall from equation (10) that land rent taxes are limited to 100%. An interesting question thus is whether this upper limit should be fully exhausted or not. In the following we show that full land rent taxation is optimal under very mild conditions. However, it is possible to construct cases, where it is not optimal to tax land rents fully.

For standard utility functions[4], we will have $MCF > 1$. In empirically relevant cases, we can thus expect $MCF > 1$. As argued in Section 3.2 we can also expect $\xi_a > 0$.

Proposition 2 *Consider an optimum with $MCF > 1$ and $\xi_a \geq 0$. In this optimum full land rent taxation is optimal, $\tau_a = 1$.*

[4]If household labor supply is extremely inelastic we have that $\overline{\varepsilon_{l\tau_l}}$ is close to zero. From equation (23) it follows that in the optimum $MCF < 1$. A "standard utility function" is thus one where labor supply is somewhat elastic.

Proof. Solving (21) for μ we have $\mu = \eta\bar{a}\left(1 - \frac{1-\xi_a}{MCF}\right)$. From $\eta > 0$, $\bar{a} > 0$, $MCF > 1$ and $\xi_a > 0$ it follows that $\mu > 0$. Inserting this in (22) we obtain $\tau_a = 1$. □

The proposition thus says that when a government faces an efficiency loss from labor income taxation and when a high land rent income is not positively correlated to the social welfare weight, it is optimal to exploit land rent taxation fully. In this case land rent taxes have a positive effect on both efficiency and equity, so that the tax should be used as much as possible. If one of the two conditions is not met, an equity-efficiency trade-off results.

Next, we will study specific cases, where the second condition is fulfilled.

Corollary 1 When all households are identical, full land rent taxation is optimal, $\tau_a = 1$.

Proof. When all households are identical we have $\xi_a = \xi_l = 0$. We assumed that household labor supply is not perfectly inelastic so that $\overline{\varepsilon_{l\tau_l}} < 0$. From $\xi_l = 0$ and $\overline{\varepsilon_{l\tau_l}} < 0$ it follows that $MCF > 1$. Proposition 2 thus applies. □

The corollary shows that the result on the optimality of full land rent taxation in a model with a representative household derives as a special case of our model. In this case, only efficiency matters and as land rent taxation is the more efficient form of taxation, it should be used fully.

Corollary 2 Consider an optimum with $MCF > 1$ and either all households have the same welfare weight, or all households receive the same amount of land rents. In this optimum full land rent taxation is optimal, $\tau_a = 1$.

Proof. In both cases we have $cov[\lambda_n^*, a_n] = 0$ and thus $\xi_a = 0$. Proposition 2 thus applies. □

The corollary may sound artificial, but it reflects an interesting situation. Consider for example an economy with $MCF > 1$, income inequality and households which all own the same amount of land. Then it is optimal for the government to tax away the land rent fully and use the revenue to lower labor income taxes. The reason is that $MCF > 1$ ensures that the efficiency gained in this way is more important for social welfare than potentially adverse distributional effects.

The opposite case, where all households have equal welfare weights, occurs only in very special cases. When a government has utilitarian preferences, we have that Ψ' is constant. From Definition 1, however, we can see that this is insufficient to have equal welfare weights. If, however, the government has utilitarian preferences, household utility is additively separable, and all households have the same labor productivity, social welfare weights would be constant, and land rents should be fully taxed, no matter how unequally they are distributed.

As we will see in Section 6, the absolute amount of housing assets increases with total household wealth. The relative share of housing assets, however, decreases. We can apply Proposition 2 to determine the optimal level of land rent taxes in our model in this case. Recall that we have defined household income as the sum of net labor income, capital income and net land rent income. Capital has played no role so far since we did not consider capital taxation. The welfare weight, however, depends on total income, so that capital is an important contribution to the social welfare weight.

Corollary 3 Let capital and labor income be non-decreasing functions of land rent income. Then in an optimum with $MCF > 1$ land rents are fully taxed, $\tau_a = 1$.

Proof. Both labor and land rent taxes are linear by assumption. If capital and labor income are non-decreasing functions of land rent income, it follows that the social welfare weight λ_n^* is a non-increasing function of a_n. As shown by Egozcue et al. (2009) and Schmidt (2003), among others, it follows that $cov[\lambda_n^*, a_n] \leq 0$. $\xi_a \geq 0$ follows. Proposition 2 thus applies. □

From this corollary we can take that in a case where households increase all their asset holdings in absolute terms with higher wealth, full land rent taxation is optimal. If the relative share of land rents in total wealth decreases, very wealthy households pay a lower share of their wealth for the land rent tax. Nevertheless, they pay a higher absolute amount. The higher absolute amount paid by the very wealthy, in combination with the efficiency gain through land value taxes makes land value taxes preferable to higher labor taxes.

Results in this section so far have highlighted cases where full land rent taxation is optimal. However, the optimal tax system can require less than full land rent taxation whenever land is owned mainly by low income households. In order to show that not only land rent taxes slightly below 100% can be optimal, we show that, in fact, any level of land rent taxes, even zero, can be optimal. To show this we construct an example in the proof, which can be adjusted to make any level of land rent taxes optimal.

Proposition 3 *Any level of land taxes $0 \leq \tau_a \leq 1$ can be an optimal tax rate.*

Proof

Assume that all households have the same labor productivity, $f_n = 1$, and that utility is given by $u(c_n, l_n) = c_n - \frac{1}{1+\frac{1}{\varepsilon}} l^{1+\frac{1}{\varepsilon}}$ with $0 < \varepsilon < 1$. It follows that labor supply is $l = (1-\tau_l)^{\varepsilon}$.

For the distribution of land and capital income we assume $k_n = \begin{cases} \bar{k} & \text{if } 0 < n \leq \frac{1}{2} \, , \\ 0 & \text{if } \frac{1}{2} < n \leq 1 \, . \end{cases}$, where $0 \leq \bar{k}$ is a constant, and $a_n = \begin{cases} 0 & \text{if } 0 < n \leq \frac{1}{2} \, , \\ 1 & \text{if } \frac{1}{2} < n \leq 1 \, . \end{cases}$. The budget for $n \leq \frac{1}{2}$ is $c = (1-\tau_l)l + k$ and for $n > \frac{1}{2}$ it is $c = (1-\tau_l)l + 1 - \tau_a$.

Assuming that the constraint τ_a is not binding, the Lagrangian is

$$L = \frac{1}{2}\Psi\left((1-\tau_l)^{1+\varepsilon} + k\right) + \frac{1}{2}\Psi\left((1-\tau_l)^{1+\varepsilon} + 1 - \tau_a\right) - \eta\left[G - \tau_l(1-\tau_l)^{\varepsilon} - \frac{\tau_a}{2}\right] \, . \quad (25)$$

Using $\Psi'_k := \Psi'\left((1-\tau_l)^{1+\varepsilon} + k\right)$ and $\Psi'_a := \Psi'\left((1-\tau_l)^{1+\varepsilon} + 1 - \tau_a\right)$ to simplify notation we obtain as FOCs:

$$\begin{aligned} \left(\frac{1}{2}\Psi'_k + \frac{1}{2}\Psi'_a\right)(1+\varepsilon)(1-\tau_l)^{\varepsilon} &= \eta\left[(1-\tau_l)^{\varepsilon} - \tau_l\varepsilon(1-\tau_l)^{\varepsilon-1}\right] \, , & (26) \\ \frac{1}{2}\Psi'_a &= \frac{\eta}{2} \, , & (27) \\ G &= \tau_l(1-\tau_l)^{\varepsilon} + \frac{\tau_a}{2} \, . & (28) \end{aligned}$$

Normalizing $\Psi'_a = 1$ (implying $\eta = 1$) we obtain

$$\begin{aligned} (\Psi'_k + 1)(1+\varepsilon) &= 2\left[1 - \frac{\varepsilon\tau_l}{1-\tau_l}\right] \, , & (29) \\ \frac{\tau_l}{1-\tau_l} &= \frac{1}{\varepsilon} - (\Psi'_k + 1)\left(\frac{1+\varepsilon}{2\varepsilon}\right) \, . & (30) \end{aligned}$$

We further assume $\varepsilon = 0.5$. With this we can write

$$\begin{aligned} \frac{\tau_l}{1-\tau_l} &= 2 - (\Psi'_k + 1)\left(\frac{3}{2}\right) \, , & (31) \\ \tau_l &= \frac{2 - (\Psi'_k + 1)\left(\frac{3}{2}\right)}{3 - (\Psi'_k + 1)\left(\frac{3}{2}\right)} \, . & (32) \end{aligned}$$

In order to have $\tau_l > 0$, on must have $2 > (\Psi'_k + 1)\left(\frac{3}{2}\right)$, i.e. $\Psi'_k < \frac{1}{3}$. For $\Psi'_k \to 0$ one has

$\tau_l \to \frac{1}{3}$.

With this, we obtain

$$\begin{aligned}\tau_a &= 2G - \frac{2-(\Psi_k'+1)\left(\frac{3}{2}\right)}{3-(\Psi_k'+1)\left(\frac{3}{2}\right)}\sqrt{1-\frac{2-(\Psi_k'+1)\left(\frac{3}{2}\right)}{3-(\Psi_k'+1)\left(\frac{3}{2}\right)}}\,, \quad (33)\\ &= 2G - \frac{2-(\Psi_k'+1)\left(\frac{3}{2}\right)}{(3-(\Psi_k'+1)\left(\frac{3}{2}\right))^{1.5}} \quad (34)\end{aligned}$$

By varying G, Ψ_k' and ε, all values for $\tau_a \in [0,1]$ can be reached. □

Proposition 3 shows, in an illustrative way, that for a very unequal distribution of assets any arbitrarily low level of land rent taxes can be optimal. The situation in developing economies with subsistence landowners might be a case where full land rent taxation would not be welfare optimal. In many developing economies the households with the lowest total income own land (Kalkuhl et al., 2018) so that taxing land in strictly linear fashion could be undesirable for distributional reasons.

Taken together, the propositions illustrate that there are situations, in which it is optimal to tax land rents fully and other situations where distributional concerns call for less than full land rent taxation. In the case modeled here, the decisive feature is the portfolio composition with respect to land and capital across households.

5 Lump-sum transfers

Lump-sum taxes are often considered infeasible due to distributional issues. Jacobs and de Mooij (2015), however, show that the combination of a lump-sum instrument and labor income taxes achieves a higher level of welfare. This is intuitive, as the government has an additional policy instrument available. In a realistic setting (that is with ineqality aversion and moderate government expenses) the lump-sum instrument is taking the form of transfers. It is thus used as a means of reducing inequality.

5.1 The model with lump-sum transfers

Given the potential benefits of lump-sum transfers, we present a version of the model including lump-sum transfers. For this, we adjust the household and government budgets to

$$\begin{aligned}c_n &= (1-\tau_l)f_n l_n + k_n + (1-\tau_a)a_n + T\,, \quad (35)\\ G+T &= \int_{\mathcal{N}} (\tau_l l_n + \tau_a a_n)dn\,. \quad (36)\end{aligned}$$

Applying Roy's identity we obtain the following derivatives of the indirect utility function: $\frac{\partial v_n}{\partial \tau_l} = -\lambda_n f_n l_n$, $\frac{\partial v_n}{\partial \tau_a} = -\lambda_n a_n$ and $\frac{\partial v_n}{\partial T} = -\lambda_n$.

The Lagrangian for maximizing social welfare becomes:

$$\max_{\tau_l,\tau_a,T} \mathcal{L} = \int_{\mathcal{N}} \Psi(v_n(\tau_l,\tau_a,T))dn + \eta\left(\int_{\mathcal{N}} (\tau_l f_n l_n + \tau_a a_n)dn - G - T\right) + \mu(1-\tau_a)\,. \quad (37)$$

The Lagrange multiplier η denotes the marginal social value of public resources and the Lagrange multiplier μ denotes the value of relaxing the upper limit on land rent taxation.

The first-order conditions for an optimal allocation are given by:

$$
\begin{aligned}
\frac{\partial \mathcal{L}}{\partial T} = \int_{\mathcal{N}} \left(\Psi' \lambda_n + \eta \left(\tau_l f_n \frac{\partial l_n}{\partial T} - 1 \right) \right) dn &= 0 \,, &(38)\\
\frac{\partial \mathcal{L}}{\partial \tau_l} = \int_{\mathcal{N}} \left(-\Psi' \lambda_n f_n l_n + \eta \left(f_n l_n + \tau_l f_n \frac{\partial l_n}{\partial \tau_l} \right) \right) dn &= 0 \,, &(39)\\
\frac{\partial \mathcal{L}}{\partial \tau_a} = \int_{\mathcal{N}} \left(-\Psi' \lambda_n a_n + \eta \left(\tau_l f_n \frac{\partial l_n}{\partial \tau_a} + a_n \right) \right) dn - \mu &= 0 \,, &(40)\\
\mu(1-\tau_a) &= 0 &(41)\\
\int_{\mathcal{N}} (\tau_l f_n l_n + \tau_a a_n) dn - G &= 0 \,. &(42)
\end{aligned}
$$

The Slutsky equations remain as in the above model: $\frac{\partial l_n}{\partial \tau_l} = \frac{\partial l_n^*}{\partial \tau_l} - f_n l_n \frac{\partial l_n}{\partial T}$ and $\frac{\partial l_n}{\partial \tau_a} = \frac{\partial l_n^*}{\partial \tau_a} - a_n \frac{\partial l_n}{\partial T}$.

Using the same definitions as in Section 3.1, we obtain a modified proposition:

Proposition 4 *The policy rules for the optimal labor and land rent tax are given by:*

$$
\begin{aligned}
MCF &= 1 \,, &(43)\\
\xi_l &= \frac{\tau_l}{1-\tau_l} (-\overline{\varepsilon_{l\tau_l}}) \,, &(44)\\
\xi_a &= \mu \frac{1}{\eta \bar{a}} &(45)\\
\mu(1-\tau_a) &= 0 \,, &(46)
\end{aligned}
$$

where $\overline{\varepsilon_{l\tau_l}} = \frac{\int_{\mathcal{N}} \varepsilon_{l\tau_l} f_n l_n dn}{\int_{\mathcal{N}} f_n n l_n dn}$ *is the income weighted average of the labor supply elasticity.*

Proof. Applying Definition 2 to equation (38) directly yields equation (43). Proceeding as in the proof of Proposition 1, we obtain equations (20) and (21). Applying $MCF = 1$ to these two equations, we obtain equations (44) and (45). □

Unsurprisingly, labor income taxation in our model has the same role as in Jacobs and de Mooij (2015): the distributional benefits of labor taxes on the left are balanced with the losses of lower labor supply on the right, see equation (44). As land rent taxation has no distortionary effect, their role is to reduce the inequality originating from the unequal distribution of land value.

5.2 The level of land rent taxes when lump-sum transfers are available

With this, we can derive results equivalent to Section 4 for the case where lump-sum transfers are available:

Proposition 5 *In an optimum with $\xi_a > 0$ full land rent taxation is optimal, $\tau_a = 1$.*

Proof. Follows immediately from equations (45) and (46). □

According to this proposition, land rents should be fully taxed if they are negatively correlated to the social welfare weight. In that case, it would be welfare enhancing to tax the land rents and distribute the revenue evenly to all households through the lump-sum transfers. There is no equivalent to the corollaries to Proposition 2, since they all consider the case of $MCF > 1$.

We also find an analogous result to Proposition 3:

Proposition 6 *In the model version with lump-sum transfers, any level of land taxes $0 \leq \tau_a \leq 1$ can be an optimal tax rate.*

Proof

The example is constructed in the same way as in the proof of Proposition 3. The budgets are given as $c = (1-\tau_l)l + k + b$ and $c = (1-\tau_l)l + 1 - \tau_a + b$.

Assuming that $\tau_a \leq 1$ is not binding, the Lagrangian is

$$L = \frac{1}{2}\Psi\left((1-\tau_l)^{1+\varepsilon} + k + T\right) + \frac{1}{2}\Psi\left((1-\tau_l)^{1+\varepsilon} + 1 - \tau_a + T\right) - \eta\left[G + T - \tau_l(1-\tau_l)^{\varepsilon} - \frac{\tau_a}{2}\right] . \tag{47}$$

Using analogous simplifying notation to Proposition 3, the FOCs are

$$\left(\frac{1}{2}\Psi'_k + \frac{1}{2}\Psi'_a\right)(1+\varepsilon)(1-\tau_l)^{\varepsilon} = \eta\left[(1-\tau_l)^{\varepsilon} - \tau_l\varepsilon(1-\tau_l)^{\varepsilon-1}\right] , \tag{48}$$

$$\frac{1}{2}\Psi'_a = \frac{\eta}{2} , \tag{49}$$

$$\frac{1}{2}\Psi'_k + \frac{1}{2}\Psi'_a = \eta , \tag{50}$$

$$G + T = \tau_l(1-\tau_l)^{\varepsilon} + \frac{\tau_a}{2} . \tag{51}$$

From equations (49) and (50) it follows that $\Psi'_k = \Psi'_a$, so that $\tau_a = 1 - k$. By varying k any level of τ_a can be optimal. □

6 Empirical evidence

The theoretical analysis has identified a central role for the distributional characteristic of land, ξ_a. This variable reflects the covariance between land rents and the social welfare weight. When the government is inequality averse, high income households have a lower social welfare weight. The optimality of land rent taxes thus depends on which income group owns the most land rents (or land value). An exact measurement of ξ_a requires knowledge of the parameters in the governments social welfare function. The correlation between overall wealth and wealth in the form of land, however, will give a strong indication on the value of ξ_a. In this section we provide evidence on this empirical correlation.

For France and the United States, data on the share of housing in total wealth are available for different wealth or income deciles. This provides interesting insights on the distributional effects of a land rent tax. Land value is only a share of housing value, but data for the land value owned by different income groups is not available. However, it is plausible that the share of land value in housing value is similar across different types of housing, since the most valuable buildings are likely constructed on the most valuable land. Based on this, a distribution of housing wealth across income groups should give a good indication of the distribution of land value across income groups. Data from Sweden indicate that the distribution of housing wealth is similar there to the distribution in France (Bach et al., 2016).

We proceed by presenting complementary pieces of data descriptively before discussing the emerging picture in Section 6.4. In Section 6.1 we review the trends for the land price index as well as the share of land in housing prices. The data of this section has been presented in similar form in Knoll et al. (2017). We reproduce it here since it is an important complement to the following data. Sections 6.2 and 6.3 present evidence on the housing assets held across wealth or income deciles. For these sections we use data from Garbinti et al. (2021) and Bricker et al. (2017), but present and analyze different aspects than these articles do.

6.1 Price trends for housing and land

Figure 1 shows that housing prices have increased in France and the US between 1998 and 2008 at a historically unprecedented speed. Since then it remained at the historical high value in France and returned roughly to the 1998 value in the US. In both countries, the sharp rise has been driven by an even more pronounced increase in land prices. The land price index more than tripled in that period in France.

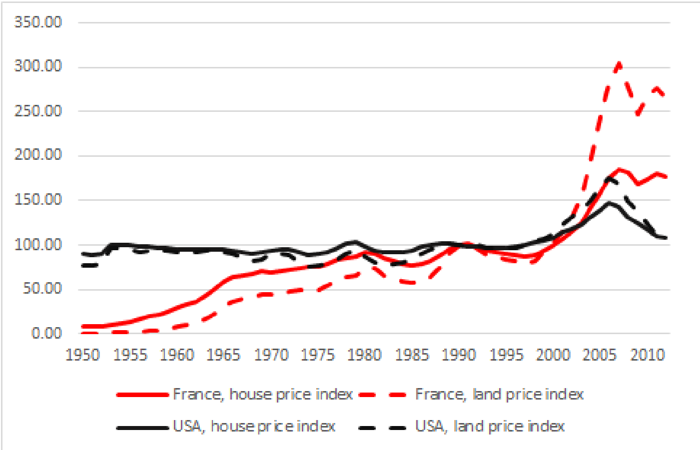

Figure 1: House and land price indices in France and the United States, 1950 - 2010
Data source: Knoll et al. (2017)

Land prices as a driver of housing prices are further documented in Figure 2. In both France and the US, the share of land in housing prices has doubled between 1930 and 2010. In France, this share has risen rapidly from 40 to 60% between 2000 and 2010.

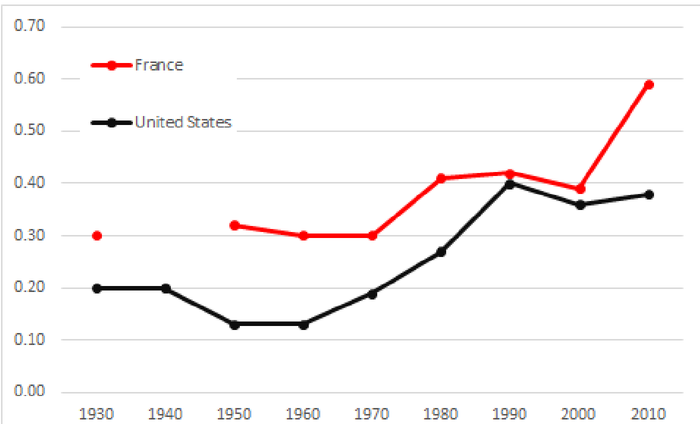

Figure 2: Share of land in housing prices in France and the United States, 1930 - 2010
Data source: Knoll et al. (2017)

6.2 France

Garbinti et al. (2021) provide data for the asset composition of wealth deciles in France. As Figure 3 shows, wealthier households have a higher absolute amount of housing wealth. These housing assets, however, are financed with considerable leverage, where we define financial leverage as the ratio between debt and net personal wealth. Figure 4 illustrates that the first three wealth deciles have an average leverage of below 10%. The fourth decile, however, has an average leverage of 74%, with the leverage in the following deciles dropping off to below 10% at the top decile.

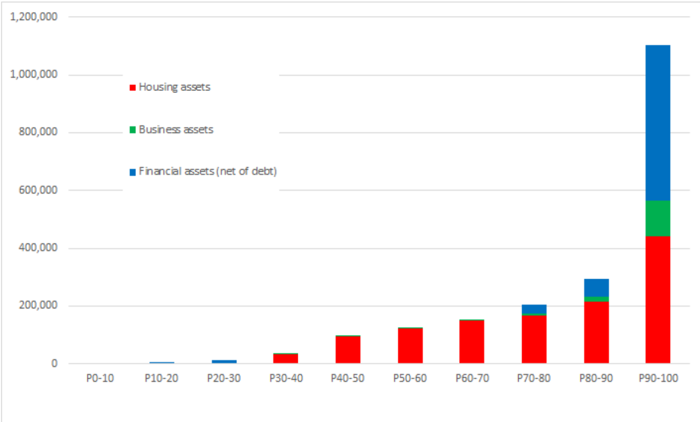

Figure 3: Asset composition for wealth deciles, France 2014, average value in Euro per decile
Data source: Garbinti et al. (2021)

For an analysis of the asset composition it would be most meaningful to display net housing wealth, that is housing wealth less debt. As we are interested in the distributional effect of a land value tax, we display the gross housing wealth plus the net financial asset position, that is total financial assets less debt. From Knoll et al. (2017) we know that 59% of housing value is given by land in France. If the land share in housing value does not vary much between wealth deciles, we can conclude from Figure 3 that the absolute amount of wealth in the form of land increases with total wealth.

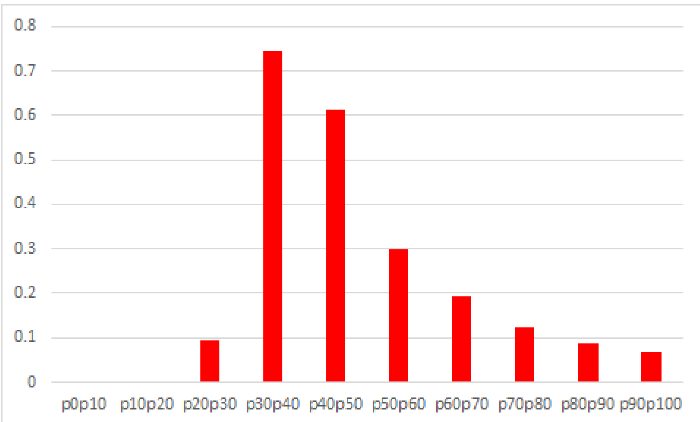

Figure 4: Financial leverage for wealth deciles, France 2014
Data source: Garbinti et al. (2021)

In absolute terms, land value taxes would thus increase with wealth on average. The progressivity of a tax, however, depends on relative tax payments. Figure 5 shows the share of housing wealth across deciles. The wealth deciles can be clustered into three groups. Each of the first three deciles owns less than 12% of their wealth in the form of housing on average. Their wealth falls almost exclusively in the category "currency, bonds and deposits". The second group are the fourth to seventh deciles. They own between 99 and 127% of their net wealth in the form of housing and achieve values above 100% with debt financing. The top three wealth deciles own between 40 and 81% of their wealth in the form of housing. This group holds between 13 and 41% in the form of equity, fund shares, offshore wealth, pension funds and life insurance.

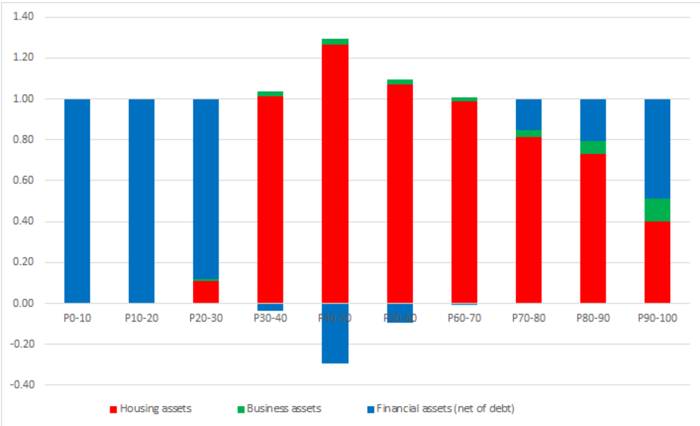

Figure 5: Asset composition for wealth deciles, France 2014, relative values
Data source: Garbinti et al. (2021)

6.3 United States

The Survey of Consumer Finances (SCF) provides data for the asset composition of income quintiles[5] in the United States, see Bricker et al. (2017). Figure 6 shows which share of each quintile owns property. Less than 64% of all households own their primary residence and less than 15% own the other two categories of property each. A land value tax would thus have a broad tax base across households, in particular among the high income earners. At the same time, a considerable part of the population would not be affected directly by the tax.

[5]Note that the SCF uses *income* quintiles while Garbinti et al. (2021) use *wealth* deciles. In the P0-20 group, that is the 20% of the population with the lowest income, 4.4% own business equity. This business equity is worth 513.3 thousand dollars on average. There is thus a group of rather wealthy families in the group of families with the least income.

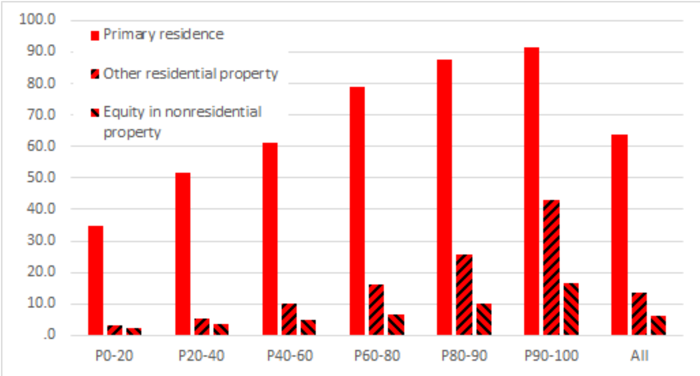

Figure 6: Property ownership in the US
Data source: Bricker et al. (2017)

Figure 7 shows that the wealth households hold in the form of property increases in wealth. Similar to the situation described for France, the absolute amount of land tax payments would increase in income on average.

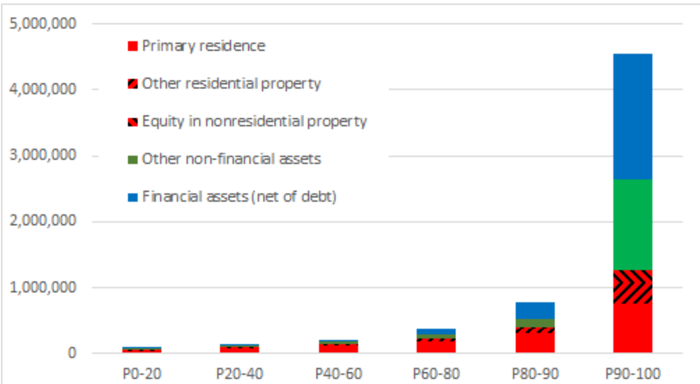

Figure 7: Asset composition for wealth deciles, US 2016, average value in Dollar
Data source: Bricker et al. (2017)

Figure 8 by contrast marks a strong difference to France. No quintile has net negative financial assets[6] on average and the sum of the three property categories does not exceed 73% for any quintile on average. In addition, the share of land in housing value is only 38% according to the data by Knoll et al. (2017). The general shape of the curve, however, is the same as in France with middle income households holding the highest share of their wealth in property value.

[6]According to Table 6.3 in OECD (2015) the bottom wealth quintile in the US has much lower net wealth than in France. The data from France and the US presented here are thus not directly comparable.

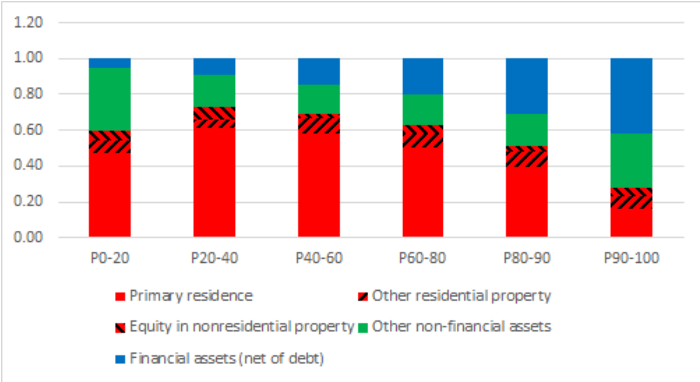

Figure 8: Asset composition for wealth deciles, US 2016, relative values
Data source: Bricker et al. (2017)

6.4 Discussion

The empirical evidence contains several important insights on the distributional effect of a land value tax. Figure 2 in combination with 3 and 7 shows that a very considerable share of total wealth is held in the form of land value. This demonstrates that a land value tax could make an important contribution to the government budget and could thus allow reducing distortionary taxes to such an extent that it could be worth the political effort of a tax reform. In addition, the land used for housing appears to exceed the land used for commercial activities as in both countries wealth held in the form of housing exceeds that held in the form of business and financial assets. We could not find data on the share of land in the value of firms.

Figures 3 and 7 also reveal that the direct effect of a linear land value tax would be neither clearly progressive nor clearly regressive. In relative terms, households around the median level of wealth would have to pay the highest share of land value taxes. Taking Figure 2 concerning the high share of land in housing value into account, we see that some deciles own more than 50% of their net wealth in the form of land. Further, Figure 4 shows that these households are highly leveraged. A high level of a land value tax would thus not only have a very uneven impact on households, it would also raise a serious concern that the most exposed households may be unable to service their debt.

The theoretical model highlights the importance of considering the direct effect of land value taxation together with the effects of a reduction in other taxes. While middle income households pay a high share of their income in land value tax, they pay less in absolute terms. This means that if they receive an average labor income tax cut, their net tax burden would decrease. This would make a tax shift from labor income to land value progressive. Low income households would gain strongly as they pay hardly any land value tax and benefit from lower labor income taxes. Middle income households would benefit a little as they gain more than they lose. The net tax burden of high income households would increase, but less than the two other groups lose, because aggregate efficiency increases.

Households that finance housing assets with debt typically need to prove a reliable labor income to the bank in order to obtain a loan. A tax reform of increasing land value taxes and reducing labor income in particular for low and middle incomes could address the concern of leveraged households. While the land value tax would be added to regular debt servicing, net labor income would also increase substantially.

7 Practical obstacles to land value taxation

Land rent taxes receive substantially less attention than other taxes in research and policy making, despite the apparent merits for both efficiency and equity. This may be due to a perception that the implementation of land rent taxes faces disproportionate obstacles. In this section we discuss some of these potential practical obstacles. We argue that some concerns may be based on an incomplete understand of the tax, while other obstacles can be addressed with rather minor modifications.

7.1 Financial sector

Land value has an important economic role as collateral for credit. Consider the case of a 100% land rent tax. The tax would eliminate the sales value of land. This may seem as if an important credit-enabling mechanism would be lost. However, the person acquiring ownership of a piece of land would not have to pay for the transfer of the land, only for possible buildings on it. She would only take the commitment of paying the tax to the government. A land rent tax is thus equivalent to giving an automatic credit to someone purchasing a piece of land. The "interest" on the land is paid in the form of land rent taxes. Instead of reducing access to credit a land rent tax would effectively extend credit automatically to every person purchasing land.

As Ryan-Collins et al. (2017) point out, providing credit for housing purchases is an important part of the business of banks. A high land rent tax would reduce this business considerably. Consumers would benefit from that, since they could save expenses for financial services. In the long run, the stability of the financial sector may benefit since housing bubbles would no longer be harmful. Collapsing land value would simply cause lower land rent taxes paid to the government. In the short run, however, the stability of the financial sector would be a concern since banks with a large part of their business in lending for housing purchases would lose an important part of their business volume. Once there is an awareness of this effect on the financial sector and the policy is announced with some lead time, the sector can be expected to adjust.

7.2 Political economy

According to "Director's Law" (Stigler, 1970; Acemoglu et al., 2015), the middle class holds most of the political power and manages to change the tax system such that it pays a disproportionately low amount of taxes. In addition, homeowners (and thus, landowners) can be expected to be much better politically connected than those who do not own land. Any tax reform that is perceived as hurting the interest of the middle class is thus likely to face unfavorable odds to pass into law in a democracy.

However, this does not have to imply that a land value tax is ruled out for political economy reasons. As discussed above, any additional revenue from a land value tax can be used to reduce other taxes. The middle class would benefit from these other taxes. And as not only residences, but also commercially used land would be affected by the tax, a moderate primary residence may require less than average payments in land value taxes. This would make the owner of a moderate primary residence a net winner of the tax reform. Even if the taxes paid in addition and the taxes paid less by an individual household are roughly of the same magnitude, there would still be the advantage of a more efficient tax system. If a tax reform towards a land value tax would be communicated well, the political economy would not necessarily be biased against it.

7.3 Transition effects

There could be transition effects, which create concerns for the welfare of particular groups. Consider for example a low-quality apartment building on a piece of land in a very attractive location. If the value of land would be determined mostly by the location of the land, the land value tax for this land would be high. The low quality of the building, however, would mean that the rent[7] paid for the apartments is low. The land owners might thus be forced to end the rental agreements in order to build a more high quality building.

Such a scenario is unlikely to occur, however. If it were legally possible to end the tenancy agreements and oblige the tenants to move out, many land owners would exercise this right in order to earn more from a new investment. This would be independent of a land value tax. If there are legal restrictions prohibiting the termination of the tenancy agreements, this would reduce the economic value of the land, so that the land value tax would be proportionate to the rent income.

For the remaining cases, where it is legally possible to evict tenants, but land-owners do not do so out of consideration for the tenants, transition arrangements could be included in the law. These could take the form of reducing land rent taxes to an amount proportionate to the rents paid by tenants. Alternatively, the transition arrangements could provide for acceptable alternatives to tenants who are moving out for investments into improved housing.

7.4 Tax interaction effects

Property taxes are often deductible from corporate income taxes. Since the same could be expected for a land value tax, it could be argued that the tax does not make much of a difference. In effect, the tax payments would be labeled differently, but may not be much different in size in some cases. This is a valid point, because a firm deducting a land value tax from corporate income taxes does not face improved investment incentives. The point could be addressed, however, by making the land value tax non-deductible and reducing the corporate income tax rate.

While land value is often not taxed explicitly, it is taxed implicitly. Farmers for example pay an income tax, which captures land rents. As discussed above, corporations pay corporate income tax on their land rents. However, even a revenue neutral shift towards a higher land vale tax and lower income and corporate income taxes would improve efficiency. This highlights that even if a land value tax on residences is politically not feasible, it would be beneficial to introduce a land rent tax on commercially used land and reduce the distorting taxes on commercial activity.

7.5 Hardship cases

A land rent tax close to 100% could potentially generate some hardship cases. Consider for example a person (i) owning a piece of land with high economic value (so that significant land rent taxes would be due), (ii) not having important revenues or wealth aside the land value, (iii) attaching a great (emotional) importance to that particular piece of land, (iv) considering the personal value of the land lost if it were to be commercially used. Such a person would lose the enjoyment of the land through a high land rent tax. Notice that all four conditions are important to constitute the hardship case. Without (i) the tax payments would be low and could be paid out of other income. Without (ii) the taxes might be high,

[7] In this case rent refers to the payment made by a tenant to the landlord. To avoid confusion, rents in the sense of the definition by Varian (2006) given above are always referred to as "economic rent" or "land rent".

but could be paid out of other revenues. Without (iii) the land could be sold and less valuable land elsewhere could be bought. Without (iv) the land could be used commercially and the revenue from that could be used to pay for the land.

However, if all four conditions hold, there would still be room for practical resolutions. If this kind of situation would occur frequently, the above theory would postulate a tax rate significantly below 100%. In this case, the remaining land value could serve as a collateral for a credit to pay the land rent tax. If the combination of the four conditions does occur, but is very rare, a hardship clause could be build into new tax laws which applies a tax exemption to people who owned a very high share of total wealth in land before the tax was introduced.

7.6 Additional efficiency effects

In the experience of many apartment tenants any increase in cost for the landlord is passed on to tenants as higher rent payments for apartments. Would the same apply to land rent taxes? Consider first a rental market in competitive equilibrium. Land rents are already fully priced into apartment rents, so that a landlord using land rent taxes as an "excuse" for rent increases would simply not find any tenants.

Now consider the case where the government imposes limitations on apartment rents, so that there is an excess demand for apartments. Landlords could exploit the introduction of the land rent tax to increase apartment rents. However, if the government is only interested in collecting land rent taxes (and not in reforming the regulation of apartment rents) it would have to (i) consider the limitations on apartment rents in calculating the land rent and (ii) prohibit the pass-on of land rent taxes to tenants. Condition (i) is necessary to insure that landlords receive a fair return on the capital invested in buildings. Condition (ii) is necessary to avoid the exploitation of the land rent tax to circumvent the existing regulation of apartment rents. If both conditions are met, a land rent tax would not interfere with the apartment rental market.

In principle, a further efficiency effect could come from portfolio optimization. Land is a low risk asset so that the loss of net land value due to land rent taxation would require a rebalancing of the asset portfolio. However, all investors would demand more safe assets. As a result, land rent taxes would not cause additional land trades, even if land rents are not taxed at 100%. It could be expected that returns on assets adjust to the land rent tax with risky assets being demanded less and safe asset being demanded more. The overall efficiency analysis of land rent taxes, by contrast, would not be affected significantly by explicitly modeling portfolio optimization.

8 Conclusion

The stylized model employed in this paper shows that optimal land value taxation depends on the co-variance between total wealth (as a proxy for the social welfare weight) and wealth in the form of land. Both full land value taxation and less than full taxation could be optimal. We show that it is difficult, though possible, to construct a case where it is not optimal to tax land value fully.

Land value taxation has been proposed by Henry George (1879), a proposal which sparked an intense debate. It appears that three main arguments are advanced against it. The first is that there is no direct way of measuring land value, so that it is difficult to assess the tax base. Reviews on the optimal design of the tax system like Henry et al. (2009) and Mirrlees et al. (2011) acknowledge this difficulty but consider it resolvable. A second argument is that land value taxes cannot finance the government alone, a claim which had been ascribed to Henry George. Whether or not a land value tax is sufficient to cover all government expenditure, however, is not relevant for the question whether or not it is optimal to use land value taxation.

The third main argument is that a land value tax is unfair to land owners. However, the tax revenue from the land tax will not disappear but will be returned to the economy in some form. In this paper we consider a reduction in labor taxes as a way of returning the revenue. Land owners will benefit from this return, so the distributional effect of the net effect of a tax reform will need to be assessed. Finally, the empirical data from the US show that a large part of the population owns land directly, more than 60% of the total population and more than 90% of the top income decile. The shares are even higher if indirect land ownership through firms is included. Land owners are thus not a threatened minority, but rather a very large part of the population. Distributional considerations thus do not contradict the optimality of land value taxation, even if low or middle income households own land.

We argue that the debate on land value taxation needs to move beyond this type of argument. The theory of taxation has developed powerful approaches to debate the optimal level and distribution of individual taxes. Land value should be evaluated by the same standards as other tax bases like labor and capital.

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A Proofs

A.1 Proof of Proposition 1

We start with (12), the first order condition of the government with respect to the labor tax and transform it step by step into the tax rule (20):

$$
\begin{aligned}
\int_{\mathcal{N}} \left(-\Psi' \lambda_n f_n l_n + \eta \left(f_n l_n + \tau_l f_n \frac{\partial l_n}{\partial \tau_l} \right) \right) dF(n) &= 0 && (52)\\
\Leftrightarrow \int_{\mathcal{N}} \left(-\Psi' \lambda_n f_n l_n + \eta f_n l_n + \eta \tau_l f_n \left(\frac{\partial l_n^*}{\partial \tau_l} - f_n l_n \frac{\partial l_n}{\partial T} \right) \right) dF(n) &= 0 && (53)\\
\Leftrightarrow \int_{\mathcal{N}} \left(-f_n l_n \lambda_n^* + \eta f_n l_n + \eta \tau_l f_n \frac{\partial l_n^*}{\partial \tau_l} \right) dF(n) &= 0 && (54)\\
\Leftrightarrow \int_{\mathcal{N}} \left(-f_n l_n \lambda_n^* + \eta f_n l_n + \eta \tau_l f_n \frac{l_n}{1-\tau_l} \varepsilon_{l,\tau_l} \right) dF(n) &= 0 && (55)\\
\Leftrightarrow \int_{\mathcal{N}} \left(-f_n l_n \lambda_n^* + \eta f_n l_n \right) dF(n) + \eta \frac{\tau_l}{1-\tau_l} \bar{z}\, \overline{\varepsilon_{l,\tau_l}} &= 0 && (56)\\
\Leftrightarrow -\frac{1}{MCF} \frac{1}{\overline{\overline{\lambda_n^*}}} \frac{1}{\bar{z}} \int_{\mathcal{N}} z_n \lambda_n^* dF(n) + \frac{1}{MCF} - \frac{1}{MCF} + 1 &= \frac{\tau_l}{1-\tau_l} (-\overline{\varepsilon_{l,\tau_l}}) && (57)\\
\Leftrightarrow \frac{\xi_l}{MCF} - \frac{1}{MCF} + 1 &= \frac{\tau_l}{1-\tau_l} (-\overline{\varepsilon_{l,\tau_l}}) && (58)
\end{aligned}
$$

We proceed similarly with (13) and use $\frac{\partial l_n^*}{\partial \tau_a} = 0$:

$$
\begin{aligned}
\int_{\mathcal{N}} \left(-\Psi' \lambda_n a_n + \eta \tau_l f_n \frac{\partial l_n}{\partial \tau_a} + \eta a_n \right) dF(n) - \mu &= 0 && (59)\\
\Leftrightarrow \int_{\mathcal{N}} \left(-\Psi' \lambda_n a_n + \eta \tau_l f_n \left(\frac{\partial l_n^*}{\partial \tau_a} - a_n \frac{\partial l_n}{\partial T} \right) + \eta a_n \right) dF(n) - \mu &= 0 && (60)\\
\Leftrightarrow \int_{\mathcal{N}} \left(-a_n \lambda_n^* + \eta a_n + \eta \tau_l f_n \frac{\partial l_n^*}{\partial \tau_a} \right) dF(n) - \mu &= 0 && (61)\\
\Leftrightarrow \int_{\mathcal{N}} \left(-a_n \lambda_n^* + \eta a_n \right) dF(n) - \mu &= 0 && (62)\\
\Leftrightarrow \int_{\mathcal{N}} \left(-a_n \lambda_n^* + \eta a_n \right) dF(n) - \mu &= 0 && (63)\\
\Leftrightarrow -\frac{1}{MCF} \frac{1}{\overline{\overline{\lambda_n^*}}} \frac{1}{\bar{a}} \int_{\mathcal{N}} a_n \lambda_n^* dF(n) + \frac{1}{MCF} - \frac{1}{MCF} + 1 - \frac{\mu}{\eta \bar{a}} &= 0 && (64)\\
\Leftrightarrow \frac{\xi_a}{MCF} - \frac{1}{MCF} + 1 - \frac{\mu}{\eta \bar{a}} &= 0 && (65)
\end{aligned}
$$

B Data appendix

B.1 Data in Section 6.1

Data for Figure 1 are taken from the data appendix for Knoll et al. (2017), table KSS_NPLH_Decomposition.xlsx. Data for Figure 2 are from Knoll et al. (2017), Table 2.

B.2 Data in Section 6.2

The data used for Figures 3, 4 and 5 are from Garbinti et al. (2021), downloaded from the World Wealth and Income Database (WID.world). The data is contained in the full data set for France in the table WID_FR_InequalityData.csv.

The data for housing assets are from the variable named "Personal housing assets | equal-split adults | Average | Adults | constant 2015 local currency". The data for business assets are from the variable named "Personal business and other non-financial assets | equal-split adults | Average | Adults | constant 2015 local currency". The data for financial assets (net of debt) are from the variable named "Personal financial assets | equal-split adults | Average | Adults | constant 2015 local currency" less the value from the variable "Personal debt | equal-split adults | Average | Adults | constant 2015 local currency".

The sum of the three categories equals the the variable "Net personal wealth | equal-split adults | Average | Adults | constant 2015 local currency". Figure 4 thus gives the ratio of the variable "personal debt to "net personal wealth". Similarly, Figure 5 gives the ratio of the three asset categories used in Figure 3 to net personal wealth.

B.3 Data in Section 6.3

Data used in Section 6.3 is from Bricker et al. (2017) and downloaded from the web page of the Survey of Consumer Finances (SCF) at https://www.federalreserve.gov/econres/scfindex.htm. The table used is scf2016_tables_internal_nominal_historical.xlsx. This table contains for each asset category a data sheet with "Percentage of families holding asset" and another with "Mean value of holdings for families holding asset (thousands of dollars)". The data in Figure 6 are taken directly from the table of "Percentage of families holding asset".

The average values in Figure 7 are obtained by multiplying the respective entries from the percentages and the mean values of holdings for families holding asset. The variable "other non-financial assets" is obtained as "Any nonfinancial asset" less the entries for "Primary residence", "Other residential property" and "Equity in nonresidential property". The variable "Financial assets (net of debt)" is obtained as "Any financial asset" less "Any debt".

The sum of the categories "Primary residence", "Other residential property", "Equity in nonresidential property", "other non-financial assets" and "Financial assets (net of debt)" equals to the value given in "any asset". The values in Figure 8 are thus the ratio between the values of the individual categories with the value from "any asset".