Economic synopsis

Simple guidelines for the taxation of housing

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1. Introduction

The purpose of this note is to develop simple guidelines for the optimal taxation of housing. In order to do this, we need to first review the principles of optimal taxation of capital, and understand how housing differs from other capital. The analysis is based on two papers, Chari, Nicolini and Teles (2020) on the optimal taxation of capital income and Correia, Reis and Teles (2017) on the optimal taxation of housing. The models used in those papers, and in this note, are simple models that abstract from many important features of actual economies including the extreme complexity of the tax codes. The policy exercise is useful because of the clarity with which the main principles of optimal taxation can be derived. The underlying assumption is that Ramsey (1927) distortionary taxation is necessary in order to finance government consumption, transfers and outstanding debt in the most efficient way. The available taxes resemble the ones that can be found in actual economies.

The main take away from the results on the taxation of capital is that capital accumulation should not be distorted. The reason for this is that distortions on capital accumulation introduce wedges between consumption in different periods and between labor in different periods. Such distortions are not second-best efficient for preferences that are standard in macro models. This means that they are not desirable even when other distortions must be imposed. This result can be seen as an application of the classical Diamond and Mirrlees (1971) principle of production efficiency.

Abstaining from distorting capital accumulation does not mean that capital cannot be taxed. It does mean, though, that taxation of capital has to be redesigned so that the preexistent capital can be taxed, while future capital is exempted. A full deduction of investment accomplishes this. Abel (2007) made this important point in an unpublished manuscript. Recently, the US Tax Cuts and Jobs Act of 2017 allowed for an immediate full deduction of the cost of short-lived investments. This was however a temporary measure, to be in full effect for only five years, expiring in 2026 after a transition period.

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Does the same principle, that the accumulation of capital should not be distorted, apply to housing? Yes, in the sense that the only reason to distort the accumulation of housing is to be able to tax housing services. A labor income tax or a value added tax (VAT) on both investment in housing and consumption goods is all that is needed in order to tax efficiently.

In what follows, we are going to go through the derivations of optimal policy, first in a model with capital only, and then in a model with capital and housing. In the model with capital only, we start by assuming that taxes on capital income resemble corporate income taxes with an allowance for depreciation. An alternative tax structure allows for the deduction of investment, so that the tax resembles a dividend tax. The implementations assume that households carry the capital stock, but an alternative implementation in which the firms accumulate capital is also described. In the model with both capital and housing, we also allow for a tax on investment in housing that resembles a value-added tax on housing. The analysis gets into unavoidable technical detail, so that the principles of optimal taxation of capital and housing may be derived clearly.

2. A model with capital only

In this section, we review the main principles of optimal taxation of capital. The main take aways are: (1) Capital accumulation should not be distorted. (2) Taxation of capital income with or without an allowance for depreciation should be zero, meaning that corporate income taxes as they are usually designed should be zero. (3) Taxes on capital income with an investment deduction can be positive since there are no efficiency losses from dividend taxes, other than reputational costs associated with confiscatory taxation.

To keep the analysis simple, we are going to model taxation in a representative agent model where the household accumulates the capital stock. The household is taxed on the labor income, consumption, and capital income. The taxes on capital income resemble either a corporate income tax, with a deduction for depreciation, or a dividend tax with full investment expensing.

The preferences of a representative household, over consumption c_t, and labor n_t, are described by $\sum_{t=0}^{\infty} \beta^t u(c_t, n_t)$ where the period utility function has the familiar isoelastic form:

$$u(c_t, n_t) = \frac{c_t^{1-\sigma^c} - 1}{1-\sigma^c} - \eta n_t^{1+\psi}. \tag{1}$$

with $\sigma^c > 0$ and $\psi > 0$.

The production technology is described by

$$c_t + g_t + k_{t+1} - \left(1 - \delta^k\right) k_t \leq F(k_t, n_t) \tag{2}$$

where k_t is capital, g_t is exogenous government consumption, and δ^k is the depreciation rate of capital. The production function F is constant returns to scale.

The household owns the capital stock and rents it to a representative firm every period at rate u_t^k. The household accumulates real public debt, b_{t+1}, in units of goods at

$t+1$, that cost $\frac{b_{t+1}}{1+r_{t+1}}$ units of goods at t. The household pays taxes on capital income, τ_t^k, and on labor income, τ_t^n. There is also a consumption tax τ_t^c. The flow of funds constraint is

$$\begin{aligned} \frac{1}{1+r_{t+1}} b_{t+1} + k_{t+1} &\leq b_t + \left[1 - \delta^k + \left(1 - \tau_t^k\right) u_t^k\right] k_t \\ &+ (1 - \tau_t^n) w_t n_t - (1 + \tau_t^c) c_t, \text{ for } t \geq 0. \end{aligned} \tag{3}$$

The household maximizes utility (1), subject to the budget constraint obtained from these flow of funds constraints, (3), together with a no-Ponzi games condition that ensures solvency.

The choices of the household over consumption, labor, and capital accumulation must satisfy the following marginal conditions

$$\frac{u_{c,t}}{-u_{n,t}} = \frac{1+\tau_t^c}{(1-\tau_t^n) w_t}, \tag{4}$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = \frac{1+\tau_t^c}{1+\tau_{t+1}^c} (1 + r_{t+1}), \tag{5}$$

and

$$1 + r_{t+1} = 1 - \delta^k + \left(1 - \tau_{t+1}^k\right) u_{t+1}^k, \tag{6}$$

where $u_{c,t}$ and $u_{n,t}$ are the marginal utility of consumption and labor, respectively.

The flow of funds conditions for the household together with the no-Ponzi games condition can be written, using (6), as a single budget constraint which, written with equality, is

$$\sum_{t=0}^{\infty} q_t \left[(1+\tau_t^c) c_t - (1-\tau_t^n) w_t n_t\right] = b_0 + \left(1 - \delta^k\right) k_0 + \left(1 - \tau_0^k\right) u_0 k_0 \tag{7}$$

where $q_t = \frac{1}{(1+r_1)\ldots(1+r_t)}$ for $t \geq 1$, with $q_0 = 1$.

A representative firm produces output that can be used as consumption, capital, or government consumption. The first order conditions for the firm are

$$1 = \frac{w_t}{F_{n,t}} = \frac{u_t^k}{F_{k,t}}, \tag{8}$$

where $F_{n,t}$ and $F_{k,t}$ are the marginal productivity of labor and capital, respectively.

It follows from the marginal conditions of both household and firm that, in a competitive equilibrium, it must be that

$$\frac{u_{c,t}}{-u_{n,t}} = \frac{1+\tau_t^c}{(1-\tau_t^n) F_{n,t}}, \tag{9}$$

and

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = \frac{1+\tau_t^c}{1+\tau_{t+1}^c} \left[1 - \delta^k + \left(1 - \tau_{t+1}^k\right) F_{k,t+1}\right]. \tag{10}$$

This shows how taxes create wedges in both within period and across period margins. In particular, time varying consumption or labor income taxes and a tax on capital income introduce intertemporal distortions.

The first best allocation can be described by the marginal conditions above, with the tax rates set to zero,

$$-\frac{u_{c,t}}{u_{n,t}} = \frac{1}{F_{n,t}}, t \geq 0,$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = 1 - \delta^k + F_{k,t+1}, t \geq 0,$$

together with the resource constraints, (2) , with equality. This first-best solution solution cannot be implemented because there are limitations on the capacity of the government to tax lump sum, without imposing distortions. The optimal solution with distortionary taxes is obtained by solving a Ramsey problem that we analyze next.

The Ramsey optimal solution The competitive equilibrium conditions can be summarized by a small set of conditions. The Ramsey problem in this economy is to maximize utility subject to those conditions, namely, the implementability condition

$$\sum_{t=0}^{\infty} \beta^t \left[u_{c,t}c_t + u_{n,t}n_t\right] = W_0 \tag{11}$$

where $W_0 = \frac{u_{c,0}}{1+\tau_0^c}\left[b_0 + \left[1 - \delta^k + \left(1 - \tau_0^k\right) F_{k,0}\right] k_0\right]$ and the resource constraints, (2).

The first order conditions of the Ramsey problem, assuming W_0 is exogenous, can be written as:

$$\frac{u_{c,t}}{-u_{n,t}} = \frac{1 + \varphi\left(1 + \psi\right)}{\left[1 + \varphi\left(1 - \sigma^c\right)\right] F_{n,t}} \tag{12}$$

and

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = 1 - \delta^k + F_{k,t+1}, t \geq 0, \tag{13}$$

for $t \geq 0$, where φ is the multiplier of the implementability condition, (11). The parameters ψ and σ^c are the labor and consumption elasticities. If lump-sum taxes could fully fund the government, the multiplier would be zero and the solution would be the first best.

From (12) and (13), it follows that intratemporal distortions are constant over time, and there are no intertemporal distortions at the optimal solution. The comparison of these conditions for the optimal wedges with the competitive equilibrium conditions above, (9) and (10), tells us how the optimal allocations can be implemented with the available tax instruments. A simple way to implement the optimal solution is to set the tax on capital income to zero, starting in period one, $\tau_{t+1}^k = 0$, $t \geq 0$, and to keep both consumption and labor income taxes constant over time.

If W_0 was not assumed to be exogenous, but rather b_0 and k_0 were the exogenous variables, then the optimal initial distortion on capital accumulation would be non-zero, meaning that $\tau_1^k > 0$. From period one onward, intertemporal distortions and taxes on capital income should be zero.

Taxing capital with an allowance for depreciation We have seen, so far, that consumption and/or labor income taxes are all the taxes that are needed for implementation of the Ramsey allocation. There is no need for other taxes. Furthermore, except for the initial distortion, consumption and labor tax rates should be constant, avoiding intertemporal distortions.

Is there any way of taxing capital that avoids intertemporal distortions? What if the capital income tax includes a depreciation allowance? With a depreciation allowance, $\delta^{k\prime}$, that does not have to coincide with the actual economic depreciation, the flow of funds constraint of the representative household can be written as

$$\begin{aligned} \frac{1}{1+r_{t+1}} b_{t+1} + k_{t+1} - \left(1-\delta^k\right) k_t &\leq b_t + \left(1-\tau_t^k\right) u_t^k k_t + \tau_t^k \delta^{k\prime} k_t + \\ (1-\tau_t^n)\, w_t n_t - (1+\tau_t^c)\, c_t, \text{ for } t &\geq 0. \end{aligned}$$

The non-arbitrage condition between bonds and capital is now

$$1 + r_{t+1} = 1 - \delta^k + \left(1 - \tau_{t+1}^k\right) u_{t+1}^k + \tau_{t+1}^k \delta^{k\prime}.$$

Since $u_{t+1}^k = F_{k,t+1}$, we have that the two gross returns are equal if

$$1 + r_{t+1} = 1 - \delta^k + F_{k,t+1} - \tau_{t+1}^k \left(F_{k,t+1} - \delta^{k\prime}\right).$$

As long as the fiscal depreciation is less that the total user cost of capital, $F_k\,(t+1) > \delta^{k\prime}$, so that the tax is effective, there is a distortionary burden on capital accumulation. If the fiscal depreciation coincides with the economic one, $\delta^{k\prime} = \delta^k$, then

$$1 + r_{t+1} = 1 + \left(1 - \tau_{t+1}^k\right)\left(F_{k,t+1} - \delta^k\right).$$

In this case, the intertemporal marginal condition is

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = \frac{1+\tau_t^c}{1+\tau_{t+1}^c}\left[1 - \delta^k + \left(1 - \tau_{t+1}^k\right)\left(F_{k,t+1} - \delta^k\right)\right]. \tag{14}$$

The Ramsey problem is exactly the same as before, and therefore the optimal solution eliminates the intertemporal distortion. The only way this can be accomplished with a depreciation allowance is if the allowance for depreciation is $\delta^{k\prime} = F_k\,(t+1) = \delta^k + r_{t+1}$, eliminating all capital income tax revenues.

In sum, the depreciation allowance is a tax break but does not solve the distortion, except by eliminating the tax altogether. The initial tax τ_0^k does not distort. If bounded above by 100%, all it taxes is the capital income in period zero, as is clear from (7).

Taxing capital with an allowance for investment: The Abel tax If instead of an allowance for depreciation, the tax base of capital income allowed for the deduction of investment, with full investment expensing, the flow of funds constraint of the representative household would then be written as

$$\frac{1}{1+r_{t+1}}b_{t+1}+k_{t+1}-\left(1-\delta^k\right)k_t \leq b_t+\left(1-\tau_t^d\right)u_t^k k_t+\tau_t^d\left[k_{t+1}-\left(1-\delta^k\right)k_t\right]$$
$$+\left(1-\tau_t^n\right)w_t n_t-\left(1+\tau_t^c\right)c_t,\text{ for } t \geq 0,$$

where we now call this tax τ_t^d, since it resembles more a dividend tax, rather than a capital income tax or profit tax. This tax includes a positive deduction as long as investment is positive, $k_{t+1}-\left(1-\delta^k\right)k_t \geq 0$. The deduction would be negative otherwise.

The returns on bonds and capital are equated if

$$1+r_{t+1}=\frac{1-\tau_{t+1}^d}{1-\tau_t^d}\left(1-\delta^k+u_{t+1}^k\right),$$

so that the intertemporal wedge is now described by

$$\frac{u_{c,t}}{\beta u_{c,t+1}}=\frac{1+\tau_t^c}{1+\tau_{t+1}^c}\frac{1-\tau_{t+1}^d}{1-\tau_t^d}\left(1-\delta^k+F_{k,t+1}\right). \tag{15}$$

which compares to (14). If the tax rate on capital income is constant, $\tau_t^d=\tau^d$, $t\geq 0$, then there is no intertemporal distortion. As the tax rate approaches one, the initial capital is fully taxed. Indeed, the single intertemporal budget constraint can be written as

$$\sum_{t=0}^{\infty}q_t\left[\left(1+\tau_t^c\right)c_t-\left(1-\tau_t^n\right)w_t n_t\right]=b_0+\left(1-\tau_0^d\right)\left(1-\delta^k+u_0^k\right)k_0.$$

If $\tau_0^d=\tau^d\to 1$, no distortions are imposed and all the preexistent capital stock is confiscated.

Ramsey optimal taxation assumes that the government is able to commit to a policy path. A government that is able to commit to future policies is likely to be a government that must honor previous commitments. That may rule out unanticipated confiscatory taxation, preventing the welfare gains from non-distortionary taxes on both capital or housing income.

An alternative decentralization with capital accumulation by the firm Suppose now that a representative firm produces and invests in order to maximize the present value of dividends, net of taxes, $\sum_{t=0}^{\infty}q_t\left(1-\tau_t^d\right)d_t$, where τ_t^d are dividend taxes. The tax τ_t^k is now a profit tax with an allowance for depreciation at fiscal rate $\delta^{k\prime}$. The present value of dividends is

$$\sum_{t=0}^{\infty}q_t\left(1-\tau_t^d\right)\left\{\left(1-\tau_t^k\right)\left[F(k_t,n_t)-w_t n_t\right]+\tau_t^k\delta^{k\prime}k_t-k_{t+1}+(1-\delta^k)k_t\right\}.$$

The firm chooses labor and capital to maximize the value of dividends according to $F_{n,t}=w_t$, and

$$\frac{q_t}{q_{t+1}}=\frac{1-\tau_{t+1}^d}{1-\tau_t^d}\left[1+\left(1-\tau_{t+1}^k\right)\left(F_{k,t+1}-\delta^k\right)+\tau_{t+1}^k\left(\delta^{k\prime}-\delta^k\right)\right]. \tag{16}$$

The household owns the firm and receives the dividends. The present value budget constraint of the household is

$$\sum_{t=0}^{\infty} q_t \left[\left(1+\tau_t^c\right) c_t - \left(1-\tau_t^n\right) w_t n_t \right] \leq \sum_{t=0}^{\infty} q_t \left(1-\tau_t^d\right) d_t + b_0.$$

The household marginal conditions are the same as before, (4) and (5), except for the arbitrage condition on bonds and capital, (6), that was replaced by the analog condition for the firm (16) since here it is the firm that makes those choices.

The competitive equilibrium wedges are now

$$\frac{u_{c,t}}{-u_{n,t}} = \frac{1+\tau_t^c}{\left(1-\tau_t^n\right) F_{n,t}}, \tag{17}$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = \frac{1+\tau_t^c}{1+\tau_{t+1}^c} \frac{1-\tau_{t+1}^d}{1-\tau_t^d} \left[1 + \left(1-\tau_{t+1}^k\right) \left(F_{k,t+1} - \delta^k\right) + \tau_{t+1}^k \left(\delta^{k\prime} - \delta^k\right) \right]. \tag{18}$$

The present value of dividends can be written as

$$\sum_{t=0}^{\infty} q_t \left(1-\tau_t^d\right) d_t = \left(1-\tau_0^d\right) \left[F_{k,0} + 1 - \delta - \tau_0^k \left(F_{k,0} - \delta^{k\prime}\right) \right] k_0$$

so, as long as the dividend tax is constant over time, $\tau_t^d = \tau^d, t \geq 0$, the tax causes no intertemporal distortions.

The dividend tax on the firm is equivalent to the Abel (2007) tax on capital income with a full investment deduction. Both the Ramsey optimal solution and the decentralization coincide in the two economies. This alternative decentralization makes it apparent that capital income should be taxed as dividends at a non-distortionary constant rate while the profits of the firm should not be taxed.

Heterogeneity and distribution Would the Ramsey optimal solution be any different if the economy had heterogeneous agents with different initial wealth levels? In this economy, if we were to consider heterogeneous agents sharing the same isoelastic preferences but with different levels of initial wealth, the optimal tax on the accumulation of capital is zero, as in the case with the representative agent. This is again an application of the Diamond and Mirrlees (1971) result of production efficiency. See Chari, Nicolini and Teles (2020) for a formal discussion of the argument. Depending on the distribution of wealth and on the welfare weights of the different agents, the constant tax on dividends could be used as a redistributive tool.

3. A model with capital and housing

We now turn our attention to the optimal taxation of housing which is the main focus of this article. The analyzes follows closely Correia, Reis and Teles (2020). Should housing be treated like capital, so that no distortions should be imposed on the accumulation of housing? On the other hand, people get utility out of housing services. Services and goods should, in general, be taxed at comparable rates. Does this mean that accumulation of housing should be distorted?

Consider a model with capital and housing. Housing is an asset that can be accumulated, like capital, but it enters the utility function. The preferences of a representative household, over consumption c_t, housing h_t^u and labor n_t, are described by $\sum_{t=0}^{\infty} \beta^t u(c_t, h_t^u, n_t)$ where

$$u(c_t, h_t^u, n_t) = \frac{c_t^{1-\sigma^c} - 1}{1-\sigma^c} + \frac{(h_t^u)^{1-\sigma^h} - 1}{1-\sigma^h} - \eta n_t^{1+\psi}. \tag{19}$$

with $\sigma^c > 0$, $\sigma^h > 0$, and $\psi > 0$. We assume, again, separability and constant elasticity. When $\sigma^c = \sigma^h$, the function is separable in leisure and homothetic in the two goods, consumption and housing services.

The production technology is described by

$$c_t + g_t + h_{t+1}^u - \left(1-\delta^h\right) h_t^u + k_{t+1} - \left(1-\delta^k\right) k_t \leq F(k_t, n_t) \tag{20}$$

where h_t^u is housing, and δ^h is the depreciation rate of housing.

The equilibrium implementation assumes that the household owns the capital stock and rents it out to the representative firm every period at rate u_t^k. We will be distinguishing between the housing in which the household lives, h_t^u, and the housing the household owns, h_t. The household chooses both, even if in equilibrium they must be equal. The household also accumulates real debt, b_t. The household pays taxes on income from rents on houses owned, τ_t^h, on the rent (or imputed rent) on the house that the household lives in (a tax on housing services), $\tau_t^{h^u}$, pays taxes on capital income, τ_t^k, and on labor income, τ_t^n. There is also a consumption tax, τ_t^c, and a tax on the investment in housing, $\tau_t^{h^i}$. The reason we assume that there is a tax on investment in housing and not on investment in capital is that housing in this model is a final good that would be taxed with a value-added tax, while capital is an intermediate good in production. The flow of funds constraint is, for $t \geq 0$,

$$\begin{aligned} & \frac{1}{1+r_{t+1}} b_{t+1} + k_{t+1} - \left(1-\delta^k\right) k_t + \left(1+\tau_t^{h^i}\right)\left[h_{t+1} - \left(1-\delta^h\right) h_t\right] \\ \leq \; & b_t + \left(1-\tau_t^k\right) u_t^k k_t + \left(1-\tau_t^h\right) u_t^h h_t + \left(1-\tau_t^n\right) w_t n_t - \left(1+\tau_t^c\right) c_t - \left(1+\tau_t^{h^u}\right) u_t^h h_t^u \end{aligned}$$

The household maximizes utility (19), subject to these constraints, together with a no-Ponzi games condition.

A representative firm produces output that can be used as consumption, capital, housing or government consumption.

The competitive equilibrium In a competitive equilibrium, the returns on bonds, housing and capital must be equal,

$$1 + r_{t+1} = \frac{\left(1+\tau_{t+1}^{h^i}\right)\left(1-\delta^h\right) + \left(1-\tau_{t+1}^h\right) u_{t+1}^h}{1+\tau_t^{h^i}} \tag{21}$$

and

$$1+r_{t+1}=1-\delta^{k}+\left(1-\tau_{t+1}^{k}\right)u_{t+1}^{k}. \tag{22}$$

Using these arbitrage conditions, the single budget constraint for the household is

$$\begin{aligned}&\sum_{t=0}^{\infty}q_t\left[\left(1+\tau_t^c\right)c_t-\left(1-\tau_t^n\right)w_tn_t\right]+\sum_{t=0}^{\infty}q_t\left(1+\tau_t^{h^u}\right)u_t^h h_t^u+\\ \leq\ & b_0+\left[1-\delta^k+\left(1-\tau_0^k\right)u_0^k\right]k_0+\left[\left(1+\tau_0^{h^i}\right)\left(1-\delta^h\right)+\left(1-\tau_0^h\right)u_0^h\right]h_0\end{aligned}$$

where $q_t=\frac{1}{(1+r_1)...(1+r_t)}$ for $t\geq 1$, with $q_0=1$.

The household choices must also satisfy (4), (5) and

$$\frac{u_{h^u,t}}{u_{c,t}}=\frac{\left(1+\tau_t^{h^u}\right)u_t^h}{1+\tau_t^c}. \tag{23}$$

The marginal conditions for the firm are (8).

The equilibrium wedges can then be summarized by

$$\frac{u_{c,t}}{-u_{n,t}}=\frac{1+\tau_t^c}{\left(1-\tau_t^n\right)F_{n,t}}, \tag{24}$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}}=\frac{1+\tau_t^c}{1+\tau_{t+1}^c}\left[1-\delta^k+\left(1-\tau_{t+1}^k\right)F_{k,t+1}\right] \tag{25}$$

and

$$\frac{\left(1+\tau_{t+1}^{h^i}\right)\left(1-\delta^h\right)}{1+\tau_t^{h^i}}+\frac{\left(1-\tau_{t+1}^h\right)\left(1+\tau_{t+1}^c\right)}{\left(1+\tau_t^{h^i}\right)\left(1+\tau_{t+1}^{h^u}\right)}\frac{u_{h^u,t+1}}{u_{c,t+1}}=1-\delta^k+\left(1-\tau_{t+1}^k\right)F_{k,t+1} \tag{26}$$

If the tax rates on capital income were set to zero, $\tau_{t+1}^k=0$, and if the other taxes were constant over time, $\tau_t^c=\tau^c$, $\tau_{t+1}^h=\tau^h$, $\tau_{t+1}^{h^u}=\tau^{h^u}$, $\tau_t^{h^i}=\tau^{h^i}$, $\tau_t^n=\tau^n$, $t\geq 0$, the distortions would be result of the combined taxes on consumption and labor income on the intratemporal margin,

$$\frac{u_{c,t}}{-u_{n,t}}=\frac{1+\tau^c}{\left(1-\tau^n\right)F_{n,t}}, \tag{27}$$

and the distortion resulting from the differential taxation of consumption and housing in

$$1-\delta^h+\frac{\left(1+\tau^c\right)\left(1-\tau^h\right)}{\left(1+\tau^{h^i}\right)\left(1+\tau^{h^u}\right)}\frac{u_{h^u,t+1}}{u_{c,t+1}}=1-\delta^k+F_{k,t+1}. \tag{28}$$

If the joint tax on housing would be equal to the consumption tax, $1+\tau^c=(1+\tau^{h^i})\left(1+\tau^{h^u}\right)/\left(1-\tau^h\right)$, the only distortion would be in the margin between consumption and leisure (or between housing services and leisure) and it would be a constant distortion over time.

Taxation of capital and housing income with an investment deduction We now consider that the taxes on income from capital and housing allow for an investment deduction, as in the Abel tax. The deduction of the investment in housing is gross of investment taxes. We call these taxes τ_t^{dh} and τ_t^{dk}, on housing and capital, respectively, where d stands for dividends. The budget constraint of the household is, for $t \geq 0$,

$$\begin{aligned} & \frac{1}{1+r_{t+1}} b_{t+1} + \left(1-\tau_t^{dk}\right)\left[k_{t+1} - \left(1-\delta^k\right)k_t\right] \\ & + \left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)\left[h_{t+1} - \left(1-\delta^h\right)h_t\right] \\ \leq \; & b_t + \left(1-\tau_t^{dk}\right)u_t^k k_t + \left(1-\tau_t^{dh}\right)u_t^h h_t + \left(1-\tau_t^n\right)w_t n_t - \left(1+\tau_t^c\right)c_t - \left(1+\tau_t^{h^u}\right)u_t^h h_t^u \end{aligned}$$

The marginal conditions of the households are (4), (5), (23) together with

$$1 + r_{t+1} = \frac{\left(1-\tau_{t+1}^{dh}\right)\left(1+\tau_{t+1}^{h^i}\right)\left(1-\delta^h\right)}{\left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)} + \frac{\left(1-\tau_{t+1}^{dh}\right)u_{t+1}^h}{\left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)}$$

$$1 + r_{t+1} = \frac{1-\tau_{t+1}^{dk}}{1-\tau_t^{dk}}\left(1-\delta^k + u_{t+1}^k\right)$$

The marginal conditions of the competitive equilibrium can now be summarized as (24),

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = \frac{1+\tau_t^c}{1+\tau_{t+1}^c}\frac{1-\tau_{t+1}^{dk}}{1-\tau_t^{dk}}\left(1-\delta^k + F_{k,t+1}\right) \tag{29}$$

and

$$\begin{aligned} & \frac{\left(1-\tau_{t+1}^{dh}\right)\left(1+\tau_{t+1}^{h^i}\right)}{\left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)}\left(1-\delta^h\right) + \frac{1-\tau_{t+1}^{dh}}{\left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)}\frac{1+\tau_{t+1}^c}{1+\tau_{t+1}^{h^u}}\frac{u_{h^u,t+1}}{u_{c,t+1}} \\ = \; & \frac{1-\tau_{t+1}^{dk}}{1-\tau_t^{dk}}\left(1-\delta^k + F_{k,t+1}\right). \end{aligned} \tag{30}$$

As long as the tax rates on capital and housing income are constant over time, $\tau_t^{dk} = \tau^{dk}$ and $\tau_t^{dh} = \tau^{dh}$, those taxes impose no distortions regardless of the levels. If, in addition, the other taxes are also constant over time, then condition (30) becomes

$$1 - \delta^h + \frac{1+\tau^c}{\left(1+\tau^{h^i}\right)\left(1+\tau^{h^u}\right)}\frac{u_{h^u,t+1}}{u_{c,t+1}} = F_{k,t+1} + 1 - \delta^k. \tag{31}$$

There is no wedge on this margin as long as the tax rate on housing services, either through τ^{h^i} or τ^{h^u} is equal to the consumption tax. Only consumption and housing services are distorted relative to leisure at the same constant rate over time. The intratemporal margin, (24), is distorted by $\left(1+\tau^c\right)/\left(1-\tau^n\right)$, and there are no distortions on the other two margins, (29) and (30).

The present value budget constraint in this case is

$$\begin{aligned} & \sum_{t=0}^{\infty} q_t\left[\left(1+\tau_t^c\right)c_t - \left(1-\tau_t^n\right)w_t n_t\right] + \sum_{t=0}^{\infty} q_{t+1}\left(1+\tau_{t+1}^{h^u}\right)u_{t+1}^h h_{t+1}^u + \\ \leq \; & b_0 + \left(1-\tau_0^{dk}\right)\left[1-\delta^k + u_0^k\right]k_0 + \left(1-\tau_0^{dh}\right)\left[\left(1+\tau_0^{h^i}\right)\left(1-\delta^h\right) - \frac{\tau_0^{dh} + \tau_0^{h^u}}{1-\tau_0^{dh}}u_0^h\right]h_0^u. \end{aligned}$$

Constant dividend-like taxes on capital and housing income that would be confiscating the pre-existent levels of capital and housing without distorting the accumulation.

The Ramsey problem The Ramsey problem is to maximize utility (19), subject to the resource constraints (2), and the implementability condition

$$\sum_{t=0}^{\infty}\beta^t\left[u_{c,t}c_t+u_{n,t}n_t\right]+\sum_{t=0}^{\infty}\beta^{t+1}u_{h^u,t+1}h_{t+1}^u=W_0$$

where

$$\begin{aligned} W_0 &= \frac{u_{c,0}}{1+\tau_0^c}\left[b_0+\left[1-\delta^k+\left(1-\tau_0^k\right)F_{k,0}\right]k_0\right] \\ &+\frac{u_{c,0}}{1+\tau_0^c}\left[1-\delta^h-\left(\tau_0^h+\tau_0^{h^u}\right)\frac{u_{h^u,0}\left(1+\tau_0^c\right)}{u_{c,0}\left(1+\tau_0^{h^u}\right)}\right]h_0^u, \end{aligned}$$

when the tax rate on capital and housing income does not allow for any deductions, or

$$\begin{aligned} W_0 &= \frac{u_{c,0}}{1+\tau_0^c}\left[b_0+\left(1-\tau_0^{dk}\right)\left[1-\delta^k+F_{k,0}\right]k_0\right] \\ &+\frac{u_{c,0}}{1+\tau_0^c}\left(1-\tau_0^{dh}\right)\left((1+\tau_0^{h^i})\left(1-\delta^h\right)-\frac{\tau_0^{dh}+\tau_0^{h^u}}{1-\tau_0^{dh}}\frac{u_{h,0}\left(1+\tau_0^c\right)}{u_{c,0}\left(1+\tau_0^{h^u}\right)}\right)h_0^u, \end{aligned}$$

when the tax on capital and housing income allows for the deduction of investment.

The first order conditions of the Ramsey problem treating W_0 as exogenous include:

$$\frac{u_{c,t}}{-u_{n,t}}\frac{1+\varphi\left(1-\sigma^c\right)}{1+\varphi\left(1+\psi\right)}=\frac{1}{F_{n,t}},\ t\geq 0, \tag{32}$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}}=1-\delta^k+F_{k,t+1},\ t\geq 0, \tag{33}$$

$$\frac{1+\varphi\left(1-\sigma^h\right)}{1+\varphi\left(1-\sigma^c\right)}\frac{u_{h,t+1}}{u_{c,t+1}}-\delta^h=F_{k,t+1}-\delta^k. \tag{34}$$

With these constant elasticity preferences, intratemporal distortions should be constant. Furthermore if the consumption and housing price elasticities coincide, $\sigma^c=\sigma^h$, then there should be no distortions on the margin (34).

Preferences with $\sigma^h=\sigma^c$ are homothetic in consumption and housing services, and separable in leisure, and they are also homothetic over labor in different periods. The optimal solution is to have consumption and housing services taxed at the same constant rate. This is achieved with a constant labor income tax, $\tau_t^n=\tau^n$, $t\geq 0$, a constant consumption tax, $\tau_t^c=\tau^c$, $t\geq 0$, and a constant tax on investment in housing equal to the consumption tax, $\tau_t^{h^i}=\tau^{h^i}=\tau^c$, $t\geq 0$. Taxes on housing services would then be set to zero, $\tau_{t+1}^{hu}=0$, $t\geq 0$. The same allocation can be achieved with a zero tax on investment in housing and a tax on rents (actual and imputed) equal to the consumption tax, $\tau_{t+1}^{h^u}=\tau^{h^u}=\tau^c$.

In the economy with investment expensing, the taxes on capital and housing income should be constant.

In sum, if housing investment is taxed with a consumption-type tax, as is the case in most economies with value added taxes, then there is no need to use any other taxes on housing services or income. Furthermore value-added taxes at different rates are able to accommodate differential elasticities between consumption and housing services.

4. Concluding remarks

There are two main lessons from the analysis in this note that follows closely Chari et al. (2020) and Correia et al. (2017). First, taxation of any form of capital or housing income should allow for full investment expensing. Second, there is no need for any other form of taxation of housing services other than labor and/or value added taxes applied to all consumption goods and services including housing.

We have assumed preferences with constant consumption and labor elasticities. If consumption and housing services share the same elasticity, then the solution of the optimal taxation problem is very simple. A constant value-added tax applied to all goods including housing, possibly complemented with a labor income tax, is all that is needed to implement the optimal wedges. Departing from constant-elasticity preferences is going to result in deviations from this simple prescription, but the constant tax result is still a useful benchmark. Finally, constant taxes on capital and housing income, with full investment expensing, can take care of the desired initial confiscation.

In the extreme simplicity of the set up that we use here, the confiscation of the installed capital or housing stock is efficient. This is true because we are abstracting from important features in firm dynamics and also from reputational concerns.

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