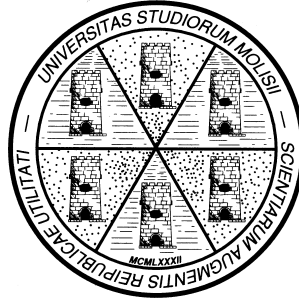


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**The Incidence of a Tax on Pure Rent in a
Small Open Economy**

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The Incidence of a Tax on Pure Rent in a Small Open Economy*

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Abstract

This paper analyzes the effects of a land rent tax on capital formation and foreign investment in a life-cycle small open economy with endogenous labor-leisure choices. The consequences of land taxation critically depend on how the tax proceeds are used by the government. A land tax depresses capital formation, crowds out foreign investment and increases national wealth and consumption when the land tax revenues are distributed as lump-sum payments. If the proceeds from land taxation are used to finance unproductive government expenditure, the land tax will be neutral in its effects on the capital

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stock, nonhuman wealth and labor. When the tax revenues are used to reduce labor taxes, the land rent tax spurs nonhuman wealth accumulation and ambiguously affects the capital stock and labor.

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1 Introduction

In a non-altruistic OLG closed economy, where land serves as an input as well as an asset, a tax on land rent is associated with a higher capital stock and output per person in the steady state. The rationale for this result, discovered by Feldstein (1977), is that a land tax hike, by initially reducing the value of land, diverts saving away from land into real capital, therefore spurring capital accumulation and temporarily output growth. The increase in the capital stock in turn lowers the real interest rate and raises the marginal productivity of land as well as the wage rate. Steady state financial wealth, consumption and welfare rise.

The positive effect of the land rent tax on capital formation, which can be denominated the "Feldstein effect", is grounded in the portfolio choice. Since capital and land are the only assets of the economy, any "flight from land", determined by the land rent tax, is by necessity a "flight into real capital". The "Feldstein effect" is independent of alternative uses of land tax revenues.

There have been many articles analyzing the implications of land rent taxes for the resource allocation and incidence analysis.¹ Calvo, Kotlikoff, and Rodriguez (1979) demonstrated that the Feldstein findings depend on

¹A particular line of research has focused on the consequences of land taxation on the gestation period of land investment projects. See, for example, Bentick (1979) and Mills (1981), who showed that a tax on land value favors land uses with early-payoff income streams.

the non-Ricardian (in the demographic sense) structure of the economy, by showing that in a Barro-Ramsey economy, a tax on land rent is fully capitalized in the price of land and no effect on capital accumulation occurs, as originally predicted by Ricardo (1817). Fane (1984) argued that, once a fully compensated land tax is considered in a finite-lived setup with disconnected generations, the unique effect of taxation is to cause a fall in the land value with no shifting; a land tax is fully compensated when the land tax shift is accompanied by the issuance of perpetual government bonds, whose sale proceeds are used to make lump-sum transfers to the landlords hit by the tax, and the land tax revenues are employed to finance the interest payments on the newly issued government bonds.² The Ricardian results on the land tax shifting can also be obtained in a life-cycle setting with no-bequests if current consumption and future consumption are perfect substitutes in the individuals' utility function; see Kotlikoff and Summers (1987).

Chamley and Wright (1987) analyzed the dynamic incidence of pure rent taxation in the Feldstein (1977) model. They found that the impact response of the land price to an increase in the land tax may be positive or negative. If positive, this response is always smaller than one-half of the tax revenues; if instead the price of land falls immediately, the loss in value is never greater than indicated by the full Ricardian capitalization of the land tax.

In a finite-lived small open economy having unrestricted access to the world capital market and a fixed labor supply, saving diverted from land by a

²The equivalence between land taxation and government debt has also been demonstrated by Buiter (1989), who showed, by considering an overlapping generations model without operative intergenerational gift and bequest motives, that "debt neutrality" prevails when government debt is accompanied by a tax on land.

rise in land taxation is not directed towards real capital; under perfect capital mobility, in fact, the portfolio mechanism discovered by Feldstein implies that the "flight from land" necessarily determines a "flight into foreign assets". This was shown by Eaton (1988), who discovered that a land tax leaves the capital stock, domestic output and non-land input prices unaffected.³ The land tax however reduces the price of land, crowds out foreign investment and hence raises national income as well as the consumption and welfare of nationals. There is nothing surprising in the Eaton (1988) findings, since, even though the economy he analyzed is in principle a three-asset economy (as net foreign assets enter the asset menu of savers in addition to physical capital and land), it *de facto* works as a two-asset economy, since the capital stock is tied down by the given world interest rate.

By considering a monetary growth model, Ihori (1990) investigated the role of land taxation in an inflationary OLG economy. He obtained that a balanced budget rise in land taxation accompanied by an increase in government spending induces an increase in the capital stock and a reduction in factor returns, while a tax reform from lump-sum taxes to land taxes crowds out capital formation and increases the real return on land and capital. In all the cases studied by Ihori (1990), the nominal price of land is normally reduced by land taxes, while the real price may rise or fall.

Hashimoto and Sakuragawa (1998) found in a "learning by doing" endogenous growth economy with finite horizons that the effects of the imposition of a land tax differ according to the tax-transfer programme adopted. If the

³The analysis of the land tax effects is only one of the several issues investigated by Eaton (1988) in an open economy with reproducible capital and unimproved land.

tax revenues are wasted or transferred wholly to the younger generations, the growth rate is always increased by pure rent taxes, whereas if they are transferred wholly to the older generations, the output growth rate may be reduced.

None of these articles has analyzed the implications of endogenous labor-leisure decisions for the macroeconomic consequences of land taxation. As originally recognized by Feldstein (1977),⁴ the labor supply responses may strongly affect the incidence of a pure rent tax because of the income effects that can arise according to the compensatory financing adopted by the government.

The purpose of this paper is to investigate the effects of a land tax on capital formation and foreign investment in a life-cycle small open economy with perfect capital mobility, where the supply of labor is endogenous. We find that the consequences of land rent taxation differ substantially from those predicted by Feldstein (1977), Eaton (1988), and the others, and critically depend on how the tax proceeds are used by the government.

Land taxation does not spur capital accumulation as in a closed economy, but instead depresses capital formation and economic growth when the tax revenues are lump-sum transferred to consumers. Labor supply and domestic output are reduced by the shock, while nonhuman wealth and national income are increased. If, instead, the proceeds from land taxation were used to finance unproductive government expenditure, the tax on pure rent would be neutral in its effects on the capital stock and aggregate wealth. In this case, the reduction in the land price stemming from higher taxation only implies

⁴See pp. 350 and 357.

a compensating decrease in foreign investment. When the tax proceeds are used to cut labor income taxes, land taxation ambiguously affects the labor supply and the capital stock, while it raises domestic wealth and aggregate consumption.

The paper is organized as follows. Section 2 outlines the analytical framework. Section 3 investigates the steady state consequences of land taxation under different compensatory financing schemes. Section 4 concludes.

2 The model

Consider a small open economy producing a single tradable good, which is perfectly substitutable with the foreign-produced good, and having access to a perfect world capital market. Domestic production is obtained by using capital, land and labor. Domestic assets, namely real capital and land, are partly owned by nationals and partly by foreigners.

The consumers' behavior is obtained by using the OLG demographics with uncertain lifetime and no bequest motives formulated by Yaari (1965) and Blanchard (1985), extended to incorporate endogenous labor-leisure choices, as in Phelps (1994, ch. 16).⁵ Agents face a constant mortality rate θ . New cohorts are born continuously. As the birth rate is assumed to equal the death

⁵The analysis of Feldstein (1977), Chamley and Wright (1987), and Eaton (1988) are instead based on the Diamond-Samuelson specification of the overlapping-generations structure, in which two generations are alive in each period and members of different generations are distinguished explicitly. The adoption of the Blanchard-Yaari continuous-time OLG setup, which does not distinguish members of different generations explicitly, is inconsequential for the main qualitative results of our analysis.

rate, population, composed of cohorts of different ages, remains constant and hence can be normalized to one.

Assuming that the individual utility is logarithmic in consumption, c , and leisure, $1 - l$ (where l represents the labor hours supplied and the time endowment has been normalized to one), at each instant t a consumer born at time $s \leq t$ solves the following problem

$$\max \int_t^\infty \{\alpha \ln c(s, j) + (1 - \alpha) \ln [1 - l(s, j)]\} \exp[-(\theta + \rho)(j - t)] dj \quad (1)$$

subject to the instantaneous budget constraint

$$c(s, t) + \frac{d}{dt}v^d(s, t) = (r^* + \theta)v^d(s, t) + (1 - \tau)w(t)l(s, t) + z(s, t), \quad (2)$$

and the solvency condition precluding Ponzi schemes

$$\lim_{j \rightarrow \infty} v^d(j, t) \exp[-(r^* + \theta)(j - t)] = 0, \quad (3)$$

where $v^d(s, t)$ and $z(s, t)$ denote nonhuman wealth and lump-sum transfers of a consumer born at time s ; $w(t)$ is the hourly real wage, ρ the rate of time preference (exogenous), r^* the world interest rate (exogenous), τ the proportional tax on labor income, and $\alpha \in (0, 1)$ a preference parameter.

The optimality conditions for the individual problem (1)-(3) are

$$c(s, t) = \alpha(\theta + \rho)[v^d(s, t) + h(s, t)],$$

$$1 - l(s, t) = \frac{(1 - \alpha)c(s, t)}{\alpha(1 - \tau)w(t)},$$

$$\frac{d}{dt}c(s, t) = (r^* - \rho)c(s, t),$$

where $h(s, t)$ is the consumer's human wealth, given by

$$h(s, t) = \int_t^\infty [(1 - \tau)w(j) + z(s, j)] \exp[-(r^* + \theta)(j - t)] dj.$$

Aggregating over all the cohorts and omitting the time index, the demand-side of the model can be expressed as

$$C = \alpha(\theta + \rho)(V^d + H), \quad (4a)$$

$$1 - L = \frac{(1 - \alpha)C}{\alpha(1 - \tau)w}, \quad (4b)$$

$$\dot{H} = (r^* + \theta)H - (1 - \tau)w - Z, \quad (4c)$$

$$C + \dot{V}^d = r^*V^d + (1 - \tau)wL + Z, \quad (4d)$$

where capital letters denote aggregate variables of the corresponding individual ones.⁶ Equation (4a) describes the life-cycle consumption function, (4b) is the Cobb-Douglas labor supply, (4c) gives the dynamics of human wealth, and (4d) represents the consumers' aggregate budget constraint, which describes the dynamics of nonhuman wealth.

By using equations (4), the Blanchard-Yaari law of motion for consumption can be obtained:

⁶Each aggregate variable is defined as $X = \int_{-\infty}^t x(s, t) \theta e^{\theta(s-t)} ds$, where $x(s, t)$ indicates a generic individual variable.

$$\dot{C} = (r^* - \rho)C - \alpha\theta(\theta + \rho)V^d. \quad (4a')$$

The financial wealth of domestic residents is composed of two perfectly substitutable assets, i.e. physical capital K^d and unimproved land T^d ; that is

$$V^d = K^d + qT^d,$$

where q is the price of land. As the stock of financial wealth held by nationals is strictly positive, the steady state equilibrium requires $r^* > \rho$.

After-tax rates of return of perfectly substitutable assets must satisfy the following relationship

$$r^* = \frac{(1 - \lambda)R}{q} + \frac{\dot{q}}{q}, \quad (5)$$

where λ is a proportional tax rate on land rent, and R the land rent; perfect foresight has been assumed.

Domestic output Y is produced by competitive firms through a well-behaved and linearly homogeneous production function: $Y = F(K, T, L)$, where K and T represent total capital stock and land, respectively. Factors of production are complementary in the Edgeworth sense.

Total capital and land are defined as

$$K = K^d + K^f, \quad (6a)$$

$$T = T^d + T^f, \quad (6b)$$

where K^f and T^f are capital and land owned by foreigners, respectively.

First-order conditions for maximum profit entail

$$F_K(K, T, L) = r^*, \quad (7a)$$

$$F_T(K, T, L) = R, \quad (7b)$$

$$F_L(K, T, L) = w. \quad (7c)$$

The economy has a fixed endowment of unimproved land, \tilde{T} , fully used in production. Land endowment is normalized to one, i.e. $\tilde{T} = 1$.

The government uses revenues from taxing land rents and labor income to finance lump-sum transfers to consumers and unproductive public spending G ; ⁷ that is

$$\lambda RT + \tau wL = Z + G. \quad (8)$$

The current account gives the rate of accumulation of foreign investment:

$$\dot{B} = C + \dot{K} + G - Y + r^*B, \quad (9)$$

where B denotes foreign investment, i.e. capital and land owned by foreigners, defined as

$$B = K^f + qT^f. \quad (10)$$

⁷ G does not affect the productive capacity of the economy as well as consumption and labor supply decisions. If however G entered the agent instantaneous utility function, our analysis would remain unchanged provided that individual preferences are additively separable in consumption and leisure, on the one hand, and public expenditure, on the other.

The full model of the economy is obtained by combining the optimality conditions for consumers and firms together with the equilibrium condition on factor markets and the relevant equations of accumulation.

Our study of the macroeconomic consequences of land taxation is only concerned with the steady state equilibrium.

3 Land taxation and resource allocation

Three alternative policy-experiments concerning the effects of a parametric change in λ are studied: one in which the government distributes the revenues from taxation in a lump-sum fashion, one in which the additional tax proceeds are used for financing an increase in the public expenditure, and one in which land tax revenues are employed to reduce the labor income tax rate.

3.1 Lump-sum distribution of land tax revenues

In this experiment, the rise in the land tax is accompanied by the lump-sum distribution of the land tax proceeds. Government expenditure and the labor income tax rate remain fixed at \tilde{G} and $\tilde{\tau}$ respectively.

The marginal productivity of capital is fixed by the world interest rate. From (7a), we obtain

$$\bar{L} = l(\bar{K}), \quad l' > 0, \quad (11)$$

where overbars denote long-run values and $l' = -\frac{F_{KK}}{F_{KL}} > 0$. An increase in the capital stock, by reducing the marginal productivity of capital, requires

an increase in labor so as to keep the real rate of return on capital fixed at r^* . Plugging (11) into (7b) and (7c), we obtain that $\bar{R} = R(\bar{K})$ and $\bar{w} = w(\bar{K})$, where $R' = \frac{\bar{L} \Phi}{F_{KL}} > 0$, $w' = -\frac{\Phi}{F_{KL}} < 0$, and $\Phi = F_{KK}F_{LL} - F_{KL}^2 > 0$.

Substituting (11) into (4b) for \bar{L} , we can express consumption in terms of the capital stock and the labor income tax rate as follows

$$\bar{C} = c(\bar{K}, \tilde{\tau}), \quad c_{\bar{K}} < 0, \quad c_{\tilde{\tau}} < 0, \quad (12)$$

where $c_{\bar{K}} = -\frac{\alpha(1-\tilde{\tau})[(1-\bar{L})\Phi - F_L F_{KK}]}{(1-\alpha)F_{KL}} < 0$, and $c_{\tilde{\tau}} = -\frac{\alpha(1-\bar{L})F_L}{(1-\alpha)} < 0$. This equation gives, for any level of the capital stock and the wage tax rate, the level of consumption compatible with the labor market equilibrium.

From (4a'), the Blanchard-Yaari consumption function is derived

$$\bar{C} = \frac{\alpha\theta(\theta + \rho)}{(r^* - \rho)} (\bar{K} + \bar{q} - \bar{B}), \quad (13)$$

where $\bar{K} + \bar{q} - \bar{B} = \bar{V}^d$.⁸

The current account balance implies that

$$\bar{C} + \tilde{G} = r^* (\bar{K} + \bar{q} - \bar{B}) + F_L \bar{L} + \lambda F_T. \quad (14)$$

This equation states that the long-run aggregate demand, given by private consumption plus the government spending, is equal to national income.

Alternatively, (14) can be re-written, by using the government budget constraint (8), as

⁸Equation (13) represents the life-cycle consumption function since it is obtained from (4a), once the long-run expression for human wealth from (4b), and the private budget constraint (4d) have been used.

$$\bar{C} = r^* (\bar{K} + \bar{q} - \bar{B}) + (1 - \tilde{\tau}) F_L \bar{L} + \bar{Z}. \quad (15)$$

This relationship is the consumers' budget constraint, which says that in the steady state, consumption is equal to the disposable income.

Substituting (13) into (14) for $\bar{K} + \bar{q} - \bar{B}$ and using (11), we obtain

$$\bar{C} = \frac{\alpha\theta(\theta + \rho)}{[\alpha\theta(\theta + \rho) - r^*(r^* - \rho)]} \left[h(\bar{K}, \lambda) - \tilde{G} \right], \quad (16)$$

where $h(\bar{K}, \lambda) = F_L \bar{L} + \lambda F_T$, $h_{\bar{K}} = -\frac{[(1 - \lambda) \bar{L} \Phi + F_L F_{KK}]}{F_{KL}}$, $h_{\lambda} = F_T > 0$ and $\alpha\theta(\theta + \rho) > r^*(r^* - \rho)$.⁹ Equation (16) describes, for given levels of the capital stock, the land tax rate and the government expenditure, the corresponding consumption compatible with the current account balance and the life-cycle consumption decisions.

Differentiating (12) and (16) yields¹⁰

$$\frac{d \bar{C}}{d \lambda} = \frac{\alpha\theta(\theta + \rho) F_T c_{\bar{K}}}{\Delta},$$

$$\frac{d \bar{K}}{d \lambda} = \frac{\alpha\theta(\theta + \rho) F_T}{\Delta},$$

where $\Delta = [\alpha\theta(\theta + \rho) - r^*(r^* - \rho)] c_{\bar{K}} - \alpha\theta(\theta + \rho) h_{\bar{K}}$.

⁹The sign of the latter inequality is inferred from the following relationship

$$\alpha\theta(\theta + \rho) - r^*(r^* - \rho) = \frac{(r^* - \rho) [(1 - \tilde{\tau}) F_L \bar{L} + \bar{Z}]}{(\bar{K} + \bar{q} - \bar{B})} > 0.$$

This equation is obtained by combining (13) with (15).

¹⁰The labor and nonhuman wealth multipliers are easily obtained by using the expressions for $\frac{d \bar{K}}{d \lambda}$ and $\frac{d \bar{C}}{d \lambda}$ together with (11) and (13), respectively.

Saddle-point stability of the steady state equilibrium is satisfied as long as $\Delta < 0$.¹¹ Thus, a rise in the land tax leads to a higher consumption and a lower capital stock. The rise in consumption is accompanied by an expansion of national wealth from (13), while the reduction in the capital stock goes together with a contraction in the labor supply from (11).¹² The drop in the capital stock implies that the before-tax return on land falls, while the wage rate rises. The price of land falls more than the capitalized amount of the tax because of the reduction of the marginal productivity of land. Moreover, since domestic wealth $\bar{K} + \bar{q}$ is reduced and national wealth $\bar{K} + \bar{q} - \bar{B}$ is increased, a reduction of foreign investment takes place.

The consequences of λ on consumption, national wealth and the capital stock (and hence on all the other endogenous variables) are due to the exporting of the tax burden to non-residents as well as the intergenerational wealth transfer. The role of these mechanisms can be explained as follows. The land taxes fall on both nationals and foreigners, but the land tax revenues go entirely to nationals. Thus, the land taxation raises the disposable income and hence consumption of nationals, since at an aggregate level they

¹¹The dynamic properties of the model are discussed in an unpublished Mathematical Supplement, available from the author upon request. A sufficient condition for Δ to be negative is $h_{\bar{K}} > 0$; the condition $h_{\bar{K}} > 0$ is reasonably satisfied as it plausibly requires that an increase in the capital stock raises total labor income and land tax revenues.

¹²Notice that, despite our results are formulated in terms of the capital stock (this is done to facilitate the comparability with the analysis of Feldstein, 1977, Chamley and Wright, 1987, and Eaton, 1988), the casual mechanism that drives capital formation depends, as will be explained below, on the response of the labor supply to changes in λ ; the capital stock simply adjusts to changes in the labor supply in order to keep the marginal productivity of capital fixed at r^* .

pay land taxes in amount $\lambda \bar{T}^d F_T$ and receive λF_T as government lump-sum transfers. The rents $\lambda \bar{T}^f F_T$, which are shifted from foreigners to domestic residents, represent the exporting of the tax burden.¹³ The portion of the lump-sum transfers equal to $\lambda \bar{T}^d F_T$, which exactly compensates nationals for the aggregate taxes they pay, instead, redistributes income intergenerationally from those who consume more and save less to those who consume less and save more, increasing *per se* aggregate saving, national wealth and consumption.

The higher consumption in turn induces a higher demand for leisure and a lower supply of labor. Manhours are therefore reduced. Since the marginal product of capital is given, and labor and capital are Edgeworth complements, the lower labor hours imply a lower capital stock. The decline in the marginal product of land follows from the decline in the labor supply and the capital stock. The wage rate increases because of the decline in the labor supply more than it offsets the decline in the marginal product of labor due to the decline in the capital stock.

Notice that if land taxation is introduced *ex novo* (i.e. λ is initially zero), the consequences of the land tax are to be attributed to the tax exporting effect for a proportion \bar{T}^f and to the intergenerational redistribution mech-

¹³In open economies using capital and land, the tax exporting effect may lead policy-makers to set the land tax inefficiently at too high a rate with the scope of exploiting absentee land owners and the capital tax at too low a rate in order to avoid distortions in the allocation of mobile capital. Lee (2003), instead, shows that a uniform taxation of land and capital is to be preferred from a normative standpoint since it makes it possible to alleviate the inefficiency of overtaxing land and overproviding public goods.

anism for a proportion \bar{T}^d .¹⁴

3.2 Compensatory increase in government expenditure

When land tax revenues are used to finance an increase in government expenditure, the implications of the land tax can be easily understood as follows. Using (15) together with (13), we obtain

$$\bar{C} = \frac{\alpha\theta(\theta + \rho)}{[\alpha\theta(\theta + \rho) - r^*(r^* - \rho)]} \left[j(\bar{K}, \tilde{\tau}) + \tilde{Z} \right], \quad (17)$$

¹⁴This decomposition of the effects of λ can be demonstrated as follows. Suppose that only foreigners have to pay taxes on land ownership. In this case, (5) and (8) must be respectively replaced by the equations: $qr^* = (1 - \lambda T^f)R + \dot{q}$, and $\lambda RT^f + \tau wL = Z + G$.

Therefore, (14) becomes

$$\bar{C} + \tilde{G} = r^* (\bar{K} + \bar{q} - \bar{B}) + F_L \bar{L} + \lambda \bar{T}^f F_T. \quad (14')$$

Substituting (13) into (14'), and using (11), we obtain

$$\bar{C} = \frac{\alpha\theta(\theta + \rho)}{[\alpha\theta(\theta + \rho) - r^*(r^* - \rho)]} \left[h(\bar{K}, \lambda \bar{T}^f) - \tilde{G} \right], \quad (16')$$

where $h(\bar{K}, \lambda \bar{T}^f) = F_L \bar{L} + \lambda \bar{T}^f F_T$.

Differentiating (12) and (16') and supposing that the land tax is initially zero, yields

$$\frac{d\bar{C}}{d\lambda} = \frac{\bar{T}^f [\alpha\theta(\theta + \rho) F_T c_{\bar{K}}]}{\Delta} > 0, \text{ and } \frac{d\bar{K}}{d\lambda} = \frac{\bar{T}^f [\alpha\theta(\theta + \rho) F_T]}{\Delta} < 0.$$

These multipliers (as well as all the other ones) are equal to \bar{T}^f multiplied by the multipliers obtained under the hypothesis of land taxation borne by both nationals and foreigners. Thus, this demonstrates that the tax exporting is responsible for a proportion \bar{T}^f of the total long-run effects of land taxation. The intergenerational wealth transfer, instead, explains the residual proportion $\bar{T}^d = 1 - \bar{T}^f$ of the total steady state effects of land taxes.

where $j(\bar{K}, \tilde{\tau}) = (1 - \tilde{\tau})F_L \bar{L}$, $j_{\bar{K}} = -\frac{(1 - \tilde{\tau})(\bar{L} \Phi + F_L F_{KK})}{F_{KL}}$, $j_{\tilde{\tau}} = -F_L \bar{L} < 0$, and \tilde{Z} represents the exogenous lump-sum transfers. This equation gives, for given levels of the capital stock, the wage tax rate and lump-sum transfers, the level of consumption planned by Blanchard-Yaari agents, which is compatible with the consumer budget constraint.

Equations (12) and (17), which jointly determine \bar{C} and \bar{K} , are independent of λ and \bar{G} . Hence, a rise in the land tax rate accompanied by an increase in the government spending leaves consumption and the capital stock unchanged. National wealth, labor hours, the before-tax land reward and the wage rate also remain unaffected. As the gross land rental \bar{R} is constant, the land price drops by exactly the fall in $1 - \lambda$. Hence, the land rent tax is fully capitalized in the price of land.

Since the capital stock does not change and the price of land is reduced, foreign investment must fall in order to keep national wealth constant. Moreover, while domestic output remains constant, national income is increased. The increase in national income is entirely absorbed by the government. The welfare of nationals remains unaltered.¹⁵

Thus, when the government budget is balanced through the endogenous adjustment of the government expenditure, financial wealth, consumption, labor hours and the capital stock are independent of the land tax, since the intergenerational redistribution of income seen above is absent and the

¹⁵If welfare-improving government spending entered the instantaneous utility function of consumers in a strongly separable manner with respect to consumption and leisure, the land tax shift would increase the nationals' welfare; however, the 'positive' macroeconomic effects of λ just described would be unaltered, as the structural model is unchanged.

shifting of the tax burden to foreigners does not matter as the government expenditure does not affect consumption or leisure choices.

3.3 Compensatory reduction in τ

Suppose now that the increase in the land tax is matched by the endogenous change in the labor tax rate so as to keep the government budget balanced.

Using the government budget constraint (8) together with (7) and (11), we obtain

$$\frac{d\bar{\tau}}{d\lambda} = -\frac{F_T}{F_L \bar{L}} + \Pi \frac{d\bar{K}}{d\lambda},$$

where $\Pi = \frac{[\bar{\tau} (\bar{L} \Phi + F_L F_{KK}) - \lambda \bar{L} \Phi]}{F_L \bar{L} F_{KL}}$.¹⁶

From (12) and (16), after using the above expression for $\frac{d\bar{\tau}}{d\lambda}$, we get

$$\frac{d\bar{C}}{d\lambda} = \frac{(1-\bar{\tau})\alpha\theta(\theta+\rho)F_L F_T F_{KK}}{(1-\alpha)\bar{L}\Lambda F_{KL}},$$

$$\frac{d\bar{K}}{d\lambda} = -\frac{\alpha F_T [\theta(\theta+\rho)(\alpha-\bar{L}) - (1-\bar{L})r^*(r^*-\rho)]}{(1-\alpha)\bar{L}\Lambda},$$

where $\Lambda = [\alpha\theta(\theta+\rho) - r^*(r^*-\rho)](c_{\bar{K}} + \Pi c_{\bar{\tau}}) - \alpha\theta(\theta+\rho)h_{\bar{K}}$ and $\alpha > \bar{L}$.

Thus, a rise in the land tax exerts a positive effect on consumption and an ambiguous effect on the capital stock, since $\Lambda < 0$, as a necessary and sufficient condition for having saddle-point stability of the steady state.¹⁷ The effects on manhours, the pre-tax land reward and the wage rate are

¹⁶If a Cobb-Douglas production function were used, Π would be unambiguously negative.

¹⁷This is demonstrated in the unpublished Mathematical Supplement.

also ambiguous.¹⁸ Financial wealth is instead pulled up by the rise in land taxation.

The ambiguity of the land tax effects on capital and labor depends on two contrasting effects that are at work in this experiment. These effects derive from a composite income effect (due to the exporting of the tax burden and the intergenerational wealth transfer), on the one hand, and the consumption-leisure substitution effect, on the other hand.

The higher λ , by inducing a reduction in the wage income tax, redistributes income across non-residents and nationals as well as the living generations and the future ones. Both these redistributive mechanisms lead to an increase in the stock of financial wealth and consumption.¹⁹ The higher consumption drives the labor supply down; the capital stock declines. On the other hand, the increase in the after-tax wage, due to the reduction in $\bar{\tau}$, brings about a fall in the leisure-consumption ratio. This causes a substitution away from leisure towards labor and consumption. The induced rise in the labor supply stimulates capital from (11). Thus, the overall effect of the land tax hike on the labor supply and the capital stock is determined by which one of these two effects dominates.

From a mechanical perspective, it can be observed that, since consumption and the after-tax wage are increased, the net effect on labor and hence

¹⁸Notice once again that, although the results are formulated in terms of \bar{K} , the labor supply responses to the exogenous shift are responsible for the changes in the capital stock and factor prices.

¹⁹The tax exporting and intergenerational mechanisms, brought into action by the compensatory change in $\bar{\tau}$, are the same as those activated when lump-sum transfers are accommodated.

the capital stock depends, according to (4b), on whether the consumption-to-after-tax-wage ratio increases or not. If the effect of the higher land tax on $\frac{\bar{C}}{(1-\bar{\tau})\bar{w}}$ is positive, namely consumption rises more than the net wage, labor supply is reduced and the capital stock contracts, since the income effect (stemming from the tax exporting and the intergenerational mechanisms) dominates the substitution effect; in this case, the qualitative consequences on the whole system are the same as those seen in Sub-section 3.1. If, instead, the after-tax wage rate increases more than consumption, the labor supply is stimulated as the magnitude of the substitution effect prevails over the magnitude of the income effect; the rise in manhours in turn increases the capital stock. Foreign investment may either rise or fall.

4 Conclusion

This paper has investigated the consequences of land taxes in a small open economy of wealth formation, where the rate of return on capital is exogenously determined on the world capital market, consumers are finite-lived, and the supply of labor is endogenous. This latter feature differentiates our analysis from the previous articles on land taxation, which have instead assumed inelastic labor choices.

A variable labor supply alters the conventional conclusions regarding the long-run incidence of land taxes. The final effects of land taxation on the resource allocation, wealth formation and economic growth depend upon the government uses of the tax proceeds; in our analysis the land tax revenues are alternatively employed to increase lump-sum transfers, the government

expenditure, or to cut wage taxes.

Land taxation increases consumption and stimulates wealth formation, but reduces the capital stock and manhours, when the tax revenues are distributed as lump-sum payments. The exporting of the tax burden to non-residents (who do not receive government transfers) and the intergenerational wealth transfer (due to the fact that changes in lump-sum payments, by altering the distribution of resources across heterogeneous generations, modify aggregate saving and nonhuman wealth) are the basic mechanisms that underpin these effects.

A rise in the land tax, whose proceeds are used to finance an increase in the government spending, produces no consequences on consumption, wealth, labor hours, and capital formation, since the intergenerational redistribution of resources seen in the case of lump-sum compensatory finance does not occur and the tax exporting does not matter, as the government spending leaves consumption and the labor supply choices unaffected.

Finally, a revenue-neutral tax reform that reduces labor income taxes in favor of land taxes raises consumption and national wealth, but exerts ambiguous effects on labor and the capital stock as the international and intergenerational redistributive mechanisms conflict with a substitution effect due to the increase in the after-tax wage rate.

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The Incidence of a Tax on Pure Rent in a Small Open Economy

MATHEMATICAL SUPPLEMENT

(not to be published)

Appendix A

Lump-sum distribution of tax revenues: Analysis of stability

The short-run model can be written as

$$\dot{C} = (r^* - \rho)C - \alpha\theta(\theta + \rho)(K + q - B) \quad (\text{A.1a})$$

$$\dot{q} = r^*q - (1 - \lambda)F_T(K, L) \quad (\text{A.1b})$$

$$\dot{B} = \dot{K} + C + G - F(K, L) + r^*B \quad (\text{A.1c})$$

$$1 - L = \frac{(1 - \alpha)C}{\alpha(1 - \tilde{\tau})F_L(K, L)} \quad (\text{A.1d})$$

$$F_K(K, L) = r^* \quad (\text{A.1e})$$

Since we are considering the case of a lump-sum distribution of tax revenues, lump-sum transfers are obtained residually from the relationship:

$$Z = \lambda F_T(K, L) + \tilde{\tau} F_L(K, L)L - \tilde{G}.$$

Equations (A.1d) and (A.1e) can be solved, once linearized around the steady state, for L and K in terms of the dynamic variable C to yield

$$L = n(C), \quad n' < 0 \quad (\text{A.2a})$$

$$K = k(C), \quad k' < 0 \quad (\text{A.2b})$$

where $n' = \frac{(1-\alpha)F_{KK}}{\Sigma} = l'k' = \frac{l'}{c_{\bar{K}}} < 0$, $k' = -\frac{(1-\alpha)F_{KL}}{\Sigma} = \frac{1}{c_{\bar{K}}} < 0$, $\Sigma = \alpha(1-\tau)[(1-\bar{L})\Phi - F_L F_{KK}] > 0$ and $\Phi = F_{KK}F_{LL} - F_{KL}^2 > 0$.²⁰

Substituting out the values of L and K from equations (A.2) into equations (A.1a)-(A.1c),²¹ the model can be reduced to the following system of differential equations linearized around the steady state

$$\begin{bmatrix} \dot{C} \\ \dot{q} \\ \dot{B} \end{bmatrix} = \begin{bmatrix} j_{11} & -\alpha\theta(\theta + \rho) & \alpha\theta(\theta + \rho) \\ -(1-\lambda)Q' & r^* & 0 \\ j_{31} & -\alpha\theta(\theta + \rho)k' & r^* + \alpha\theta(\theta + \rho)k' \end{bmatrix} \begin{bmatrix} C - \bar{C} \\ q - \bar{q} \\ B - \bar{B} \end{bmatrix} \quad (\text{A.3})$$

where

$$\begin{aligned} j_{11} &= r^* - \rho - \alpha\theta(\theta + \rho)k' > 0; \\ Q' &= F_{TK}k' + F_{TL}n' = \frac{\bar{L}\Phi}{c_{\bar{K}}F_{KL}} < 0; \\ j_{31} &= 1 - r^*k' - F_L n' + j_{11}k'. \end{aligned}$$

²⁰The expressions for l' and $c_{\bar{K}}$, given in Sub-section 3.1, are:

$$l' = -\frac{F_{KK}}{F_{KL}} > 0 \text{ and } c_{\bar{K}} = -\frac{\alpha(1-\tilde{\tau})[(1-\bar{L})\Phi - F_L F_{KK}]}{(1-\alpha)F_{KL}} < 0.$$

²¹Note that equation (A.2b) is employed, once linearized, to eliminate both K and \dot{K} from equations (A.1a)-(A.1c).

The transition matrix must have two positive eigenvalues associated with the jump variables C and q , and one negative eigenvalue associated with the predetermined variable B .²²

The determinant and the trace of the above Jacobian are

$$|J| = -r^* \alpha \theta (\theta + \rho) \left\{ 1 - \frac{r^* (r^* - \rho)}{\alpha \theta (\theta + \rho)} - \frac{1}{c_{\bar{K}}} \left[l' F_L - \frac{(1 - \lambda) \bar{L} \Phi}{F_{KL}} \right] \right\};$$

$$\text{tr}(J) = 3r^* - \rho > 0.$$

The determinant must be negative as a necessary and sufficient condition for saddle-point stability since the trace is necessarily positive. This condition implies that, once the relationship $l' F_L - \frac{(1 - \lambda) \bar{L} \Phi}{F_{KL}} = h_{\bar{K}} =$
 $= - \frac{[(1 - \lambda) \bar{L} \Phi + F_L F_{KK}]}{F_{KL}}$ is taken into account, the following inequality must hold

$$\Delta = [\alpha \theta (\theta + \rho) - r^* (r^* - \rho)] c_{\bar{K}} - \alpha \theta (\theta + \rho) h_{\bar{K}} < 0.$$

Therefore the condition $\Delta < 0$ ensures that the steady state equilibrium is saddle-point stable as stated in Sub-section 3.1.

²²Since C adjusts on impact, K (hence L) jumps instantaneously as well, provided we assume, as in Mundell (1957) and Obstfeld (1989), that capital is instantaneously and costlessly mobile across borders. By considering foreign investment $B = K^f + qT^f$ a predetermined variable, we are implicitly assuming that as q moves repentinely K^f adjusts instantaneously as well, but in an opposite direction so as to leave B unchanged on impact (note that T^f is also predetermined).

Appendix B

Compensatory reduction in τ : Analysis of stability

The complete short-run model is given by

$$\dot{C} = (r^* - \rho)C - \alpha\theta(\theta + \rho)(K + q - B) \quad (\text{B.1a})$$

$$\dot{q} = r^*q - (1 - \lambda)F_T(K, L) \quad (\text{B.1b})$$

$$\dot{B} = \dot{K} + C + G - F(K, L) + r^*B \quad (\text{B.1c})$$

$$1 - L = \frac{(1 - \alpha)C}{\alpha(1 - \tau)F_L(K, L)} \quad (\text{B.1d})$$

$$F_K(K, L) = r^* \quad (\text{B.1e})$$

$$\tau = \tau(K) \quad (\text{B.1f})$$

where $\tau' = \Pi = \frac{[\bar{\tau} (\bar{L} \Phi + F_L F_{KK}) - \lambda \bar{L} \Phi]}{F_L \bar{L} F_{KL}}$.

Equation (B.1f) has been obtained by solving the government budget constraint for τ .²³

Equations (B.1d) and (B.1e) can be solved, after linearizing around the steady state and taking (B.1f) into account, for L and K in terms of C as follows

²³The exogenous effect of λ on τ has been omitted for simplicity.

$$L = v(C), \quad v' < 0 \quad (\text{B.2a})$$

$$K = \kappa(C), \quad \kappa' < 0 \quad (\text{B.2b})$$

where $v' = l'\kappa' = \frac{l'}{(c_{\bar{K}} + \Pi c_{\bar{\tau}})} < 0$, $\kappa' = \frac{1}{(c_{\bar{K}} + \Pi c_{\bar{\tau}})} < 0$,
 $c_{\bar{K}} = -\frac{\alpha(1-\tilde{\tau})[(1-\bar{L})\Phi - F_L F_{KK}]}{(1-\alpha)F_{KL}} < 0$, $c_{\bar{\tau}} = -\frac{\alpha(1-\bar{L})F_L}{(1-\alpha)} < 0$
and $\Phi = F_{KK}F_{LL} - F_{KL}^2 > 0$.

Substituting out the values of L and K from equations (B.2) into equations (B.1a)-(B.1c), the model can be reduced to the following system of differential equations linearized around the steady state

$$\begin{bmatrix} \dot{C} \\ \dot{q} \\ \dot{B} \end{bmatrix} = \begin{bmatrix} j_{11} & -\alpha\theta(\theta + \rho) & \alpha\theta(\theta + \rho) \\ -(1-\lambda)Q' & r^* & 0 \\ j_{31} & -\alpha\theta(\theta + \rho)\kappa' & r^* + \alpha\theta(\theta + \rho)\kappa' \end{bmatrix} \begin{bmatrix} C - \bar{C} \\ q - \bar{q} \\ B - \bar{B} \end{bmatrix} \quad (\text{B.3})$$

where

$$\begin{aligned} j_{11} &= r^* - \rho - \alpha\theta(\theta + \rho)\kappa' > 0; \\ Q' &= F_{TK}\kappa' + F_{TL}v' = \frac{\bar{L}\Phi}{(c_{\bar{K}} + \Pi c_{\bar{\tau}})F_{KL}} < 0; \\ j_{31} &= 1 - r^*\kappa' - F_L v' + j_{11}\kappa'. \end{aligned}$$

The transition matrix must admit two positive eigenvalues associated with C and q and one negative eigenvalue associated with B .

Since the trace of the coefficient matrix in (B.3) is positive, the determinant, given by

$$|J| = -r^*\alpha\theta(\theta + \rho) \left\{ 1 - \frac{r^*(r^* - \rho)}{\alpha\theta(\theta + \rho)} - \frac{1}{(c_{\bar{K}} + \Pi c_{\bar{\tau}})} [l'F_L - \frac{(1-\lambda)\bar{L}\Phi}{F_{KL}}] \right\},$$

must be negative. This condition is satisfied if the following expression

$$\Lambda = [\alpha\theta(\theta + \rho) - r^*(r^* - \rho)](c_{\bar{K}} + \Pi c_{\bar{\tau}}) - \alpha\theta(\theta + \rho)h_{\bar{K}} < 0$$

is, as stated in Subsection 3.3, negative.²⁴

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²⁴Note that the relationship $l'F_L - \frac{(1-\lambda)\bar{L}\Phi}{F_{KL}} = h_{\bar{K}}$ has been used.