On the Incidence of a Tax on Pure Rent with Infinite Horizons

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Summary

This paper studies the incidence of a tax on pure rent within an intertemporal optimizing model of capital accumulation and endogenous labor with infinite-lived agents. Two cases are considered for the labor market: the neoclassical theory, characterized by perfectly competitive wages and no unemployment, and the incentive-wage theory of the labor-turnover type, characterized by real wage rigidity and structural unemployment. In the neoclassical equilibrium, the land rent tax is unshifted when consumers are lump-sum compensated for the tax. If tax revenues are used to finance government spending, pure rent taxation increases employment, boosts capital accumulation and reduces real wage as well as land yield. In the incentive-wage economy, the land rent tax, regardless of the way in which tax proceeds are employed, always increases employment, capital stock, and land reward, but exerts an ambiguous effect on the wage rate.

Keywords: Pure rent taxation, Capital formation, Land, Structural unemployment

JEL Classification: E21, E62, H22

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1 Introduction

Within a finite-lived economy with endogenous capital formation and inelastic labor supply, the Ricardian proposition that a tax on pure rent is unshifted does not hold. The imposition of a tax on land rental income, by reducing the value of unimproved land, diverts saving from the fixed asset toward reproducible capital, i.e. the alternative asset, spurring capital formation and raising output. The rate of interest falls, while the wage rate and the marginal productivity of land increase. The price of land, after the initial drop, may increase in the final equilibrium because of the interest rate decline. These results, discovered by Feldstein (1977), are very robust as they are independent of alternative uses of the land tax revenues.

The Feldstein results, however, hinge on the crucial assumption of non-altruistic overlapping-generations demographics. Calvo, Kotlikoff and Rodriguez (1979) (henceforth CKR) demostrate that in an intertemporal optimizing model of saving and capital formation with Ricardian demographics, like a dynamic life-cycle model with bequests and intergenerational transfers (as in Barro, 1974), the Ricardian effects of a compensated rent tax are confirmed. Although the CKR analysis assumes that the tax revenues are returned to consumers in a lump-sum fashion, the way in which rent tax proceeds are employed is fundamentally immaterial for the incidence of the land rent tax.[1]

[1] This result (which holds provided that agent preferences are strongly separable in consumption and the utility of future generations) comes about because, as labor supply is inelastic, capital stock is pinned down by the "modified golden rule". See also Kotlikoff and Summers (1987).

Does an elastic labor supply or a variable employment level matter for the land rent tax shifting and the resource allocation in a Barro–Ramsey–Ricardo economy?

The purpose of this paper is to answer this question by investigating the effects of a rent tax in a model of optimal saving with infinite-lived agents and different labor market structures.[2] Two cases are considered for the labor market: the neoclassical theory, characterized by perfectly competitive wages, variable labor hours and no unemployment, and the incentive-wage theory, characterized by real wage rigidity, fixed labor hours per worker and a structural rate of unemployment due to labor-turnover considerations.

In the neoclassical analysis, we show that the consequences of a rent tax depend on the way in which the tax proceeds are used by the government. A land rent tax is neutral for the macroeconomic equilibrium (except for the price of land) when consumers are lump-sum compensated for the tax, as in CKR. If the tax revenues are spent unproductively by the government, instead, a "Feldstein effect" on capital stock and output is obtained. We depart from CKR, as government spending, by changing consumption, affects labor-leisure choices and hence capital stock.

In a labor-turnover economy, where firms are motivated to adopt an incentive-wage policy to curtail labor-turnover costs (as in Hoon and Phelps, 1992, and Phelps, 1994), the imposition of a rent tax stimulates employment and boosts capital accumulation regardless of the use of the tax proceeds.

[2]Since our objective is to study an economy that exhibits "Ricardian debt neutrality", we directly use a Ramsey-Ricardo immortal economy (instead of a life-cycle economy with intergenerational transfers *à la* Barro).

These effects stem from the fall in the land value induced by the tax, which, by decreasing income from wealth, dampens employee quittings and hence reduces the natural rate of unemployment. In the labor-turnover case, our findings differ substantially from the CKR ones.

The paper is organized as follows. Section 2 analyzes the implications of the land rent tax in the neoclassical economy. The effects of the rent tax within the labor-turnover economy are investigated in Section 3. Section 4 briefly concludes.

2 Neoclassical economy

2.1 The model

Consider a real economy populated by infinite-lived consumers that decide on consumption C, labor supply L, accumulation of nonhuman wealth W, and portfolio composition. Population is constant.

Assuming logarithmic preferences, the consumers' behavior is described by the following set of relationships[3]

$$\frac{\dot{C}}{C} = r - \rho \tag{1a}$$

$$1 - L = \frac{(1-\alpha)C}{\alpha v} \tag{1b}$$

$$C + \dot{W} = rW + vL + S, \tag{1c}$$

[3] See, for example, Judd (1987).

where r is the rate of return on wealth, ρ the exogenous rate of time preference, v the real wage, S lump-sum transfers from the government and α a preference parameter. Equation (1a) is the Euler law of motion of consumption, (1b) is a Cobb-Douglas labor supply, and (1c) the consumers' budget constraint.

Nonhuman wealth is composed of two perfectly substitutable assets, physical capital K and unimproved land T; that is, $W = K + qT$, where q is the price of land. Perfect asset substitutability requires

$$qr = (1 - \tau)R + \dot{q}, \tag{2}$$

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

Firms operate in competitive output and factor markets. They produce output X through capital, land and labor by means of a linearly homogeneous production function of the usual type: $X = F(K, T, L)$. Factors of production are Edgeworth complementary. Maximum profit requires that the factors of production are paid their marginal products

$$F_K(K, T, L) = r \tag{3a}$$

$$F_T(K, T, L) = R \tag{3b}$$

$$F_L(K, T, L) = v. \tag{3c}$$

The economy is endowed with a fixed quantity of unimproved land $\widetilde{T}$, fully used in production. The normalization $\widetilde{T} = 1$ is used.

The government maintains a balanced budget. Tax revenues are either rebated back to consumers or spent unproductively; that is

$$\tau RT = S + G, \tag{4}$$

where G represents unproductive government spending.

The good market equilibrium requires that output always equals consumption plus investment plus government spending; that is

$$Y = C + \dot{K} + G. \tag{5}$$

2.2 Effects of the tax on pure rent

Our analysis considers the comparative statics effects of an exogenous change in τ, accompanied alternatively, in order to preserve the government budget balance, by the compensatory accommodation of either S or G.

Since in the long-run $F_K(\bar{K}, \bar{L}) = \rho$ (overbars denote long-run variables), we can express capital as an implicit function of labor as follows

$$\bar{K} = K(\bar{L}),\ K' = -\frac{F_{KL}}{F_{KK}} > 0. \tag{6}$$

Using (6), the core model of the economy can be specified as follows

$$1 - \bar{L} = \frac{(1-\alpha)[Y(\bar{L}) - G]}{\alpha v(\bar{L})},\ \ Y' > 0,\ v' < 0 \tag{7a}$$

$$\bar{q}\ \rho = (1-\tau)R(\bar{L}),\ \ R' > 0 \tag{7b}$$

$$\tau R(\bar{L}) = S + G, \tag{7c}$$

where $Y(\bar{L}) = F[K(\bar{L}), \bar{L}]$, $v(\bar{L}) = F_L[K(\bar{L}), \bar{L}]$, and $R(\bar{L}) = F_T[K(\bar{L}), \bar{L}]$.[4]

Consider the case in which consumers are lump-sum compensated for the rent tax, i.e. $S = \bar{S}$ and $G = \widetilde{G}$; $\widetilde{G}$ is the exogenous level of government spending. The increase in the land tax leaves labor hours unchanged, as (7a), which uniquely determines $\bar{L}$, is independent of τ and $\bar{S}$. Capital stock, consumption and factor prices are also unaltered. The sole effect of the rent tax is to reduce the price of land.

Thus, the tax on pure rental income is unshifted. This result, which confirms the CKR discovery, is not surprising since saving is not modified (because of the "Ricardian equivalence") and the land tax does not affect labor-leisure choices.

When the compensatory finance is based on the endogenous adjustment of government spending, i.e. $G = \bar{G}$ and $S = \widetilde{S}$ (where $\widetilde{S}$ represents exogenous lump-sum transfers), the consequences of a rise in τ on the allocation of resources differ. Substituting $\bar{G}$ from (7c) into (7a) and totally differentiating, we get

$$\frac{d\,\bar{L}}{d\tau} = \frac{(1-\alpha)\,\bar{R}}{\Delta} > 0,$$

where $\Delta = (1-\alpha)(Y' - \tau R') + \alpha[\bar{v} - (1-\bar{L})v'] > 0$.

[4] The derivatives of the functions $Y(\bar{L})$, $v(\bar{L})$ and $R(\bar{L})$ have the following expressions: $Y' = \dfrac{(F_L F_{KK} - F_K F_{KL})}{F_{KK}} > 0$, $v' = \dfrac{(F_{KK}F_{LL} - F_{KL}^2)}{F_{KK}} < 0$, and $R' = -\dfrac{\bar{L}\,(F_{KK}F_{LL} - F_{KL}^2)}{F_{KK}} > 0$.

Thus, a rise in the land tax increases labor hours and, through (6), capital stock. Output is pulled up, while consumption is crowded out. The before-tax return on land increases and the wage rate falls. The price of land falls less than the capitalized amount of the tax, because of the rise in $\bar{R}$.

When tax revenues are used to increase government spending, the consideration of an endogenous labor supply invalidates the Ricardian result on the incidence of a pure rent tax, giving support to a "Feldstein effect" on capital stock and output.[5] The endogenous adjustment of government spending alters the allocation of resources and results in the land tax shifting because the induced change in consumption affects labor supply.[6]

3 Labor-turnover economy

3.1 The model

In the neoclassical economy, there is no unemployment, since labor supply and demand instantaneously adjust, so as to eliminate any kind of disequilibrium that may arise in the labor market.

In this section, we consider a labor-turnover economy, which offers an explanation for the natural rate of unemployment. The analysis is based on the works of Hoon and Phelps (1992 and 1996) and Phelps (1994, ch. 7), which originate from Phelps (1968) and Salop (1979). According to such an

[5] Contrary to Feldstein (1977), in this case the wage rate falls, while the interest rate remains constant.

[6] If the government budget constraint were maintained balanced through the compensatory change in consumption taxation, the effects of a τ shock would be qualitatively the same as those obtained under the endogenous adjustment of government spending.

approach, firms find it optimal to set wages above the competitive level with the scope of raising the cost of employees being fired, as a result discouraging quittings among employees and reducing the firm's labor-turnover costs. The firms' incentive-wage policy results in involuntary unemployment.

Output X is produced by atomistic firms by means of the production function $X = F(K, T, N)$, where N represents the stock of employees. $F(\ )$ retains all the properties postulated before.

Workers, who are prone to quit their work-place in order to find a "better" job, base quitting decisions on the wage policy of the firm, the prospects of the labor market and their nonwage income. After the workers quit, firms face turnover costs for recruiting and training new employees. Suppose, as in Hoon and Phelps (1996), that the unit cost of training a new worker is βh, where β is a positive parameter and h the gross hiring rate as a fraction of the workforce; labor-turnover costs are given by $\beta h N$.

Each firm decides on hirings, wages and factor use by maximizing the present discounted value of its cash-flow subject to the accumulation constraint for the stock of employees. The relative change in the stock of employees is given by the difference between the number of workers hired, hN, and the number of workers that quit, ζN, where ζ is the quittig rate; that is

$$\dot{N} = N[h - \zeta(\frac{z}{v}, \frac{y^W}{v})], \tag{8}$$

where z represents the expected value of real earnings of a quitting worker, v the real wage per worker and y^W nonwage income per capita. The quitting rate is assumed to be a positive convex function of the wage paid elsewhere in the economy in comparison with the wage paid by the firm and the nonwage

income in comparison with the firm's wage, i.e. $\zeta_i > 0$, $\zeta_{ii} > 0$ for $i = 1, 2$; we assume for simplicity that $\zeta_{12} = 0$.

The representative firm's intertemporal optimization problem is

$$\max \int_0^\infty \left[F(K,T,N) - rK - RT - vN - \beta hN\right] e^{-rt} dt$$

subject to (8) and the initial condition $N(0) = N_0$. z and y^W are taken as given by the firm. The first-order conditions for maximum profit imply[7]

$$F_K(K,T,N) = r \tag{9a}$$

$$F_T(K,T,N) = R \tag{9b}$$

$$b = \beta \tag{9c}$$

$$\dot{b} - rb = -F_N(K,T,N) + v + (\beta - b)h + b\zeta(\frac{z}{v}, \frac{y^W}{v}) \tag{9d}$$

$$1 = b\left(\zeta_1 \frac{z}{v^2} + \zeta_2 \frac{y^W}{v^2}\right), \tag{9e}$$

together with (8) and the transversality condition $\lim_{t\to\infty} bNe^{-rt} = 0$.

The shadow price of trained employees b is constant according to (9c). Equation (9d) represents the firm's labor demand. Using (9c), the labor demand can be rewritten as

[7] The concavity of the production function and the assumed signs of the second derivatives of the quitting function ensure that the second-order conditions of the firm's optimality problem are satisfied.

$$v = F_N(K, T, N) - \beta[\zeta(\frac{z}{v}, \frac{y^W}{v}) + r]. \tag{9d'}$$

In a labor-turnover economy, the demand for labor depends on the marginal productivity of labor, the quitting rate and the rate of interest.

Equation (9e) represents the incentive-wage equation. It states that the optimal wage set by firms ensures that the marginal cost of a wage rise is just equal to the marginal benefit (in terms of reduced quitting-turnover costs).

According to Calvo (1979) and Salop (1979), the expected real wage of a quitting worker in (9d') and (9e) can be specified as $z = Nv$.[8] Nonwage income is given by the interest income earned on wealth, i.e. $y^W = rW$. In this labor-turnover economy, wealth is given by the sum of physical capital, the value of land and the value of trained employees βN;[9] that is, $W = K + qT + \beta N$.

The resource constraint implies that output less labor-turnover costs must be equal to aggregate demand; that is

$$X - \beta hN = C + \dot{K} + G. \tag{10}$$

The demand-side of the economy and the government budget constraint are the same as before, once L is replaced by N.

[8] In the expression for z, the labor force has been normalized to one and unemployment benefits have been disregarded.

[9] This is because β can be interpreted as the value of one unit of labor asset and N is the amount of an asset held by the average worker. See Hoon and Phelps (1992 and 1996).

3.2 Effects of the tax on pure rent

The steady state model can be summarized as follows

$$\bar{v}= F_N(\bar{K}, \bar{N}) - \beta\zeta \left[\bar{N}, \frac{\rho(\bar{K} + \bar{q} +\beta\ \bar{N})}{\bar{v}}\right] - \beta\rho \tag{11a}$$

$$\bar{v}= \beta \left[\zeta_1(\cdot,\cdot)\ \bar{N} +\zeta_2(\cdot,\cdot)\frac{\rho(\bar{K} + \bar{q} +\beta\ \bar{N})}{\bar{v}}\right] \tag{11b}$$

$$\bar{q}\ \rho = (1-\tau)F_T(\bar{K}, \bar{N}) \tag{11c}$$

$$F_K(\bar{K}, \bar{N}) = \rho, \tag{11d}$$

where the expression for $\bar{z}=\bar{N}\bar{v}$, the definition of $\bar{y}^W$ and $\widetilde{T}=1$ have been used. Consumption and, according to the compensatory public financing scheme, either lump-sum transfers or government spending can be computed residually through (10) or the government budget constraint (7c), respectively.

Using (11d), we can express capital stock as a function of the stock of the employees, i.e. $\bar{K}= K(\bar{N})$ (where $K' = -\frac{F_{KN}}{F_{KK}} > 0$). Employing this relationship, we can eliminate capital from (11a)-(11c) and obtain[10]

[10]The expressions for the derivatives of the $\Omega(\ )$, $\Gamma(\ )$, and $R(\ )$ functions are given in the Appendix. Equation (12a) gives the demand price of labor. Given $\bar{q}$, an increase in $\bar{N}$ (and hence in $\bar{K}$), in raising quittings of employees (because of the improved labor market prospects and the higher nonwage income), decreases the demand wage. An increase in the land price, by increasing nonwage income and hence quittings, likewise reduces the demand wage at a given $\bar{N}$ (and hence $\bar{K}$).

Equation (12b) represents the equilibrium labor supply price. The supply wage is increasing in $\bar{N}$, given $\bar{q}$, and in $\bar{q}$, given $\bar{N}$. An increase in employment pushes the supply

$$\bar{v} = \Omega(\bar{N}, \bar{q}), \quad \Omega_N < 0, \ \Omega_q < 0; \tag{12a}$$

$$\bar{v} = \Gamma(\bar{N}, \bar{q}), \quad \Gamma_N > 0, \ \Gamma_q > 0; \tag{12b}$$

$$\bar{q}\ \rho = (1-\tau)R(\bar{N}), \quad R' > 0. \tag{12c}$$

Differentiating (12a)-(12c) yields

$$\frac{d\,\bar{N}}{d\tau} = \frac{\bar{R}\,(\Gamma_q - \Omega_q)}{\Pi} > 0,$$

$$\frac{d\,\bar{v}}{d\tau} = \frac{\bar{R}\,(\Gamma_q \Omega_N - \Gamma_N \Omega_q)}{\Pi} \lessgtr 0,$$

$$\frac{d\,\bar{q}}{d\tau} = -\frac{\bar{R}\,(\Gamma_N - \Omega_N)}{\Pi} < 0,$$

where $\Pi = (1-\tau)R'(\Gamma_q - \Omega_q) + \rho(\Gamma_N - \Omega_N) > 0$.

A rise in the land rent tax stimulates employment, exerts an ambiguous effect on the wage rate, and lowers the land price. The rationale for these effects is as follows. The reduction of the land value, induced by the rent tax, causes a fall in nonwage income, thereby dampening quittings of employees. This stimulates the demand for labor and gives firms the incentive to pay lower wages. As a consequence, employment rises, while the wage rate may

wage up since quittings are stimulated via the expected wage of quitting workers and nonwage income. $\bar{v}$ is increasing in $\bar{q}$ since a higher land value implies a higher nonwage income, which in stimulating quittings requires firms to raise their wage supply at a given $\bar{N}$ (and $\bar{K}$).

rise or fall.[11] Higher employment in turn implies higher capital stock from (11d) and hence output. The land reward is pulled up. Despite the rise in employment and capital, income from wealth drops unambiguously because of the fall in the land price.

These results hold independently of whether rent tax revenues are distributed to consumers or spent unproductively by the government. The compensatory financing scheme for the government budget, instead, matters for the consequence of the rent tax on consumption. If the tax revenues are rebated to consumers, consumption goes up; otherwise if tax revenues are employed to finance a rise in government spending, consumption falls.[12]

4 Conclusions

We have studied the consequences of a land rent tax within an infinite-lived economy, paying special attention to the role of the labor market structure. Two types of labor market have been explored: one with competitive wages and no unemployment, and one with incentive-wages and structural unemployment.

In the case of an endogenous labor supply and competitive wages, we have shown that the connection between Ricardian demographics and the Ricardian incidence of a tax on pure rent, discovered by CKR, requires an

[11] The ambiguous effect on the wage rate is due to the upward shift of the labor demand and the simultaneous downward shift of the incentive-wage equation.

[12] A compensatory reduction of the consumption tax rate that may alternatively accompany the rise in τ would increase consumption, but leave the other qualitative effects of the rent tax unaffected.

additional element to be satisfied: a special compensatory financing scheme for the government budget. When tax revenues are transferred back to consumers, such a connection is preserved. If the higher land rent taxes are, instead, accompanied by a rise in government spending, capital stock, labor and output are spurred, the wage rate declines, and the pre-tax land reward is pulled up. In this case, the connection identified by CKR no longer holds.

In a model with structural unemployment, we have found that the land rent tax increases employment and capital stock, while it reduces income from wealth and the stock of nonhuman wealth because of the fall in the land value. Precisely, the mechanics of these effects are as follows. The tax-induced reduction in the price of land, by lowering income from wealth compared to the workers' wage, decreases the quittings of employees. Firms then find it optimal to pay lower wages in order to dampen quittings and curtail labor-turnover costs. Lower wages and quittings stimulate labor demand. Employment is increased and therefore capital formation is spurred. The effect on the wage rate is ambiguous, while the land reward is increased.

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APPENDIX

Derivatives of the $\Omega(\ ,\ )$, $\Gamma(\ ,\ )$ and $R(\ )$ functions

The derivatives of the $\Omega(\ ,\ )$, $\Gamma(\ ,\ )$ and $R(\ )$ functions in system (12) are given by the following expressions

$$\Omega_N = \frac{\left[\bar{v}\ (\frac{v'}{\beta} - \xi_1) - \xi_2\rho(K' + \beta)\right]}{\xi_1\ \bar{N}} < 0;\ \ \Omega_q = -\frac{\xi_2\rho}{\xi_1\ \bar{N}} < 0;$$

$$\Gamma_N = \frac{\left[(\xi_1 + \bar{N}\ \xi_{11}) + (\frac{\xi_2}{\bar{v}} + \frac{\bar{y}^W}{\bar{v}^2}\xi_{22})\rho(K' + \beta)\right]}{\left[\frac{1}{\beta} + (\xi_2 + \frac{\bar{y}^W}{\bar{v}}\xi_{22})\frac{\bar{y}^W}{\bar{v}^2}\right]} > 0;$$

$$\Gamma_q = \frac{\rho\left(\frac{\xi_2}{v} + \frac{\bar{y}^W}{\bar{v}^2}\xi_{22}\right)}{\left[\frac{1}{\beta} + (\xi_2 + \frac{\bar{y}^W}{\bar{v}}\xi_{22})\frac{\bar{y}^W}{\bar{v}^2}\right]} > 0;$$

$$R' = -\frac{\bar{N}\ (F_{KK}F_{NN} - F_{KN}^2)}{F_{KK}} > 0,$$

where $K' = -\frac{F_{KN}}{F_{KK}} > 0$ and $v' = \frac{(F_{KK}F_{NN} - F_{KN}^2)}{F_{KK}} < 0.$

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(lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003
(lxvi) This paper has been presented at the 4th BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL) , Venice, August 28-29, 2003
(lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003
(lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003
(lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003
(lxx) This paper was presented at the 9th Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004
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