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Specific-Factors Model of Trade and Finance

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Abstract

This paper investigates the allocative properties of an OLG specific-factors small open economy facing perfect capital mobility. Wealth formation, economic development and different labor market regimes are at the center-stage of the analysis. In a model with competitive wages and no unemployment, we find that exogenous shocks that do not affect human wealth –like the terms of trade and land endowment shifts– or the propensity to save, leave nonhuman wealth, consumption and aggregate labor unchanged; in such cases, capital formation is driven

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by the static effects exerted on sectoral labor. Disturbances that alter human wealth –like the world interest rate, and capital and labor taxation shocks– or the thrift rate, instead, affect nonhuman wealth and consumption as they involve an intergenerational redistribution of resources that modifies aggregate saving; labor hours supplied may be changed. In these circumstances, capital accumulation is the result of the consequences exerted on financial wealth and input demands. The consideration of a labor market with structural unemployment does not qualitatively affect the results, except for the world interest rate and the rate of time discount shifts. Our results differ substantially from those obtained in static and dynamic specific-factors setups with financial autharky.

JEL classification: F41, F43, O41.

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1   Introduction

The specific-factors model of international trade, developed by Jones (1971) and Samuelson (1971), represents, once formulated in a dynamic version, the natural apparatus for investigating the distinct role that reproducible and non-reproducible productive assets play in the intertemporal allocation of resources. In fact, physical capital and unimproved land –the usual specific-factors considered– represent alternative vehicles for holding wealth. More-over, specific-factor supplies and values are strictly linked to wealth accumulation; in particular, saving decisions make the supply of physical capital endogenous, but only affect the land market value, as the supply of land is fixed.[1]

The analysis of a specific-factors economy in an intertemporal context was first carried out by Eaton (1987), who considers factor-asset specificity in a two-sector life-cycle model of capital formation with financial autharky. In such a dynamic setting, the predictions of the simple Jones-Samuelson model in terms of relative commodity prices and factor endowments are enriched and sometimes modified. This is because the consideration of capital and land as stores of value introduces an asset-valuation effect into the model due to the change in the land value induced by exogenous shifts, which affects the amount of saving left over for capital formation. For example, an increase in

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[1]The simultaneous role of land as a fixed factor of production and an asset was initially considered within a dynamic optimizing model by Feldstein (1977), who analyzed the incidence of a tax on pure rent. The original idea of the interaction between the land value and capital accumulation, however, dates back to Ricardo (1817).

the relative price of the land-using commodity has ambiguous implications on factor rents, the value of land, and the capital stock. These ambiguities depend on the contrasting consequences exerted by the asset-valuation effect, on the one hand, and the Jones-Samuelson static effect, on the other, on the labor market, factor prices, and the value of land. When the labor share and the elasticity of substitution in the land-using industry are small, the asset-valuation effect dominates, implying that the terms of trade shock leads to a rise in the interest rate and a reduction in the wage rate and investment in fixed capital; the opposite is true, when the labor share and elasticity of substitution are large.

Financial capital immobility is, however, at odds with the reality for many advanced economies that have an unrestricted access to the world financial market and are exposed to the repeated waves of financial globalization, as agents also hold foreign assets (in addition to the domestic ones) in their portfolios.

Some recent articles have developed intertemporal optimizing specific-factors models in a perfectly integrated financial world. See, for example, Roldos (1991), Brock and Turnovsky (1993), and Kose (2002). These studies, addressing different issues –like the growth effects of tariffs and the international generation-propagation of the business cycle– within representative-agent small open economies, do not consider land as an asset, but simply as a fixed factor of production.[2] Therefore, they do not consider the transmission mechanism of exogenous impulses on the market value of the fixed asset

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[2]In the literature, sector-specific capital models have also been developed; see, for example, Ryder (1969) and, when capital adjustment costs are high, Morshed and Turnovsky (2004). These models incorporate the assumption that capital is completely immobile across sectors, being specific to the sector in which it is located.

and hence their feedbacks on saving funneled into capital formation and net foreign asset holdings.

The purpose of this paper is to investigate the allocative properties of an OLG specific-factors two-sector economy, facing perfect capital mobility and using labor endogenously, in which land is a productive asset.[3] The analysis focuses on wealth formation and economic development within an articulated portfolio structure, characterized by two productive assets –one reproducible and one non-reproducible– and one non-productive asset. Furthermore, two alternative labor market structures are considered: one with competitive wages and no unemployment, one with incentive-wages and structural unemployment.

We study the quasi-opposite case of the Jones-Samuelson static one – where the capital stock is inelastically supplied and the price of capital is flexible– as in our analysis capital formation is endogenous and the price of capital is fixed at a world level because of perfect capital mobility.[4]

One of the key-findings of the analysis is that exogenous shocks that do not affect human wealth –like the terms of trade and land endowment shifts– or the saving rate, leave consumption, nonhuman wealth and aggregate labor unchanged. In these cases, capital formation is driven by the static effects

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[3] A specific-factors model of capital accumulation in a financially globalized economy with an inelastic labor supply has been developed by Eaton (1988). In this paper, Eaton only investigates the effects of parametric changes in foreign assets, in an economy that is financially semi-integrated at a world level, and the relative commodity prices, in an economy with perfect capital mobility.

[4] The hypothesis of unrestricted access to the world capital market exerts strong implications on income distribution of a specific-factors setup. The income distribution of a specific-factors model is also heavily affected in economies with infinite horizons; see, for example, Roldos (1992), where an immortal monetary economy with financial capital immobility is studied.

that the exogenous disturbances exert on labor used in the capital-using sector.

Disturbances that alter human wealth –like exogenous shifts regarding the world interest rate, as well as capital and labor taxation– or the thrift rate, instead, affect financial wealth and consumption as they involve a re-distribution of resources across different generations that modifies individual and aggregate savings. In such cases, while wealth formation is driven by intergenerational forces operating through human wealth, capital formation is the result of changes in financial wealth, the firm's cost of capital and the production structure. The land-valuation effect along with capital formation determines the consequence of the exogenous shocks on the holdings of net foreign assets. Aggregate labor supplied is only responsive to disturbances that affect the world interest rate and the rate of time preference.

Finally, we show that the consideration of a labor market with structural unemployment, due to incentive-wages of the shirking type, may qualitatively affect the results obtained with competitive wages and no unemployment only in the case that the interest rate or propensity to save shifts.[5]

Our results differ substantially from those obtained in the static and dynamic specific-factors analyses with capital and land; see Jones (1971), Samuelson (1971), and Eaton (1987 and 1988).

The structure of the paper is as follows. Section 2 sets out the neoclassical model and investigates its allocative characteristics as well as the steady state effects of several shifts. Section 3 studies the properties of an incentive-wage economy. Section 4 concludes.

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[5]Structural unemployment was introduced into a specific-factors economy also by Kee and Hoon (2005) through the consideration of unions' wage setting with the aim of studying the factors responsible for the secular decline of Singapore's unemployment.

2 Neoclassical economy

2.1 The model

Consider a real small open economy that produces two goods, X and Y, and operates in a world of perfect financial capital mobility. The two sectors of production, which present a Jones-Samuelson physiognomy, are competitive and use standard neoclassical constant-returns-to-scale production functions.[6] Good X, assumed to be the numeraire, is obtained by using physical capital K, which is sector-specific, and labor L_X, which is perfectly mobile across sectors, namely $X = F(K, L_X) = L_X f(\frac{K}{L_X})$, where $f(\ )$ is the sectoral output-labor ratio, $f' > 0$, and $f'' < 0$. Good Y, whose price measured in terms of the numeraire is $\widetilde{p}$ fixed at world level, is produced by employing unimproved land T and sectoral labor L_Y, i.e. $Y = H(T, L_Y)$.

First-order conditions for maximum profit in the two sectors entail

$$f'(\frac{K}{L_X}) = r^*(1 + \tau_K), \tag{1a}$$

$$f(\frac{K}{L_X}) - \frac{K}{L_X} f'(\frac{K}{L_X}) = v(1 + \tau_L), \tag{1b}$$

$$\widetilde{p} \, H_T(T, L_Y) = R, \tag{1c}$$

$$\widetilde{p} \, H_L(T, L_Y) = v(1 + \tau_L), \tag{1d}$$

where r^* is the given world interest rate (equal to the domestic interest rate because of perfect capital mobility), τ_K the *ad valorem* tax rate on capital, v the hourly real wage, τ_L the *ad valorem* tax rate on labor, and R the land

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[6]See Jones (1971), Samuelson (1971) and Mussa (1974).

reward. Full wage flexibility and perfect sectoral mobility of labor ensure that both sectors face identical wages. We assume that only capital and labor are taxed, while land is untaxed.[7]

On the demographic-side, we postulate that this economy is peopled by Blanchard-Yaari households having uncertain lifetimes, leaving no bequest, facing a constant mortality rate θ, and supplying labor endogenously; see Yaari (1965) and Blanchard (1985).[8] The population, composed of chronologically disconnected cohorts continuously entering the economy, is assumed to remain constant and hence is normalized to one.

Suppose that the individual utility is logarithmic in consumption, c, and leisure, $\widetilde{l} - l$ (where $\widetilde{l}$ represents the time endowment and l labor hours supplied). A consumer born at time s solves the following problem at each instant t

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

subject to the instantaneous budget constraint

$$\frac{dw(s,t)}{dt} + c(s,t) = (r^* + \theta)w(s,t) + v(t)l(s,t),$$

and the solvency condition precluding Ponzi schemes

$$\lim_{j \to \infty} w(j,t) \exp[-(r^* + \theta)(j - t)] = 0,$$

[7]This is because taxing land rent is basically inessential for the macroeconomic equilibrium in the case of the accommodation regime for the government budget considered here; see footnote 19 below for some considerations on the effects of a tax on land.

[8]Kanaginis and Phelps (1994), and Phelps (1994, ch. 16) develop the Blanchard-Yaari setup in the case of elastic labor-leisure choices. On the consumer-side, we depart from Eaton (1987) and (1988), where, instead, the two-period Diamond-Samuelson demographics are employed, and labor is inelastically supplied.

where $w(s,t)$ denotes nonhuman wealth of a consumer born at time s, ρ the rate of time preference (exogenous), and α a positive preference parameter.

The optimality conditions for the individual problem are

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

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

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

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

$$h(s,t) = \int_t^\infty [v(j)l(j,t)] \exp[-(r^* + \theta)(j-t)]dj.$$

The demand-side of the model can be expressed in aggregate terms as

$$\dot{C} = (r^* - \rho)C - \alpha\theta(\theta + \rho)W, \qquad (2a)$$

$$\tilde{L} - L = \frac{(1-\alpha)C}{\alpha v}, \qquad (2b)$$

$$\dot{H} = (r^* + \theta)H - vL, \qquad (2c)$$

$$C + \dot{W} = r^*W + vL, \qquad (2d)$$

where time indices have been omitted and capital letters denote aggregate variables of the corresponding individual ones. Equation (2a) describes the Blanchard-Yaari law for consumption dynamics,[9] (2b) the supply of labor,

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[9] Note that equation (2a) is obtained by using the aggregate life-cycle consumption function, i.e. $C = \alpha(\theta + \rho)(W + H)$, together with (2c) and (2d).

(2c) the human wealth dynamics, and (2d) the aggregate consumer budget constraint.

Nonhuman wealth is composed of physical capital K, unimproved land T and net foreign assets B; that is, $W = K + qT + B$, where q is the price of land (expressed in terms of the capital-using good).[10] The stock of nonhuman wealth is assumed to be strictly positive; hence, the steady state equilibrium requires from (2a) that $r^* > \rho$.

As assets are considered to be perfectly substitutable, their rates of return must be equal when expressed in terms of the same numeraire:

$$r^* = \frac{R}{q} + \frac{\dot{q}}{q}, \tag{3}$$

where perfect foresight has been assumed.

The economy is endowed with a fixed quantity of non-reproducible land $\tilde{T}$, fully used in the Y-sector. The labor market equilibrium requires that the amount of labor employed by firms in the two sectors of production must equal aggregate labor supplied by households; that is,

$$L_X + L_Y = L. \tag{4}$$

The government collects revenues by taxing capital and labor, and spends them unproductively for acquiring goods and services. Therefore, the government budget constraint is given by

$$\tau_K r^* K + \tau_L v L = G, \tag{5}$$

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[10]We are assuming that capital and land are entirely owned by domestic residents, who are free to borrow and lend abroad. It could be alternatively assumed, without altering the equilibrium, that the stock of capital and land are partly owned by domestic residents and partly by foreigners (see, for example, Eaton, 1988).

where G represents unproductive government spending. We assume that the government budget is kept continuously balanced through the endogenous adjustment of G.[11]

Finally, the current account, i.e. the trade balance plus the interest income earned from net foreign assets, gives the rate of accumulation of B:

$$\dot{B} = X + \widetilde{p}\,Y - C - \dot{K} - G + r^*B. \tag{6}$$

2.2 Comparative statics

The analysis focuses on the long-run properties of our OLG specific-factors economy.[12] It is worth emphasizing some mechanical features of the steady state in order to facilitate the understanding of the comparative static analysis. First, the marginal productivity of capital is tied down by the given cost of capital for firms, $r^*(1 + \tau_K)$. This implies that (1a) uniquely determines the capital intensity in the X-sector; that is,

$$\frac{\bar{K}}{\bar{L}_X} = \kappa[r^*(1 + \tau_K)], \quad \kappa' < 0, \tag{7a}$$

where overbar variables denote steady state values and $\kappa(\,\cdot\,) = f'^{-1}(\,\cdot\,)$. Equation (7a) establishes, for a given $r^*(1 + \tau_K)$, a positive relationship

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[11] We deliberately avoid considering lump-sum tax financing as changes in lump-sum taxes would cause a redistribution of income across generations, modifying aggregate saving and the stock of nonhuman wealth, and hence obscuring the implications of the exogenous shocks on the resource allocation. Notice that the case of a compensatory finance based on consumption taxation would leave our findings unchanged.

[12] The complete macroeconomic model –obtained by combining the optimality conditions for firms and households with the market clearing conditions, the government budget constraint, and the relevant equations of accumulation– is saddle-point stable as shown in an unpublished Appendix.

between the capital stock and labor employed in the capital-using sector. An increase in the cost of capital for firms, due to either higher r^* or τ_K, lowers the capital intensity as it reduces the demand for capital.

Second, by using (1b) and (7a), the wage rate can be expressed as

$$\bar{v} = \frac{\omega[r^*(1 + \tau_K)]}{(1 + \tau_L)}, \quad \omega' < 0, \tag{7b}$$

where $\omega(\,\cdot\,) = f[\kappa(\,\cdot\,)] - \kappa(\,\cdot\,)f'[\kappa(\,\cdot\,)]$. A rise in either the world interest rate or the capital tax rate, by shrinking the capital intensity, drives the real wage down. A higher labor taxation leaves the firm's labor cost unchanged, but lowers the household take-home wage.

Third, the reduced-form for labor employed in the land-using sector – obtained by solving $\widetilde{p}\, H_L(\widetilde{T}, \bar{L}_Y) = \omega[r^*(1 + \tau_K)]$– is given by

$$\bar{L}_Y = \Lambda[\widetilde{p}, \widetilde{T}, r^*(1 + \tau_K)], \quad \Lambda_{\widetilde{p}} > 0, \ \Lambda_{\widetilde{T}} > 0, \ \Lambda_{r^*(1 + \tau_K)} > 0.^{13} \tag{7c}$$

A rise in the terms of trade (or in the land endowment) stimulates labor demand in the land-using sector and hence increases $\bar{L}_Y$. A higher cost of capital, by reducing the wage rate through the fall in $\dfrac{\bar{K}}{\bar{L}_X}$, induces firms to hire more labor in the Y-sector.

Define $\bar{y}^W$ as the income from nonhuman wealth, given by the sum of the interest income on wealth and the actuarial premium on wealth received by households from competitive insurance companies; that is, $\bar{y}^W = (r^* + \theta)\, \bar{W}.^{14}$ Taking into account such a definition together with relationships (7), the

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[13]The partial derivatives of the $\Lambda(\,)$ function are:
$\Lambda_{\widetilde{p}} = -\dfrac{H_L}{\widetilde{p}\, H_{LL}} > 0$, $\Lambda_{\widetilde{T}} = \dfrac{\bar{L}_Y}{\widetilde{T}} > 0$, and $\Lambda_{r^*(1+\tau_K)} = -\dfrac{\kappa[r^*(1 + \tau_K)]}{\widetilde{p}\, H_{LL}} > 0$.

[14]The introduction of the auxiliary variable $\bar{y}^W$ is done with the aim of facilitating the comparison of the neoclassical economy with the incentive-wage one.

economy can be summarized by the system

$$\bar{K} = \kappa[r^*(1 + \tau_K)] \left\{ \bar{L} - \Lambda[\tilde{p}, \tilde{T}, r^*(1 + \tau_K)] \right\}, \quad (8a)$$

$$\tilde{L} - \bar{L} = \frac{(1 - \alpha)\,\bar{C}}{\alpha\,\bar{v}}, \quad (8b)$$

$$\bar{C} = \frac{\alpha\theta(\theta + \rho)}{(r^* - \rho)(r^* + \theta)}\,\bar{y}^W, \quad (8c)$$

$$\bar{C} = \frac{r^*}{(r^* + \theta)}\,\bar{y}^W + \bar{v}\bar{L}. \quad (8d)$$

$\bar{L}_X$ is determined from (7a), once (8a) is used to substitute out the capital stock.

In order to understand how aggregate labor hours are determined, we proceed as in Petrucci and Phelps (2005). Substituting $\bar{C}$ from (8d) into (8b), and rearranging, we obtain

$$\frac{\bar{L}}{\tilde{L}} = \alpha - \frac{(1 - \alpha)r^*}{(r^* + \theta)}\frac{\bar{y}^W}{\bar{v}\tilde{L}}. \quad (9)$$

Equation (9) gives the labor supply in terms of the nonwage-income-to-wage ratio. An increase in $\dfrac{\bar{y}^W}{\bar{v}\tilde{L}}$ lowers manhours worked because it raises, through (8d), the consumption-to-wage ratio and hence, through (8b), the demand for leisure. Equation (9) is represented by the LS schedule in Fig. 1. The LS schedule becomes steeper if a rise in r^* takes place.

Plugging (8d) into (8c) yields

$$\frac{\bar{L}}{\tilde{L}} = \Theta(r^*, \rho)\frac{\bar{y}^W}{\bar{v}\tilde{L}}, \quad \Theta_{r^*} < 0, \quad \Theta_\rho > 0, \quad (10)$$

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where $\Theta(r^*, \rho) = \dfrac{[\alpha\theta(\theta + \rho) - r^*(r^* - \rho)]}{(r^* - \rho)(r^* + \theta)} > 0$.[15] Equation (10) describes

the combinations of $\dfrac{\bar{L}}{\tilde{L}}$ and $\dfrac{\bar{y}^W}{\bar{v}\tilde{L}}$ compatible with the Blanchard-Yaari asset market equilibrium as described by the arbitrage condition between consumption and nonhuman wealth returns. This relationship is represented by the upward-sloping BY schedule in Fig. 1. Intuitively, an increase in the ratio of income-from-wealth-to-wage pulls up the consumption-to-wage ratio from (8c); since the disposable-income-to-wage ratio increases less than $\dfrac{\bar{y}^W}{\bar{v}\tilde{L}}$, a compensatory rise in manhours is needed in order to satisfy the consumer budget constraint (8d). The BY curve is rotated in a clockwise direction by either a rise in r^* or a fall in ρ.

The intersection between the LS and BY schedules determines aggregate labor hours worked and the nonwage-income-to-wage ratio. Since the exogenous shifts that impinge on (9) and (10) only regard r^* and ρ, manhours and the income-from-wealth-to-wage ratio remain invariant when any other exogenous disturbance occurs.

[Insert Fig. 1 about here]

Once the consequences of the exogenous shocks on $\bar{L}$ and $\dfrac{\bar{y}^W}{\bar{v}\tilde{L}}$ are identified, the effects on $\bar{y}^W$ and $\bar{C}$ can be inferred by using (7b), (8c), and (8d). $\bar{K}$, instead, is derived from (8a).

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[15] The condition $\alpha\theta(\theta + \rho) > r^*(r^* - \rho)$ guarantees the saddle-point stability of the steady state.

Moreover, the reduced-forms for the land reward and the land value are given by[16]

$$\bar{R}= R[\widetilde{p}, r^*(1+\tau_K)], \quad R_{\widetilde{p}} > 0, \ R_{r^*(1+\tau_K)} > 0, \tag{11a}$$

$$\bar{q}= \frac{R[\widetilde{p}, r^*(1+\tau_K)]}{r^*} = q[\widetilde{p}, r^*(1+\tau_K)], \quad q_{\widetilde{p}} > 0, \ q_{r^*} \lessgtr 0, q_{\tau_K} > 0. \tag{11b}$$

Finally, the stock of net foreign assets can be computed through the following expression

$$\bar{B}= \frac{\bar{y}^W}{(r^* + \theta)} - \bar{K} - q[\widetilde{p}, r^*(1+\tau_K)] \ \widetilde{T} . \tag{11c}$$

We can now study the long-run effects of several exogenous shifts. Table 1 provides a synoptical view of the various comparative static results.

2.2.1 The terms of trade

Consider the effects of a rise in the relative price of the land-using good $\widetilde{p}$.[17] Since the terms of trade do not impact on (9) and (10), $\bar{L}$ and $\dfrac{\bar{y}^W}{\bar{v}\widetilde{L}}$ remain unchanged. Therefore, nonhuman wealth and consumption are invariant, as the household wage is constant from (7b). As the increase in $\widetilde{p}$ expands $\bar{L}_Y$ from (7c), a reduction of labor used in the capital-using sector occurs so as

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[16]Equations (11) are obtained by using (1c), (3) and (7). The effects of exogenous shifts on the land reward and the land market value are given by:

$R_{\widetilde{p}} = H_T + \dfrac{H_L \ \bar{L}_Y}{\widetilde{T}} > 0, \ R_{r^*(1+\tau_K)} = \dfrac{\kappa(r^*,\tau_K) \ \bar{L}_Y}{\widetilde{T}} > 0;$ and

$q_{\widetilde{p}} = \dfrac{R_{\widetilde{p}}}{r^*} > 0, \ q_{r^*} = \dfrac{1}{r^{*2} \ \widetilde{T}} \{ \dfrac{\bar{K}}{\bar{L}_X} r^*(1+\tau_K) \ \bar{L}_Y - \bar{R}\widetilde{T}\} \lessgtr 0, \ q_{\tau_K} = \dfrac{R_{\tau_K}}{r^*} > 0 .$

[17]A terms of trade shock can be assimilated qualitatively to a technological shock that affects the land-using sector.

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to leave aggregate labor hours constant. The contraction of $\bar{L}_X$ brings about a fall in the capital stock.

Non-land input prices are constant, while the land reward is driven up since land and labor are Edgeworth complementary. Thus, the market value of land is increased. The stock of foreign assets may either rise or fall, since the capital stock diminishes and the land value is pulled up.[18]

2.2.2 Land endowment

A rise in $\widetilde{T}$ reproduces qualitatively most of the macroeconomic effects of an increase in $\widetilde{p}$; such a shock, however, does not affect the marginal productivity of land and the land market value.[19]

2.2.3 Capital shift

Since the experiment of a pure parametric change in the reproducible specific-factor cannot be performed, as capital is endogenously accumulated, we alternatively study the effect of a capital-promoting shock, like the reduction in the capital tax rate.[20]

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[18] The net foreign assets multiplier is given by

$$\frac{d\,\bar{B}}{d\,\widetilde{p}} = -\frac{\widetilde{T}}{r^*} H_T - H_L \left\{ \frac{\kappa[r^*(1+\tau)]}{\widetilde{p}\,H_{LL}} + \frac{\bar{L}_Y}{r^*} \right\} \gtrless 0.$$

[19] Note that if land rent taxation were considered (under the government spending financing rule adopted here), a rise in the land tax would be neutral for the resource allocation and the incidence analysis; the sole effects of the land tax would be a fall in the land value and a compensatory rise in the stock of net foreign assets. The same effects are obtained by Eaton (1988) and Petrucci (2005) in one-sector economies operating under perfect capital mobility.

[20] This shock is qualitatively equivalent to a technological change that affects the production of the capital-using sector.

A fall in τ_K, accompanied by a compensatory accommodation of government spending, does not change both labor hours and the income-from-wealth-to-wage ratio. The reduction in the capital tax rate raises the capital intensity and hence the wage rate –through (7a) and (7b), respectively– as the cost of capital for firms falls. The higher household wage rate pulls non-human wealth up alongside consumption. Labor in the land-using sector is reduced because of the higher wage rate, while labor used for producing X rises. The increase in the capital intensity implies that the capital stock expands proportionally more than $\bar{L}_X$. The land yield and the land price fall. Net foreign assets may go up or down.

The consequences of τ_K on income from wealth and consumption have an intergenerational motivation stemming from the induced change in human wealth. In fact, the decline in τ_K brings about an increase in human wealth (because of the higher household wage),[21] which redistributes income from the older generations, who consume more and save less, to the younger generations, who consume less and save more. This mechanism increases aggregate saving and, in turn, expands the stock of nonhuman wealth and consumption.

2.2.4 Labor shift

As the supply of labor is endogenous, we consider a labor taxation shift as the exogenous shock that affects the mobile factor.[22] A reduction in the labor

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[21] From (2c) and (7b), long-run human wealth can be expressed as $\bar{H} = \dfrac{\omega[r^*(1+\tau_K)]\,\bar{L}}{(1+\tau_L)(r^*+\theta)}$.

[22] Another possible labor shift that could be considered is the parametric change in the aggregate time endowment. An increase in $\widetilde{L}$ can be associated with a more efficient use of time, due, for example, to a reduction of the commuting-time in traffic congested areas (this can be ascribed to succesful transport and anti-traffic policies) or technical changes

tax rate τ_L exerts no effects on $\bar{L}$ and $\dfrac{\bar{y}^W}{\bar{\tilde{v}}\tilde{L}}$. The cost of labor for firms is unchanged; this implies that the workers' take-home wage is pulled up being the labor tax rate lower. Nonhuman wealth and consumption are therefore increased. Since $\bar{L}$ and $\bar{L}_Y$ are invariant, labor used in the capital-using sector and hence the capital stock also remain unchanged. The price of capital, the land reward and the price of land are unaltered by the τ_L shock as well. A rise in net foreign assets occurs.

2.2.5 Saving shift

In order to fully understand how this specific-factor economy works, we study the consequences of a saving-stimulative shock.[23] Our experiment considers an increase in thrift, i.e. a reduction in the rate of time preference.[24]

A fall in ρ rotates the BY schedule in a clockwise direction; see Fig. 1. The equilibrium moves from point A to point A'. Thus, a lower ρ reduces aggregate labor and increases the income-from-nonhuman-wealth-to-wage ra-

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(like the ICT revolution) that in some circumstances may make it possible to work at home and *de facto* expand the available time for leisure and work. A higher $\tilde{L}$ raises manhours supplied and, given that the wage rate remains constant, nonhuman wealth. Consumption also expands. Since labor used to produce Y is unchanged, the rise in aggregate labor is entirely matched by an increase of labor employed in the capital-using sector, which results in a higher capital stock. Input prices and the land value are not touched by the disturbance, while the stock of net foreign assets is unclearly affected.

[23]When financial capital immobility is considered, as in Eaton (1987), this shock is equivalent to a capital stock stimulus; in our context, instead, such a shock differs from a pure capital shift because domestic savers also hold net foreign assets in their portfolios.

[24]Note that a decrease in either the mortality rate θ, i.e. a longer consumer life-time span, or a nonwage income or a nonhuman wealth tax would generate the same qualitative consequences of a fall in ρ. The analysis of the effects of a nonwage income tax in a one-sector OLG small open economy is provided, for example, by Nielsen and Sørensen (1991).

tio. This implies that $\bar{y}^W$ increases as $\bar{v}$ is given. Consumption also rises, but proportionally less than the cash-flow from wealth. Labor in the capital-using sector reflects the reduction in $\bar{L}$, since $\bar{L}_Y$ is constant; consequently a fall in $\bar{K}$ takes place.[25] Factor prices and the land value do not move. The rise in nonhuman wealth derives entirely from the accumulation of net foreign assets, which represent the only way-out to support the higher saving.[26]

2.2.6 World interest rate

A world interest rate shift may be seen as a composite disturbance resulting from the simultaneous change in τ_K, in the same direction, and ρ, in the opposite direction.

A rise in r^*, for example, rotates both the LS and BY schedules in a clockwise direction; the BY schedule rotates horizontally to a greater extent; the new equilibrium is at A". Thus, $\bar{L}$ falls and $\dfrac{\bar{y}^W}{\bar{v}\tilde{L}}$ increases. The capital intensity in the X-sector shrinks as capital is more expensive for firms. The workers' wage is reduced. Income from nonhuman wealth moves ambiguously; also the effect on consumption is unclear.[27]

Labor in the land-using sector is stimulated by the lower labor cost for firms, while labor in the capital-using sector is reduced because of the re-

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[25]If the labor supply were inelastic, i.e. $\alpha = 1$ and $\bar{L}=\tilde{L}$, the decline in ρ would always be stimulative for nonhuman wealth and consumption, but inconsequential for capital formation and the sectoral allocation of labor.

[26]Note that if a hike in consumption taxation (accompanied by a compensatory increase in government spending) were implemented with the aim of stimulating saving, its effects would be neutral for the macroeconomic equilibrium, except for the level of physical consumption, which would fall, leaving consumption expenditure constant.

[27]The lower the mortality rate θ, the more likely the negative multipliers for nonwage income and consumption are.

duced labor supply; $\bar{K}$ falls proportionally more than $\bar{L}_X$. The marginal productivity of land is pulled up, while the land value and net foreign assets move unclearly.

3 Incentive-wage economy

3.1 The model

The neoclassical model does not explain equilibrium unemployment as wages adjust to equate the labor supply and demand, and changes in labor are only due to variations of manhours. In order to investigate the implications of the 'natural' rate of unemployment for the macroeconomic equilibrium of our specific-factors economy, we use the incentive-wage theory, based on the assumption of the shirking behavior of workers, as developed by Calvo (1979), Solow (1979), and Shapiro and Stiglitz (1984). We adapt the two-sector Heckscher-Ohlin economy with structural unemployment, developed by Phelps (1994, ch. 9), to our case.

The production function for good X is now given by $X = F(K, \varepsilon N_X) = \varepsilon N_X f(k)$, where $F(\ ,\ )$ is linearly homogeneous, ε is a continuous variable that represents the efficiency of a single worker in the firm, N_X is the number of workers employed in the X-sector, $f(k)$ is the output per unit of labor expressed in efficiency units, $k = \dfrac{K}{\varepsilon N_X}$ represents the efficiency-adjusted capital-labor ratio, $f' > 0$, and $f'' < 0$. The production of good Y uses the constant-return-to-scale technology $Y = H(T, \varepsilon N_Y)$, where N_Y is the number of employees in Y-sector. The workers' effort is the same in the two-sectors.

Following Phelps (1994), we use the function $\varepsilon = \varepsilon(\dfrac{z}{v}, \dfrac{y^W}{v})$ –where $\varepsilon_i < 0$, $\varepsilon_{ij} < 0$, for $i, j = 1, 2$– to describe the employee's effort; z is the expected

income obtainable elsewhere if the worker is fired, v the wage per employee paid in the firm and y^W the average nonwage income of workers, taken as a ratio to the worker population (whose size is unity).[28]

The first-order conditions for maximum profit in the two sectors are[29]

$$f'(k) = r^*(1 + \tau_K), \tag{12a}$$

$$\varepsilon[f(k) - kf'(k)] = \varepsilon \, \widetilde{p} \, H_N(T, \varepsilon N_Y) = v(1 + \tau_L), \tag{12b}$$

$$-[f(k) - kf'(k)] \left(\varepsilon_1 \frac{z}{v} + \varepsilon_2 \frac{y^W}{v} \right) = - \, \widetilde{p} \, H_N \left(\varepsilon_1 \frac{z}{v} + \varepsilon_2 \frac{y^W}{v} \right) = v(1 + \tau_L), \tag{12c}$$

$$\widetilde{p} \, H_T(T, \varepsilon N_Y) = R. \tag{12d}$$

The workers' expected income can be expressed as $z = Nv$ if the population and the labor force are normalized to one and there are no unemployment subsidies (see Calvo, 1979, and Salop, 1979). Combining (12b) and (12c) and using $z = Nv$, we obtain the "generalized Solow condition"; that is,

$$- \left(\frac{\varepsilon_1}{\varepsilon} N + \frac{\varepsilon_2}{\varepsilon} \frac{y^W}{v} \right) = 1. \tag{12c'}$$

According to (12c'), the sum of the partial elasticities of the effort function, taken in absolute value, must be equal to one.

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[28]Phelps (1994) demonstrates theoretically why the propensity to shirk can be considered homogeneous of degree zero in z, v and y^W.

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

Equation (12c') can be solved for N as follows

$$N = \Gamma(\frac{y^W}{v}), \ \Gamma' < 0, \tag{13}$$

where $\Gamma' = -\dfrac{(2\varepsilon_2 + \varepsilon_{12}\ \bar{N} + \varepsilon_{22}\dfrac{\bar{y}^W}{\bar{v}})}{(\bar{v}\ /\ \bar{y}^W)^{-2}(2\varepsilon_1 + \varepsilon_{11}\ \bar{N} + \dfrac{\bar{y}^W}{\bar{v}^h}\varepsilon_{12})} < 0$. Equation (13) repre-

sents the incentive-wage equation in implicit form. It implicitly gives the optimal wage that firms wish to pay for any level of N and y^W. Equation (13) is depicted in Fig. 2 as the IW schedule.

Employment in the two sectors equals total employment in the economy:

$$N_X + N_Y = N. \tag{14}$$

The rest of the model is the same as in the neoclassical economy, once L is replaced by N.

The Blanchard-Yaari asset market equilibrium condition is now given by

$$\bar{N} = \Theta(r^*, \rho)\frac{\bar{y}^W}{\bar{v}}, \ \ \Theta_{r^*} < 0, \ \ \Theta_\rho > 0.^{30} \tag{15}$$

The rest of the long-run economy is described by

$$\bar{K} = \kappa[r^*(1 + \tau_K)]\ \bar{\varepsilon}\left(\bar{N} - \bar{N}_Y\right), \ \ \kappa' < 0, \tag{16a}$$

$$\bar{v}\ (1 + \tau_L) = \bar{\varepsilon}\ \omega[r^*(1 + \tau_K)], \tag{16b}$$

$$\widetilde{p}\ H_N(\widetilde{T}, \bar{\varepsilon}\bar{N}_Y) = \omega[r^*(1 + \tau_K)], \ \omega' < 0, \tag{16c}$$

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[30] $\Theta(\cdot, \cdot)$ has been defined above for equation (10).

$$\bar{C} = \frac{r^*}{(r^* + \theta)}\,\bar{y}^W + \bar{v}\bar{N}, \tag{16d}$$

where $\bar{\varepsilon} = \varepsilon\left(\bar{N}, \dfrac{\bar{y}^W}{\bar{v}}\right)$.[31] The stock of net claims on foreigners is obtained

residually by using: $\bar{B} = \dfrac{\bar{y}^W}{(r^* + \theta)} - \bar{K} - \bar{q}\widetilde{T}$.

3.2 Comparative statics

In the long-run, employment and the income-from-wealth-to-wage ratio are determined by (13) and (15). Therefore, $\bar{N}$ and $\dfrac{\bar{y}^W}{\bar{v}}$ (and therefore $\bar{\varepsilon}$) are only affected by changes in ρ and r^*.

Shocks to the terms of trade, land endowment and input tax rates are inconsequential for aggregate employment, the income-from-weath-to-wage ratio, and the effort of employees. No qualitative changes are obtained in the incentive-wage case, once $\bar{L}$, $\bar{L}_X$ and $\bar{L}_Y$ are respectively replaced by $\bar{N}$, $\bar{N}_X$ and $\bar{N}_Y$. Since the factor demand system that governs the effects of these shocks is basically the same as in the competitive-wage economy ($\bar{\varepsilon}$ being unaltered). Hence, for these shocks, it is not worth repeating the comparative static analysis developed before.

Disturbances that influence ρ and r^* –although affecting (13) and (15) in a way that is qualitatively equivalent to the one seen in the neoclassical economy–, instead, alter the workers' efficiency and produce macroeconomic effects that are not immediate and may differ from the case of competitive wages.

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[31] In the system (16), the expressions $\kappa(\,\cdot\,) = f'^{-1}(\,\cdot\,)$, and $\omega(\,\cdot\,) = f[\kappa(\,\cdot\,)] - \kappa(\,\cdot\,)f'[\kappa(\,\cdot\,)]$ have been used.

3.2.1 Saving shift

A reduction in ρ rotates the BY schedule downward in Fig. 2. The equilibrium moves from A to A'. The effect is to reduce aggregate employment and increase the income-from-wealth-to-wage ratio.

The employee's effort is pulled up by the deterioration of the labor market prospects (due to the lower $\bar{N}$), but is simultaneously driven down by the higher $\dfrac{\bar{y}^W}{\bar{v}}$. The net effect on $\bar{\bar{\varepsilon}}$ is therefore ambiguous. However, aggregate employment expressed in efficiency units $\bar{\bar{\varepsilon}}\bar{N}$ declines.[32] Since $\bar{\bar{\varepsilon}}\,\bar{N}_Y$ is constant from (16c), $\bar{\bar{\varepsilon}}\,\bar{N}_X$ falls; also the capital stock is driven down, as the capital intensity in efficiency units is tied down by the given cost of capital. The unclear effect on $\bar{\bar{\varepsilon}}$ implies that the wage rate, income from wealth, consumption, sectoral employment, and net foreign assets may rise or fall. The land reward and the land value, instead, do not move.

Let us see what happens if $\bar{\bar{\varepsilon}}$ rises.[33] The workers' wage, income from nonhuman wealth, consumption and net foreign assets increase. $\bar{y}^W$ increases proportionally more than $\bar{v}$. $\bar{N}_Y$ and $\bar{N}_X$ are both reduced.

If instead $\bar{\bar{\varepsilon}}$ declines, the wage per employee falls from (12b). The cashflow from nonhuman wealth, consumption and the net claims on foreigners may rise or decline. Employment in the Y-sector increases, while employment in the capital-using sector contracts.

[Insert Fig. 2 about here]

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[32]Its multiplier is given by: $\dfrac{d(\bar{\bar{\varepsilon}}\bar{N})}{d\rho} = -\dfrac{\bar{N}^2\varepsilon_2\Theta_\rho}{\Theta^2} > 0.$

[33]This case occurs when the effect of the labor market prospects on the effort function is relatively stronger in magnitude than the effect of the nonwage-income-to-wage ratio.

3.2.2 World interest rate

Fig. 2 can be used to describe the consequences of a rise in r^*. $\bar{N}$ falls and $\dfrac{\bar{y}^W}{\bar{v}}$ rises because the BY schedule rotates downward for an invariant IW schedule. The employee's effort moves unclearly, but $\bar{\varepsilon}\bar{N}$ is decreased. The capital intensity is diminished by the higher cost of capital.

Labor employed in the land-using sector expressed in efficiency units is stimulated –see (16c)–, while employment in efficiency units in the capital-using sector shrinks. The wage rate per employee most probably falls, while income from wealth and consumption may rise or diminish. The marginal productivity of land is pulled up, while the land market value as well as net foreign assets are ambiguously affected.

4   Conclusions

This paper has investigated the steady state properties of a financially globalized specific-factors economy with two-sectors of production. Two features are incorporated into the analysis: the chronological disconnection of heterogeneous generations, on the one hand, and the interaction between productive assets (namely, physical capital and land) and unproductive ones (namely, net claims of foreigners), on the other. An additional element of relevance studied in the paper is the role of the labor market structure. Two types of labor market have been considered: a neoclassical one, with flexible wage and no unemployment, and an incentive-wage one, with sticky real wage and the "natural rate" of unemployment.

The terms of trade, land endowment, factor taxation, the rate of subjective time discount and the world interest rate impact on the intertemporal

allocation resources in differentiated non-obvious ways. Our findings depart substantially from what is contemplated in the static specific-factors model of Jones (1971) and Samuelson (1971), as well as the dynamic specific-factors setup of a financially-closed economy developed by Eaton (1987).

Shocks that leave human wealth or the saving rate unaffected exert no intergenerational consequences on the economy, but only change factor employment according to the static input demand system. Disturbances that impact on human wealth or the subjective rate of time preference, instead, exert intergenerational effects on the macroeconomic equilibrium by altering the distribution of income across generations with different propensity to save. Such a redistributive mechanism leads to a change in aggregate saving, which in turn alters the stock of nonhuman wealth and consumption. The implications for factor prices and employment originate from these aggregate consequences.

Differently from the dynamic specific-factors model with financial autharky –where the price of land affects the amount of saving devoted to capital formation– in a model with perfect capital mobility, the land-valuation effect has no direct implications on wealth accumulation and economic growth, but only influences the net claims of foreigners.

Within an incentive-wage economy, the consequences of exogenous shifts obtained under full wage flexibility do not change, except for the subjective discount rate and the world interest rate shocks; in these circumstances, the induced effect on the employee's propensity to shirk may alter the results for sectoral employment, the wage rate, nonhuman wealth, and consumption.

The analysis has shown that, in a two-sector small open economy with asset-factor specificity and an interest rate fixed at world level, wealth and capital formation obey different rules of macroeconomic determination. In

a neoclassical economy, long-run financial wealth (which is proportional to nonwage income) is determined by human wealth, i.e. the present discounted value of the wage-bill (which is overall influenced by the capital and labor tax rates, the world interest rate and the rate of time discount). Therefore, the reduced-form for long-run nonhuman wealth can be expressed as

$$\bar{W} = W(\underset{(-)}{\tau_K}, \underset{(-)}{\tau_L}, \underset{(-)}{\rho}, \underset{(+)}{r^*}).$$

The terms of trade and land endowment exert no effects on nonhuman wealth.

The capital stock is, instead, determined by the capital intensity (affected by the capital tax rate and the world interest rate), aggregate labor hours (altered by the rate of time preference and the interest rate) and labor in the land-using sector (influenced in turn by the terms of trade, land endowment, the capital tax rate and the world interest rate); hence, its long-run reduced-form is given by

$$\bar{K} = K(\underset{(-)}{\widetilde{p}}, \underset{(-)}{\widetilde{T}}, \underset{(-)}{\tau_K}, \underset{(+)}{\rho}, \underset{(-)}{r^*}).$$

Labor taxation is neutral for the capital stock. Among the several exogenous shocks investigated, only capital taxation has the same steady state effects, in qualitative terms, on nonhuman wealth and the capital stock.

Finally, aggregate labor hours or workers' employment are only affected by those exogenous variables capable of changing the income-from-wealth-to-wage ratio, like, for example, the saving rate and the world interest rate. We discover that capital and labor tax rates do not affect aggregate manhours as they change income from wealth and the household wage by the same proportion.[34]

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[34] The long-run (but not short-run) neutrality of capital and labor taxation also holds in a one-sector small open economy with finite lives (see Petrucci and Phelps, 2005).

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Table 1. Neoclassical economy: Qualitative steady state effects of exogenous shifts.

	$\dfrac{\overline{L}}{\widetilde{L}}$	$\dfrac{\overline{y}^{W}}{\widetilde{v}\widetilde{L}}$	$\overline{v}$	$\overline{y}^{W}$	$\overline{C}$	$\dfrac{\overline{K}}{\overline{L}_{X}}$	$\overline{L}_{X}$	$\overline{K}$	$\overline{X}$	$\overline{L}_{Y}$	$\overline{Y}$	$\overline{R}$	$\overline{q}$	$\overline{B}$
Exogenous shocks														
$\uparrow \tilde{p}$	0	0	0	0	0	0	−	−	−	+	+	+	+	?
$\uparrow \tilde{T}$	0	0	0	0	0	0	−	−	−	+	+	0	0	?
$\downarrow \tau_{K}$	0	0	+	+	+	+	+	+	+	−	−	−	−	?
$\downarrow \tau_{L}$	0	0	+	+	+	0	0	0	0	0	0	0	0	+
$\downarrow \rho$	−	+	0	+	+	0	−	−	−	0	0	0	0	+
$\uparrow r^{*}$	−	+	−	?	?	−	−	−	−	+	+	+	?	?

Fig. 1

Fig. 2