Fondazione Eni Enrico Mattei

Government Debt, Agent Heterogeneity and Wealth Displacement in a Small Open Economy

Alberto R. Petrucci

NOTA DI LAVORO 80.2002

SEPTEMBER 2002

PRIV – Privatisation, Regulation, Antitrust

Alberto R. Petrucci, *LUISS G. Carli and Università del Molise*

Government Debt, Agent Heterogeneity and Wealth Displacement in a Small Open Economy

Summary

The consequences of government debt on capital formation, financial wealth and labor are investigated in a small open economy with demographic heterogeneity. Two alternative types of demographics are considered: one with intragenerational heterogeneity of the "savers-spenders" (SS) type, and one with intergenerational heterogeneity of the OLG type. The effects of debt and the financial crowding out morphology strictly depend on the type of demographic heterogeneity. While in the SS economy debt crowds out capital, increases net foreign assets and contracts labor, in the OLG economy it generates the exact opposite results. Our results differ substantially from those observed in a closed economy, where the type of demographic heterogeneity plays no qualitative role for the effects of debt on wealth and factor employment.

Address for correspondence:

Alberto R. Petrucci
LUISS G. Carli and Università del Molise
Department of Economics
Via O. Tomassini, 1
00162 Rome
Italy
Phone: +39-06-85225770/782
Fax: +39-06-86506513
E-mail: albpetru@luiss.it

1. Introduction

When Ricardian equivalence is violated, a debt-for-tax-swap policy displaces private financial wealth from portfolios of savers. This occurs because the increase in lump-sum taxation reduces aggregate saving by redistributing income across heterogeneous agents. Financial crowding out may regard either physical capital or net foreign assets. The structure of the setup considered plays a crucial role for the precise morphology of the crowding out.

In a non-Ricardian closed economy, as physical capital is the only alternative asset to goverment bonds, the displacement of wealth takes of necessity the form of capital stock reduction. See, among others, Diamond (1965), Blanchard (1985) and Elmendorf-Mankiw (1999).

In a non-Ricardian open economy, however, the introduction of foreign assets, besides capital and government bonds, in the household asset menu can generate non-obvious crowding out effects.

Within an OLG small open economy with an inelastic labor supply, government debt, for example, totally crowds out foreign bond holdings and exerts no impact on physical capital; see Persson (1985).[1] The rationale behind this result is immediate to grasp: the world interest rate fixes capital intensity, which given labor supply sets capital stock at an invariant debt level; this economy behaves *de facto* like an economy with no capital. Therefore in such a setup, government debt

---

[1]Blanchard (1985) and Fried-Howitt (1988) obtain the same results in models with capital in fixed supply.

impacts only on net claims on foreigners as the current account is the reflecting mirror of aggregate saving.

Obstfeld (1990) discovers, by using a two-sector small open economy model with overlapping infinitely-lived families that enter the economy continuously (as in Weil, 1989), that public debt stimulates capital formation and displaces net foreign assets. In the Obstfeld analysis, debt by altering relative prices impacts on the supply side of the economy and hence exerts an effects on capital stock despite labor is supplied inelastically.[2]

Domestic debt manipulations are shown to reduce capital stock at home and in the rest of the world in a two-country open economy model with disconnected finite-lived agents; theoretical evidence is provided by Persson (1985), Obstfeld (1990) and Obstfeld-Rogoff (1996).

What are the effects of government debt on capital formation and financial wealth within a non-Ricardian one-sector small open economy when capital stock is defrosted from the isolated world interest rate determination? Which assets are the final receivers of the financial crowding out in such an economic environment?

In the absence of an answer from the literature, this paper tries to answer these questions by considering demographic heterogeneity as a way to violate Ricardian neutrality and endogenous labor-leisure choices as a way to allow capital adjustment within a small open economy.

---

[2]Note that the Obstfeld findings hinge on the assumption that, in a "tradable-nontradable" economy, tradables are capital intensive goods.

Two alternative types of demographics are considered, one with agents of the same generations, i.e. "synchronous" or intragenerational heterogeneity, and one with agents that belong to different generations, i.e. "dyachronous" or intergenerational heterogeneity. The first type of heterogeneity is given by the "savers-spenders" (henceforth denominated SS) demographics; this structure, proposed by Mankiw (2000), is populated by an immortal generation composed of no-liquidity-constrained Barro-Ramsey agents, the savers, and liquidity-constrained Keynesian agents, the spenders. The second type of heterogeneity studied in the paper is represented by non-altruistic overlapping-generations demographics of the Blanchard-Yaari type.

The analysis focuses on the steady state implications of government debt in a small open economy with one sector whose demand-side is characterized by either SS or OLG demographics.

In a closed economy, the two types of demographics considered here exhibit the negative association between public debt and capital stock that mark the one-way crowding out above mentioned.[3]

The violation of Ricardian neutrality in an infinitely-lived SS economy occurs because debt, through lump-sum taxation levied on every agent, accomplishes a redistribution of income across Barro-Ramsey and Keynesian individuals, leading to irreversible changes in consumption, labor and consequently capital stock.[4] If

---

[3]See, for example, Petrucci (2000), for the SS demographics, and Auerbach-Kotlikoff (1987) and Phelps (1994), for the OLG demographics.

[4]Note that within a SS economy agents that do not hold government bonds play the same

3

plausible values of taste parameters are considered, higher debt is associated with lower labor and capital.[5]

In a closed economy with finite-lived non-altruistic agents and endogenous labor-leisure choices, higher government debt redistributes income through lump-sum taxation between young and older generations (namely generations with different propensities to save), leading to lower aggregate saving and capital formation. The reduction of capital lowers in turn labor, output and hence consumption.[6]

Therefore, from these theoretical results, one is tempted to infer mechanically that the basic results obtained for a closed economy, i.e. the type of demographic heterogeneity is unimportant for the morphology of the financial crowding out, can be replicated for an one-sector small open economy having an adjustable capital. The only difference is that within a small open economy the financial crowding

role in invalidating Ricardian equivalence that the "new entrants" play in a non-altruistic OLG economy.

[5]When labor supply is inelastic government debt is neutral in a SS economy (see Mankiw, 2000). Debt neutrality has in this case a mechanical reasoning rather than a proper economic one, since it is entirely due to the "modified golden rule" entrapment of capital stock.

However, when labor choices are endogenous, there are two dimensions of heterogeneity that matter in a SS economy to have debt nonneutrality: the distinction between Ricardian and Keynesian agents, on the one hand, and differences in tastes among agents for the consumption-leisure trade-off, on the other hand. See Petrucci (2000).

[6]The hypothesis of endogenous labor decisions is qualitatively insignificant for the final effects of government debt on capital stock, output and factor prices in OLG closed economy setups.

out, by a sort of physics' principle of "communicating vessels", can be spread over all the assets alternative to government bonds, i.e. capital and net claims on foreigners. Thus we expect that a higher government debt lowers saving and hence physical capital as well as net foreign assets, no matter what demographic heterogeneity is.

This deduction is incorrect. We find that within a small open economy the morphology of debt crowding out strictly depends on the type of demographic heterogeneity considered. The general rule we are able to identify is that government debt moves domestic capital and foreign asset in opposite direction, but the direction in which each asset is moved is determined by the demographic typology.

The main finding for the SS economy is that higher debt, by redistributing income from nonsavers to savers through taxation, increases savers' consumption, reduces their labor effort and aggregate labor; this in turn contracts capital and raises the stock of foreign bonds. Therefore in this case the receiver of financial wealth displacement is solely capital stock.

These results are unchanged if the increase in debt is financed through a cut of public spending.

In the model with OLG demographics, we discover that government debt coupled with higher taxes, by depressing aggregate saving (as the usual intergenerational redistribution of income takes place) and consumption, increases labor hours and hence crowds capital stock in (allowing for more investment and permanently higher output); foreign bond holding is reduced. In this circumstance,

5

the financial crowding out is entirely addressed to net foreign assets.

When a compensatory reduction in public spending finances the debt rise, no effects on capital stock and labor are registered; debt only crowds out net foreign assets one for one.

2. SS demographics

2.1. The model

Consider a real small open economy that produces a single tradable good, which is perfectly substitutable with the foreign-produced good and faces a perfect world capital market.

The economy is populated by two types of households: savers and nonsavers.[7] Savers and nonsavers belong to the same generation as they are both infinitely-lived. Savers decide on consumption, labor supply and financial wealth accumulation as well as portfolio composition. Financial wealth is composed of capital stock K, government bonds D, and net foreign assets B. Nonsavers choose only consumption, as they do not accumulate wealth and supply labor inelastically. Both agents pay lump-sum taxes for financing government expenditures.

Government decisions on debt and on how to split the burden of taxation between savers and nonsavers are considered to be exogenous.

---

[7]See Mankiw (2000). Although we will always speak of the SS, i.e. "savers-spenders", economy, we prefer to use the term nonsavers instead of spenders.

The representative agent of the saver-type makes consumption, C_S, labor, L_S, and saving decisions in order to solve the following intertemporal problem

$$\max \int_0^\infty [\alpha \ln C_S + (1 - \alpha) \ln(1 - L_S)] e^{-\rho t} dt \tag{1}$$

subject to the flow budget constraint

$$C_S + \dot{D} + \dot{B} = wL_S + \Pi + r^*(D + B) - Q_S \tag{2}$$

and the initial conditions: $D(0) = D_0$ and $B(0) = B_0$. In the formulation of problem (1)-(2) the undefined notation has to be interpreted as follows: w is the real wage, Π represents real dividends distributed by firms to savers, r^* denotes the given world interest rate, Q_S represents lump-sum taxes levied on savers, ρ is the exogenous rate of time preference and $\alpha \in (0, 1)$ a preference parameter. The instantaneous utility function has been assumed logarithmic for simplicity.

The necessary and sufficient conditions for the optimality problem (1)-(2) are

$$\alpha C_S^{-1} = \lambda \tag{3a}$$

$$(1 - \alpha)(1 - L_S)^{-1} = \lambda w \tag{3b}$$

$$\dot{\lambda} = -\lambda(r^* - \rho) \tag{3c}$$

where λ represents the shadow value of wealth in the form of government bonds and net foreign assets. The flow budget constraint (2) and the transversality condition $\lim_{t \to \infty} \lambda(D + B)e^{-\rho t} = 0$ must also be satisfied at the optimum.

7

Since in equation (3c) both r^* and ρ are exogenous, the steady state equilibrium can be reached if and only if $r^* = \rho$; we assume that this condition is satisfied. This implies that $\dot{\lambda} = 0$ and

$$\lambda = \bar{\lambda} \tag{3c'}$$

where $\bar{\lambda}$ represents the long-run value of the shadow value of wealth. This requisite in turn implies that the transversality condition becomes

$$\lim_{t \to \infty} (D + B)e^{-r^* t} = 0 \tag{3d}$$

Each member of the nonsaver group supplies labor inelastically[8] and decides on consumption, C_N, in order to maximize the lifetime utility function $\int_0^\infty (\ln C_N)e^{-\rho t} dt$ subject to the static budget constraint

$$C_N = w \, \tilde{L}_N - Q_N \tag{4}$$

where $\tilde{L}_N$ is the exogenous labor supply of nonsavers and Q_N represents lump-sum taxes paid by nonsavers. Savers and nonsavers are paid the same wage as their labor is assumed to be perfectly substitutable.

The optimality program of nonsavers, being *de facto* a static problem, is described by equation (4).

_____

[8]Nonsavers' endogenous labor decisions would not change qualitatively the results if their tastes for the consumption-leisure trade-off are less elastic of those of savers with respect to the consumption-wage ratio.

Firms behave competitively in the output and factor markets. They produce output Y by using capital and labor L according to the linearly homogeneous technology $Y = F(K, L) = Lf(k)$, where f is the output-labor ratio and $k = \dfrac{K}{L}$ is the capital-labor ratio. This production function satisfies the conventional properties of regularity.

There exist installation costs for changing capital. These adjustment costs are described by the function $\Phi(\dfrac{I}{K})$, where I represents the investment rate, i.e. $\dot{K}$, and $\Phi(0) = 0$, $\Phi'(0) = 0$, $\Phi' > 0$ for $I \neq 0$, and $\Phi'' > 0$.

The representative firm maximizes the present discounted value of profits net of investment expenditures. Net profits are: $\Pi = F(K, L) - wL - I - \Phi(\dfrac{I}{K})$. Hence the intertemporal optimization problem of the firm is

$$\max \int_0^\infty \Pi e^{-r^* t} dt$$

subject to $I = \dot{K}$, the definition of Π and the initial condition $K(0) = K_0$.

First order conditions for the maximum profit entail

$$\Phi'(\frac{\dot{K}}{K}) + 1 = q \tag{5a}$$

$$\dot{q} = r^* q - F_K(K, L) \tag{5b}$$

$$F_L(K, L) = w \tag{5c}$$

plus the proper transversality condition. q represents the shadow price of capital.

Total amount of labor employed by firms must be equal to the sum of labor supplied by the two types of individuals, that is

$$L = L_S + \widetilde{L}_N \tag{6}$$

Equation (6) ensures the equilibrium on the labor market.

The government dynamic budget constraint is

$$\dot{D} = G + r^* D - Q \tag{7}$$

where G is government consumption expenditure and $Q = Q_S + Q_N$ represents total lump-sum taxes levied on the two types of agents. The government deficit, given by public expenditure plus interest payments on government debt less lump-sum taxes, can be financed by issuing new debt. However we assume that the government keeps the debt level fixed at $\widetilde{D}$ and maintains the budget balanced through the endogenous adjustment of either lump-sum taxes Q or public spending G.

Furthermore, we assume that each type of household pays a fixed proportion of total lump-sum taxes:

$$Q_N = \tau Q \tag{8a}$$

$$Q_S = (1 - \tau)Q \tag{8b}$$

10

where $\tau \in (0,1)$ represents the proportion of total lump-sum taxes paid by non-savers; τ is exogenously determined by the policymaker.

Finally, the balance of payments must be considered

$$\dot{B} = Y + r^*B - C_S - C_N - G - I - \Phi(\frac{I}{K}) \tag{9}$$

According to equation (8), the current account, namely national income less absorption, gives the rate of accumulation of foreign bonds.

The complete macroeconomic model is obtained by combining the optimality conditions for savers, nonsavers, and firms with the government budget constraint and the current account equation.

Equations (3a), (3b) and (3c') may be solved -once equations (5c) and (6) are employed- for C_S and L_S in terms of $\bar{\lambda}$ and K as follows:

$$C_S = C_S(\bar{\lambda}), \quad C_S' = -\alpha\, \bar{\lambda}^{-2} < 0; \tag{10a}$$

$$L_S = L_S(\bar{\lambda}, K), \quad L_{S,\bar{\lambda}} = \frac{(1-\bar{L_S})F_L}{\bar{\lambda}\,[F_L - (1-\bar{L_S})F_{LL}]} > 0;$$

$$L_{S,K} = \frac{F_{LK}}{[F_L - (1-\bar{L_S})F_{LL}]} > 0; \tag{10b}$$

where overbar variables denote long-run equilibrium values.

Using the above short-run solutions for C_S and L_S toghether with equation (6), equations (5a) and (5b) can be easily reduced to the following pair of differential equations linearized around the steady state

11

$$
\begin{bmatrix} \dot{K} \\ \dot{q} \end{bmatrix} = \begin{bmatrix} 0 & \bar{K}/\Phi'' \\ j_{21} & r^* \end{bmatrix} \begin{bmatrix} K - \bar{K} \\ q - 1 \end{bmatrix}
\tag{11}
$$

where

$$
j_{21} = -\frac{F_L F_{KK}}{[F_L - (1 - \bar{L}_S)F_{LL}]} > 0.
$$

Since the determinant of the coefficient matrix in (11), given by $| J | = \frac{\bar{K}}{\Phi''} \frac{F_L F_{KK}}{[F_L - (1 - \bar{L}_S)F_{LL}]}$, is negative, the long-run equilibrium is a saddle-point stable, since K evolves continuously, while q is a jump variable -i.e. $q(0)$ is free.[9]

The stable solution to system (11) is given by

$$
K = \bar{K} + (K_0 - \bar{K})e^{\eta_1 t}
\tag{12a}
$$

$$
q = 1 + \eta_1 \Phi''(K - \bar{K})
\tag{12b}
$$

where $\eta_1 < 0$ denotes the stable eigenvalue of the Jacobian in (11).

The determination of the solution for B can be obtained as follows.[10] Inserting equations (10) into equation (9), linearizing around the steady state and substituting out the expression $(K - \bar{K})$ through equation (12a), we obtain

$$
\dot{B} = \Theta(K_0 - \bar{K})e^{\eta_1 t} + r^*(B - \bar{B})
$$

where $\Theta = r^* + \dfrac{F_{LK}\left[F_L(1 - \widetilde{L}_N) - \bar{L}_S \widetilde{L}_N F_{LL}\right]}{[F_L - (1 - \bar{L}_S)F_{LL}]} - \eta_1 \bar{K} > 0.$

---

[9]The existence of convex installation costs for changing capital stock represents a necessary condition to have a well-defined long-run equilibrium and non-degenerate dynamics.

[10]See Turnovsky (1997).

If the initial condition $B(0) = B_0$ is satisfied, the solution to this equation is

$$B = \bar{B} + \frac{\Theta}{(\eta_1 - r^*)}(K_0 - \bar{K})e^{\eta_1 t} + \Sigma e^{r^* t}$$

where $\Sigma = B_0 - \bar{B} - \frac{\Theta}{(\eta_1 - r^*)}(K_0 - \bar{K})$.

The transversality condition (3d), which becomes under the hypothesis of a fixed stock of government debt a "no Ponzi games" condition (henceforth NPG) on net foreign assets, implies that $\Sigma = 0$; that is

$$B_0 = \bar{B} + \frac{\Theta}{(\eta_1 - r^*)}(K_0 - \bar{K}) \tag{13'}$$

Therefore the short-run solution for B consistent with NPG is

$$B = \bar{B} + \frac{\Theta}{(\eta_1 - r^*)}(K - \bar{K}) \tag{13''}$$

The steady state solvency of the economy implies that there exists a negative relationship between capital stock (investment) and net foreign assets (the current account).

2.2. Long-run effects of government debt

Our study of the macroeconomic consequences of public debt is solely concerned with the steady state equilibrium, when $\dot{B} = \dot{K} = 0$ and $q = 1$.

In the long-run, the economy can be succinctly described by the system

$$1 - \bar{L}_S = \frac{(1 - \alpha)}{\alpha \omega^*} \bar{C}_S \tag{14a}$$

13

$$\bar{C}_N = \omega^* \, \tilde{\bar{L}}_N - \tau(G + r^* \, \tilde{\bar{D}}) \qquad (14\text{b})$$

$$\bar{K} = \kappa^* \left(\bar{L}_S + \tilde{\bar{L}}_N \right) \qquad (14\text{c})$$

$$r^* \left(\bar{K} + \bar{B} \right) + \omega^* \left(\bar{L}_S + \tilde{\bar{L}}_N \right) = \bar{C}_S + \bar{C}_N + G \qquad (14\text{d})$$

$$\bar{B} = B_0 + \frac{\Theta}{(\eta_1 - r^*)}(\bar{K} - K_0) \qquad (14\text{e})$$

where $\omega^* = f(\kappa^*) - \kappa^* f'(\kappa^*) = \bar{w}$ and $\kappa^* = f'^{-1}(r^*)$.

According to equation (14c), in the long-run capital intensity is uniquely determined by the world interest rate since the production function is linearly homogeneous. Therefore the capital-labor ratio is independent of the government debt, and aggregate labor and capital move in the same direction and by the same proportion. Long-run wage rate $\bar{w}$ is also given at ω^*.

A clear understanding of the model can be obtained by substituting $\bar{L}_S$ from (14c) into (14a); we then get

$$\bar{C}_S = \frac{\alpha \omega^*}{(1 - \alpha)} (1 + \tilde{\bar{L}}_N - \frac{\bar{K}}{\kappa^*}) \qquad (15\text{a})$$

This equation represents the labor market clearing condition, incorporating the capital market equilibrium, i.e. $F_K = f' = r^*$. Equation (15a) describes a negative relationship between $\bar{K}$ and $\bar{C}_S$ as an increase in capital stock by raising labor

14

demand of firms requires higher labor supplied by savers (as nonsavers supply labor inelastically) that must be associated through (14a) with lower consumption of savers.

Equation (15a) is represented in Fig. 1 as the LM schedule. This downward-sloping schedule is unaffected by government debt shocks.

Insert Fig. 1

Substituting equations (14b), (14c), and (14e) respectively for $\bar{C}_N$, $\bar{L}_S + \widetilde{L}_N$ and $\bar{B}$ into equation (14d), we obtain

$$\bar{C}_S = \tau(G + r^* \widetilde{D}) - G + \left[r^* + \frac{\omega^*}{\kappa^*} + \frac{r^*\Theta}{(\eta_1 - r^*)} \right] \bar{K} + \Gamma \tag{15b}$$

where $\Gamma = r^* \left[B_0 - \dfrac{\Theta}{(\eta_1 - r^*)} K_0 \right] - \omega^* \widetilde{L}_N$.

Equation (15b) describes the combinations of consumption of savers and capital stock that ensure the equilibrium of the current account compatible with NPG and the capital market equilibrium. According to this equation, a rise in capital stock increases labor and domestic output and reduces through (14e) the stock of net foreign assets; since national income raises after the increase in capital,[11] a compensatory increase in consumption of savers is needed in order to maintain the current account balance equal to zero. Equation (15b) is depicted in Fig. 1 as the CA-NPG schedule.

---

[11]This is because $r^* + \dfrac{\omega^*}{\kappa^*} + \dfrac{r^*\Theta}{(\eta_1 - r^*)} > 0.$

For a given capital stock (and hence total labor), an increase in government debt by reducing consumption of nonsavers, as some fraction of the taxes that service the debt will fall on them, and home absorption, calls for an increase in consumption of savers in order to keep the current account in equilibrium; this implies that an increase in $\widetilde{D}$ moves the CA-NPG schedule upward. The same type of shift for the CA-NPG schedule is observed when a reduction of G takes place.

The intersection of the two schedules at point E in Fig. 1 describes the pre-shock macroeconomic equilibrium.

2.2.1. Lump-sum tax financing

Firstly, we assume that the debt shock is accompanied by the endogenous adjustment of lump-sum taxes levied on savers and nonsavers.

We use the diagram of Fig. 1 to illustrate the long-run effect of an increase in $\widetilde{D}$.

An increase in public debt causes, by shifting the CA-NPG schedule up and to the left, a reduction of capital stock and a rise in steady state consumption of

savers.[12] In Fig. 1 the new equilibrium is at point E'.

The intuition behind these results is simple. Consumption of nonsavers is reduced by the higher government debt as it lowers their disposable income. In fact, as the experiment assumes that the tax burden is spread across agents, a portion τ of lump-sum taxes necessary to finance the higher interest payments on debt is levied on nonsavers, who do not hold government bonds and do not receive the "interest gift" from the government.

Lump-sum taxes paid by savers for financing an additional dollar of government debt, $(1 - \tau)r^*$, are lower than the benefits of public debt, r^*, as nonsavers are making their tax contributions of τr^*. Therefore, government debt raises the disposable income of savers as they obtain a net income of $\tau r^* \widetilde{D}$, by holding an amount $\widetilde{D}$ of government bonds.

The net transfer of income brought about by government debt in favor of savers induces these agents to demand more leisure and supply less labor; therefore aggregate labor is reduced and capital stock crowded out.

Domestic output, national income and aggregate demand are reduced as well.[13]

---

[12]The respective multipliers are:

$$\frac{d \bar{K}}{d \widetilde{D}} = -\frac{\tau r^*}{\Delta} < 0;$$

$$\frac{d \bar{C}_S}{d \widetilde{D}} = \frac{\tau \alpha r^* \omega^*}{(1 - \alpha)\kappa^* \Delta} > 0;$$

where $\Delta = \dfrac{\omega^*}{(1 - \alpha)\kappa^*} + r^* + \dfrac{r^*\Theta}{(\eta_1 - r^*)} > 0$.

[13]The multiplier for national income (as well as aggregate demand) is:

The stock of net foreign assets is increased because of the long-run solvency of the economy.

Let Z denote national wealth, namely domestic capital plus net foreign assets. Public debt displaces national wealth; the crowding out may be larger or smaller than one for one.[14]

The redistribution of income across households also implies an intragenerational welfare redistribution. In fact, welfare of nonsavers is unambiguously lowered by higher government debt, because of the reduction in their consumption. The opposite occurs for savers as their consumption of goods and leisure is increased.

Finally, note that the effects of higher debt on capital stock, labor and consumption in this small open economy replicates qualitatively the results for the corresponding closed economy.

2.2.2. Government spending financing

Consider a second type of experiment: a rise in government debt accompanied by a reduction of government spending in order to balance the budget.

In this case, since $\bar{G} + r^* \widetilde{D}$ is fixed, the debt disturbance impacts on the

$$\frac{d(\bar{Y} + r^* \bar{B})}{d \widetilde{D}} = -\frac{\tau r^*}{\Delta} \left[\frac{\omega^*}{\kappa^*} + r^* + \frac{r^* \Theta}{(\eta_1 - r^*)} \right] < 0.$$

[14]The national wealth multiplier is: $\dfrac{d \bar{Z}}{d \widetilde{D}} = -\dfrac{\tau r^*}{\Delta}[1 + \dfrac{\Theta}{(\eta_1 - r^*)}] \gtrless -1.$

18

macroeconomic equilibrium entirely through the reduction of public spending. The effects of the debt shock remain qualitative the same as before as it is evident by looking at equation (15b). The CA-NPG of Fig. 1 is still moved upward and to the left.

In the current and previous experiments debt manipulations imply a change of opposite sign in the absorption of the economy. While in the previous case the reduction of aggregate demand comes from the reduction of nonsavers' consumption, now the reduction of aggregate demand stems from the shrink of $\bar{G}$.[15]

Finally, note that also the results obtained under the current financing regime confirm those observed in the closed economy.

3. OLG demographics

3.1. The model

Consider the real small open economy of section 2 with a different demographic structure. Population is now composed of overlapping-generations continuously entering the economy and having no intergenerational bequest motive. The continuous-time OLG model of Yaari (1965) and Blanchard (1985), extended to include an endogenous labor supply as in Phelps (1994), is adopted.

---

[15]The only difference between the effects of debt shocks under the two financing regime is merely quantitative: the public spending financing amplifies the effects of a debt shock on the whole macroeconomic system compared to the case of lump-sum tax financing (provided that $\tau < 1$).

Individuals face uncertainty on the duration of their lives, since they face a constant probability of death θ. In every instant of time, a large new cohort is born. Population, composed of the cohorts of all ages, remains constant, since the birth rate is assumed to equal the death rate.

Assuming logarithmic preferences at individual level, the aggregate behavior of consumers is described by[16]

$$\dot{C} = (r^* - \rho)C - \beta\theta(\theta + \rho)A \qquad (16a)$$

$$1 - L = \frac{(1 - \beta)C}{\beta w} \qquad (16b)$$

$$\dot{A} = r^*A + wL - Q - C \qquad (16c)$$

where A is the stock of financial wealth, i.e. $A = K + D + B$, β is a positive preference parameter and other variables and parameters are easily understood.

Equation (16a) represents the Blanchard-Yaari "modified golden rule".[17] This equation can be seen as the intertemporal arbitrage relationship between the return on consumption, i.e. $\rho + \dfrac{\dot{C}}{C} + \beta\theta(\theta + \rho)\dfrac{A}{C}$, and the return on saving, i.e.

---

[16]See Appendix A for the derivation of the demand-side of the model.

[17]As we assume that the stock of financial wealth is strictly positive (that is, if B is negative, it is not too negative), the steady state equilibrium requires $r^* > \rho$. This condition guarantees that individuals save initially more and have an increasing profile of consumption.

r^*. Equation (16b) is the labor supply and (16c) represents the private budget constraint in aggregate terms.

Since we study our economy in the long-run equilibrium and the OLG demographics ensure *per se* the existence of a unique stationary position and a single convergent path, we assume for simplicity that capital accumulation does not involve installation costs; this implies that the shadow price of capital is always equal to one. Such as an assumption has no consequences on the steady state equilibrium, which is the focus of our analysis.

Using the same production function as before, the first order conditions for the maximum profit entail: $f'(k) = r^*$ and $f(k) - kf'(k) = w$, where $k = \dfrac{K}{L}$. From the input demands, the following relationships are obtained

$$\frac{K}{L} = \kappa^* \tag{17a}$$

$$w = \bar{w} = \omega^* \tag{17b}$$

where ω^* and κ^* are constant defined above.

The rest of the model is the same as before.

The government budget constraint, whose features and underlying assumptions have been described in Section 2.1, implies $Q = G + r^* \, \widetilde{D}$, while the balance of payments can be written by using (17) as $\dot{B} = r^*(K + B) + \omega^* L - C - G - \dot{K}$.

The complete short-run macroeconomic model exhibits saddle-point stability

if $\theta(\theta + \rho) > r^*(r^* - \rho)$.[18]

3.2. Long-run effects of government debt

The long-run economy is given by the system

$$\bar{C} = \frac{\beta\theta(\theta + \rho)}{(r^* - \rho)} \ \bar{A} \tag{18a}$$

$$1 - \bar{L} = \frac{(1 - \beta)}{\beta\omega^*} \ \bar{C} \tag{18b}$$

$$\bar{K} = \kappa^* \ \bar{L} \tag{18c}$$

$$r^* \ \bar{A} + \omega^* \ \bar{L} = \bar{C} + G + r^* \ \widetilde{D} \tag{18d}$$

where $\bar{A} \equiv \bar{K} + \bar{B} + \widetilde{D}$.

After substituting $\bar{A}$ from (18a) into (18d) and using (18c) to eliminate $\bar{L}$, the following equation is obtained

$$\bar{C} = \frac{\beta\theta(\theta + \rho)}{[\beta\theta(\theta + \rho) - r^*(r^* - \rho)]} \left[\frac{\omega^*}{\kappa^*} \ \bar{K} - (G + r^* \ \widetilde{D}) \right] \tag{19a}$$

Equation (19a) describes a positive relationship between consumption and capital stock compatible with the Blanchard-Yaari asset market equilibrium and

---

[18]See Appendix B. This condition is easily satisfied under the reasonable assumption that the in the aggregate the wage-bill exceeds lump-sum taxes, i.e. $\omega^* \ \bar{L} > \bar{Q}$.

the current account balance.[19] A rise in $\bar{K}$ by increasing domestic output and national income requires higher consumption in order to keep the current account balanced. This equation is depicted in Fig. 2 and labelled the CA-BY schedule.

Insert Fig. 2

A higher government debt lowers consumption for a given capital stock by reducing consumers' disposable income because of the higher taxes, and shifts the CA-BY schedule down and on the right.

By substituting out $\bar{L}$ from equation (18c) into the optimal consumption-leisure trade-off, we obtain the labor market equilibrium schedule

$$\bar{C} = \frac{\beta \omega^*}{(1-\beta)} (1 - \frac{\bar{K}}{\kappa^*}) \qquad (19b)$$

Equation (19b) is downward-sloping in the $\bar{C} - \bar{K}$ plane; it corresponds to the LM schedule of Fig. 2. A change in fiscal variables does not affect this functional relationship.

Equation (19a) can be used toghether with equation (19b) to describe the long-run effects of government debt on aggregate consumption and capital stock. The complete steady state equilibrium is illustrated in Fig. 2.

---

[19]Note that the assumption $\omega^* \bar{L} > \bar{Q}$ ensures that $\beta\theta(\theta + \rho) - r^*(r^* - \rho) > 0$.

3.2.1. Lump-sum tax financing

We begin by studying the case of lump-sum tax financing. An increase in government debt causes a shift in the CA-BY schedule down and to the right. In Fig. 2, the long-run equilibrium moves from E to E'. The effect of the rise in $\widetilde{D}$ is for $\bar{K}$ to rise and for $\bar{C}$ to fall.[20]

The higher public debt decreases aggregate saving because a part of the additional tax burden necessary to finance the interest payments on debt are paid by future yet unborn generations. The reduction of national saving causes a fall in private financial wealth, which in turn contracts consumption. National income and aggregate demand may fall or rise.[21] The drop in $\bar{C}$ increases labor hours and deepens capital formation.

The reduction of consumption leads to a fall in net foreign assets, which is greater than the rise of $\bar{K} + \widetilde{D}$.

---

[20]The respective multipliers are:

$$\frac{d\,\bar{K}}{d\,\widetilde{D}} = \frac{(1-\beta)r^*\theta(\theta+\rho)\kappa^*/\omega^*}{[\theta(\theta+\rho) - r^*(r^*-\rho)]} > 0;$$

$$\frac{d\,\bar{C}}{d\,\widetilde{D}} = -\frac{\beta r^*\theta(\theta+\rho)}{[\theta(\theta+\rho) - r^*(r^*-\rho)]} < 0.$$

[21]The national income multiplier is

$$\frac{d(\bar{Y} + r^*\,\bar{B})}{d\,\widetilde{D}} = \frac{r^*\left[(1-\beta)\theta(\theta+\rho) - r^*(r^*-\rho)\right]}{[\theta(\theta+\rho) - r^*(r^*-\rho)]} \gtrless 0.$$

This multiplier is negative (positive) if $\bar{Q} + \bar{C} < (>)\omega^*$.

Public debt crowds out national wealth, i.e. the sum of physical capital and net foreign assets, more than one for one; this occurs because the interest rate is greater than the rate of time discount.[22]

The effects of government debt on financial wealth are rather conventional, even if they are greatly simplified, compared to the closed economy, by the factor prices' invariance. What turns out to be rather unconventional in this open economy setup are the consequences upon factors' employment.[23]

The consequences of government debt on capital stock sharply contrasts with the result obtained in an OLG closed economy and in SS economies with an endogenous labor supply.

The motivation for our findings is to be found in the hypothesis of overlapping-generations with new entries combined with the tax revenue distribution scheme adopted, on the one side, and the small open economy environment, on the other side. When there are finite lives with new births, government debt affects the saving-consumption decision at aggregate level.

---

[22]The multiplier for national wealth is

$$\frac{d\,\tilde{Z}}{d\,\widetilde{D}} = -\frac{\theta(\theta+\rho)}{[\theta(\theta+\rho) - r^*(r^* - \rho)]} < -1.$$

The same quantitative result holds for a small open economy with an inelastic labor supply and hence an invariant capital stock. See Blanchard (1985).

[23]As it has been emphasized in the Introduction, there is a close similarity with Obstfeld (1990) findings for a small open economy, i.e. a positive effect of public debt on capital formation and a negative effect on net foreign assets; our setup has nearly the same demographics of Obstfeld but a radically different structure of the supply-side.

Since young people save more than old people, a redistribution of wealth among generations (caused by the increase in lump-sum taxation) occurs, in particular between the living generations and the still unborn generations; the current generation bears only a part of the tax burden. Saving is reduced by the tax hike; as a consequence financial wealth is reduced as well, bringing consumption down. But since factor prices are given, lower consumption imply through labor supply higher labor hours, which in turn, given capital intensity, leads to higher capital stock.

3.2.2. Government spending financing

If the parametric increase of debt is a accompanied by a compensatory reduction in government spending, such that $\bar{G} + r^* \widetilde{D}$ is fixed, no effects on consumption, labor hours, capital stock and financial wealth are registered. As financial wealth remain unchanged, the higher government debt reflects only on the foreign component of wealth, leading to a complete crowding out of foreign assets, i.e. $\dfrac{d\,\bar{B}}{d\,\widetilde{D}} = -1$.

Also in this case, we depart from an OLG closed economy, where this type of shock generates the same qualitative effects of a change in debt financed through taxation[24] and SS economies

4. Concluding remarks

[24]See Marini-Van der Ploeg (1988) for the case of inelastic labor-leisure choices. Their results carry over when labor is supplied endogenously.

In this article we have investigated the steady state consequences of government debt on capital formation, financial wealth and labor in a small open economy with endogenous labor decisions.

The analysis has focused on the role played by two alternative types of demographic heterogeneity: An intragenerational heterogeneity and an intergenerational one. The two types of demographics that characterize our non-Ricardian world are the "savers-spenders" demographics and the overlapping-generations with new entries ones.

We discover that the financial crowding out morphology when the asset menu is supplemented by an additional asset, i.e. net foreign assets, depends on the type of demographics. Our results differ substantially from those seen in a closed economy with an elastic labor supply, where the type of demographic heterogeneity plays no qualitative role for the final consequences of debt on wealth and factor employment.

The general findings indicate the existence of a trade-off between capital and outside financial wealth in response to government debt manipulations. While the SS economy predicts that debt crowds out capital and increases net foreign assets, the OLG economy is characterized by the exact opposite results.

The behavior of consumption is responsible for the differentiated consequences of debt shocks under the two types of demographics. In fact a change in consumption modifies in opposite direction labor supply, which in turn, because of the fixed capital intensity, moves capital stock in the same direction.

While in the SS economy debt, by raising the tax bill on every agent, pushes savers to increase consumption, reduces hours worked and hence aggregate capital, in the OLG economy debt by contracting saving and financial wealth depresses aggregate consumption and results in higher labor effort and capital stock.

The financing procedure of debt manipulations is immaterial in the case of SS demographics, while it is not immaterial in the case of an OLG structure. In fact, in the latter demographics, the public spending financing of debt shock is neutral.

What can be said about an integrated SS-OLG demographics, where the dyachronous heterogeneity is combined with the synchronous one?

In a composite SS-OLG demographic setup the results seen for the OLG economy are qualitatively confirmed.[25] This mean that the effects of debt on capital, labor and net foreign assets seen in the OLG case prevail over those obtained in the SS one. This is contrary to the closed economy findings of Evans (1991), where also for a composite demographics it is established that debt crowds out capital stock.

In this integrated demographics, the effect of debt are reduced comparatively to the simple OLG economy by the proportion of the tax-bill that falls on savers. Debt becomes neutral in terms of consumption, labor and capital when nonsavers are required to pay the entire burden of taxation for financing the rise of the government debt service.

---

[25]See Appendix C.

References

Auerbach, A.J.-Kotlikoff, L.J. (1987), *Dynamic Fiscal Policy*, Cambridge University Press, Cambridge (UK).

Barro, R.J. (1974), "Are Government Bonds Net Wealth?", *Journal of Political Economy*, 82, 1095-1117.

Blanchard, O.J. (1985), "Debt, Deficit, and Finite Horizons", *Journal of Political Economy*, 93, 223-247.

Buiter, W.H.-Kletzer, K.M. (1992), "Who's Afraid of the Public Debt?", *American Economic Review, Papers and Proceedings*, 82, 290-294.

Diamond, P. (1965), "National Debt in a Neoclassical Growth Model", *American Economic Review*, 55, 1126-50

Elmendorf, D. and N. G. Mankiw, (1999), "Government Debt", in *Handbook of Macroeconomics*, edited by J.B. Taylor and M. Woodford, Elsevier Science B.V., 1615-1669.

Evans, P. (1991), "Is Ricardian Equivalence a Good Approximation?", *Economic Inquiry*, 29, 626-644.

Fried, J.-Howitt, P. (1988), "Fiscal Deficits, International Trade and Welfare", *Journal of International Economics*, 24, 1-22.

Kanaginis, G.T.-Phelps, E.S. (1994), "Fiscal Policy and Economic Activity in the Neoclassical Theory with and without Bequests", *Finanz Archiv*, 51, 137-171.

Mankiw, N.G. (2000), "The Savers-Spenders Theory of Fiscal Policy", *American Economic Review, Papers and Proceedings*, 120-125.

Marini, G. - Van der Ploeg, F. (1988), "Monetary and Fiscal Policy in an Optimising Model with Capital Accumulation and Finite Lives", *Economic Journal*, 98, 772-786.

Obstfeld, M. (1990), "Intertemporal Dependence, Impatience, and Dynamics", *Journal of Monetary Economics*, 26, 45-75 .

Obstfeld, M. - Rogoff, K. (1996), *Foundations of International Economics*, The MIT Press, Cambridge (MA).

Persson, T. (1985), "Deficits and Intergenerational Welfare in Open Economies", *Journal of International Economics*, 19, 67-84.

Petrucci, A. (2000), "On Debt Neutrality in the Savers-Spenders Theory of Fiscal Policy", FEEM discussion paper, n. 104.00, Fondazione ENI Enrico Mattei, Milan.

Phelps, E.S. (1994), *Structural Slumps: The Modern Equilibrium Theory of Unemployment, Interest, and Assets*, Cambridge (MA), Harvard University Press.

Seater, J. (1993), "Ricardian Equivalence", *Journal of Economic Literature*, 31, 142-190.

Turnovsky, S.J. (1997), *International Macroeconomic Dynamics*, The MIT Press, Cambridge (MA).

Weil, P. (1989), "Overlapping Families of Infinitely-Lived Agents", *Journal of Public Economics*, 38, 183-198.

Yaari, M.E. (1965), "Uncertain Lifetime, Life Insurance and the Theory of the Consumer", *Review of Economic Studies*, 32, 137-150.

APPENDICES

A. OLG demographics: Derivation of the demand-side

Here, we provide a derivation of the aggregate behavior of consumers described by system (16) in Section 3.1.

Assume that instantaneous preferences of each consumer are logarithmic. The consumer born at time $s \leqslant t$ maximizes the following expected lifetime welfare

$$\int_t^\infty \left\{ \beta \ln c(s,j) + (1-\beta) \ln \left[z - l(s,j) \right] \right\} e^{-(\theta+\rho)(j-t)} dj \qquad \text{(A.1)}$$

subject to the flow budget constraint

$$\frac{da(s,t)}{dt} = (r^* + \theta)a(s,t) + w(t)l(s,t) - q(s,t) - c(s,t) \qquad \text{(A.2)}$$

and the solvency condition precluding "Ponzi games"

$$\lim_{j \to \infty} a(j,t)e^{-(r^*+\theta)(j-t)} = 0 \qquad \text{(A.3)}$$

where $c(s,t)$, $l(s,t)$, $a(s,t)$, and $q(s,t)$ denote at time t consumption of goods, labor hours, nonhuman wealth, and lump-sum taxes of a consumer born at time s, respectively; $w(t)$ denotes the real wage at time t; z, ρ and r^* are the individual time endownment, the exogenous rate of time preference and the real world interest rate, respectively; $\beta \in (0,1)$ is a preference parameter.

The budget constraint (A.2) incorporates the hypothesis that consumers receive an actuarially fair premium $\theta a(s,t)$ from competitive life insurance companies and give all their wealth to the life insurance companies contingent on their death.

By integrating the budget constraint (A.2) forward and using the condition (A.3), we obtain the consumer's intertemporal budget constraint

$$\int_t^\infty c(s,j)e^{-(r^*+\theta)(j-t)}dj = a(s,t) + h(s,t)$$

where $h(s,t)$ represents human wealth. This is defined as

$$h(s,t) = \int_t^\infty [w(j)l(s,j) - q(s,j)]e^{-(r^*+\theta)(j-t)}dj$$

The first-order conditions for the individual problem (A.1)-(A.3) are

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

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

The forward integration of the Euler equation for individual consumption and the joint use of the intertemporal budget constraint yields the following consumption function

$$c(s,t) = \beta(\theta + \rho)\left[a(s,t) + h(s,t)\right]$$

Summing all over the choorts and omitting the time index, the aggregate demand-side is described by

$$C = \beta(\theta + \rho)(A + H) \tag{A.4a}$$

$$1 - L = \frac{(1 - \beta)C}{\beta w} \tag{A.4b}$$

$$\dot{H} = (r^* + \theta)H - wL + Q \tag{A.4c}$$

$$C + \dot{A} = r^*A + wL - Q \tag{A.4d}$$

where capital letters denote aggregate variables of the corresponding lower-case letters and the aggregate time endownment Z has been set equal to one.

¿From system (A.4), the Blanchard-Yaari dynamic equation for consumption is easily obtained

$$\dot{C} = (r^* - \rho)C - \beta\theta(\theta + \rho)A \tag{A.4a'}$$

B. OLG demographics: Analysis of stability

The short-run model can be written as

$$1 - L = \frac{(1 - \beta)C}{\beta\omega^*} \tag{B.1a}$$

$$K = \kappa^*L \tag{B.1b}$$

$$\dot{C} = (r^* - \rho)C - \beta\theta(\theta + \rho)(K + B + \tilde{D}) \tag{B.1c}$$

$$\dot{B} = f(\kappa^*)L - C - G - \dot{K} + r^*B \tag{B.1d}$$

where $\omega^* = f(\kappa^*) - \kappa^* f'(\kappa^*) = \bar{w}$ and $\kappa^* = f'^{-1}(r^*)$.

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

$$L = L(C), \quad L' = -\frac{(1 - \beta)}{\beta\omega^*} < 0 \tag{B.2a}$$

$$K = K(C), \quad K' = -\frac{(1 - \beta)\kappa^*}{\beta\omega^*} < 0 \tag{B.2b}$$

Substituting out the values of L and K from equations (B.2a) and (B.2b) into equations (B.1c) and (B.1d),[26] the model can be reduced to the following pair of differential equations linearized around the steady state

$$\begin{bmatrix} \dot{C} \\ \dot{B} \end{bmatrix} = \begin{bmatrix} j_{11} & -\beta\theta(\theta + \rho) \\ j_{21} & j_{22} \end{bmatrix} \begin{bmatrix} C - \bar{C} \\ B - \bar{B} \end{bmatrix} \tag{B.3}$$

where

$$j_{11} = (r^* - \rho) - \theta(\theta + \rho)\frac{(1 - \beta)\kappa^*}{\omega^*} > 0;$$

$$j_{21} = -\frac{(1 - \beta)f}{\beta\omega^*} - 1 + \left[(r^* - \rho) - \theta(\theta + \rho)\frac{(1 - \beta)\kappa^*}{\omega^*}\right]\frac{(1 - \beta)\kappa^*}{\beta\omega^*} > 0;$$

[26]Equation (B.2b) is employed, once linearized, to eliminate both K and $\dot{K}$ from equations (B.1c) and (B.1d).

34

$$j_{22} = r^* - \theta(\theta + \rho)\frac{(1 - \beta)\kappa^*}{\omega^*}.$$

The coefficient matrix of system (B.3) must have one positive eigenvalue associated with the jump variable, C, and one negative eigenvalue associated with the predetermined variable, B. The determinant of the above Jacobian is given by

$$\mid J \mid = -\theta(\theta + \rho) + r^*(r^* - \rho) = \frac{(r^* - \rho)}{\beta \ \bar{A}}\left[\beta(\bar{Q} - \omega^* \ \bar{L}) - (1 - \beta) \ \bar{C}\right] < 0.$$

This determinant is unambiguously negative, as we can reasonably assume that $\omega^* \ \bar{L} > \bar{Q}$, and hence the required condition for saddle-point stability is satisfied.

C. SS-OLG demographics

When the SS demographics is combined with the OLG one, the corresponding long-run economy is described by

$$\bar{C}_S = \frac{\gamma\theta(\theta + \rho)}{(r^* - \rho)} \ \bar{A} \tag{C.1a}$$

$$1 - \bar{L}_S = \frac{(1 - \gamma)}{\gamma\omega^*} \ \bar{C}_S \tag{C.1b}$$

$$\bar{C}_N = \omega^* \ \widetilde{L}_N - \tau(G + r^* \ \widetilde{D}) \tag{C.1c}$$

$$r^* \ \bar{A} + \omega^*(\bar{L}_S + \widetilde{L}_N) = \bar{C}_S + \bar{C}_N + G + r^* \ \widetilde{D} \tag{C.1d}$$

$$\bar{K} = \kappa^*(\bar{L}_S + \widetilde{L}_N) \tag{C.1e}$$

where γ is a preference parameter and $\bar{A} \equiv \bar{K} + \bar{B} + \widetilde{D}$.

In this context, savers are Blanchard-Yaari agents, while nonsaver remain Keynesian agents.

By operating as in section 3, the core model can be described by the following system

$$\bar{C}_S = \frac{\gamma\theta(\theta + \rho)}{[\gamma\theta(\theta + \rho) - r^*(r^* - \rho)]} \left[\frac{\omega^*}{\kappa^*} \bar{K} - (1 - \tau)(G + r^* \widetilde{D}) - \omega^* \widetilde{L}_N \right] \tag{C.2a}$$

$$\bar{C}_S = \frac{\gamma\omega^*}{(1 - \gamma)}(1 + \widetilde{L}_N - \frac{\bar{K}}{\kappa^*}) \tag{C.2b}$$

Equations (C.2) give immediately the perception that the basic results for capital and financial wealth of the OLG demographics are qualitatively confirmed.

$\overline{C}_S$

LM

CA-NPG'

CA-NPG

E'

E

$\overline{K}$
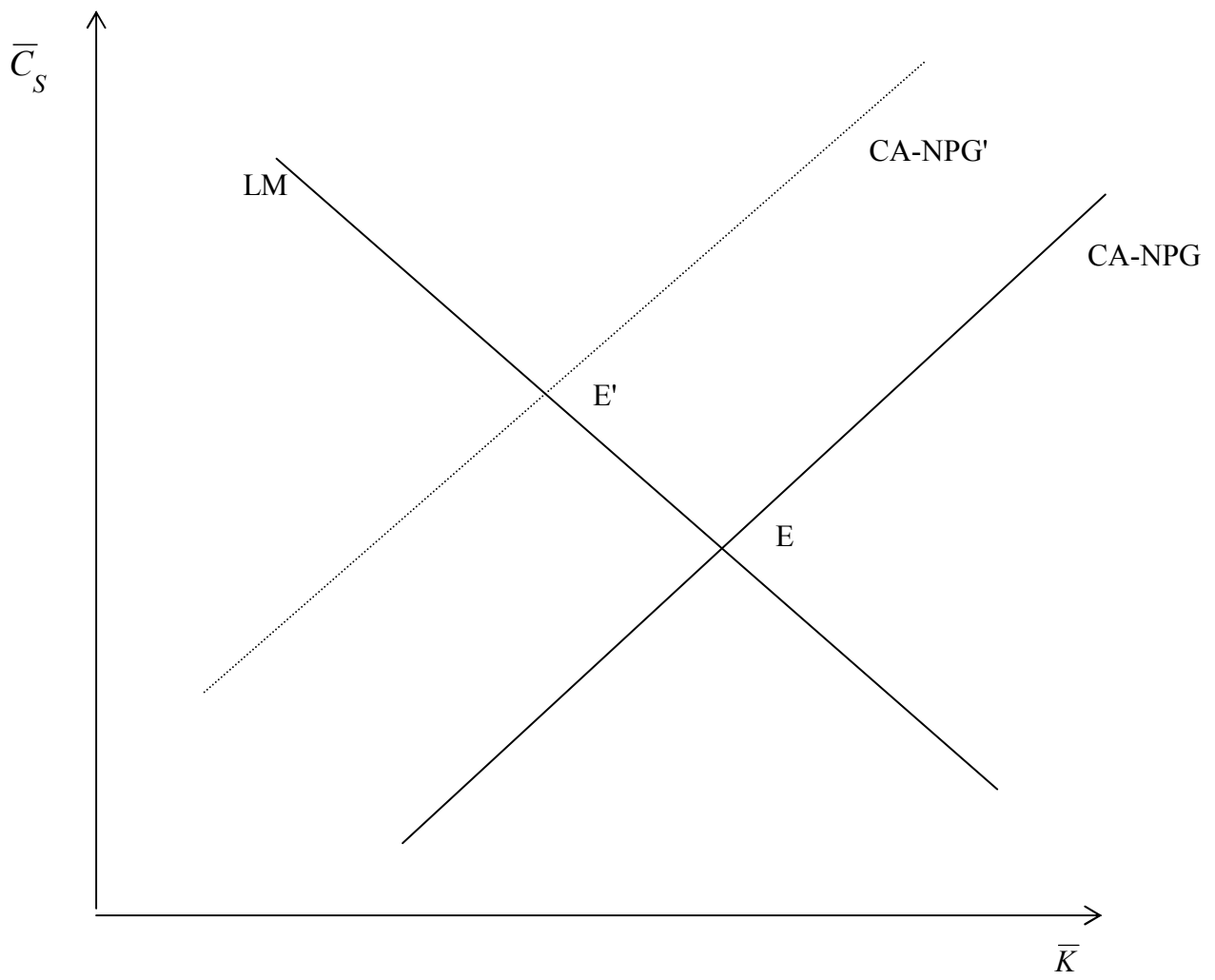
SS DEMOGRAPHICS

Fig. 1
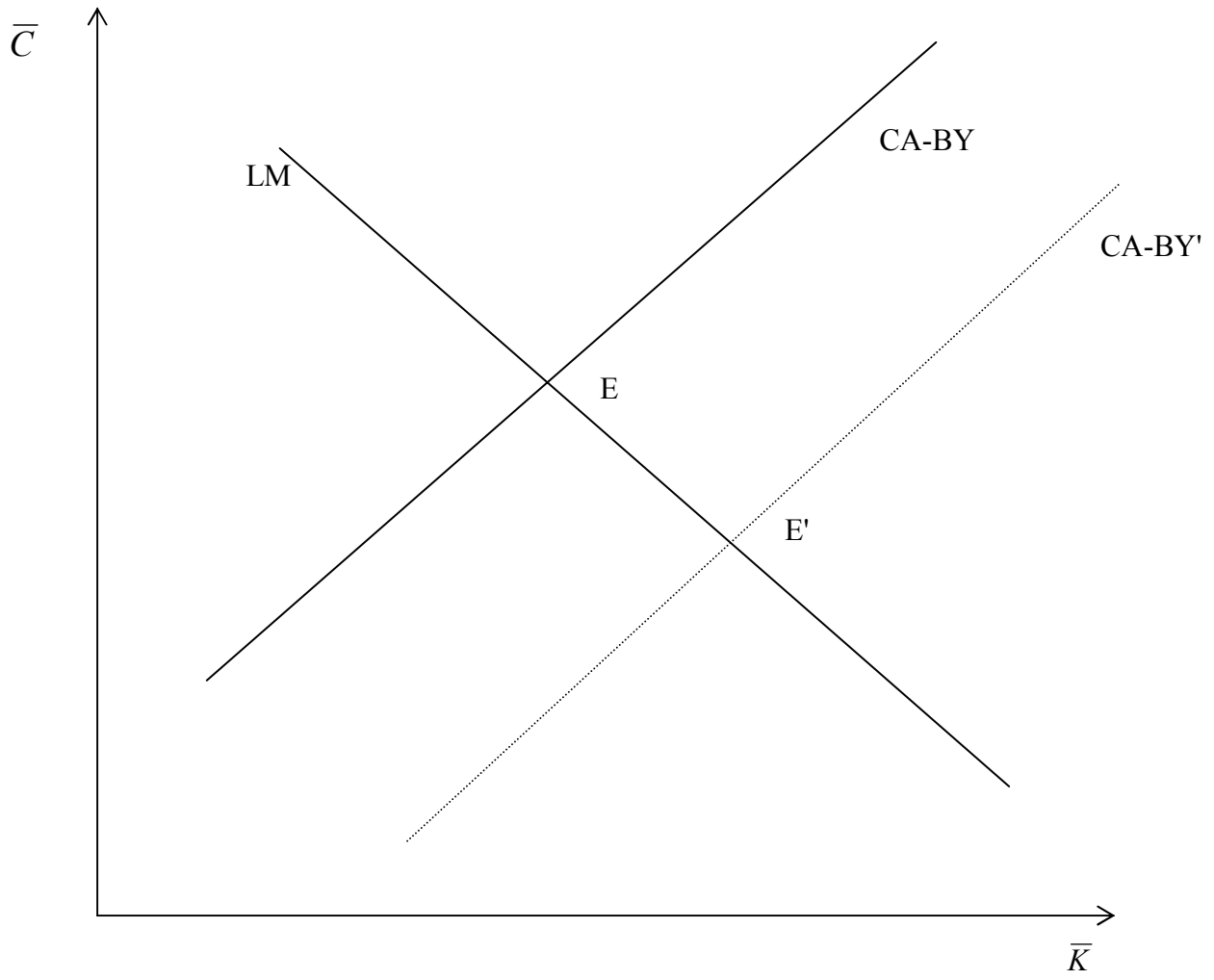
OLG DEMOGRAPHICS

Fig. 2

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI
Fondazione Eni Enrico Mattei Working Papers Series
Our working papers are available on the Internet at the following addresses:
Server WWW: WWW.FEEM.IT
Anonymous FTP: FTP.FEEM.IT
http://papers.ssrn.com/abstract_id=XXXXXX

NRM	35.2001	*Carlo GIUPPONI*: The Substitution of Hazardous Molecules in Production Processes: The Atrazine Case Study in Italian Agriculture
KNOW	36.2001	*Raffaele PACI and Francesco PIGLIARU*: Technological Diffusion, Spatial Spillovers and Regional Convergence in Europe
PRIV	37.2001	*Bernardo BORTOLOTTI*: Privatisation, Large Shareholders, and Sequential Auctions of Shares
CLIM	38.2001	*Barbara BUCHNER*: What Really Happened in The Hague? Report on the COP6, Part I, 13-25 November 2000, The Hague, The Netherlands
PRIV	39.2001	*Giacomo CALZOLARI and Carlo SCARPA*: Regulation at Home, Competition Abroad: A Theoretical Framework
KNOW	40.2001	*Giorgio BRUNELLO*: On the Complementarity between Education and Training in Europe
Coalition Theory Network	41.2001	*Alain DESDOIGTS and Fabien MOIZEAU* (xlvi): Multiple Politico-Economic Regimes, Inequality and Growth
Coalition Theory Network	42.2001	*Parkash CHANDER and Henry TULKENS* (xlvi): Limits to Climate Change
Coalition Theory Network	43.2001	*Michael FINUS and Bianca RUNDSHAGEN* (xlvi): Endogenous Coalition Formation in Global Pollution Control
Coalition Theory Network	44.2001	*Wietze LISE, Richard S.J. TOL and Bob van der ZWAAN* (xlvi): Negotiating Climate Change as a Social Situation
NRM	45.2001	*Mohamad R. KHAWLIE* (xlvii): The Impacts of Climate Change on Water Resources of Lebanon- Eastern Mediterranean
NRM	46.2001	*Mutasem EL-FADEL and E. BOU-ZEID* (xlvii): Climate Change and Water Resources in the Middle East: Vulnerability, Socio-Economic Impacts and Adaptation
NRM	47.2001	*Eva IGLESIAS, Alberto GARRIDO and Almudena GOMEZ* (xlvii): An Economic Drought Management Index to Evaluate Water Institutions' Performance Under Uncertainty and Climate Change
CLIM	48.2001	*Wietze LISE and Richard S.J. TOL* (xlvii): Impact of Climate on Tourist Demand
CLIM	49.2001	*Francesco BOSELLO, Barbara BUCHNER, Carlo CARRARO and Davide RAGGI*: Can Equity Enhance Efficiency? Lessons from the Kyoto Protocol
SUST	50.2001	*Roberto ROSON* (xlviii): Carbon Leakage in a Small Open Economy with Capital Mobility
SUST	51.2001	*Edwin WOERDMAN* (xlviii): Developing a European Carbon Trading Market: Will Permit Allocation Distort Competition and Lead to State Aid?
SUST	52.2001	*Richard N. COOPER* (xlviii): The Kyoto Protocol: A Flawed Concept
SUST	53.2001	*Kari KANGAS* (xlviii): Trade Liberalisation, Changing Forest Management and Roundwood Trade in Europe
SUST	54.2001	*Xueqin ZHU and Ekko VAN IERLAND* (xlviii): Effects of the Enlargement of EU on Trade and the Environment
SUST	55.2001	*M. Ozgur KAYALICA and Sajal LAHIRI* (xlviii): Strategic Environmental Policies in the Presence of Foreign Direct Investment
SUST	56.2001	*Savas ALPAY* (xlviii): Can Environmental Regulations be Compatible with Higher International Competitiveness? Some New Theoretical Insights
SUST	57.2001	*Roldan MURADIAN, Martin O'CONNOR, Joan MARTINEZ-ALER* (xlviii): Embodied Pollution in Trade: Estimating the "Environmental Load Displacement" of Industrialised Countries
SUST	58.2001	*Matthew R. AUER and Rafael REUVENY* (xlviii): Foreign Aid and Direct Investment: Key Players in the Environmental Restoration of Central and Eastern Europe
SUST	59.2001	*Onno J. KUIK and Frans H. OOSTERHUIS* (xlviii): Lessons from the Southern Enlargement of the EU for the Environmental Dimensions of Eastern Enlargement, in particular for Poland
ETA	60.2001	*Carlo CARRARO, Alessandra POME and Domenico SINISCALCO* (xlix): Science vs. Profit in Research: Lessons from the Human Genome Project
CLIM	61.2001	*Efrem CASTELNUOVO, Michele MORETTO and Sergio VERGALLI*: Global Warming, Uncertainty and Endogenous Technical Change: Implications for Kyoto
PRIV	62.2001	*Gian Luigi ALBANO, Fabrizio GERMANO and Stefano LOVO*: On Some Collusive and Signaling Equilibria in Ascending Auctions for Multiple Objects
CLIM	63.2001	*Elbert DIJKGRAAF and Herman R.J. VOLLEBERGH*: A Note on Testing for Environmental Kuznets Curves with Panel Data
CLIM	64.2001	*Paolo BUONANNO, Carlo CARRARO and Marzio GALEOTTI*: Endogenous Induced Technical Change and the Costs of Kyoto
CLIM	65.2001	*Guido CAZZAVILLAN and Ignazio MUSU* (l): Transitional Dynamics and Uniqueness of the Balanced-Growth Path in a Simple Model of Endogenous Growth with an Environmental Asset
CLIM	66.2001	*Giovanni BAIOCCHI and Salvatore DI FALCO* (l): Investigating the Shape of the EKC: A Nonparametric Approach
CLIM	67.2001	*Marzio GALEOTTI, Alessandro LANZA and Francesco PAULI* (l): Desperately Seeking (Environmental) Kuznets: A New Look at the Evidence
CLIM	68.2001	*Alexey VIKHLYAEV* (xlviii): The Use of Trade Measures for Environmental Purposes – Globally and in the EU Context
NRM	69.2001	*Gary D. LIBECAP and Zeynep K. HANSEN* (li): U.S. Land Policy, Property Rights, and the Dust Bowl of the 1930s

NRM	70.2001	*Lee J. ALSTON, Gary D. LIBECAP and Bernardo MUELLER* (li): <u>Land Reform Policies, The Sources of Violent Conflict and Implications for Deforestation in the Brazilian Amazon</u>
CLIM	71.2001	*Claudia KEMFERT*: <u>Economy-Energy-Climate Interaction – The Model WIAGEM -</u>
SUST	72.2001	*Paulo A.L.D. NUNES and Yohanes E. RIYANTO*: <u>Policy Instruments for Creating Markets for Bodiversity: Certification and Ecolabeling</u>
SUST	73.2001	*Paulo A.L.D. NUNES and Erik SCHOKKAERT* (lii): <u>Warm Glow and Embedding in Contingent Valuation</u>
SUST	74.2001	*Paulo A.L.D. NUNES, Jeroen C.J.M. van den BERGH and Peter NIJKAMP* (lii): <u>Ecological-Economic Analysis and Valuation of Biodiversity</u>
VOL	75.2001	*Johan EYCKMANS and Henry TULKENS* (li): <u>Simulating Coalitionally Stable Burden Sharing Agreements for the Climate Change Problem</u>
PRIV	76.2001	*Axel GAUTIER and Florian HEIDER*: <u>What Do Internal Capital Markets Do? Redistribution vs. Incentives</u>
PRIV	77.2001	*Bernardo BORTOLOTTI, Marcella FANTINI and Domenico SINISCALCO*: <u>Privatisation around the World: New Evidence from Panel Data</u>
ETA	78.2001	*Toke S. AIDT and Jayasri DUTTA* (li): <u>Transitional Politics. Emerging Incentive-based Instruments in Environmental Regulation</u>
ETA	79.2001	*Alberto PETRUCCI*: <u>Consumption Taxation and Endogenous Growth in a Model with New Generations</u>
ETA	80.2001	*Pierre LASSERRE and Antoine SOUBEYRAN* (li): <u>A Ricardian Model of the Tragedy of the Commons</u>
ETA	81.2001	*Pierre COURTOIS, Jean Christophe PÉREAU and Tarik TAZDAÏT*: <u>An Evolutionary Approach to the Climate Change Negotiation Game</u>
NRM	82.2001	*Christophe BONTEMPS, Stéphane COUTURE and Pascal FAVARD*: <u>Is the Irrigation Water Demand Really Convex?</u>
NRM	83.2001	*Unai PASCUAL and Edward BARBIER*: <u>A Model of Optimal Labour and Soil Use with Shifting Cultivation</u>
CLIM	84.2001	*Jesper JENSEN and Martin Hvidt THELLE*: <u>What are the Gains from a Multi-Gas Strategy?</u>
CLIM	85.2001	*Maurizio MICHELINI* (liii): <u>IPCC "Summary for Policymakers" in TAR. Do its results give a scientific support always adequate to the urgencies of Kyoto negotiations?</u>
CLIM	86.2001	*Claudia KEMFERT* (liii): <u>Economic Impact Assessment of Alternative Climate Policy Strategies</u>
CLIM	87.2001	*Cesare DOSI and Michele MORETTO*: <u>Global Warming and Financial Umbrellas</u>
ETA	88.2001	*Elena BONTEMPI, Alessandra DEL BOCA, Alessandra FRANZOSI, Marzio GALEOTTI and Paola ROTA*: <u>Capital Heterogeneity: Does it Matter? Fundamental Q and Investment on a Panel of Italian Firms</u>
ETA	89.2001	*Efrem CASTELNUOVO and Paolo SURICO*: <u>Model Uncertainty, Optimal Monetary Policy and the Preferences of the Fed</u>
CLIM	90.2001	*Umberto CIORBA, Alessandro LANZA and Francesco PAULI*: <u>Kyoto Protocol and Emission Trading: Does the US Make a Difference?</u>
CLIM	91.2001	*ZhongXiang ZHANG and Lucas ASSUNCAO*: <u>Domestic Climate Policies and the WTO</u>
SUST	92.2001	*Anna ALBERINI, Alan KRUPNICK, Maureen CROPPER, Nathalie SIMON and Joseph COOK* (lii): <u>The Willingness to Pay for Mortality Risk Reductions: A Comparison of the United States and Canada</u>
SUST	93.2001	*Riccardo SCARPA, Guy D. GARROD and Kenneth G. WILLIS* (lii): <u>Valuing Local Public Goods with Advanced Stated Preference Models: Traffic Calming Schemes in Northern England</u>
CLIM	94.2001	*Ming CHEN and Larry KARP*: <u>Environmental Indices for the Chinese Grain Sector</u>
CLIM	95.2001	*Larry KARP and Jiangfeng ZHANG*: <u>Controlling a Stock Pollutant with Endogenous Investment and Asymmetric Information</u>
ETA	96.2001	*Michele MORETTO and Gianpaolo ROSSINI*: <u>On the Opportunity Cost of Nontradable Stock Options</u>
SUST	97.2001	*Elisabetta STRAZZERA, Margarita GENIUS, Riccardo SCARPA and George HUTCHINSON*: <u>The Effect of Protest Votes on the Estimates of Willingness to Pay for Use Values of Recreational Sites</u>
NRM	98.2001	*Frédéric BROCHIER, Carlo GIUPPONI and Alberto LONGO*: <u>Integrated Coastal Zone Management in the Venice Area – Perspectives of Development for the Rural Island of Sant'Erasmo</u>
NRM	99.2001	*Frédéric BROCHIER, Carlo GIUPPONI and Julie SORS*: <u>Integrated Coastal Management in the Venice Area – Potentials of the Integrated Participatory Management Approach</u>
NRM	100.2001	*Frédéric BROCHIER and Carlo GIUPPONI*: <u>Integrated Coastal Zone Management in the Venice Area – A Methodological Framework</u>
PRIV	101.2001	*Enrico C. PEROTTI and Luc LAEVEN*: <u>Confidence Building in Emerging Stock Markets</u>
CLIM	102.2001	*Barbara BUCHNER, Carlo CARRARO and Igor CERSOSIMO*: <u>On the Consequences of the U.S. Withdrawal from the Kyoto/Bonn Protocol</u>
SUST	103.2001	*Riccardo SCARPA, Adam DRUCKER, Simon ANDERSON, Nancy FERRAES-EHUAN, Veronica GOMEZ, Carlos R. RISOPATRON and Olga RUBIO-LEONEL*: <u>Valuing Animal Genetic Resources in Peasant Economies: The Case of the Box Keken Creole Pig in Yucatan</u>
SUST	104.2001	*R. SCARPA, P. KRISTJANSON, A. DRUCKER, M. RADENY, E.S.K. RUTO, and J.E.O. REGE*: <u>Valuing Indigenous Cattle Breeds in Kenya: An Empirical Comparison of Stated and Revealed Preference Value Estimates</u>
SUST	105.2001	*Clemens B.A. WOLLNY*: <u>The Need to Conserve Farm Animal Genetic Resources Through Community-Based Management in Africa: Should Policy Makers be Concerned?</u>
SUST	106.2001	*J.T. KARUGIA, O.A. MWAI, R. KAITHO, Adam G. DRUCKER, C.B.A. WOLLNY and J.E.O. REGE*: <u>Economic Analysis of Crossbreeding Programmes in Sub-Saharan Africa: A Conceptual Framework and Kenyan Case Study</u>
SUST	107.2001	*W. AYALEW, J.M. KING, E. BRUNS and B. RISCHKOWSKY*: <u>Economic Evaluation of Smallholder Subsistence Livestock Production: Lessons from an Ethiopian Goat Development Program</u>

SUST	108.2001	*Gianni CICIA, Elisabetta D'ERCOLE and Davide MARINO*: Valuing Farm Animal Genetic Resources by Means of Contingent Valuation and a Bio-Economic Model: The Case of the Pentro Horse
SUST	109.2001	*Clem TISDELL*: Socioeconomic Causes of Loss of Animal Genetic Diversity: Analysis and Assessment
SUST	110.2001	*M.A. JABBAR and M.L. DIEDHOU*: Does Breed Matter to Cattle Farmers and Buyers? Evidence from West Africa
SUST	1.2002	*K. TANO, M.D. FAMINOW, M. KAMUANGA and B. SWALLOW*: Using Conjoint Analysis to Estimate Farmers' Preferences for Cattle Traits in West Africa
ETA	2.2002	*Efrem CASTELNUOVO and Paolo SURICO*: What Does Monetary Policy Reveal about Central Bank's Preferences?
WAT	3.2002	*Duncan KNOWLER and Edward BARBIER*: The Economics of a "Mixed Blessing" Effect: A Case Study of the Black Sea
CLIM	4.2002	*Andreas LÖSCHEL*: Technological Change in Economic Models of Environmental Policy: A Survey
VOL	5.2002	*Carlo CARRARO and Carmen MARCHIORI*: Stable Coalitions
CLIM	6.2002	*Marzio GALEOTTI, Alessandro LANZA and Matteo MANERA*: Rockets and Feathers Revisited: An International Comparison on European Gasoline Markets
ETA	7.2002	*Effrosyni DIAMANTOUDI and Eftichios S. SARTZETAKIS*: Stable International Environmental Agreements: An Analytical Approach
KNOW	8.2002	*Alain DESDOIGTS*: Neoclassical Convergence Versus Technological Catch-up: A Contribution for Reaching a Consensus
NRM	9.2002	*Giuseppe DI VITA:* Renewable Resources and Waste Recycling
KNOW	10.2002	*Giorgio BRUNELLO*: Is Training More Frequent when Wage Compression is Higher? Evidence from 11 European Countries
ETA	11.2002	*Mordecai KURZ, Hehui JIN and Maurizio MOTOLESE*: Endogenous Fluctuations and the Role of Monetary Policy
KNOW	12.2002	*Reyer GERLAGH and Marjan W. HOFKES:* Escaping Lock-in: The Scope for a Transition towards Sustainable Growth?
NRM	13.2002	*Michele MORETTO and Paolo ROSATO*: The Use of Common Property Resources: A Dynamic Model
CLIM	14.2002	*Philippe QUIRION*: Macroeconomic Effects of an Energy Saving Policy in the Public Sector
CLIM	15.2002	*Roberto ROSON*: Dynamic and Distributional Effects of Environmental Revenue Recycling Schemes: Simulations with a General Equilibrium Model of the Italian Economy
CLIM	16.2002	*Francesco RICCI* (l): Environmental Policy Growth when Inputs are Differentiated in Pollution Intensity
ETA	17.2002	*Alberto PETRUCCI*: Devaluation (Levels versus Rates) and Balance of Payments in a Cash-in-Advance Economy
Coalition Theory Network	18.2002	*László Á. KÓCZY* (liv*):* The Core in the Presence of Externalities
Coalition Theory Network	19.2002	*Steven J. BRAMS, Michael A. JONES and D. Marc KILGOUR* (liv): Single-Peakedness and Disconnected Coalitions
Coalition Theory Network	20.2002	*Guillaume HAERINGER* (liv): On the Stability of Cooperation Structures
NRM	21.2002	*Fausto CAVALLARO and Luigi CIRAOLO:* Economic and Environmental Sustainability: A Dynamic Approach in Insular Systems
CLIM	22.2002	*Barbara BUCHNER, Carlo CARRARO, Igor CERSOSIMO and Carmen MARCHIORI*: Back to Kyoto? US Participation and the Linkage between R&D and Climate Cooperation
CLIM	23.2002	*Andreas LÖSCHEL and ZhongXIANG ZHANG:* The Economic and Environmental Implications of the US Repudiation of the Kyoto Protocol and the Subsequent Deals in Bonn and Marrakech
ETA	24.2002	*Marzio GALEOTTI, Louis J. MACCINI and Fabio SCHIANTARELLI*: Inventories, Employment and Hours
CLIM	25.2002	*Hannes EGLI:* Are Cross-Country Studies of the Environmental Kuznets Curve Misleading? New Evidence from Time Series Data for Germany
ETA	26.2002	*Adam B. JAFFE, Richard G. NEWELL and Robert N. STAVINS*: Environmental Policy and Technological Change
SUST	27.2002	*Joseph C. COOPER and Giovanni SIGNORELLO*: Farmer Premiums for the Voluntary Adoption of Conservation Plans
SUST	28.2002	*The ANSEA Network*: Towards An Analytical Strategic Environmental Assessment
KNOW	29.2002	*Paolo SURICO*: Geographic Concentration and Increasing Returns: a Survey of Evidence
ETA	30.2002	*Robert N. STAVINS:* Lessons from the American Experiment with Market-Based Environmental Policies
NRM	31.2002	*Carlo GIUPPONI and Paolo ROSATO:* Multi-Criteria Analysis and Decision-Support for Water Management at the Catchment Scale: An Application to Diffuse Pollution Control in the Venice Lagoon
NRM	32.2002	*Robert N. STAVINS*: National Environmental Policy During the Clinton Years
KNOW	33.2002	*A. SOUBEYRAN and H. STAHN* : Do Investments in Specialized Knowledge Lead to Composite Good Industries?
KNOW	34.2002	*G. BRUNELLO, M.L. PARISI and Daniela SONEDDA:* Labor Taxes, Wage Setting and the Relative Wage Effect
CLIM	35.2002	*C. BOEMARE and P. QUIRION* (lv): Implementing Greenhouse Gas Trading in Europe: Lessons from Economic Theory and International Experiences

PRIV	77.2002	*Christoph LÜLSFESMANN*: <u>Benevolent Government, Managerial Incentives, and the Virtues of Privatization</u>
PRIV	78.2002	*Kate BISHOP, Igor FILATOTCHEV and Tomasz MICKIEWICZ*: <u>Endogenous Ownership Structure: Factors Affecting the Post-Privatisation Equity in Largest Hungarian Firms</u>
PRIV	79.2002	*Theodora WELCH and Rick MOLZ*: <u>How Does Trade Sale Privatization Work? Evidence from the Fixed-Line Telecommunications Sector in Developing Economies</u>
PRIV	80.2002	*Alberto R. PETRUCCI*: <u>Government Debt, Agent Heterogeneity and Wealth Displacement in a Small Open Economy</u>

(xlii) This paper was presented at the International Workshop on "Climate Change and Mediterranean Coastal Systems: Regional Scenarios and Vulnerability Assessment" organised by the Fondazione Eni Enrico Mattei in co-operation with the Istituto Veneto di Scienze, Lettere ed Arti, Venice, December 9-10, 1999.

(xliii)This paper was presented at the International Workshop on "Voluntary Approaches, Competition and Competitiveness" organised by the Fondazione Eni Enrico Mattei within the research activities of the CAVA Network, Milan, May 25-26,2000.

(xliv) This paper was presented at the International Workshop on "Green National Accounting in Europe: Comparison of Methods and Experiences" organised by the Fondazione Eni Enrico Mattei within the Concerted Action of Environmental Valuation in Europe (EVE), Milan, March 4-7, 2000

(xlv) This paper was presented at the International Workshop on "New Ports and Urban and Regional Development. The Dynamics of Sustainability" organised by the Fondazione Eni Enrico Mattei, Venice, May 5-6, 2000.

(xlvi) This paper was presented at the Sixth Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei and the CORE, Université Catholique de Louvain, Louvain-la-Neuve, Belgium, January 26-27, 2001

(xlvii) This paper was presented at the RICAMARE Workshop "Socioeconomic Assessments of Climate Change in the Mediterranean: Impact, Adaptation and Mitigation Co-benefits", organised by the Fondazione Eni Enrico Mattei, Milan, February 9-10, 2001

(xlviii) This paper was presented at the International Workshop "Trade and the Environment in the Perspective of the EU Enlargement ", organised by the Fondazione Eni Enrico Mattei, Milan, May 17-18, 2001

(xlix) This paper was presented at the International Conference "Knowledge as an Economic Good", organised by Fondazione Eni Enrico Mattei and The Beijer International Institute of Environmental Economics, Palermo, April 20-21, 2001

(l) This paper was presented at the Workshop "Growth, Environmental Policies and Sustainability" organised by the Fondazione Eni Enrico Mattei, Venice, June 1, 2001

(li) This paper was presented at the Fourth Toulouse Conference on Environment and Resource Economics on "Property Rights, Institutions and Management of Environmental and Natural Resources", organised by Fondazione Eni Enrico Mattei, IDEI and INRA and sponsored by MATE, Toulouse, May 3-4, 2001

(lii) This paper was presented at the International Conference on "Economic Valuation of Environmental Goods", organised by Fondazione Eni Enrico Mattei in cooperation with CORILA, Venice, May 11, 2001

(liii) This paper was circulated at the International Conference on "Climate Policy – Do We Need a New Approach?", jointly organised by Fondazione Eni Enrico Mattei, Stanford University and Venice International University, Isola di San Servolo, Venice, September 6-8, 2001

(liv) This paper was presented at the Seventh Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei and the CORE, Université Catholique de Louvain, Venice, Italy, January 11-12, 2002

(lv) This paper was presented at the First Workshop of the Concerted Action on Tradable Emission Permits (CATEP) organised by the Fondazione Eni Enrico Mattei, Venice, Italy, December 3-4, 2001

(lvi) This paper was presented at the ESF EURESCO Conference on Environmental Policy in a Global Economy "The International Dimension of Environmental Policy", organised with the collaboration of the Fondazione Eni Enrico Mattei , Acquafredda di Maratea, October 6-11, 2001

(lvii) This paper was presented at the First Workshop of "CFEWE – Carbon Flows between Eastern and Western Europe", organised by the Fondazione Eni Enrico Mattei and Zentrum fur Europaische Integrationsforschung (ZEI), Milan, July 5-6, 2001