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**Wirtschaftswissenschaftliche Fakultät  
der Eberhard-Karls-Universität Tübingen**

Equity and Efficiency Aspects  
of Italian Debt Reduction\*

Hans Fehr  
Anna Ruocco



**Tübinger Diskussionsbeiträge**

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**Equity and Efficiency Aspects  
of Italian Debt Reduction \***

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## Abstract

This paper examines the distributional and efficiency effects of different debt reduction schemes in Italy. To finance a given deficit reduction path, we introduce the so-called Eurotax and endogenously adjust either the consumption tax rate or lump-sum transfers in order to balance the budget. The analysis is based on a numerically specified overlapping generations model of the Auerbach-Kotlikoff type which distinguishes five different lifetime income classes within each age cohort. Our simulations suggest that the debt reduction in Italy will increase the welfare of future generations between 1 and 3 per cent of their lifetime resources. Mainly this is due to the implied reduction in future net tax burdens. However, factor price repercussions as well as efficiency gains might also be substantially beneficial to future generations. Finally, while the Eurotax is clearly progressive, consumption taxation is revealed to be, at least in our model, regressive even in the long run.

## 1. Introduction

In recent years, Italy has made substantial progress in fiscal consolidation in order to meet the Maastricht Treaty requirements. While the general government deficit amounted to 10.9 per cent of GDP in 1990, it has been reduced to 6.9 per cent in 1995 and is projected to decrease further to 3 per cent in and after 1997. This fiscal adjustment has been achieved by a mixture of spending cuts (on education, defence, health care etc.), higher indirect taxes (excise duties, levies on lotteries and gasoline) and the temporary introduction of a supplementary progressive income tax, the so-called "Eurotax" (Contributo Straordinario per l'Europa) in 1997<sup>1</sup>.

Given such a far-reaching transformation of the Italian economy, the question is who will bear the burden and who will reap the benefits of this massive debt reduction? There are four principal economic issues associated with this question. The first is the implied intergenerational redistribution. As is well known, public debt serves as an intergenerational transfer device in the standard overlapping generations model. Since public consumption is held constant, the reduction of public debt requires higher taxes or lower transfers, which increase the burden on current generations. However, the interest payments will be lower in the future. As a consequence, taxes can be decreased and/or transfers increased, which results in lower burdens for future generations. The second issue is whether debt reduction will enhance or undermine intragenerational equity. The individual members of particular generations can be affected quite differently by the tax changes depending on the specific financing scheme. If debt reduction is for example mainly financed by progressive income taxes, than rich households bear a relatively higher burden in comparison to poor households. On the other hand, if it is financed mainly by consumption taxes than households with low saving rates will bear a relatively higher burden. The third issue is related to the openness of the economy. What is the impact of debt reduction on the macroeconomy and how will factor price reactions affect the welfare change of different generations and households? In a small open economy, the interest rate is fixed to the world level and the wage rate will not vary if adjustment costs are neglected. Consequently intra- and intergenerational redistribution is only due to changes in net tax burdens (taxes minus transfers received). In a closed economy, however, changes in interest rates and wages might affect the equity position of

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<sup>1</sup>For a detailed account of the recent fiscal policy in Italy see OECD (1997).

different households quite substantially. The last issue is the efficiency gains or losses that might arise from debt reduction. In the altruism model of overlapping generations studied by Barro (1974), debt policy is neutral as long as lump-sum taxes are used. In the real world, however, government spending is mainly financed by distortionary taxes. In this case, debt policy would have real effects, even in the altruistic bequest model. Capturing the incentive effects of different taxes is therefore an important task of policy analysis.

In order to assess these economic issues, the paper aims to quantify the distributional and efficiency implications of different debt reduction schemes for Italy. Starting from a benchmark which reflects some key aspects of the Italian economy in 1995, an exogenous deficit reduction from 6 to 3 per cent of GDP is financed by introducing (either temporarily or permanently) the Eurotax and adjusting either consumption taxes or lump-sum transfers to balance the budget. The quantitative analysis is based on the overlapping generations model of the Auerbach-Kotlikoff (AK) type which distinguishes five lifetime income classes within each age cohort. The model incorporates adjustment costs and compares the transition in a small open and a closed economy.

Of course, the analysis is closely related to the numerical debt reduction studies by James (1994) for Canada and Jensen (1997) for Denmark. The Canadian model features heterogeneous agents within each cohort and is able to isolate the effects of an operative intergenerational bequest motive. The main virtue of the Danish model is the assumption of a unionized labor market that allows for the analysis of unemployment effects. Both papers apply the uncertain lifetime approach of Blanchard (1995). In this setup one can encompass overlapping generations without explicitly modelling discrete generational cohorts. While this is very convenient from the computational point of view, it also has some drawbacks. The tax system has to be substantially simplified since the model cannot distinguish individual specific average and marginal tax rates. Furthermore it is not possible to decompose the welfare effects into the respective redistributive and efficiency components. Instead, in contrast to most previous models in the AK tradition which consider only proportional taxes<sup>2</sup>, the present model presents a quite detailed progressive tax code. This is especially important for an analysis of the previously mentioned Eurotax. Ad-

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<sup>2</sup>See for example Keuschnigg (1991), Broer and Westerhout (1993) or Bettendorf (1994).

ditionally, the paper isolates the efficiency and redistributive components of the individual welfare effects. The latter are further decomposed into changes in net tax burdens and income effects due to factor price repercussions.

Our simulations suggest that the debt reduction in Italy will increase the welfare of future generations between 1 and 3 per cent of their lifetime resources. The main reason is the implied reduction in future net tax burdens. Factor price repercussions are quite substantial as are efficiency gains as well. The welfare increase of future generations is, in fact, due to higher wages or lower tax distortions. Finally, while the Eurotax is clearly progressive, consumption taxes are slightly regressive in a lifetime framework, since poor households save less than rich households throughout their lifecycle. Consequently, when consumption tax rates increase in the short run to finance the deficit reduction, low income classes have to bear a relatively higher burden. However, if consumption tax rates are reduced in the long run due to the lower interest payments, the same classes benefit overproportionally.

The outline of the paper is as follows. Section 2 describes the simulation model while section 3 reports the calibration of the initial steady state. The simulation results for different policy reforms are then presented in section 4. Finally, section 5 contains concluding remarks.

## 2. The Model

This section describes the general structure and the specific modelling of the Italian progressive tax system in the numerical simulation model. The economy consists of three sectors: households, firms and the government. In the open economy version a foreign sector is added to close the model.

### 2.1 Demography

The AK framework features 55 overlapping generations, with each adult living for 55 years, corresponding to the "natural" ages 20 to 75. There is no uncertainty with respect to lifetime. At the end of each period, the oldest generation dies and a new generation is "born" (i.e. it enters the labor force) at the beginning of the next period. The population is assumed to grow at a constant rate  $n$ , i.e.

$$N_{s+1} = (1 + n)N_s \tag{1}$$

where  $N_s$  is the number of individuals that enter the labor force in period  $s$ . An important innovation to the standard AK model is the disaggregation of multiple

lifetime income classes. We split every generation into five such classes of the same size. Hence, in every period we distinguish 275 different household types. The latter are identified by their age  $i$  (or  $a$ ) in period  $t$  (or  $s$ ) and the relevant income quintile  $v = 1, \dots, 5$ . Whereas  $t$  always denotes the period when the policy reform is implemented,  $s$  is used as a general time index ( $s \geq t$ ). From the individual perspective it is related to  $t$  since an individual who is age  $i$  in year  $t$  is defined to be age  $a$  in year  $s = t + a - i$ .

## 2.2. Consumption and asset accumulation

As we already mentioned, individuals differ with respect to age and with respect to lifetime resources. Each household decides how much to consume and how many hours to work in each period in order to maximize their lifetime utility with no bequest motive. Preferences over current and future consumption and leisure are governed by a time separable constant elasticity of substitution (CES) utility function, which is assumed to be the same for all lifetime income classes. The distinction between different lifetime income classes is therefore solely attributed to differences in their productivity or earnings capacity, not in utility functions<sup>3</sup>. To ease notation, we will therefore neglect the index  $v$  in the following equations whenever possible. In the year of the tax reform, the remaining lifetime utility of a generation age  $i$  takes the form

$$U_{it} = \frac{1}{1 - 1/\gamma} \sum_{a=i}^{55} \left( \frac{1}{1 + \theta} \right)^{a-i} \left[ c_{as}^{1-1/\rho} + \alpha \ell_{as}^{1-1/\rho} \right]^{\frac{1-1/\gamma}{1-1/\rho}}, \quad (2)$$

where  $c$  and  $\ell$  denote consumption and leisure respectively and  $s$  is defined as noted above. The term  $\theta$  represents the "pure" rate of time preference,  $\rho$  denotes the intratemporal elasticity of substitution between consumption and leisure at each age  $a$ ,  $\gamma$  is the intertemporal elasticity of substitution between consumption of different years, and finally  $\alpha$  is the leisure preference parameter.

Next we will specify the lifetime budget constraint of the household, which explains our modelling of the Italian tax and transfer system. In our specification, consumers are charged with labor and capital income taxes, consumption taxes and they receive lump-sum transfers. For simplicity, individual transfers in year  $s$ ,  $tr_s$ , are uniform

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<sup>3</sup>This reflects the belief that poor people would behave like rich people if they had the same income.



across generations and income classes. The labor income tax is progressive according to the 1995 Italian tax code. We therefore have to distinguish individual specific average and marginal wage tax rates,  $\bar{\tau}_{as}^w$  and  $\tau_{as}^w$ . The capital income tax as well as the consumption tax are modelled as proportional taxes. The respective tax rates are  $\tau_s^r$  and  $\tau_s^c$ . Using this information, the individual wages net of average and marginal taxes  $w_{as}^n$  and  $w_{as}^m$ , the net of tax interest rate  $r_s^n$  and the consumer price  $p_s$  in year  $s$  are defined as

$$w_{as}^n = w_s(1 - \bar{\tau}_{as}^w), \quad w_{as}^m = w_s(1 - \tau_{as}^w), \quad r_s^n = r_s(1 - \tau_s^r) \quad \text{and} \quad p_s = 1 + \tau_s^c,$$

where  $w_s$  and  $r_s$  define the pre-tax wage and interest rate in year  $s$  and producer prices are normalized to unity. The household accumulates wealth according to the dynamic budget constraint

$$a_{a+1\ s+1} - a_{as} = r_s^n a_{as} + (\bar{h} - \ell_{as}) e_a w_{as}^n + tr_s - p_s c_{as}. \quad (3)$$

The symbol  $\bar{h}$  in the above equation denotes the total time endowment in each period. The  $a_{as}$  are the asset holdings of individuals of age  $a$  in period  $s$ . The  $e_a$  term reflects the accumulation of human capital at age  $a$ . It describes how many units of "standard" labor the household supplies per unit of leisure foregone in any given year. Thus,  $e_a w_{as}$  may be interpreted as the individual's gross wage rate in year  $s$ . The age-wage profile  $e_i, i = 1, \dots, 55$  is set exogenously for every income class. In the absence of bequests, equation (3) is integrated forward under the constraint  $a_{56s} = 0$  to yield the intertemporal budget constraint

$$\sum_{a=i}^{55} [p_s c_{as} + w_{as}^n e_a \ell_{as}] R_s^n = (1 + r_t^n) a_{it} + \sum_{a=i}^{55} [w_{as}^n e_a \bar{h} + tr_s] R_s^n = W_{it}. \quad (4)$$

Equation (4) states that the present value of remaining lifetime consumption of goods and leisure is equal to the remaining lifetime resources  $W_{it}$ , which consist of current net financial wealth and the present discounted value of future resources net of taxes and transfers. The latter will be referred to as human wealth. The term  $R_s^n$  denotes the net compound interest rate defined by

$$R_s^n = \begin{cases} 1 & s = t, \\ \prod_{j=t+1}^s (1 + r_j^n)^{-1} & s > t. \end{cases} \quad (5)$$

Remaining lifetime utility (2) is maximized subject to the wealth constraint (4) and the requirement that labor supply can never be negative<sup>4</sup>. From the first order conditions one can derive the following expressions for the evolution of consumption and leisure demand over time

$$c_{as} = (1 + \theta)^{\gamma(i-a)} (R_s^n)^{-\gamma} \left( \frac{p_t}{p_s} \right)^\gamma \left( \frac{v_{as}}{v_{it}} \right) c_{it} \quad \text{and} \quad (6)$$

$$\ell_{as} = \alpha^\rho \left( \frac{w_{as}^m}{p_s} \right)^{-\rho} c_{as} \quad \text{with} \quad v_{as} = \left[ 1 + \alpha^\rho \left( \frac{w_{as}^m}{p_s} \right)^{1-\rho} \right]^{\frac{\rho-\gamma}{1-\rho}}. \quad (7)$$

Repeated use of the equations (6) and (7) to substitute for  $\ell_{as}$  and  $c_{as}$  for  $s > t$  in the intertemporal budget constraint (4) and rearranging yields the following individual consumption demand function

$$c_{it} = \Gamma_{it} W_{it} \quad (8)$$

where the marginal propensity to consume out of total wealth is defined by

$$\Gamma_{it} = v_{it} \left\{ p_t^\gamma \sum_{a=i}^{55} (1 + \theta)^{\gamma(i-a)} (R_s^n p_s)^{1-\gamma} v_{as} \left[ 1 + \frac{w_{as}^n e_a}{p_s} \left( \frac{w_{as}^m e_a}{\alpha p_s} \right)^{-\rho} \right] \right\}^{-1}. \quad (9)$$

Note that  $\Gamma_{it}$  increases with age<sup>5</sup> and depends on future net interest and wage rates, the subjective discount rate and the intra- and intertemporal elasticity of substitution.

Given the consumption in the initial year, the optimal consumption and leisure path is derived from equations (6) and (7). Aggregating across generations and income classes one arrives at the aggregate per-capita variables

$$\frac{A_s}{N_s} = \sum_{v=1}^5 \sum_{a=1}^{55} \frac{a_{as}^v}{(1+n)^{i-1}}, \quad \frac{C_s}{N_s} = \sum_{v=1}^5 \sum_{a=1}^{55} \frac{c_{as}^v}{(1+n)^{i-1}}, \quad \frac{Tr_s}{N_s} = \sum_{a=1}^{55} \frac{5 \cdot tr_s}{(1+n)^{i-1}}.$$

### 2.3 Production and investment

There is only one production sector and therefore only a single good that can alternatively be used for investment and consumption. Firms are perfectly competitive

<sup>4</sup>The latter is accomplished by the calculation of an appropriate shadow wage rate that reduces leisure demand to the time endowment, see Auerbach and Kotlikoff (1987, 30).

<sup>5</sup>This is an important difference to the previously mentioned Blanchard (1985) model where all generations have the same marginal propensity to consume.

and produce according to a CES technology. The firms marketable output in period  $s$ ,  $Y_s$ , is the product of labor  $L_s$  and capital  $K_s$ , net of adjustment costs associated with investment  $I_s$ , i.e.

$$Y_s = F(K_s, L_s) - \Phi(I_s, K_s). \quad (10)$$

The production technology is

$$F(K_s, L_s) = A \left[ \varepsilon K_s^{1-1/\sigma} + (1 - \varepsilon) L_s^{1-1/\sigma} \right]^{1/(1-1/\sigma)},$$

where  $\varepsilon$  is the parameter measuring the intensity of the use of capital in production,  $\sigma$  is the elasticity of substitution in production and  $A$  is a technology parameter. The adjustment cost technology is geared to the "natural" growth rate of the steady state. Total installation costs of new investment in year  $s$  are therefore

$$\Phi(I_s, K_s) = \frac{b}{2} \left( \frac{I_s}{K_s} - \delta - n \right)^2 K_s. \quad (11)$$

The term  $b$  is the adjustment cost coefficient. Larger values of  $b$  imply greater marginal cost of new capital goods for a given rate of investment. As long as the investment rate is at its steady state level, which is the sum of economic depreciation  $\delta$  and the natural growth rate  $n$ , there are no adjustment costs<sup>6</sup>. Higher or lower investment rates involve costly changes in the production process. Because these costs rise disproportionately with the difference between investment rate and natural growth rate, the firm will only move the stock of capital gradually toward its desired level.

We assume that investment expenditures of the firm are financed by retained earnings<sup>7</sup>. Hence, dividends  $DIV_s$ , distributed to shareholders in period  $s$ , are determined by the cash-flow identity

$$DIV_s + I_s + T_s^k = Y_s - w_s L_s. \quad (12)$$

The firm uses the funds from cash-flow for dividends, investment outlays and corporate tax payments  $T_s^k$ . In our formulation the corporate tax base is given by retained earnings. The important implication is that the ultimate tax burden on dividends

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<sup>6</sup>For a similar approach see Nielsen and Sørensen (1991).

<sup>7</sup>This corresponds to the so-called "new" view of the corporate income tax, see Sinn (1991) or Sørensen (1995).

is the same as that on interest income which the shareholder household earns in the capital market. Formally, the corporate tax yield is given by:

$$T_s^k = \tau_s^k [ Y_s - w_s L_s - \delta K_s - DIV_s ] . \quad (13)$$

Using (13) in (12) yields the dividends of period  $s$

$$DIV_s = Y_s - w_s L_s - \frac{I_s}{1 - \tau_s^k} + \frac{\tau_s^k}{1 - \tau_s^k} \delta K_s . \quad (14)$$

It is interesting to notice that if we substitute, in turn, equation (12) into (13), we can explicitly show that the corporate tax base is investment minus the depreciation tax shield, i.e.

$$T_s^k = \frac{\tau_s^k}{1 - \tau_s^k} [ I_s - \delta K_s ] . \quad (15)$$

In order to induce investors to hold equities, firm shares must pay the same after-tax return as alternative assets. Since we assume that all capital income is taxed at the same rate at the household level, the arbitrage condition is thus given by

$$DIV_s + V_{s+1} - V_s = r_s V_s , \quad (16)$$

where  $V_s$  stands for the market value of shares at the beginning of period  $s$ . The left hand side of equation (16) is the return of the firm's equity through period  $s$ , which consists of dividends paid out plus capital gains accruing to shareholders. The right hand side denotes the opportunity cost associated with the equity position, which equals the gross return from investment in financial assets. Iterating forward the difference equation (16) and solving for  $V_t$  while ruling out explosive time paths of share prices yields the valuation of the firm by its owner at the beginning of period  $t$

$$V_t = \sum_{s=t}^{\infty} DIV_s \prod_{j=t}^s (1 + r_j)^{-1} . \quad (17)$$

Firms maximize this market value subject to the accumulation equation of the capital stock

$$K_{s+1} - (1 - \delta)K_s = I_s . \quad (18)$$

This yields the following necessary conditions for an optimum in periods  $s \geq t$

$$w_s = F_{L_s} \quad (19)$$

$$q_{s+1} = \frac{1}{1 - \tau_s^k} + \Phi_{I_s} \quad (20)$$

$$(1 + r_s)q_s = (1 - \delta)q_{s+1} + F_{K_s} - \Phi_{K_s} + \frac{\tau_s^k \delta}{1 - \tau_s^k} \quad (21)$$

where  $\frac{\partial F}{\partial L_s} = F_{L_s}$  etc. Equations (19) and (20) determine optimal labor demand  $L_s$  and investment  $I_s$ , respectively. Labor should be employed up to the point where its marginal product equals the market wage rate. The firm will invest until the marginal costs of one additional unit investment are equal to the marginal benefits from having one additional unit of capital at the end of period  $s$ . The latter is reflected in the shadow price  $q_{s+1}$  on the left hand side of equation (20). Increasing the retained earnings by one dollar, given the presence of the corporate tax, would allow an increase in investment of only  $(1 - \tau_s^k)$ . Therefore, to buy one additional unit of capital the firm has to retain  $1/(1 - \tau_s^k)$  plus the marginal cost of installation. Equation (21) is an arbitrage condition which states that the return from investment in financial assets must be equal to the return in real assets. The right hand side of (21) is the marginal gross return to an investor who bought one unit of capital at the price  $q_s$  in period  $s - 1$ . He could sell the unit (net of economic depreciation) for the price  $q_{s+1}$  and he receives the marginal product of capital (which includes the marginally reduced adjustment costs) plus the tax savings from the depreciation tax shield. The left hand side gives the return if he would have invested the same amount in financial assets. Note that, in the steady state, conditions (20) and (21) simplify to  $r = (1 - \tau^k) [F_K - \delta]$ , which clearly expresses the distortion caused by the corporate tax. In order to understand this expression, one has to keep in mind that capital gains are taxed in the same way as dividend and interest income. Consequently, we obtain the Harberger (1962) result even in a model where dividends are endogenously determined. For an intuitive explanation, we follow the argument of Sinn (1991, 30). Let us consider a shareholder who has to decide whether to withdraw money as dividend in order to invest it in the financial market or to retain the same amount in the firm to receive dividends one year later. The shareholder should then compare the return he would get in these two different situations. Assume the shareholder withdraws  $1/(1 - \tau^d)$  lira as a dividend. After paying the dividend tax ( $\tau^d$ ), he will have one lira to invest in the financial market.

His net return at the end of the year would amount to  $r(1 - \tau^r)$  lira. The other alternative for the shareholder is to retain the  $1/(1 - \tau^d)$  lira at the firm level which increases firm value by exactly this amount. Consequently he has to pay the capital gains tax ( $\tau^g$ ) and the corporate tax ( $\tau^k$ ). The net amount he can invest in the real market is then  $(1 - \tau^g)(1 - \tau^k)/(1 - \tau^d)$ , from which he would get as a return  $(1 - \tau^g)(1 - \tau^k)/(1 - \tau^d)[F_K - \delta]$  lira. When, at the end of the period, he withdraws the return on real investment as dividend, and consequently pays the tax on it, he will have as final net return  $(1 - \tau^k)(1 - \tau^g)[F_K - \delta]$  lira. At the margin, the latter has to be the same as the net interest income that the shareholder could have earned by investing one lira in the capital market, namely the above determined  $(1 - \tau^r)r$ . Since we assume that  $\tau^r = \tau^g = \tau^d$  this arbitrage relationship reduces to  $r = (1 - \tau^k) [F_K - \delta]$ .

Following Hayashi (1982) one can furthermore establish the relationship in period  $s$

$$V_s = q_s K_s \quad (22)$$

which states that the shadow price  $q_s$  can be interpreted as the asset price of a share in the firm.

#### 2.4 Government behavior

The government sector supplies a given amount of the public good  $G_s$  and finances its outlays by issuing new debt  $B_{s+1}^g - B_s^g$  and collecting taxes  $T_s$  from individuals and companies:

$$B_{s+1}^g - B_s^g + T_s = G_s + r_s B_s^g. \quad (23)$$

The stream of expenditures for the public good is given and kept constant per capita, i.e.  $\frac{G_s}{N_s} = g$ . Since it is assumed that public goods enter the household utility function in an additive separable manner, they do not interfere with consumers' decisions. Aggregate tax revenues in period  $s$  are defined by

$$T_s = \tau_s^c C_s + \hat{\tau}_s^w w_s L_s + \tau_s^r r_s A_s + T_s^k - Tr_s. \quad (24)$$

In the above equation  $\hat{\tau}_s^w$  is the aggregate average tax rate on labor earnings. The accumulation of public debt is constrained intertemporally. Integrating the periodical budget constraint (23) forward and ruling out the explosion of public debt, the intertemporal budget constraint of the government requires that the present value

of net tax revenues must be equal to the present value of expenditures for the public good and the initial debt position. This intertemporal budget constraint rules out permanent tax reductions or expenditure increases.

### 2.5 External sector

Finally, in the small open economy version of the model goods are traded with the foreign sector and international capital flows guarantee that the domestic interest rate is fixed to the world interest rate. Formally, an additional constraint has to be taken into account. By definition, the current account surplus  $B_{s+1}^f - B_s^f$  is the difference between the national product, which is the sum of domestic product  $Y_s$  and net foreign source income  $r_s B_s^f$ , and domestic absorption, i.e.

$$B_{s+1}^f - B_s^f = Y_s + r_s B_s^f - C_s - G_s - I_s = r_s B_s^f + TB_s \quad (25)$$

where  $B_s^f$  are the net foreign bonds held by the domestic household sector. Expression (25) states that the accumulation of net foreign bonds of the home country has to be equal to the sum of net capital income received from abroad and the trade balance  $TB_s$ . The net capital income received from abroad is the difference between the interest income domestic residents receive from abroad and the returns on domestic bonds that accrue to foreign residents. For simplicity we assume that residents of each country acquire only foreign bonds but not foreign equity capital<sup>8</sup>. Interest income is taxed according to the residence principle of taxation. Foreign and domestic bonds must therefore earn the same world interest rate  $r^*$ .

Iterating (25) forward yields again the intertemporal constraint on the accumulation of foreign assets which reveals that initial positive net foreign assets must be balanced by future trade deficits of equal present value. In order to compare the closed and the small open economy we consider only the case of an initially balanced foreign sector.

### 2.6 Equilibrium conditions

Equilibrium in the labor market requires that the supply of labor equals the demand by firms, i.e.

$$L_s = N_s \sum_{v=1}^5 \sum_{a=1}^{55} \frac{(\bar{h} - \ell_{as}^v)}{(1+n)^{a-1}} \quad (26)$$

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<sup>8</sup>If one allows also for foreign equity investment, then additional international income effects complicate the story, see Fehr (1996).

The goods market is in equilibrium when total production equals aggregate demand, i.e.

$$Y_s = C_s + G_s + I_s + TB_s. \quad (27)$$

Finally the capital market is balanced when aggregate wealth equals the sum of firm values plus the outstanding government debt and net foreign assets, i.e.

$$A_s = V_s + B_s = q_s K_s + B_s^g + B_s^f. \quad (28)$$

### 3. Calibration of the model

In order to simulate the effects of different debt reduction strategies, we have assigned numerical values to the behavioral and technological parameters and the exogenous policy variables. This section presents our choice of parameter values and describes how the Italian fiscal system is represented in the model. We have chosen values for the exogenous parameters which appear to be plausible and which generate an initial steady state of the model that corresponds roughly to some stylized facts of the Italian economy in 1995. Of course, the parametrisation inevitably involves many ad-hoc assumptions and short cuts.

Table 1 reports the numerical parameter values for consumers, firms and the government. Most of the choices for the utility and production function parameters in the upper parts of Table 1 are roughly in accordance with Auerbach and Kotlikoff (1987, 50f.). The growth rate  $n$  was set to 5 per cent in order to get a realistic debt-output ratio (see below). The scaling parameter  $A$  of the production function was endogenously specified to normalize the overall wage rate  $w$  to unity. The income-specific human capital profiles  $e_a^y$  are approximated by a second order polynomial, the parameters of which have been estimated from income data. Each lifetime income class starts at a different earnings level in their first working period and experiences a different longitudinal growth in earnings across the lifecycle. The absolute earnings levels were calibrated such that workers in the lowest income class receive (after subtracting tax deductions) an annual taxable wage income of 7 million lira at age 20. Their annual taxable income increases up to 20 million when they are at age 37 and falls thereafter. When they are at age 55 they don't pay wage taxes any more. In the top income quintil, the annual taxable wage income at the beginning



**Table 1: Parameterisation of the model**

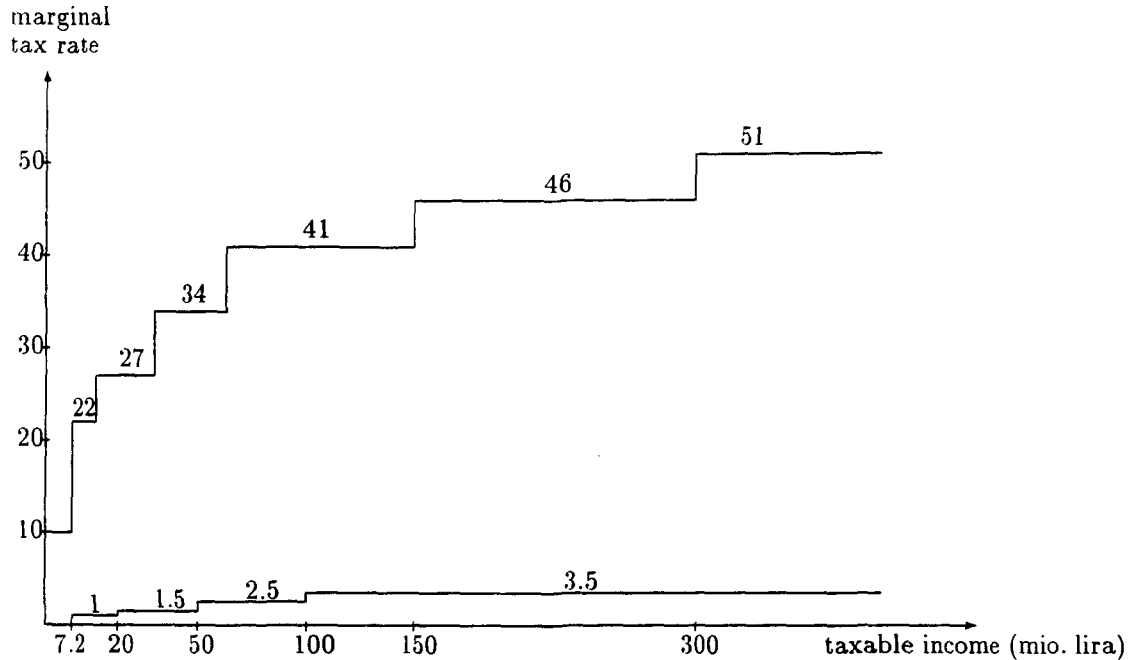
Parameter	Symbol	Value
<i>Utility Function</i>		
Subjective discount rate	$\theta$	0.01
Elasticity of intertemporal substitution	$\gamma$	0.25
Elasticity of intratemporal substitution	$\rho$	0.6
Leisure preference parameter	$\alpha$	1.5
<i>Production Technology</i>		
Substitution elasticity between capital and labor	$\sigma$	1.1
Capital share in production	$\epsilon$	0.3
Rate of economic depreciation	$\delta$	0.05
Adjustment cost parameter	$b$	7.5
Population growth rate	$n$	0.05
<i>Policy variables</i>		
Aggregate average wage tax	$\hat{\tau}^w$	0.142
Capital income tax	$\tau^r$	0.10
Corporate tax	$\tau^k$	0.28
Consumption tax	$\tau^c$	0.17
Deficit-output ratio	$nB^g/Y$	0.06

of their working life is 63 million lira. It grows until age 40 up to 142 million and falls afterwards to zero at age 64.

Of course, labor supply and the level of taxable income depend on the modelling of the actual tax system. One particular feature of the Italian fiscal system is the share of direct taxes in total revenue of almost 60 per cent. The personal income tax (*imposta sul reddito delle persone fisiche*; IRPEF) amounts to 60 per cent of direct taxes. Its tax base includes labor and capital income as well as income from self-employment and business. Note, however, that interest income is excluded from this tax base (see below). Taxable income, which is derived after deducting allowable business expenditures and specific income-connected expenses, is subject to a progressive rate schedule. The respective marginal tax rates and income brackets are illustrated in Figure 1. It starts with a marginal rate of 10 per cent up to an annual taxable income of 7.2 million lira and ends with a top rate of 51 per cent above 300 million lira. In order to reduce the deficit to the Maastricht ceiling, the so-called Eurotax package has been implemented for the year 1997. Essentially it consists of introducing additional levies between 1 and 3.5 per cent on taxable income subject to IRPEF. Figure 1 also reproduces the respective marginal

tax rates and income brackets.

**Figure 1:** Marginal tax rate schedules for IRPEF and Eurotax



Nominal interest income is taxed at the bank level. The tax rates differ according to the type of investor, the type of financial instrument and its issuer. At present, the returns from deposits and postal savings accounts are taxed at 27 per cent, while public debt instruments are taxed at 12.5 per cent. The tax is considered a definite withholding tax for individuals.

Next we turn to the corporate income tax (*imposta sul reddito delle persone giuridiche*; IRPEG). Since 1978 Italy applies the full-imputation system. Hence, taxes on dividends paid at the corporate level are credited against the IRPEF at the shareholders' level. The tax base of the corporate income tax is consequently non-distributed profits while the current tax rate is 37 per cent. The last important direct income tax to be considered is the so-called local income tax (*imposta locale sui redditi*; ILOR). ILOR is levied at a 16.2 per cent proportional tax rate on domestic capital income, on business income and on other income subject to IRPEF. Capital income subject to definitive withholding taxes are exempt from ILOR. Since ILOR cannot be deducted from IRPEG, the effective tax rate for corporate income is

currently 53.2 per cent. All other direct taxes such as taxes on estates, inheritances and gifts only constitute a minor source of revenue in Italy and can be neglected. The most important source of revenue for indirect taxes is the value added tax (imposta sul valore aggiunto; IVA). While its tax base is more or less harmonized across EU member countries, Italy applies a normal tax rate of 19 per cent and reduced tax rates of 4, 10 and 16 per cent on selected commodities. Additional indirect tax revenue is generated from numerous excise taxes such as the mineral oil tax and the tobacco tax.

The simulation model is of course not able to handle all complex details of the Italian tax system. The bottom part of Table 1 shows our choice of policy variables. An important innovative feature of the present model is that we exactly reproduce the marginal tax rate schedule of the personal income tax as displayed in Figure 1. The model replicates this step function of the marginal tax rate schedule. Most simulation models are not able to handle such kinks in the budget constraint, where the marginal tax rate changes abruptly in response to small changes in the agent's behavior. The present model bridges this discontinuity of the budget constraint by solving for so-called "virtual" marginal tax rates that place the optimizing agent exactly at the kink if they wish to be there<sup>9</sup>. Aggregating the individual average tax rates across agents in the initial steady state results in an overall average wage tax rate of 14.2 per cent. Although the marginal tax rate schedule is represented quite precisely, the modelling of allowances and tax deductions has to remain quite crude in the absence of further socio-demographic household characteristics other than age and income.

As far as the corporate tax is concerned, we only consider economic depreciation, but do not take into account accelerated depreciation schemes and other investment incentives. Note from Table 1 that the chosen statutory tax rates are much lower than the actual ones described above. Since our model does not cover tax evasion, Italian statutory tax rates would yield quite unrealistic large tax revenues when applied to the respective tax bases.

In addition to tax rates, we fixed the benchmark deficit-output ratio ( $nB^g/Y$ ) at 6 per cent, which is a slightly optimistic figure for Italy in 1995. Therefore, in order to obtain a debt-output ratio of 120 per cent, we specified a growth rate of 5 per

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<sup>9</sup>Technically these virtual tax rates are derived from the first order condition (7).

cent.

**Table 2: Initial steady state**

	Model benchmark	Italy 1995 <sup>1</sup>
<i>Expenditures on GDP (Per cent of GDP)</i>		
Private consumption	66.8	62.6
Government consumption	16.9	16.5
Gross fixed investment	16.3	18.1
Exp.-imp.	0.0	2.8
<i>General government indicators (Per cent of GDP)</i>		
Transfers to households	4.5	19.9
Gross debt	120.0	122.0
Interest paid	12.4	11.1
Current revenues		
Personal labor income tax (IRPEF, ILOR)	9.7	9.6
Personal interest income tax	3.6	2.3
Corporate income tax (IRPEG, ILOR)	3.2	2.3
Social security contributions	0.0	14.7
Taxes on goods and services	11.4	11.8
Capital-output ratio	1.6	–
Interest rate (in per cent)	10.4	–
Saving rate <sup>2</sup>	18.1	14.8

<sup>1</sup> Source: OECD (1997); Ministero delle Finanze (1996). ILOR revenue has been split and imputed by 70 per cent to IRPEG and by 30 per cent to IRPEF. <sup>2</sup>As percentage of disposable income.

Table 2 shows the initial steady state implied by the parameter values of Table 1, and compares these figures with some stylized facts of the Italian economy of 1995. Two important assumptions of the model are responsible for the differences in the two columns. First, in order to compare the macroeconomic adjustment in a small open and in a closed economy, our initial steady state reflects a closed economy. The trade balance in the benchmark is therefore by definition zero. Second, we do not consider the Italian social security system. The respective contributions and transfers are therefore not covered in the model. The remaining lump-sum transfer payments are uniformly distributed across households. The absence of the social security system explains the high saving rate in our model<sup>10</sup>.

<sup>10</sup>Note, however, that the saving rate varies between 16.6 per cent for the lowest income class and 19.1 per cent for the highest income class.

## 4. Simulation Results

### 4.1 Decomposing welfare effects of fiscal reforms

When evaluating a fiscal reform, neoclassical economists are mostly interested in their welfare effects. Welfare changes must be due either to (re)distributional effects or otherwise to efficiency effects. Distributional effects alone can work through two different channels. First, a tax reform will change the net tax burden (i.e. taxes minus transfers received) of specific households. Even when the tax reform is revenue neutral, some households will pay more taxes or receive less transfers and other households will pay less taxes or receive more transfers. Second, the tax reform might affect the gross-of-tax prices. If, for example, the marginal product of labor increases after the tax reform while the marginal product of capital falls, then workers will gain at the expense of those who are no longer working and consume their savings. As Fehr and Kotlikoff (1996) show, it is possible to decompose the total individual welfare change  $\Delta W$  into the following three components

$$\Delta W = -\Delta T + \Delta P + \Delta TA.$$

The first term on the right-hand-side (RHS),  $-\Delta T$ , captures welfare changes due to changes in the present value of net tax burdens (i.e. generational accounts). If the present value of the net tax burden increases then welfare will decrease. The second term  $\Delta P$  records welfare changes that are due to changes in the present value of factor incomes. The sum of the two terms measures the redistributive effect of the tax reform for a specific household. Finally,  $\Delta TA$  quantifies changes in the present value of individual tax payments that are due to tax avoidance reactions. These uncompensated behavioral reactions should not be confused with efficiency effects. Isolating the latter requires compensating households for any distributional gains or losses (i.e.  $-\Delta T + \Delta P$ ) by appropriate transfers<sup>11</sup>. After compensation, the first two terms on the RHS of the above equation are eliminated and tax avoidance effects are converted into changes in the present value of marginal excess burdens ( $\Delta EB$ ). This term measures the efficiency part of the welfare changes due to specific debt or taxation policy. In general  $\Delta EB \neq \Delta TA$  and consequently redistributive and efficiency effects will not exactly add up to the total welfare effects  $\Delta W$ . The efficiency changes also allow a very specific interpretation. Since they result from a simulation where all income effects between households are neutralized, the quantitative

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<sup>11</sup>Fehr (1996) and Fehr and Wiegard (1997) explain the transfer mechanism in more detail.

results can be interpreted as those of a Barro (1974) world, where all households are linked by an operative altruistic bequest motive. Because of distortionary taxation, Ricardian Equivalence does not hold in a strict sense.

The simulations of the following sections start from the initial steady state of year 0 as described above. In the years 1 to 3 of the transition, the deficit is reduced by one per cent of GDP each year and kept at 3 per cent after year 3. The deficit reduction is financed by the (temporary or permanent) introduction of the so-called Eurotax, which is levied on taxable labor income at progressive tax rates between 0 and 3.5 per cent, see Figure 1. The revenues from the Eurotax will, however, finance only roughly 20 per cent of the deficit reduction in each year. In order to balance the budget, either lump-sum transfers or consumption taxes are endogenously adjusted. After solving for the transition path of the economy arising from the change in fiscal policy, we compute the difference between each generation's utility under the new policy and the initial steady state level of utility, which represent the utility that the generation would have realized in the absence of the policy change. Additionally, we also calculate the changes in the present value of net tax burdens and factor incomes for each individual household. In a second simulation we compensate every generation for the changes in net tax payments and factor incomes. The resulting utility changes of this simulation are therefore solely due to behavioral changes and consequently reflect the changes in generations' excess burdens.

#### *4.2 The small open economy*

A useful starting point for the numerical analysis is the assumption of a small open economy. In this case, the national interest rate is fixed to the initial (world) level. Due to adjustment costs, wages will vary slightly in the short run, but return to their initial level in the long run. The left part of Table 3 shows the macroeconomic adjustment of debt reduction when the Eurotax is introduced for three years and the budget is alternatively balanced by lump-sum transfers and consumption taxes. The table presents the changes in labor supply, capital stock, consumption, asset prices, wages, interest rate, the national saving rate and alternatively the lump-sum transfers or the consumption tax rate at four points during the transition: in year 1 (i.e. when the debt reduction starts), in year 3 (i.e. the last year of the Eurotax), in year 5 (i.e. after the elimination of the Eurotax) and in the long run. Note that the changes in the interest and saving rates as well as in the transfer-output ratio

or consumption tax rates are in percentage points, not percentage of initial values. Let's consider first the deficit reduction when the budget is balanced by lump-sum transfers. In the short-run, people reduce their labor supply by 1.1 per cent in order to escape the Eurotax. At the same time the transfer-output ratio falls from 4.5 per cent in the initial steady state to 1.9 per cent in the last year of the Eurotax. Lower transfers will induce people to consume less and to save less. Since the capital stock is fixed in year 1, the marginal product of labor increases in the short run. Immediately after the elimination of the Eurotax, labor supply increases and the wage rate consequently falls. The reduction of public deficit implies that the government should pay lower interest payments than before, and therefore transfers can rise. As a consequence, consumption and savings rise as well. Note that the asset prices increase temporarily during the transition. Investors expect the increase in the marginal product of capital after the Eurotax elimination. Investment demand therefore expands slightly which results in a temporary increase of the capital stock. The reduced savings mainly balance the reduced supply of government bonds. In the long-run, lump-sum transfers can be almost doubled. As a result, consumption increases by 2.3 per cent while labor supply falls by 3.3 per cent. Since the long-run marginal product of capital is fixed to the world interest rate, the capital stock will decrease in the same way. The long-run price reactions are equal to zero.

Now compare the macroeconomic adjustment when the budget is balanced by consumption taxes. In the short-run, the consumption tax increases up to 4.6 percentage points leading to a decrease in consumption and labor supply and an increase in wage rates. In order to understand the changes of the asset prices we should look at the path of labor supply. As soon as the Eurotax is not operative, consumers will start increasing their labor supply once again. Therefore we have two different effects: first a decrease in labor supply that should lead to a reduction in the marginal product of capital and a successive increase in labor supply which would imply an increase in the marginal product of capital. In this simulation, after the elimination of the Eurotax labor supply increases only slightly due to the high consumption tax. Therefore in the short run when investors calculate their expected discounted marginal product of capital, the dominating effect is still the strong reduction in labor supply that takes place in the first 3 periods. Hence asset prices decrease at first and increase just slightly during the transition but less strongly than in the first experiment. In the long-run, the consumption tax can be reduced by 4.8 percentage

**Table 3: Macroeconomic effects of debt reduction: difference from base solution**

Year	Small open economy		Closed economy	
	Lump-sum transfer	Consumption tax	Temporary Eurotax	Permanent Eurotax
<i>Labor supply<sup>1</sup></i>				
1	-1.1	-1.5	-1.4	-1.4
3	-1.1	-2.1	-2.4	-2.0
5	0.9	0.1	-0.3	-1.6
Infinity	-3.3	-1.3	0.8	0.0
<i>Capital stock<sup>1</sup></i>				
1	0.0	0.0	0.0	0.0
3	0.0	0.0	-0.1	0.1
5	0.1	0.0	0.2	0.5
Infinity	-3.3	-1.3	12.4	11.1
<i>Consumption<sup>1</sup></i>				
1	-1.0	-1.7	-1.2	-1.6
3	-1.0	-2.7	-2.5	-2.4
5	-0.6	-1.9	-0.9	-2.0
Infinity	2.3	3.4	3.5	2.2
<i>Asset price<sup>1</sup></i>				
1	0.1	-0.3	0.0	0.0
3	0.3	0.0	-0.1	0.7
5	0.3	0.1	2.0	0.9
Infinity	0.0	0.0	0.0	0.0
<i>Wage<sup>1</sup></i>				
1	0.3	0.4	0.4	0.4
3	0.3	0.6	0.6	0.6
5	-0.2	0.0	0.1	0.6
Infinity	0.0	0.0	3.1	3.1
<i>Interest rate<sup>2</sup></i>				
1	0.0	0.0	-0.8	0.1
3	0.0	0.0	-0.1	0.1
5	0.0	0.0	-0.7	-0.2
Infinity	0.0	0.0	-0.9	-0.9
<i>Saving rate<sup>2</sup></i>				
1	-0.6	-0.7	-2.4	-0.2
3	-2.3	-2.1	-2.6	-1.8
5	-1.5	-1.4	-3.2	-2.1
Infinity	0.1	0.1	-1.0	-0.9
<i>Transf./Cons. tax<sup>2</sup></i>				
1	-0.9	1.7	0.6	1.7
3	-2.6	4.6	3.7	4.4
5	-2.1	3.7	2.4	4.0
Infinity	3.2	-4.8	-6.7	-6.9

<sup>1</sup>Percentage changes. <sup>2</sup>Changes in percentage points.



points. This will induce a strong substitution from leisure towards consumption demand. In the new steady state, consumption demand is much higher than under the transfer adjustment. Similarly, labor supply and the capital stock are higher than in the previous experiment.

Table 4 reports the associated welfare changes for different income quintiles of representative generations. We assume that individuals enter the labor market at age 20, so that a person that dies five years after the reform is born in year -70. The columns report the individual welfare effect and its decomposition into distributional and efficiency components. The welfare effects are measured as a percentage of the present value of households remaining lifetime resources  $W_{it}$  in the initial equilibrium. Since leisure accounts for more than 50 per cent of the households time in the model, the numbers would more than double if they are translated into percentages of consumption alone.

Assume for a moment that the model does not distinguish different lifetime income classes. In this case we would report the aggregate, generation specific welfare measures in the lower part of Table 4. A very general result we obtained is that, not surprisingly, debt reduction increases the welfare of currently young and future generations at the expense of most existing generations, no matter which way we financed this policy.

Let us now consider the first experiment, when the Eurotax is supplemented by an endogenous adjustment in transfer payments. The long run welfare increase, in this case, amounts to 1.58 per cent of initial lifetime resources. Most of the welfare effects are explained by changes in net tax burdens, as shown in the third column. Current generations have to pay higher wage taxes and receive less transfers while future generations will receive more transfers. As shown in the fourth column, factor price repercussions are almost zero in the small open economy case<sup>12</sup>. Neutralizing these intergenerational income effects reveals the efficiency losses that are associated with the temporary introduction of the Eurotax. This tax will not hurt the old generations since they don't pay wage taxes any more. It will also not affect generations that enter the labor force after year 3. Middle-aged generations, however, experience efficiency losses and will temporarily reduce their labor supply.

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<sup>12</sup>They would be exactly zero in the case of no adjustment costs.

**Table 4: Welfare effects of debt reduction in a small open economy<sup>1</sup>**

Birth year	Lump-sum transfers				Consumption tax			
	$\Delta W$	$-\Delta T$	$\Delta P$	$\Delta EB$	$\Delta W$	$-\Delta T$	$\Delta P$	$\Delta EB$
<i>Lowest Quintile</i>								
-70	-0.52	-0.46	0.01	0.00	-1.09	-0.86	-0.06	0.00
-50	-0.46	-0.42	0.01	0.00	-0.61	-0.48	-0.03	-0.04
-30	-0.56	-0.54	0.00	-0.01	-0.36	-0.30	0.02	-0.07
-10	0.20	0.21	-0.02	0.00	0.29	0.24	-0.01	0.05
1	1.01	0.92	0.01	0.00	0.82	0.67	0.00	0.10
Infinity	2.51	2.23	0.00	0.00	1.70	1.40	0.00	0.19
<i>Third Quintile</i>								
-70	-0.38	-0.34	0.01	0.00	-1.00	-0.78	-0.06	0.00
-50	-0.34	-0.31	0.01	-0.01	-0.55	-0.42	-0.03	-0.06
-30	-0.45	-0.44	0.00	-0.03	-0.34	-0.28	0.02	-0.10
-10	0.15	0.18	-0.02	0.00	0.27	0.24	-0.01	0.05
1	0.77	0.77	0.01	0.00	0.75	0.64	0.00	0.12
Infinity	1.88	1.87	0.00	0.00	1.54	1.33	0.00	0.23
<i>Top Quintile</i>								
-70	-0.15	-0.14	0.01	0.00	-0.76	-0.59	-0.05	0.00
-50	-0.17	-0.10	0.01	-0.08	-0.43	-0.27	-0.02	-0.13
-30	-0.32	-0.26	0.00	-0.10	-0.36	-0.27	0.02	-0.17
-10	0.07	0.12	-0.02	0.00	0.24	0.23	-0.01	0.05
1	0.38	0.46	0.01	0.00	0.62	0.59	0.00	0.14
Infinity	0.90	1.11	0.00	0.00	1.26	1.19	0.00	0.28
<i>Aggregate</i>								
-70	-0.30	-0.26	0.01	0.00	-0.91	-0.71	-0.06	0.00
-50	-0.28	-0.24	0.01	-0.04	-0.50	-0.37	-0.02	-0.08
-30	-0.41	-0.38	0.00	-0.05	-0.35	-0.29	0.02	-0.11
-10	0.13	0.16	-0.02	0.00	0.26	0.24	-0.01	0.05
1	0.65	0.66	0.01	0.00	0.71	0.62	0.00	0.12
Infinity	1.58	1.60	0.00	0.00	1.45	1.28	0.00	0.24

<sup>1</sup>Changes expressed as per cent of the present value of remaining lifetime resources.

Consider now the implications for different income classes. Since we assume that transfers are adjusted uniformly across households, agents in the lowest quintile bear a relatively higher burden in the short-run but also gain relatively more than other income quintiles in the long-run. Due to the progressivity of the Eurotax, households in the top income quintile experience the highest efficiency losses.

The first experiment mainly serves as a didactic device, whereas the adjustment of consumption taxes in the right part of Table 4 is a more realistic policy scenario.

Again we consider first the aggregate intergenerational welfare changes. Compared to the previous experiment, the welfare losses of the initial elderly have been reinforced and the welfare increases of future generations have been dampened. Middle-aged generations are slightly better off. Due to their high consumption propensities, net tax burdens now strongly increase for the elderly. In the long-run, however, the reduction in the tax burden is later in life compared to the endogenous transfer adjustment. Therefore the present value of income gains is lower. Note that the elderly are further hurt by the initial fall in asset prices. After compensating these income effects, the efficiency effects now also take into account the variation of the consumption tax rate. Therefore the initial efficiency losses are more pronounced than before, but in the long-run generations experience considerable efficiency gains due to the reduction of the consumption tax.

The disaggregation of different lifetime income quintiles reveals that poorer households initially bear a relatively higher burden while in the long-run they benefit more than other income classes. The consumption tax is therefore even regressive in a lifetime framework<sup>13</sup>. The reason is of course that in this model poor households save less than rich households throughout their whole life-cycle. They are therefore hurt relatively more in present value terms when the consumption tax is increased and they benefit relatively more when it is reduced.

This completes the analysis of debt reduction in the small open economy. In the next section we will discuss the effects of debt reduction in a closed economy.

### *4.3 The closed economy*

This section presents two simulations: the introduction of the Eurotax is in both cases supplemented by adjustments in consumption taxes. However, in one case the Eurotax lasts just for three years while in the second simulation is introduced on a permanent base. The first simulation mainly serves as a sensitivity test with respect to the openness of the economy. The second simulation will give us an idea how the duration of the Eurotax will affect intra- and intergenerational redistribution and efficiency patterns.

Consider first the macroeconomic effects of a temporary Eurotax in a closed economy reported in Table 3. While in the small open economy the excess of saving on the

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<sup>13</sup>This is in contrast with the recent literature on the lifetime incidence of consumption taxation, see for example Metcalf (1994).

domestic capital market can be invested abroad, the interest rate has to adjust in the closed economy. Debt reduction reduces the capital demand of the government and consequently the interest rate will fall. Savings decrease now more than in the previous case and consumption decreases less. Therefore the consumption tax rate has to rise only by 3.7 per cent in year 3 compared to 4.6 per cent in the small open economy. The reduction in the interest rate leads to a jump in asset prices of 2 per cent after the elimination of the Eurotax. This induces investors to build up domestic capital. As a consequence, wages now rise steadily even after the elimination of the Eurotax. Higher wages increase the labor supply and result in higher wage tax revenue. The long-run consumption tax rate can therefore be decreased by 6.7 percentage points. In the new steady state the capital stock has increased by 12.4 per cent which increases labor productivity by 3.1 per cent.

The last column shows the adjustment when the Eurotax is not eliminated after year 3. In this case there is no short-run intertemporal labor supply substitution. Consequently, in the first years labor supply falls less than in the case of the temporary Eurotax, but after year 3 it is reduced even more. In the first three years, asset prices therefore increase more strongly, but afterwards they increase less than before. Investment demand now rises immediately. The consumption reaction is also not affected by intertemporal substitution. In the short-run it tends to fall less as compared to the temporary Eurotax experiment while in the medium-run it will fall more than before. On the capital market the interest rate now even increases temporarily although it falls again by almost 1 percentage point in the long-run. Note that the consumption tax has to be increased by 4 percentage points in year 5 although there is additional revenue from the Eurotax. The reason is of course that the tax base for the consumption tax and the wage tax is now much lower.

The welfare effects of the two simulation experiments are presented in Table 5. Again we start with the aggregate numbers. The most striking difference compared to the second experiment in Table 4 are the income effects due to factor price repercussions. Middle-aged generations lose slightly due to the fall in the interest rate but generations born in the long-run benefit considerably from the increase in wages. Due to the wage increase they have to pay higher labor taxes. This explains the higher tax burdens compared to the small open economy case. Note that households in the top quintile benefit relatively more from the wage increase since their income growth over the life-cycle is stronger. On the other hand, households in

the lowest quintile will bear a lower tax burden in the long-run, since they are mainly affected by the consumption tax rate decrease. Rich households move into higher marginal tax brackets and pay more taxes. Finally, efficiency effects are almost the same as in the small open economy.

**Table 5:** Welfare effects of debt reduction in a closed economy<sup>1</sup>

Birth year	Temporary Eurotax				Permanent Eurotax			
	$\Delta W$	$-\Delta T$	$\Delta P$	$\Delta EB$	$\Delta W$	$-\Delta T$	$\Delta P$	$\Delta EB$
<i>Lowest Quintile</i>								
-70	-1.05	-0.90	0.02	-0.01	-0.88	-0.79	0.05	-0.01
-50	-0.57	-0.44	-0.09	-0.05	-0.62	-0.40	-0.17	-0.05
-30	-0.43	-0.29	-0.11	-0.07	-0.42	-0.22	-0.12	-0.12
-10	0.49	0.33	-0.03	0.05	0.54	0.40	0.02	-0.02
1	1.20	0.79	0.07	0.10	1.22	0.86	0.08	0.04
Infinity	2.63	1.46	0.47	0.19	2.64	1.56	0.45	0.12
<i>Third Quintile</i>								
-70	-0.95	-0.82	0.02	-0.01	-0.79	-0.72	0.06	-0.01
-50	-0.55	-0.40	-0.10	-0.07	-0.60	-0.36	-0.19	-0.08
-30	-0.46	-0.32	-0.12	-0.10	-0.52	-0.28	-0.12	-0.19
-10	0.40	0.26	-0.02	0.05	0.33	0.28	0.02	-0.07
1	1.03	0.66	0.07	0.12	0.93	0.69	0.08	0.00
Infinity	2.29	1.21	0.45	0.23	2.16	1.26	0.44	0.11
<i>Top Quintile</i>								
-70	-0.72	-0.61	0.01	-0.01	-0.59	-0.54	0.05	-0.01
-50	-0.45	-0.28	-0.09	-0.12	-0.52	-0.23	-0.16	-0.17
-30	-0.50	-0.38	-0.10	-0.17	-0.82	-0.46	-0.08	-0.44
-10	0.32	0.16	0.03	0.05	-0.16	-0.01	0.07	-0.30
1	0.84	0.48	0.14	0.14	0.30	0.31	0.15	-0.22
Infinity	1.88	0.87	0.56	0.27	1.25	0.69	0.55	-0.08
<i>Aggregate</i>								
-70	-0.86	-0.74	0.01	-0.01	-0.71	-0.65	0.05	-0.01
-50	-0.51	-0.35	-0.09	-0.08	-0.57	-0.31	-0.17	-0.11
-30	-0.47	-0.35	-0.11	-0.11	-0.62	-0.34	-0.11	-0.27
-10	0.38	0.24	0.00	0.05	0.17	0.19	0.04	-0.15
1	0.97	0.61	0.10	0.12	0.72	0.58	0.11	-0.08
Infinity	2.17	1.11	0.50	0.24	1.87	1.09	0.48	0.03

<sup>1</sup>Changes expressed as per cent of the present value of remaining lifetime resources.

As can be seen from the right part of Table 5, a permanent introduction of the Eurotax dampens the losses of the elderly in the reform period at the expense of younger and future generations. The aggregate numbers suggest that a permanent Eurotax has only minor intergenerational income effects, since the lower long-run

welfare increase is mainly due to efficiency losses. However, the welfare effects of the different income quintiles reveal that a permanent Eurotax will place a much higher burden of the debt reduction on the rich households. While poor households experience almost the same long-run welfare increase as in the previous experiment, rich households gain considerably less. They have to bear higher tax burdens and suffer from high efficiency losses.

This completes the numerical analysis of different debt reduction schemes for Italy. The following section summarizes the results and draws some policy conclusions.

## 5. Concluding remarks

Of course we do not claim that our simulation experiments exactly represent the Italian fiscal reforms in recent years. On the one hand, our model is not able to handle many measures of the recent fiscal adjustment program in Italy. Furthermore we do not know whether the Italian debt consolidation policy will continue after the year 1998. Nevertheless we argue that the model provides a good approximation of the quantitative importance of the different effects that are at work when the government decides to reduce the deficit level permanently. And that is indeed a topic which is currently very popular, and not just in Europe.

The model's virtues are mainly twofold: it can handle intragenerational heterogeneity and it allows the decomposition of individual welfare effects into distributional and efficiency components. The former is extremely useful since we are able to model the actual Italian progressive income tax schedule. The latter is used to compare the pure overlapping generations model with the bequest model of Barro (1974) and to isolate the income effects of factor price repercussions in the closed economy.

For a long time the public finance literature has been focused on the efficiency effects of taxation, without paying too much of attention to redistributive issues. Then, when we look at Barro's work, the other extreme position is taken and only redistributive effects are considered. The interesting point in our approach is that we show how these two lines of thought can be integrated with each other in a formal structure. On the one hand, when a policy maker faces the problem of reducing the level of public debt, we expect that the major component of welfare changes is given by the redistributive effects. Even if the direction of the latter is not controversial, we have still been able to show their magnitude numerically. The reduction of the public debt, on the other hand, can be pursued by using different types of taxes.

And when the choice of the specific fiscal instrument to be used is in question, then, in some cases, efficiency results can be crucial.

Our findings suggest that the permanent reduction of the deficit down to the Maastricht ceiling will increase the long-run welfare position of Italian households between 1 and 3 per cent of lifetime resources. Although the income redistribution is mainly due to changes in net tax burdens, factor price repercussions and efficiency gains might be also substantial. With respect to the intragenerational redistribution, the simulations reveal that consumption taxes might be regressive even in a lifetime perspective. This result is itself quite interesting given that the regressivity of consumption taxation has been often attributed to the annual incidence perspective. Finally, we have shown that the Eurotax implies a substantial intragenerational redistribution although the rates are very modest. If it would be introduced on a permanent basis it might result in efficiency losses for higher income classes although the consumption tax is decreased much further.

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