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DESIGN AND REFORM OF TAXATION POLICY

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Introduction

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1. The economic analysis of optimal taxation has permitted considerable steps to be taken towards the understanding of a number of problems: the appropriate degree of progression, the balance between different taxes, the equity-efficiency trade-off etc.. Though at times considered as abstract and of little use in policy design, the issues it addresses are real ones and very much on the agenda of many countries.

As usual in scientific debate, criticisms have contributed to the correct understanding of the theoretical problems involved and made clear that, at the present state of the art, definitive conclusions may be premature. A first well-taken criticism addresses the assumption, underlying optimal taxation models, of a competitive economy with perfect information on the part of individual agents and full market clearing. Once we leave the Arrow-Debreu world, it is no longer necessarily the case that taxes and transfers introduce distortions on otherwise efficient allocations.

A second reservation concerns the assumed absence of transaction costs and of institutional and political constraints. The economic analysis of politics has made important contributions in stressing the context within which political decisions are made. In this framework two levels of decisions making are relevant: a higher level constitutional choice, where a number of consensus criteria should apply, such as justice, social welfare and individual freedom, and a lower level, where fiscal variables are determined by the political machinery. It follows that analytical models of optimal taxation have to incorporate the notion that policy objectives cannot be simply interpreted in terms of social welfare function based solely on individual welfare.

However, much of the theory of optimal taxation is based on the implicit assumption of institutional or political constraints; the basic tenet of this theory is that, in a perfectly competitive world, taxes distort behaviour and cause excess burden. There do exist non-distortionary taxes; the optimal tax problem embodies the assumption that such taxes are difficult to institute in practice. This is due either to an information problem or to a political or institutional constraint. Taxes on genetic characteristics associated with ability may be non-distortionary but they require an informational content that is not feasible and they are, anyway, proscribed by the political or constitutional setting.

At the same time, we cannot forget that the very notion of dead-weight costs of taxes, subsidies and other types of public action is based on the strong assumption that there are no behavioural relations between revenues and expenditures. If we accept the existence of a variety of behavioural bridges between benefits and costs, the effective dead-weight cost of government actions is likely to be less than the one illustrated in our textbooks. Suppose that tax rates change because of an institutional improvement that reduces politicians' or

bureaucrats' degree of freedom. In this case the links between costs and benefits of public action become tighter and the marginal dead-weight cost of tax increase can fall.

The existence of transaction costs and the impact of social institutions have a bearing, also, on the theory of optimal tax reform.

The theory of optimal tax design is characterised by the fact that global optima are sought; in doing this, however, it overlooks the fact that an initial allocation often exists.

Even if a new tax system may be welfare preferred to an existing one, the effects of transition from old to new may be undesirable; in designing the tax reform it is necessary, therefore, to take account of these transition effects.

Moreover, in the analysis of tax reform, starting from an existing tax structure, the *direction* in which to move is not always evident. Even if all distortions can be somewhat reduced, this does not necessarily increase welfare: an increase in economic efficiency would occur only if we were, initially, sufficiently close to the global optimum.

Another related problem is that of piecemeal reforms, i.e. whether one can increase economic efficiency in a piecemeal fashion, by removing distortions one at the time; in general these reforms may reduce welfare along the transition path to a global optimum.

The theory of tax reform has stressed the fact that, in general, only small and piecemeal changes in the existing tax structure are feasible (due to transaction costs or institutional constraints) so that the emphasis has been shifted from the "second best" maximising logic of optimal tax theory to the "second best" improving logic of tax reforms. The pursuing of this less ambitious objective has somewhat produced more fruitful and simpler results.

Much remains to be done, however: the building of closer links between econometric estimations and policy implications of the results, the analysis of policy in a non Arrow-Debreu framework, the bringing together of optimal taxation or reform and public choice in a two-stage decision making, and, finally, the analyses of many neglected issues like the resource costs of implementing different tax structures, the problem of demographic changes, the definition of inter-temporal equity and so on are all fields of interesting further research

Some of these issues are discussed in this volume, whose emphasis, as suggested by the title, is mainly on filling the still wide gap between theory and practice.

2. This book is divided into two sections: the first one deals mainly with theoretical issues, while the second tackles the problem of implementation of tax reforms with the main concern of evaluating possible tax reforms.

A survey of the theory of commodity tax reform is provided by Fabrizio Bulkaen's paper that examines the most recent contributions to the literature of "uniformity versus selectivity". Whether a departure from uniformity can increase social welfare, depends on the differences in the distributional characteristics of commodities but also, in the case of non-fixed labour supply, on the differences in the marginal propensity to pay taxes out of incremental income and on the differences in the compensated wage elasticities of demand for the taxed commodity. On the other hand, it seems that we have still to establish the

possibility of obtaining some useful theoretical indications concerning the direction of desirable tax reforms in the case of differentiated tax rates' structures in the initial positions.

Much of the literature reviewed by Bulkaen deals with equity considerations that refer to "static" comparisons of income distributions. However, static inequality studies pay "excessive" attention to "snapshots" of the existing income distribution, while a better measure of the opportunities faced by the individuals should be based on lifetime earnings. The paper by Valentino Dardanoni considers two aspects of the dynamic welfare ranking of income distributions; on the one hand, it analyses the dynamic effects of the redistribution of income resulting from the operation of the fiscal system, and, on the other, it examines the effects of social mobility on social welfare. The aim of the paper is to present a simple algorithm, similar to the Lorenz curve ordering in the static case, which is able to rank different social mobility structures with respect to a class of Social Welfare Functions.

Another relevant reservation on the theory of tax reform concerns the lack of attention dedicated to the timing of reforms and the welfare effects of too many changes in the tax structure. The paper by Riccardo Martina tackles this problem; it is shown that the introduction of uncertainty on tax policies, either on effective tax rates or tax base, causes reactions in the strategy of risk-averse firms and reduces over-all welfare. This implies that tax reforms should not happen too often and that the tax system should be made as clear and as easy to comply with as possible.

In the final part of the first section of the volume, Beniamino Quintieri e Furio Rosati examine the problem of how demographic changes affect the structure of the tax system and which possible reforms are available in a world of decreasing and ageing population and its effects on savings and labour supply.

In the second section of the volume issues concerning the evaluation of possible tax reforms and their effects on relevant strategic variables are analysed.

The paper by Amedeo Fossati *et al* examines, by the use of a simulation model, the effects of a partial tax reform directed to shift a certain amount of revenue from direct to indirect taxation. The interest in the problem arises from the consideration that, because of narrow income tax bases and of high levels of avoidance, the tax on personal income cannot be considered anymore an efficient one. The results of this simulation are interesting: national income and tax revenue would increase, while total welfare loss would be almost zero.

Vincenzo Visco's paper examines the structure and the proposals of reform of the Italian fiscal system, furnishing an interesting account of the process with which decisions on fiscal reforms are made in Parliament. A complementary analysis is to be found in Francesca Stroffolini's paper, where different tax structures and proposals of reform are evaluated by the use of a Social Welfare Function that takes explicit account of the distribution of income. This class of S.W.F. is a recent contribution to economic theory and is equivalent to establishing an ethically founded social evaluation function for the index of inequality. In the paper an S.W.F. based on the mean income and the Gini coefficient is used.

Finally, the paper by Rosella Levaggi deals with the problem of local tax reforms and their implication for the traditional issue of local finance "autonomy vs. control"; the effects of

alternative methods of financing local government are examined within an intertemporal life cycle model and the simulation results are discussed.

We are grateful to all those who, on both sides of the Atlantic, have so generously given their time as referees and have helped us in the difficult selection of the papers among the many good ones discussed in the 1990 meeting of the Italian Society of Public Economics.

PART I

Tax Design and Reform: Theoretical Issues

THE THEORY OF COMMODITY TAX REFORM: A SURVEY

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1. Introduction

With the recent progress of the modern theory of Public economics, it can be said that the optimal taxation theory, which goes back to the works of Ramsey (1927), Samuelson (1951), and Diamond and Mirrlees (1971), has now reached a good level of maturity. However, Slemrod (1990), having observed the almost total absence of any consideration of a theoretical nature even in the most recent debates on the reforms of commodity taxes, reaches the conclusion that the traditional restrictions on the aims of the optimal taxation theory have led to an "incomplete" theory as a guide to solutions of current fiscal problems. In addition Slemrod (1990) underlines the need to move on to a new theory of "optimal tax systems", which also takes into consideration the resource costs of implementing alternative tax systems.

Feldstein (1976) however, from a different point of view, pointed out that the aim of designing an optimal tax was already too ambitious given the concrete problems of fiscal policy. In fact, the optimal taxation theory implicitly assumes that the tax laws are written out de novo on "a clean sheet of paper", to use the words of Woodrow Wilson quoted by Feldstein (1976, p.77). In reality, only small and piecemeal changes in the existing tax structure are generally feasible: the problem does not lie so much in designing a new tax, as verifying the opportunity to change its existing structure. So the suggestion is to move on from the second-best "maximizing" logic of the optimal taxation theory (which, as is known, looks for the conditions for the existence of a commodity tax structure which maximizes a social welfare function subject to technological and government budget constraint), to the second-best "improving" logic of the tax reform theory (which, instead, referring to a given initial position, looks for the conditions for the existence of the directions of feasible and Pareto-improving or welfare-improving tax changes[1]). In this less ambitious logic, we can expect the results of the research to really help us to clarify the terms of the debate about the possibility of improving the actual commodity tax structures.

Of course there is a connection between the commodity tax reform theory and optimal taxation theory. When Pareto-improving or welfare-improving changes in the structure of tax rates do not exist, then we can conclude that this structure is already a second best optimum.

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[1]That is to say, we are looking for a local solution, close to the initial position, to the problem of the existence of feasible tax changes which increase the utility of each consumer in the economy (pareto-improving tax reforms) or increase the government's social welfare function (welfare-improving tax reforms). this problem is still a second best problem, both because in the initial position the tax revenue is collected by distortionary commodity taxes, and because with the reform, even allowing for the availability of lump sum taxes to substitute for the existing commodity taxes, we can't generally obtain a first best optimum with a short step forward.

G. Galeotti and M. Marrelli (eds.), Design and Reform of Taxation Policy, 3–38.

But, apart from this particular case, the logic of the theory of marginal commodity tax reforms requires the determination of the conditions for the existence of directions of the marginal reforms (small changes close to the initial equilibrium) which are feasible and Pareto-improving or welfare-improving.

The general second best theorem of Lipsey and Lancaster (1956) warns us against the temptation of giving hasty answers to these problems, even if intuitively plausible. The reduction of distortion caused by a tax in one market, given the existing distortions in other markets, doesn't guarantee in fact, as is already known, a Pareto-improvement or a welfare-improvement.

Neither is a simultaneous reduction of the existing distortions in all markets able to provide such a guarantee. As Dixit reveals (1975, p.103) "...changes which appear to be steps in right direction, but stop short of attaining the full optimum, can actually reduce welfare". But the theory of marginal reforms of commodity taxes has not only served to clarify some erroneous convictions of the past. With this survey I will try to summarize the most interesting conclusions reached by research in this field.

2. Marginal reforms with lump sum tax

To begin this survey it is necessary to go back to the early seventies, to the works by Foster and Sonnenschein (1970), Kawamata (1974, 1977), Dixit (1975), Rader (1976), Dixit and Munk (1977), and Hatta (1977).

The feature common to all these initial contributions to the theory of the reforms of commodity taxes is the possibility of modifying lump sum tax in accordance with the changes in commodity taxes so as to keep tax revenue constant. For the sake of simplifying the analysis and concentrating attention on the efficiency problems, in general then the models used in these years refer to a single-consumer economy. We could object that in such an economy there are no obstacles to the attainment of a first best optimum if we raise the whole revenue just by the lump sum tax on the consumer. But such an objection, correct within the logic of the optimal taxation theory (Atkinson, 1977), does not take into consideration the different logic of the tax reform theory which considers only small changes from an arbitrary initial equilibrium. Again, in order to simplify the analysis, those works typically suppose that producer prices are fixed. Such an assumption can be justified in the case of a linear production possibility frontier with constant generalized marginal costs.
Assuming that the firms maximise profit and act as price-takers, and presuming that there are no distortions in the production, in equilibrium the producer prices will be in a fixed proportion to their respective marginal costs. So, supposing that a tight equilibrium exists[2], pure profits of all the firms will be equal to zero. Therefore, if the government's lump sum transfer payments are in physical units of the good chosen as numeraire, both the net demand

[2]So that, in this economy, in which excise taxes are the only causes that make consumer prices diverge from producer price, we have equality of demand and supply in all markets, and no good is in excess supply.

functions of the consumer and the net supply functions of the firms are homogeneous of degree zero, respectively in the consumer prices and in the producer prices. It is therefore possible to normalize the producer prices in order to make them the same as the marginal costs (with a factor of proportionality equal to one) and to normalize independently the consumer prices so as to choose the numeraire as the untaxed good, without any loss of generality.

In this economy, we suppose the initial position to be a tight equlibrium characterized by the deviation of the consumer prices q from the producer prices p due to specific taxes t = q-p.

With V(q) we indicate the indirect utility function of the consumer, having the usual properties (Varian, 1984, pp. 121-123), the lump sum income M being equal to zero, for the previous hypotheses. Indicating with x the vector of the amount of the goods, R = t ¥ x + T is the revenue that has to be assured to the government from the specific tax t and from the lump sum tax T3.

The effects of infinitesimal changes in the specific and lump sum taxes on the utility of the consumer are obtained from the total differential

$$dV = S \sum_{i} \frac{dV}{dq_1} - \frac{dV}{dM} dT = -\lambda(x\, dt + dT) \qquad (1)$$

where $l = (dV/dM) > 0$ the consumer's marginal utility of income and $(dV/dq) = -\lambda x, \forall i$, for the familiar Roy's identity.

The effects of these changes on the government's revenue constraint are given by

$$dR = x\, dt + t\, dx + dT = 0 \qquad (2)$$

and, substituting from eq. (2) to eq. (1), we obtain (Atkinson and Stiglitz, 1980, pp.382-383; Auerbach, 1985, pp.120-121)

$$dV \mid_{R=cost.} = \lambda\, t\, dx\, . \qquad (3)$$

We see that, if the infinitesimal changes of the specific taxes, accompained by an adjustment of the lump sum tax necessary to keep revenue constant, causes consumption changes such as to increase the revenue from the existing specific taxes, then the utility of the consumer increases (for $\lambda > 0$).

Using the Slutsky equation so as to explain the consumption changes dx splitting the substitution effects (indicated here with the matrix S, whose substitution terms are $dx_i/dq_j \mid_{u=cost.}, \forall\, i,j$) and the income effects, we have

---

[3] In a tight equilibrium the balance of the government's budget automatically holds. Therefore we can set the problem of studying the effects of the infinitesimal changes in the commodity taxes without considering the government's demand for public consumption.

$$dx = S\,dt - \frac{\partial x}{\partial M} x\,dt - \frac{\partial x}{\partial M} dT \qquad (4)$$

Substituting from eq. (4) to eq. (3), considering eq. (2) and eq. (3), and solving with respect to dV, we arrive at the general formula

$$dV = \frac{\lambda}{1 - t\frac{\partial x}{\partial M}} t\,S\,dt \qquad (5)$$

that holds for any marginal change in the specific and the lump sum taxes, so as to keep the revenue constant.

The term $t(\partial x/\partial M)$ that appears as the denominator of eq.(5) is the change of the specific tax revenue due to a dollar increase in the consumer's income. Then we can say that the denominator of eq.(5) is positive if "a dollar increase in income causes the consumer to pay less than a dollar in additional excise taxes". But this interpretation by Auerbach (1985,p.120) can be made clearer by taking into consideration that $t = q - p$, therefore the denominator of eq. (5) can be rewritten $1 - q(\partial x/\partial M) + p(\partial x/\partial M)$.

From the properties of Engel aggregation, we have that $q(\partial x/\partial M)=1$, therefore the denominator of eq.(5) can be rewritten $p(\partial x/\partial M)$. It has a positive sign if the change in consumption, whose value is expressed in producer prices, due to a dollar increase in income, is positive. In short, it has a positive sign if positive income effects, weighted by the corresponding producer prices, prevail in the economy. This guarantees the existence of a unique equilibrium and therefore the possibility of associating a particular marginal commodity tax reform with a unique change of the utility of the consumer. But, if in the economy the negative income effects, weighted by the corresponding producer prices, are predominant, the denominator of eq. (5) has a negative sign. In this case, which is unlikely but not to be discarded *a priori*, the existence of a unique equilibrium for each vector of the changes in the specific taxes is no longer guaranteed, and therefore it is not even possible to establish unequivocally the sign of the change of utility of the consumer[4].

As for as the numerator of eq. (5) t S dt, the sign cannot be determined without specifying the direction of the tax reform, or the vector dt. In fact, the substitution terms are negative, but there is at least one positive cross-substitution term from the Hicksian demand theory (Hatta, 1977, p.5). The case considered by Foster and Sonnenschein (1970), Kawamata (1974,1977), Dixit (1975) and by Rader (1976) concerns an equi-proportional specific tax reduction (radial distortion reduction), with offsetting change in lump sum tax to keep revenue constant. In this case we have $dt_i/t_i = b$, $\forall$ i, where $b > 0$ is the equal proportional reduction for all the specific taxes. In this case eq.(5) becomes

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[4]For a closer examination of the problem of multiple equilibria in the literature of the seventies on the theory of commodity tax reforms, with clear graphic illustrations, see Foster and Sonnenschein (1970), Dixit (1975), and Hatta (1977).

$$dV = \frac{\lambda}{p\,\frac{\partial x}{\partial M}}\, t\, S\,(-bt)\,. \qquad (6)$$

Since the matrix of the substitution terms is negative-semidefinite, the numerator of eq.(6) is positive. We can, therefore, conclude that, if in the economy the positive income effects prevail (that is $p(\partial x/\partial M) > 0$), then a radial specific tax reduction with an offsetting change in lump sum tax to keep revenue constant, increases the utility of the consumer. We must, however, point out that also in this apparently trivial case, if the negative income effects should be predominant multiple equilibria could come about, some of which characterized by a reduction of the utility of the consumer, instead of an expected increase.

3. Characterization of feasible and strictly Pareto-improving directions of the tax reforms

On the whole the research on the radial distortion reductions seems, more than anything else, to underline the difficulties raised at an analytical level from the particular second best viewpoint of the tax reform theory. An important step in overcoming these difficulties was taken in the second half of the seventies with the works by Guesnerie (1977, 1979, 1980) on the characterization of feasible and strictly Pareto-improving directions of tax reforms, and then by Diewert (1978) and Dixit (1979) on the characterization of desirable tax reforms according to a Bergson-Samuelson social welfare function. The use of more powerful mathematical algoritms in those years produced a step forward in many-consumer and variable producer price economy.

Moreover, according to the theoretical approach later defined by Stiglitz (1987) "New New Welfare Economics", in these works, the hypothesis of the availability of lump sum taxes for compensating the losses of revenue following from the reductions of the distorsive commodity taxes, is also dropped[5].

Considering in particular the works of Guesnerie (1977, 1980) we see that the competitive net supply vector y(p) of the production sector maximises the profit in the strictly convex set of production possibilities. We observe that the net supply function is homogeneous of degree zero in producer prices p[6]. The utility function of the hth. consumer $u^h(x^h)$, where x^h is his/her feasible consumption bundles, is strictly quasi-concave, monotonic and twice continuosly differentiable. This competitive consumer h chooses the bundle $x^h = x^h(q)$ which maximizes utility $u^h(x^h)$ subject to the budget constraint (labour can only be

[5]Already Guesnerie (1980, pp. 108-110) showed how in a situation of incomplete information the need to collect greater lump sum taxes from the most "able", according to the utilitarian aims of the government, resulted in fact incompatible with the individual incentives to partecipate in the economical activities.

[6]Guesnerie (1977, pp. 183-184) shows that the restrictions imposed on the net supply function guarantee that any small move in supply, the direction of which is normal to p, can be obtained through a small modification of producer prices, whose direction can be choosen normal to p. As we shall see, the possibility to adjust the net supply with small producer prices changes consentskeeping the production side behind the scenes.

consumed in negative quantities). With $X(q) = S_h x^h(q)$ we indicate the net aggregate demand function.

The aim of government is to finance the expenditure for the purchase of the bundle of goods n required to produce a fixed amount of a public good. And to this purpose the government raises the revenue through specific taxes t = q - p , Ai, and through a 100% tax on pure profits. The result is that the consumers do not receive any income other than that obtained with their own labour. So the net demand functions are homogeneous of degree zero in consumer prices. Since the equilibrium does not change if all the consumer prices multiply by a positive constant , and the same is true if all producer prices multiply by a positive constant even if it differs from the previous one, we can choose as a numeraire any good and normalize the consumer prices q and producer prices p in such a way that we have an untaxed good (for example, by writing $q_0 = p_0 = 1$)[7] . The wedge of specific tax between the consumer price and the producer price for each good is thus determined. In this economy, if a tight equilibrium exists[8] , so that the specific tax system secures exactly the financing of the given public consumption vector v, for which is X(q) + v = y(p), we can

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[7]Or, as in Guesnerie (1977, 1980) the good with least tax with respect to all the others. Even if, without any loss of generality, we can choose any good as an untaxed or less taxed numeraire, no matter which, we must always bear in mind that the sign of the tax on each good (positive if it is taxed; negative if it is subsidized), and also the hierarchy among the taxes on the different goods (according to which we can say that the tax on a good is greater or less than the tax on another good) are not preserved for every choice of the untaxed or less taxed numeraire. This affirmation can be proved also wiyh a simple numerical example. Let's consider two goods, i and j, and let's suppose that we have independently normalized the consumer price system and the producer price system in such a way that good i is the untaxed numeraire. Thus we have, for example:

$$\begin{pmatrix} q_i = 1 \\ q_j = \frac{3}{4} \end{pmatrix} ; \begin{pmatrix} p_i = 1 \\ p_j = \frac{1}{2} \end{pmatrix} \textit{ so that } \begin{pmatrix} t_i = 0 \\ t_j = \frac{1}{4} \end{pmatrix} .$$

Now we can prove that if good j is propositively taxed when good i is the untaxed numeraire, then good i is not positively taxed when god j is the untaxed numeraire. Supposing that:

$$\begin{pmatrix} q_i = 1 \times \frac{4}{3} = \frac{4}{3} \\ q_j = \frac{3}{4} \times \frac{4}{3} = 1 \end{pmatrix} ; \begin{pmatrix} p_i = 1 \times 2 = 2 \\ p_j = \frac{1}{2} \times 2 = 1 \end{pmatrix} \textit{ so that } \begin{pmatrix} t_i = -\frac{2}{3} \\ t_j = 0 \end{pmatrix} .$$

Besides we can see that, while in the previous example j the most heavily taxed good, if we normalize the consumer prices multiplying them, for example, by 100, we obtain:

$$\begin{pmatrix} q_i = 1 \times 100 = 100 \\ q_j = \frac{3}{4} \times 100 = 75 \end{pmatrix} ; \begin{pmatrix} p_i = 1 \\ p_j = \frac{1}{2} \end{pmatrix} \textit{ so that } \begin{pmatrix} t_i = 99 \\ t_j = 74,50 \end{pmatrix} .$$

Now it is good j which becomes the least taxed good (see Guesmarie 1980, pp.96-97 and also Dixit and Munk 1977, pp. 103-104; Auerbach 1985, pp. 89-90; Stern 1987b, pp.90-91)

[8]And for the assumption made, it exists and changes continuously close to initial position when specific taxes change.

study the effects of infinitesimal changes in specific taxes[9]. Since we must consider the effects on producer prices and on consumer prices due to infinitesimal changes in different taxes, these changes can be considered in function (according to the particular reform proposal) of the infinitesimal changes in a variable s, which we suppose to be indicative of the stage of the reform. So the vector $\left(\frac{dq}{ds}\ \frac{dp}{ds}\right)$ indicates the direction of the changes in producer prices and in consumer prices, due to the infinitesimal changes in the specific taxes, according to the programme of the reform in the stage s.

Considering that all the variables refer to the initial position, we can give the following definitions (Guesnerie, 1977, pp.184-185):

$$\hat{K} = \{\frac{dp}{ds} \in R^n \left| \frac{dq}{ds} x^h < 0,\ h = 1,\ 2,\ \ldots,\ H \right.\} \tag{7}$$

is the set of directions of consumer prices changes $\frac{dq}{ds}$ which imply a reduction of the value of consumption bundles x^n of every consumer h = 1,...,H, in the initial tight equilibrium.

$$Q = \{\frac{dq}{ds} \in R^n \left| p \cdot [\partial X] \cdot \left(\frac{dq}{ds}\right) \leq 0 \right.\} \tag{8}$$

is the set of directions of consumer prices changes which cause changes in net aggregate demands whose value, expressed in producer prices in the initial position, is negative or zero[10].

Guesnerie (1977, proposition 1, pp.187-188) shows that for any direction of consumer price changes $\frac{dq}{ds} \in Q$, there is at least one direction of producer price changes $\frac{dp}{ds}$ such that $\left(\frac{dq}{ds}, \frac{dp}{ds}\right)$ is equilibrium preserving. Moreover, if $\frac{dp}{ds} \in$ Frontier Q the associated direction of producer prices changes is unique and $\left(\frac{dq}{ds}, \frac{dp}{ds}\right)$ is tight eqilibrium preserving.

Besides Guesnerie (1977, proposition 3,p. 189) shows that for any direction of consumer price changes $\frac{dq}{ds} \in \hat{K} \cap Q$ one can find at least one direction of producer price changes $\frac{dp}{ds}$

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[9]We also note that, if a tight equilibrium exists, the government's budget constraint is implicitly satisfied. In fact, py + (q-p)x = qx + (y-x)p = vp, the revenue of pure profit and specific taxes are necessary aqual to the public expenditure (being x + v = y and qx = 0 from the consumer's budget constraint). In other words, in tight equilibrium the specific taxes reduce the purchasing power of the consumer so as to keep it the same as the value of the goods available in the market, once the government has purchased the bundle of goods required by public consumption. The balance of the government's budget is in this analysis equal to the Walras law which holds for an economy without a public sector (Guesnerie, 1980, p.123).

[10]By [∂X] we indicate the Jacobian matrix of net aggregate demand functions in the initial position, whose terms are $\partial X_i/\partial q_j$, $\forall$ i, j.

such that $\left(\frac{dq}{ds}, \frac{dp}{ds}\right)$ is strictly Pareto-improving. Moreover, if $\frac{dq}{ds} \in \hat{K} \cap$ Frontier Q, then $\frac{dp}{ds}$ is unique and $\left(\frac{dq}{ds}, \frac{dp}{ds}\right)$ is strictly Pareto-improving and tight equilibrium preserving.

The content of these two propositions by Guesnerie is quite intuitive. Since it is still possible to adjust the production with an opportune change in producer prices, all the directions of consumer price changes which cause a reduction of the value of all individual bundles (in the initial position), and at the same time cause negative or zero changes of the value (expressed in producer prices in the initial position) of net aggregate demands for taxed goods, are tight equilibrium preserving and strictly advantageous for all consumers.This result consents Guesnerie (1977, proposition 4, pp.189-190) to characterize the directions of specific tax reforms which are feasible and strictly Pareto-improving in terms of the position of the vector of production costs in the initial position associated with infinitesimal changes in all consumer prices $p \cdot [\partial X]$, and the position of the cone generated by consumption vectors x^h in the initial position $\Lambda = \{ x | x = \Sigma_h \lambda^h x^h$, for some $\lambda^h \geq 0\}$. In fact:

i) If $(p \cdot [\partial X]) \in - \Lambda$, for which the two vectors have the same way and move in the same direction, there are no directions of changes in consumer prices which increase the utility for every consumer (in short, we have a second best optimum)

ii) If $(p \cdot [dX]) \in + \Lambda$, for which the two vectors have the same way but move in the opposite direction, then there are directions of changes in consumer prices which increase the utility for every consumer, but none of which is tight equilibrium preserving. Guesnerie (1977, p.195; 1980, p.152) dwells quite a while on this result which is so different from the well known indications supplied by the optimal taxation theory. In fact, in this case an increase of the utility of all the consumers is only possible if we accept temporary inefficiencies in the course of reform, following a route which enters the interior of the production possibility set. But this is only a temporary "freezing" of available resources[11]. The public sector accumulates a surplus that for the moment cannot be distributed among the consumers . In the final stage of the reform, the second best optimum must however possess the usual efficiency properties

iii) If $(p \cdot [\partial X]) \in C(\Lambda \cup -\Lambda)$, for which the vectors have a different way, there are directions of changes in consumer prices advantageous for all consumers and which require the maintainance of the efficiency in production (being tight equilibrium preserving).

Even if the propositions by Guesnerie do not give rules immediately utilizable for the actual choices of fiscal policy, these propositions show that it is possible to verify the existence of strictly Pareto-improving directions of specific tax reforms just from data on: a)

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[11]Also it is evident that this result of Guesnerie's depends on assumptions about the instruments of fiscal policy available to the government. For example, admitting that it is possible to redistribute any surplus among the consumers through a poll subsidy, the problem of the existence of directions of feasible and strictly Pareto-improving reforms which require temporary inefficiencies in production would lose interest. In this case, eliminating the production inefficiencies, and distributing the resulting government revenue by a poll subsidy, we have a strict Pareto-improving tax reform which does not involve inefficiency (see Smith, 1983, pp.267-269).

current producer prices and consumer price system; b) current consumers' bundles; c) all the current price responses of net aggregate demand functions. This represents a quantity of data which is still considerable, though less than that required by the optimal taxation theory[12].

The simplicity of the results obtained by Guesnerie is rather surprising. In the condition for the existence of feasible and strictly Pareto-improving price changes we notice the absence of price responses of net aggregate supply functions (the adjustments of the production side). The explanation for this simplicity must be found, as well as in the usual assumptions on the production possibility set, also in the hypothesis on the availability of a tax which raises all the pure profits of firms. It is this hypothesis which eliminating the pure profits from the components of the consumers' net demand functions and consenting, therefore, the splitting of the consumption sector from that of production, allows Guesnerie to keep the latter behind the scenes (it being possible to obtain any local adjustment of the production by the right changes in producer prices)[13].

This overview of literature characterizing the directions of the feasible and strictly Pareto-improving tax reforms is finally completed by an important article by Fogelman, Guesnerie, and Quinzii (1978). These authors shows that, by solving a system of multivalued differential equations, it is possible to generate a dynamic process indexed by a continuous variable (time), through the linkage of feasible and desirable infinitesimal tax changes, and determine the conditions for the existence of a small but finito change in a specific tax system which increases each consumer's utility.

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[12]Guesnerie, in an article of 1979 (pp.410-415) and than in a manual of 1980 (pp.141-153), generalized his analysis so as to consider the situation in which the government, besides having to decide the reform of the specific tax system (still having 100% tax on the pure profits of firms) must also verify if it is opportune to change the supply of a public good. The results obtained by Guesnerie are substantially the same as those synthesized in the text. Except that now, considering the supply of public good as a variable choice, to verify Guesnerie's statement we also need data on the current price responses of the demand for the inputs necessary for an infinitesimal increase in public good level, and data on the consumers' marginal willingness to pay for the public good when, in the initial position, they have a given public good supply and can buy market goods at current prices. The problems in obtaining such information are certainly not easy to solve (see Bulckaen, 1988, 1989).

[13]Diewert (1978, p.140) who, on the same subject, proposes a different assumption (that the government can tax with any rate inelastically supplied primary factors of production to which to impute pure profits of firms subject to decreasing return to scale) obtains more complex conditions, which also depend on the derivatives of the net aggregate supply functions. However Weymark (1979), inserting in the Diewert's analysis the assumption about the availability of a tax of 100% on pure profits, finds conditions for the existence of directions of tax reforms feasible and strictly Pareto-improving which are the same as those obtained by Guesnerie (only dependent on the changes in the consumption side). However, for a closer study of the problems connected to the production sector in the theory of the tax reforms, when the restrictions on the production side or the assumptions directed to eliminate the pure profits (like a 100% tax) are dropped, see the recent essay by Stern (1987 b). In addition Stern shows how to face the problems connected to the production sector using "shadow prices" calculated according to cost-benefit techniques. Recently Wibaut (1987, 1989), to verify the existence of strictly Pareto-improving indirect tax reforms in Belgium, integrated the analysis of Guesnerie with a complete macro-economic model to additionally take into consideration the situations of Keynesian disequilibrium (due to excess supply of labour and commodities).

4. Tax reforms "from and towards uniformity" in a single-consumer economy

4.1. THE CORLETT-HAGUE RULE

The results of the research by Guesnerie constitute an important step in the solution of the problem of the characterization of the feasible and strictly Pareto-improving commodity tax reforms. However, in order to be able to obtain some indications for the actual fiscal choices, it is necessary to specify once again the structure of the models. In this respect the debate of these last few years on the subject, that I defined as tax reform "from and towards uniformity"[14], is particularly interesting. This is a theme which has evident points of contact, as we shall better see later, with a similar discussion on the optimality of a uniform structure of commodity tax rates (according to the conditions stated by Sadka (1977), Atkinson (1977), Deaton (1981), Deaton and Stern (1986)).

The debate on the tax reforms "from and torwards uniformity" ties up with the well known pioneering contribution by Corlett and Hague (1953-54).

In a single-consumer and fixed producer prices economy, in which however, contrary to the model considered in Paragraph 2, the possibility of using a lump sum tax is not allowed, Corlett and Hague (1953-54) consider an initial position in which all the commodities (two in the article by Corlett and Hague (1953-54), n in the generalisation by Dixit (1975)) are taxed at a common rate. The numeraire, in this case leisure, is untaxed. In literature this case is indicated as an initial uniform tax structure, in order to distinguish it from the initial proportional tax structure, in which all goods, including the numeraire, are taxed at a common rate (implying zero tax revenue).

Returning to the model considered in Paragraph 2, since the government cannot use the lump sum taxes to mantain the revenue at a fixed level when commodity tax rates are changed, the change in the indirect utility of the consumer, due to the infinitesimal changes in such taxes, is given from

$$dV = \sum_i \frac{\partial V}{\partial q_i}\, dt_i = -\lambda \text{ x } dt. \qquad (9)$$

For the government budget constraint we have

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[14]With this terminology I wish to underline one of the central results of this survey. In addition to the traditional debate on the desirability of the commodity tax reforms *from unifomity* towords the differentiation of tax rates (whose terms, as we shall see later, are sufficiently clear, both with regards to the efficiency and to the distribution), in recent years a new dabate has been opened on the desirability of commodity tax reforms which, from an initial position of differentiated tax rates, direct their steps towards a less differentiated tax rate structure, therefore, *towards uniformity*. And the terms of this debate are still to be clarified, according to the outline that will be discussed later.

$$dR = x\,dt + t\,dx = 0. \qquad (10)$$

Using the Slutsky equation, and remembering that S indicates the matrix of the substitution terms, eq.(10) may be rewritten as

$$\left(x + t\frac{S}{E}\right) dt = 0 \qquad (11)$$

where $E = 1 - t\dfrac{\partial x}{\partial M}$.

In the particular initial position now considered the numeraire, let us call the good 0, is untaxed, or $q_0 = p_0 = 1$, therefore $t_0 = 0$. All the other goods are taxed at a common rate, or $\dfrac{\hat{t}}{\hat{q}} = \theta$. For the Euler theorem, and considering that the consumer's compensated demand function is homogeneus of degree zero, we have $\hat{S} + q\,\hat{S} = 0$, where $\hat{S}_0$ is the vector of substitution terms for each commodity with respect to the price of good 0. So, eq.(11) may be rewritten

$$\left(x - \frac{\theta}{E}\hat{S}_0\right) dt = 0. \qquad (12)$$

Indicating with $\eta_{ij} = S_{ij}\dfrac{q_j}{x_i}$ the compensated cross-elasticity of demand, and given that $q_0 = 1$, eq.(12) which states the budget constraint in this particular case, may be rewritten (Auerbach, 1985, p.124)

$$\sum_i x_i\left(1 - \frac{\theta}{E}\eta_{io}\right) dt_i \qquad (13)$$

Let's suppose that for every taxed commodity the condition

$$x_i\left(1 - \frac{\theta}{E}\eta_i\right) = \frac{dR}{dt_i} > 0 \qquad (14)$$

holds, so that for every taxed commodity i = 1, ..., n an increase in the tax t_i provokes an increase in the government revenue (remembering also that E > 0, see Paragraph 2). The "crazy cases" considered by Corlett and Hague (1953-54, p. 24), in which an increase in the tax rate would leave the revenue unchanged, or would even cause its reduction, are in this way eliminated. At this point let us take just one pair of taxed commodities, for example, the commodities 1 and 2. Let's suppose that it is $\eta_{1o} > \eta_{2o}$, or the commodity 1 is a better substitute for the untaxed numeraire 0 than commodity 2. Considering eq.(9) and that, to satisfy the budget constraint, the changes in tax rates on commodities 1 and 2 must be of an opposite sign (given that eq.(14) eliminates the "crazy cases" pointed out by Corlett and Hague), we see that in absolute value

$$\frac{-\lambda x_1}{x_1\left(1-\frac{\theta}{E}\eta_{1o}\right)}\,dR > \frac{-\lambda x_2}{x_2\left(1-\frac{\theta}{E}\eta_{2o}\right)}dR \qquad (15)$$

or that in general the utility of the consumer changes in proportion to the term $\frac{1}{1-\frac{\theta}{E}\eta_{io}}$.

In particular, in the example considered, we see that a reduction of the tax rate on commodity 1, the better substitute for the untaxed numeraire 0, and an increase in tax rate on commodity 2 to keep revenue constant, will increase the consumer's utility. This result can obviously be extended to any two taxed commodities. We thus reach the Corlett and Hague rule (1953-54, p.24), in the generalization by Dixit (1975,p.117): in a competitive economy with constant producer prices and uniform initial tax rates, marginal changes in commodity tax rates, holding revenue constant, will increase the utility of the consumer if all commodities whose tax rates are lowered are better substitutes for untaxed numeraire than all those whose tax rates are raised.This result is often used in the literature on the optimal taxation theory to support Ramsey's rule and the consequences contrary to the traditional "uniform commodity taxation doctrine" (still however well rooted in the current convinctions in tax matters) which derive from this famous rule. But once again the difference in the logic of the two theoretical approaches calls for some caution. Ramsey's rule, as is well known, derives from the conditions for an optimal structure of commodity tax rates. While Corlett and Hague's result derives from the conditions for the desirability of a tax reform when in the initial position all the commodities are taxed at a common rate. The contact point between the two results is that, in the economy considered, we must exclude the possibility that an initial uniform tax structure is optimal, given that it is possible to increase the utility of the consumer by reducing the tax rates on the commodity which are better substitutes for leisure (untaxed numeraire) and increasing the tax rates on the commodities which are less substitutable for leisure. What, however, places them on a different level is that, when commodity tax rates are differentiated in the initial position, the analysis by Corlett and Hague is no longer valid and, therefore, can no longer be used to support Ramsey's rule.

4.2. A REHABILITATION OF THE "UNIFORM COMMODITY TAXATION DOCTRINE"

In an article of 1986, still considering a single-consumer economy and fixed producer prices but, now, examining the case of an initial position with differentiated commodity tax rates, Hatta reaches conclusions contrary to those of Corlett and Hague, contributing to some degree to a rehabilitation of the traditional "uniform commodity taxation doctrine". In the economy considered by Hatta (1986, pp. 100 - 101) the individual consumes n commodities (x_1, ..., x_n), the leisure x_0 , and a public good z. As usual the marginal utilities of all these goods are positive. By vector $x = x(q,u)$ we now indicate the compensated demand functions for the commodities and leisure, being $q = (q_0, q_1, ..., q_n)$ the vector of positive consumer

prices and u the level of consumer's utility[15]. The consumer's budget constraint is $qWx = 0$. As regards the production side, technology (assuming efficiency) is represented by a linear frontier of the production possibilities set $p \cdot x + z = 0$, where p is, as usual, the vector of positive fixed producer prices[16]. The government imposes ad valorem commodity taxes and wage tax. There are no other taxes and, in particular, there is no lump sum tax. Indicating with τ_i the tax rate on the good i, we have $q_i = (\tau_i + 1)p_i$, for i = 0, 1, ..., n. Since producer prices are fixed, we can consider consumer prices as functions of tax rates, or $q=q(\tau)$. Supposing that all the tax revenue is spent on the supply of public good, we have $(q-p)x = z$, as was already implicit in the equations that express the consumer's budget constraint and the technology.

On the basis of these standard assumptions, Hatta's model is expressed by the two following equations:

$$m[q(\tau),\ u] = 0 \tag{16}$$

$$p \cdot x[q(\tau),\ u] + z = 0. \tag{17}$$

Considering that $m[q(\tau), u]$ is the expenditure function of the consumer, with the usual properties, eq.(16) indicates the minimum income necessary at the tax rates τ for the consumer achieving the level of utility u. The eq.(17), rewritten as $p_1 x_1 + ... + p_n x_n + z = p_0 (-x_0)$, is nothing more then the equality of proceeds of the firms with the production costs (born to buy consumer's leisure time). The eq.(16) and eq.(17) constitute a system of two equations in n + 3 variables: the n - 1 commodities, the leisure, the level of consumer's utility, and the public good. If we exogenously fix the levels of n + 1 variables, this system is complete with respect to the remaining two variables.

Totally differentiating eq.(16) and eq.(17), the change in the level of utility of consumer due to an infinitesimal increase in τ_1, accompained by an adjustament in the level of τ_1, so as to keep revenue constant, provided $D_n \neq 0$, is (Hatta, 1986, p.102)

$$\frac{\partial u^{(n)}}{\partial \tau_1} = \frac{p_1 x_1}{\dfrac{\partial m}{\partial u}} \cdot \frac{N_{1n}}{D_n} \tag{18}$$

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[15]The level of public good z does not explicitly appear in the compensated demand functions because Hatta (1986, p.100) keeps it constant throughout his analysis.

[16]Supposing that the firms are perfect competitors, in equilibrium the vector of producer prices must be proportional to costant marginal costs of production. Hatta (1986, p.101) chooses the unit of currency so that this factor of proportionality is one, and therefore the producer prices are fixed and equal to constant marginal costs.

where: $N_{1n} = \dfrac{p\dfrac{\partial x}{\partial q_n}}{x_n} - \dfrac{p\dfrac{\partial x}{\partial q_1}}{x_1}$

and $D_n = \dfrac{p\dfrac{\partial x}{\partial u}}{\dfrac{\partial m}{\partial u}} - \dfrac{p\dfrac{\partial x}{\partial q_n}}{x_n}.$

To be able to interprete eq.(18) it is necessary to introduce a few definitions. Totally differentiating eq.(16) and eq.(17), but now considering that the vector τ is exogeneously given, the solution function for z (public good level, or tax revenue) may be written as $z = \rho(\tau)$. So if we have $\dfrac{\partial \rho}{\partial \tau_1} \begin{matrix} > \\ = \\ < \end{matrix} 0$, we can say that tax rate τ_i is, respectively, revenue-increasing, revenue-neutral, and revenue-decreasing. Then, we can also say that the ith tax rate is revenue-increasing if and only if $\dfrac{\partial \rho}{\partial \tau_1} = p_i x_i D_i > 0$ (Hatta, 1986, lemma 2, p.103).

In the context of the problem considered, we can agree with Hatta that, in the initial position, all of the commodity tax rates to be changed are revenue-increasing. In fact, if a commodity tax rate is revenue-neutral or revenue-decreasing it would still be possible to reduce it so as to increase the utility of the consumer, slackening his budget constraint without losing revenue or, even, obtaining an increase in the same revenue[17]. In fact, we could say that if commodity tax rate is revenue-decreasing we are in the "Laffer zone" (Hatta, 1986, p.103).

On the basis of these considerations, in eq.(18) $D_n > 0$, for which the sign of $\dfrac{\partial u^{(n)}}{\partial \tau_1}$ depends only on the sign of N_{1n}. It is on this term, interpretable as the weighted average of the substitution terms relative to the two goods whose tax rates are changed (the weights being the respective producer prices), that we must concentrate our attention. It is for this reason that Hatta (1986, pp.103-104) introduces the concept of substitutability of the jth good for a group of goods G. If

$$\sum_{i \in G} \frac{\partial x_j}{\partial q_i} \left| \tau_i - \tau_j \right| \; p_i > 0 \qquad (19)$$

[17]On the basis of the same consideration, the negative rate of tax on labour income τ_0 (given that $q_0 < p_0$) will be revenue-decreasing in the initial position. An increase in such a tax rate, for example, from -0. 50 to -0. 30, implies in fact a reduction of the revenue. Then, if τ_0 where in the initial position revenue-neutral or revenue-increasing, it would still be possible with a reduction of the tax rate to obtain an increase in the utility of the consumer, slackening his budget constraint, without reducing or, even, increasing the revenue.

so that, when the prices of all the goods i ∈ G increase (as if the tax rates on these goods were raised in proportion to their distances from tax rate of good j), and the compensated demand for the jth good raises, then such a good j is a substitute for the compound good G[18].

The case which is particularly interesting here considers differentiated commodity tax rates in the initial position. So that it is possible to establish an order of this type

$$\tau_1 < \tau_2 \leq \ldots \leq \tau_n \qquad (20)$$

while the lowest tax rate is that on labour (leisure supply), so that $\tau_0 < \tau_1$.

The problem is to verify the effect on the utility of the consumer of marginal commodity tax rate reforms towards uniformity: That is, the effect of an increase of the lowest tax rate (in example τ_1), accompained by a simultaneous reduction of the highest tax rate (in example τ_n), so as to mantain the initial level of revenue.

Being $q \frac{\partial x}{\partial q_j} = 0$, $\forall$ j, due to the homogeneity rule, we can write in general

$$(\tau_j + 1)\ p\frac{\partial x}{\partial q_j} = (\tau_j + 1)p\frac{\partial x}{\partial q_j} - p\frac{\partial x}{\partial q_j} = \sum_{i=0}(\tau_j - \tau_i)\ p_i \frac{\partial x_i}{\partial q_j} \qquad (21)$$

Substituting in the term N_{1n} of eq.(18), and using the symmetry property of substitution terms, following Hatta (1986, p.106-107) we obtain

$$N_{1n} = \frac{\psi_n \eta_{no} - \psi_1 \eta_{1o}}{\tau_o + 1} + \frac{\sum_{i=1}(\tau_n - \tau_i)\ p_i \frac{\partial x_n}{\partial q_i}}{x_n(\tau_n + 1)} + \frac{\sum_{i=1}(\tau_i - \tau_1)\ p_i \frac{\partial x_1}{\partial q_i}}{x_1(\tau_1 + 1)} \qquad (22)$$

The numerators of the fractions in the second and third terms of eq.(22) express the good 1 and good n substitutability for the compound good G, according to the eq.(19). In the first term of eq.(22), $\eta_n = \frac{\partial x_n}{\partial q_o}\frac{q_o}{x_n}$ is the compensated wage-elasticity of demand for the good n, and $\psi_n = \frac{\tau_n - \tau_o}{\tau_n + 1}$. Similar definitions of these two symbols are also valid for the good 1.At this point we can enunciate the theorem 2 by Hatta (1986,p.106). In the model of eq.(16) and eq.(17), assuming that the initial tax rate structure satisfies eq.(20), the utility of consumer is improved by an increase in τ_1 (the lowest tax rate) accompained by a

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[18]We must observe that, when the jth good is a substitute for each good i ∈ G so $(\partial x_j/\partial q_j) > 0$ for each i ∈ G, then it is also a substitute for the compound good G, but not vice versa (Hatta, 1986, p. 104).

simultaneous reduction of τ_n (the highest tax rate), so as to mantain the initial revenue level, if the following conditions are satisfied:

i) The tax rates of 1 and n good are both revenue-increasing;

ii) The good 1 is a substitute for the compound good G, consisting of all other goods, and so is the good n;

iii) It holds that $\psi_n\eta_n - \psi_1\eta_1 \geq 0$.

Observe that the condition (*iii*) is automatically satisfied if good n is an equal or better substitute for leisure than good 1. In fact, in the initial position considered, where $\tau_0 < \tau_1 < \tau_n$, we have $\psi_n > \psi_1$ and therefore, if $\eta_n \geq \eta_1$, the condition (*iii*) is satisfied. However, even if η_1 were notably higher than η_n, to the point of violating the condition (*iii*), the eq.(22) could still give a positive result due to the positivity of the last two terms, whose value depends on the degree of substitution existing between the two goods considered and the compound good G. We can thus conclude that if the initial tax rate structure is considerably divergent (for which τ_n is much higher than τ_1), a change towards uniformity is likely to increase consumer's utility, regardless of the relative magnitudes of the compensated wage-elasticity of demands for the goods considered[19].

In general, then, as long as the conditions of the 2nd theorem by Hatta (1986, p.106-107) holds, we can say that the consumer's utility increases if, once $\tau_1 = \tau_2$ is reached, then these two tax rates will be jointly increased in the same measure. And, at the same time, if, once $\tau_n = \tau_{n-1}$ is reached, then these two tax rates are jointly reduced in the same measure, so as to keep the revenue constant. Therefore, we can conclude that the utility of the consumer increases if, beginning from the bottom, we raise the tax rates $\tau_1 =...= \tau_k$ in the same measure and, beginning from the top, we reduce the tax rates $\tau_{k+1} =...= \tau_n$ in the same measure, so as to mantain the initial revenue level. Applying this rule to each phase of the reform, as long as the possibility of substitution prevails, and the tax structure is not very close to uniformity, tax reforms towards uniformity will monotonically improve the utility of the consumer (Hatta, 1986, p.108).

4.3. A COMPARISON BETWEEN HATTA AND CORLETT-HAGUE RULES

As we have seen, while the results obtained by Corlett and Hague justify reforms from uniformity towards differentiated commodity tax rates, the conclusions which we can draw from the work by Hatta justify, by contrast, reforms from a differentiated commodity tax rate structure towards uniformity. The heart of the matter is the initial structure of commodity tax rates.

In the case of an initially uniform structure of tax rates, for which $\tau_0 < \tau_1 =...= \tau_n$, the last two terms of eq.(22), which pull tax rates towards uniformity, are zero. Thus eq.(22) becomes

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[19] As long as the commodity tax rates are revenue-increasing and the goods are substitutes for the compound good G.

$$N_{1n} = \frac{\psi_1(\eta_n - \eta_1)}{\tau_o + 1} \qquad (23)$$

Only the term which pulls towards a differentiation of commodity tax rates, on the basis of the differences in the compensated wage-elasticities of demands, operates. Therefore, in the case of an initial uniform tax rate structure, $N_{1n} > 0$ if we increase the tax rate on good 1 (less substitutable for leisure), and if we reduce the tax rate on good n (more substitutable for leisure), since it is $\eta_n > \eta_1$. We find therefore in the analysis by Hatta the same result as Corlett and Hague.

However as soon as we depart from uniformity, also the other two terms in eq.(22), which, as we have already said, pull tax rates towards uniformity, begin to have weight. The value of these terms becomes larger and the "pulling power" stronger as the gaps among tax rates increase, as long as the possibility for substitution for taxed goods dominates (Hatta, 1986, p.107).

From all these considerations a more sophisticated rule for a single-consumer economy (and therefore only in terms of efficiency) emerges from the tax reform theory. From an initial position characterized by a considerable differentiation in tax rates, as long as the possibility for substitution for taxed goods predominates, the tax rate structure should generally be closer to uniformity. Then, when the initial position approaches a uniform tax rate structure, fine-tuning verification, which concentrates on empirically estimated values of parameters, is necessary. Hatta (1986, pp.107-108), focuses his attention on the dominance of the pulls towards uniformity, due to the degrees of substitution among differently taxed commodities, on the pulls which lead, instead, to a departure from uniformity, due to the degrees of substitution of the taxed commodities for untaxed leisure. Thus he believes that the "zero-gravity point" must stand in proximity to a uniform tax rate position, even if the differences in the compensated wage-elasticities of demand are considerable. In practice, even without having to estimate the sign of relevant parameters in the initial position, the traditional "uniform commodity taxation doctrine" can constitute a useful guide for tax reform programs (Hatta, 1986, p 111).

5. Departure from uniformity in a many-consumer economy

5.1. DISTRIBUTIONAL CONSIDERATIONS IN THE AHMAD-STERN ANALYSIS

Although in the debate on tax reforms "from and towards uniformity" several useful indications have emerged, we must keep in mind that these indications have been obtained for a single-consumer economy.

Hatta (1986,pp.109-111) discusses the possibility of extending his analysis to a many-consumer economy interpreting the single consumer's utility function as the Scitovsky utility function of a consumer for some fixed utility levels of all other consumers. Then, the utility improvement caused by a tax reform can be interpreted as a movement towards a higher

Scitovsky indifference curve (which lies above the original curve, according to Samuelson, 1950). However Hatta also recognises that an efficiency-improving tax reform, in the sense of Scitovsky-Samuelson, can be considered desirable from the social welfare point of view only if the distribution is optimal (lump sum transfers not being allowed), or as long as the Gorman restrictions on consumers' preferences, required so as to be able to delineate a "one-consumer equivalent economy" (Deaton and Muellbauer,1980, pp.149-166), are satisfied. In fact, even an efficiency-improving tax reform will make some consumers worse off. Hence it is not at all excluded that such a reform may also reduce the value of a reasonably defined social welfare function. In short, the impossibility of keeping the distributive problems separate from those of efficiency, justifies the reservations that can be advanced with regards to the indications provided in theory for single-consumer economies[20].

A model of economy which considers many consumers, although maintaining the usual simplifying assumptions on the production side (fixed producer prices), was proposed by Ahmad and Stern (1984) to verify the emerging indications in the context of the tax reform theory on the basis of the data available for the economy of India (years 1979-1980). Later this model was taken up by Newbery and Stern (1987) and by Stern (1987 a).

Ahmad and Stern (1984,p.262) assume that there is an inelastic supply of a single untaxed factor (in the case considered, labour). So every consumer h has a fixed income of labour $M^h = -q_o^h \; x_o^h$ and his indirect utility function $V^h(q)$ and so his demand functions for commodities $x^h(q)$ depend only on the consumer prices vector q. The government collects revenue R by means of a system of commodity taxes $t = q - p$. For which we have $R = \Sigma_i \, t_i \, X_i$ where $X_i = \Sigma_h \, x_i^h(q)$, $\forall$ i.

The problem dicussed by Ahmad and Stern is to find the conditions for the existence of tax changes which increase the level of a Bergson-Samuelson social welfare function $W = W[V^1(q), ...,V^H(q)]$, without decrease in tax revenue[21].

The increase in the tax on the ith commodity to raise an extra dollar of revenue is given by $(\partial t_i/\partial R)$. On the other hand, the change of social welfare due to the infinitesimal change of this tax on commodity i is given by $(\partial W/\partial t_i)$. So the social marginal cost of an extra dollar raised via the ith commodity tax is (Ahmad and Stern, 1984, p.263)

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[20]Hatta (1986,pp.110-111), however, with commendable pragmatism, believes that in a dynamic economy, characterized by continuous efficiency-improving reforms in different areas (for example, antitrust policies, trade liberalizations, financial market liberalizations, marginal cost pricing and public good investments based on cost-benefit analysis, etc.), it is right to expect, in gneneral, an increase in social welfare even without foreseeing compensations for the losers in the single processes of reform. We should look at the final result obtained from all the reforms carried out, rather than to verify the improvement of social welfare for each single reform.

[21]Formally the problem is to determine the conditions for the existence of the directions of infinitesimal changes in commodity taxes such as $dW = \Sigma_i(\partial W/\partial t_i) \, dt_i \geq 0$ and $dR = \Sigma_i(\partial R/\partial t_i) \, dt_i \geq 0$.

$$\lambda_i = \frac{-\frac{\partial W}{\partial t_i}}{\frac{\partial R}{\partial t_i}} \qquad (24)$$

If in the initial position $\lambda_i = \lambda_j$ for every commodity i and j, then there is no chance of increasing social welfare without reducing government tax revenue[22]. Vice versa, if in the initial position the social marginal cost of an extra dollar raised via the ith commodity tax is, for example, greater than the social marginal cost of an extra dollar raised via the jth commodity tax, for which $\lambda_i > \lambda_j$, then we can increase social welfare, without reducing government tax revenue, decreasing the tax on commodity i and increasing the tax on commodity j.

Once this simple general principle has been established, to verify the existence of marginal commodity tax reforms increasing the level of a Bergson-Samuelson welfare function, it is necessary to study in more detail the significance of λ_i. The numerator of eq.(24), keeping in mind the assumption of fixed producer prices and using Roy's identity, may be rewritten

$$\frac{\partial W}{\partial t_i} = -\sum_h \beta^h x_i^h. \qquad (25)$$

where $\beta^h = \frac{\partial W}{\partial V^h}\frac{\partial V^h}{\partial M^h}$ is the marginal social valuation of income of consumer h, which expresses the welfare weight of this consumer. The denominator of eq.(24), differentiating the government budget constraint $R = \Sigma_i t_i X_i$ with respect to tax t_i, may be rewritten as

$$\frac{\partial R}{\partial t_i} = X_i + \sum_j t_j \frac{\partial X_j}{\partial t_i}. \qquad (26)$$

For which eq.(24) becomes

$$\lambda_i = \frac{-\sum_h \beta^h x_i^h}{X_i + \sum_j t_j \frac{\partial X_j}{\partial t_i}} \qquad (27)$$

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[22]This is the first-order condition for the solution to the problem: maximise W(t) subject to $R(t) \geq \bar{R}$ (Ahmad and Stern, 1984 pp.263-264).

To point out the differences in the indications which are obtained for a many-consumer economy, in which also distributional problems become considerable, with respect to those derived for a single-consumer economy, Ahmad and Stern (1984, p.265) dwell in particular on the expression of the inverse of the social marginal cost of an extra dollar raised via the ith commodity tax, that is the revenue cost on the margin of generating an extra unit of welfare via a reduction in the ith commodity tax

$$\frac{1}{\lambda_i} = \frac{X_i}{-\sum_h \beta^h x_i^h} + \frac{\sum_j t_j \frac{\partial X_j}{\partial t_i}}{-\sum_h \beta^h x_i^h}. \qquad (28)$$

The first term of the right-hand side of eq.(28) is the reciprocal of the distributional characteristic of commodity i (Feldstein, 1972; Atkinson and Stiglitz, 1980). The more different the models of consumptions of those belonging to different classes of income are, and the stronger the social aversion to inequality is in the economy, the more this term takes on a role of greater importance in ordering of $1/\lambda_i$[23]. The second term of the right-hand side of eq.(28) considers in the numerator the tax revenue effects due to responses of the aggregate demands to the infinitesimal changes in commodity taxes.

In particular, Ahmad and Stern (1986, p.266) consider also the case in which the tax rates structure is initially uniform, that is $t_i = \theta\, q_i$, $\forall$ i. In this case, having fixed producer prices, so that $dt_i = dq_i$, $\forall$ i, we have

$$\sum_j t_j \frac{\partial X_j}{\partial t_i} = \theta \sum_j q_j \frac{\partial X_j}{\partial q_i}. \qquad (29)$$

Since $\Sigma_j\, q_j\, (\partial X_j/\partial q_i) = - X_i$ for the adding-up restriction, eq.(28) may be rewritten as

$$\frac{1}{\lambda_i} = \frac{(1-\theta)X_i}{-\sum_h \beta^h x_i^h}. \qquad (30)$$

Ahmad and Stern thus reach the conclusion that in a uniform initial position, the differences in social marginal costs of an extra dollar raised via commodity taxes are solely dependent on the differences in their distributional characteristics. So, supposing that the social welfare function implies a certain degree of aversion to inequality, in a uniform initial position it is possible to increase social welfare by means of reforms which consider a

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[23]Observe that if the hwelfare weights are equal for all consumers, for example $\beta^h = 1$, $\forall$ h, the inverse of the distributional characteristics becomes 1 for all the commodities, and the considerations of a distributive nature cease to affect the ordering of λ_i.

reduction of the taxes raised on commodities mostly consumed by low income groups (or with distributional characteristics higher, therefore with a λ_i greater), and, to keep tax revenue constant, an increase of taxes on commodities mostly consumed by high income groups (or with lower distributional characteristics, therefore with a λ_i lower)[24].

We can notice a certain discordance between the results obtained by Corlett and Hague (1953-54) and by Hatta (1986) for a single-consumer economy, in which only efficiency problems arise, and this result obtained by Ahmad and Stern (1984) for a many-consumer economy. We can not see why, still in the case of a uniform initial position, the move from a single-consumer economy to a many-consumer economy, apart from showing the problems of a distributive nature (tied to the differences in the distributional characteristics of the commodities), should necessarily also lead to an absence of considerations of efficiency (tied to the degrees of substitution of the taxed commodities for the untaxed leisure). In fact, the explanation for this discordance may be that Ahmad and Stern (1984, p.262) set in their model an inelastic supply of labour so that, as we have seen, every consumer's labour income is fixed. However from this hypothesis it follows that a uniform commodity tax is actually a lump sum tax. So, supposing that the tax revenue requirement does not cause the "bankruptcy" of the consumer, a uniform commodity taxation is optimal in a single-consumer economy (from the efficiency point of view). It is also optimal in a many-consumer economy as long as there are no problems regarding distributional concerns. Only in consideration of the differences in the distributional characteristics of the commodities can a departure from the initial uniform tax rate structure (now a lump sum taxation) be justified if the hypothesis of inelastic supply of labour proposed by Ahmad and Stern holds. Since such a hypothesis seems considerably restrictive, we must expect that in reality both the considerations, of efficiency and of a distributive nature, are fully pertinent in a many-consumer economy.

5.2. THE ROLE OF EFFICIENCY AND OF DISTRIBUTION IN A UNIFORM INITIAL POSITION

Recently Gordon (1989 a) studied the problem of marginal commodity tax reforms, still in a uniform initial position, in a many-consumer economy, but without assuming a fixed income of labour which, as we have seen, heavily conditioned the Ahmad-Stern analysis.

As usual, in the economy considered by Gordon (1989 a, p.157), the government collects a given revenue R via an ad valorem tax system on the commodities $(x_1, ..., x_n)$. The good 0, the labour, is chosen as the untaxed numeraire. The vectors q, p, and τ respectively indicate the consumer prices, the producer prices (fixed because of a linear technology), and the ad valorem tax rates. The case considered by Gordon is still that of a uniform commodity tax rate structure, so we have $\tau_i = \theta$ for every commodity i.

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[24] Still in the case now considered of a uniform initial position, if all thle welfare weights were equal, $\beta^h = 1$, $\forall$ h, we should have $\lambda_i = \frac{1}{1 - \theta}$, $\forall$ i. So the uniform initial position would constitute a second best optimum, there not being directions of tax reforms capable of increasing the social welfare without reducing tax revenue.

Indicating with $V^h(q)$ the indirect utility function of consumer h, the Bergson-Samuelson social welfare function is

$$W = W\left[V^1(q), ...,V^H(q)\right]. \tag{31}$$

The government's budget constraint is, in this uniform initial position,

$$T(\tau) = \theta\sum_i p_i \sum_h x_i^h(q) = R \tag{32}$$

The effect on the social welfare of an infinitesimal change in the commodity tax rate τ_j, using Roy's identity and indicating still with $\beta^h = (\partial W/\partial v^h)(\partial V^h/\partial M^h)$ the marginal social valuation of consumer h income (his welfare weight), is given by

$$\frac{\partial W}{\partial \tau_j} = \sum_h \frac{\partial W}{\partial V^h}\frac{\partial V^h}{\partial q_j}\frac{\partial q_j}{\partial \tau_j} = -p_j \sum_h \beta^h x_j^h \tag{33}$$

Due to the assumption of fixed producer prices, we have $\frac{\partial q_j}{\partial \tau_j}\ \frac{\partial[(1+\tau_j)p_j]}{\partial \tau_j} = p_j$. So the effect on the commodity tax revenue of an infinitesimal change in the tax rate τ_j, in this uniform initial position is given by

$$\frac{\partial T}{\partial \tau_j} = \sum_h p_j x_j^h + \theta\sum_i p_i \sum_h \frac{\partial x_i^h}{\partial q_j} p_j \tag{34}$$

Applying the Slutsky decomposition we have

$$\frac{\partial T}{\partial \tau_j} = p_j \sum\left(x_i^h - \theta\sum_i p_i \frac{\partial x_i^h}{\partial M^h} + \theta\sum_i p_i \frac{\partial x_i^h}{\partial q_j}\Big|_{\bar{u}} \right).$$

Considering that $p_i = \frac{q_i}{1+\theta}$, and that, due to the homogeneity of degree zero of compensated demand functions, we have

$$\sum_i q_i \frac{\partial x_i^h}{\partial q_j}\Big|_{\bar{u}} = -\frac{\partial x_i^h}{\partial q_o}\Big|_{\bar{u}} ,$$

eq.(34) may be rewritten

$$\frac{\partial T}{\partial \tau_j} = p_j \sum_h \left(x_i^h - \theta \sum_i p_i \frac{\partial x_i^h}{\partial M^h} x_i^h - \frac{\theta}{1+\theta} \frac{\partial x_i^h}{\partial q_o}\Big|_{\bar{u}} \right)$$

and, therefore, multiplying and dividing the last term of the right-hand side by x_j^h, and remembering that $q_o = 1$, we have

$$\frac{\partial T}{\partial \tau_j} = p_j \sum_h x_j^h \left(1 - \delta^h - \frac{\theta}{1+\theta} \eta_{jo}^h \right) \tag{35}$$

where $\delta^h = \Sigma_i \, \theta \, p_i \, (\partial x_i^h / \partial M^h)$ is the marginal propensity to pay commodity tax out of increments to income of the consumer h, and $\eta_{jo}^h = \frac{\partial x_j^h}{\partial q_o}\Big|_{\bar{u}} \cdot \frac{1}{x_j^h}$ is the compensated wage-elasticity of demand for commodity j of the consumer h (Gordon, 1989 a, p.158).

We now consider the case of an infinitesimal change in tax rate on commodity, called a, with a simultaneous adjustment to tax rate on a second commodity, called b, necessary to keep revenue constant. Assuming that both the tax rates are revenue-increasing (that is, exluding the "crazy cases" discussed by Corlett and Hague), $d\tau_a$ and $d\tau_b$ must have opposite sign to satisfy the budget constraint.

Analytically this reform can be described as follow:

$$dW = \frac{\partial W}{\partial \tau_a} \, d\tau_a + \frac{\partial W}{\partial \tau_b} \, d\tau_b \tag{36}$$

subject to the budget constraint

$$dT = \frac{\partial T}{\partial \tau_a} \, d\tau_a + \frac{\partial T}{\partial \tau_b} \, d\tau_b = 0 \tag{37}$$

Dividing eq.(36) by $d\tau_a$ and substituting $\frac{d\tau_b}{d\tau_a} = - \frac{\partial T / \partial \tau_a}{\partial T / \partial \tau_b}$ from eq.(37), we have

$$\frac{dW}{d\tau_a}\Big|_{dT=0} = \frac{dT}{d\tau_a} \left(\frac{\partial W / \partial \tau_a}{\partial T / \partial \tau_a} - \frac{\partial W / \partial \tau_a}{\partial T / \partial \tau_a} \right) \tag{38}$$

which, rewritten in synthetic form, becomes

$$\frac{dW}{d\tau_a}\Big|_{dT=0} = \frac{dT}{d\tau_a}(\xi_b - \xi_a) \tag{39}$$

where, for j = 1,...,n,

$$\xi_j = -\frac{\partial W/\partial \tau_j}{\partial T/\partial \tau_j} = \frac{\sum_h \beta^h x_j^h}{\sum_h x_j^h \left(1 - \delta^h - \frac{\theta}{1+\theta}\eta_{jo}^h\right)} \tag{40}$$

is, to use the same terminology used by Gordon (1989 a, p.158), the optimal tax characteristic of commodity j in the uniform initial position. Naturally, ξ_j can also be interpreted as the social marginal cost of an extra dollar raised via the jth commodity tax, to use instead the terminology used by Ahmad and Stern, as long as the labour income is not exogenously fixed.

From eq.(39) we can see that in a many-consumer economy, when the two commodities have identical optimal tax characteristics, thus $\xi_b = \xi_a$, a departure from uniformity is not welfare-improving (the uniform initial position is second best optimum). Vice versa, if the optimal tax characteristic of commodity b is greater than the optimal tax characteristic of the commodity a, thus $\xi = \frac{\partial W}{\partial \tau_b}\frac{\partial \tau_b}{\partial T} > \frac{\partial W}{\partial \tau_a}\frac{\partial \tau_a}{\partial T} = \xi_a$, by a reduction of the tax rate τ_b, such as to reduce by a dollar the revenue, and the simultaneous increase in τ_a, such as to guarantee an extra dollar of revenue, we obtain an increase in the social welfare.

In this way, Gordon obtains the many-good many-consumer Corlett-Hague rule, considering together the efficiency and distributive aspects of the marginal commodity tax reform. In fact, thinking of eq.(40) again in terms of $1/\lambda_j$, we can observe that the differences in the optimal tax characteristics of commodities now depend, apart from the differences in the distributional characteristics of commodities (as in the results obtained by Ahmad and Stern), also on the differences in the marginal propensity to pay commodity taxes out of an increase in the income, and on the compensated wage-elasticity of demand for taxed commodities, keeping in mind the aggregate consumptions in the initial position[25].

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[25]Gordon (1989 a, p. 160) extends his analysis as for as considering the case in which the government besides raising revenue via a uniform commodity tax system, has also a poll tax at its disposal. For a single-consumer economy (or H identical consumer economy) Gordon shows that with commodity taxation initially uniform, switching from indirect taxation to poll taxation will be welfare-improving, irrespective of how large a proportion of revenue is raised via poll tax. Thus, this confirms the result obtained by Atkinson and Stern (1974), according to whom in a single-consumer economy (or H identical consumers) there would be no point in using commodity taxes as all the revenue can be raised via poll taxes. Vice versa, in a many-consumer economy with inelastic labour supply, supposing that there is a certain social aversion to the disparity, such a reform would be the cause of a reduction in social welfare. In fact, with inelastic labour supply, both the tax systems are lump sum. However now, the exclusive emphasis on the

6. Reforms in a differentiated tax rate initial position in a many-consumer economy

We can say, at this point, that the roles of the efficiency and distributive considerations are sufficiently clarified in the case of a uniform initial position.

However we still have to define these roles in a many-consumer economy in the general case of a differentiated tax rate initial position.We can already find a few indications for this case in the essay by Deaton (1987) who, on the lines of previous research in the field of optimal taxation theory, tries to establish the necessary and sufficient conditions for any movement towords uniformity always increasing social wefare. Deaton (1987, pp. 94-100) shows that the following three conditions must be satisfied: *i*) linear Engel curves; *ii*) additive separability between each and every good; *iii*) optimal benefits levels with complete coverage (all consumers receiving an optimal subsidy). As we can see, these are very restrictive conditions. Even more restrictive than those required in the optimal taxation theory so that a uniform structure of commodity tax rates is optimal (or linear Engel curves and separability between commodities and leisure, Deaton, 1979). In short, the result obtained must more than anything be interpreted in a negative sense: as a rule we can exclude that, in a many-consumer economy, movements towards uniformity always guarantee an increase in social welfare[26].

However, in a recent article by Yitzhaki and Thirsk (1990), we can find a new criterion for characterizing, in a many-consumer economy (but still with fixed producer prices), also in the case of differentiated tax rate initial position, marginal commodity tax reforms which are desirable according to virtually all plausible social welfare functions (such, however, as to display a positive and strictly non-increasing marginal social valuation of consumers' income). Clearly the class of desirable tax reforms according to this new principle is larger than the class of strictly Pareto-improving tax reforms characterized by Guesnerie (1977, 1979, 1980). It is not only limited to the directions of marginal tax reforms which consent an increase in the utility of all the consumers, but allows also the possibility of some redistributions to occur (as long as lower income consumers gain more than higher income consumers).

To see the substance of the Yitzhaki-Tirsk analysis, let us consider an infinitesimal increment in the rate of tax levied on the commodity t (the taxed commodity) and a decrement in the rate of tax levied on the commodity s (the subsidized commodity), so as to keep revenue constant.

On the basis of a Bergson-Samuelson social welfare function

$$W = W\left[V^1(q,M^h), \ldots, V^H(q,M^H)\right] \tag{41}$$

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distributives aspects (as we saw in Ahmad and Stern) causes the uniform commodity taxation accompained by a poll tax (or by a linear income tax) to dominate the sole regressive poll tax.

[26]Furthermore Deaton (1987, pp.96-101) is above all interested in showing the trivial results obtained by empirical works when, to obviate the problem of lack of data, the usual restrictions on consumer preferences are resorted to.

Yitzhaki and Thirsk (1990, p.3) suppose that the marginal social valuation of consumer h's income $\beta^h = \frac{\partial W}{\partial V^h}\frac{\partial V^h}{\partial M^h} > 0$, for h=1, ..., H, is declining over the range of observed incomes. So, if $M^h > M^k$, then it must be $\beta^h < \beta^k$. In short, Yitzhaki and Thirsk suppose that, although consumers may differ in taste, there is an identical marginal social valuation of consumer's income for consumers with equal income.

Supposing that producer prices are fixed and normalized at one. Indicating the consumer prices vector with $q = (q_1,...,q_n)$, and excluding the "crazy cases" discussed by Corlett and Hague, the first-order approximation to the change in social welfare function caused by the reform here considered is

$$dW = \sum_h \left(\frac{\partial W}{\partial V^h}\frac{\partial V^h}{\partial q_t} dq_t + \frac{\partial W}{\partial V^h}\frac{\partial V^h}{\partial q_s} dq_s \right). \tag{42}$$

Using Roy's identity, and remembering the definition of β^h, eq.(42) may be rewritten

$$dW = \sum_h -\beta^h \left(x_t^h \, dq_t + x_s^h \, dq_s \right). \tag{43}$$

The commodity tax revenue is

$$T = \sum_i \tau_i X_i \tag{44}$$

where $X_i = \Sigma_h \, x_i^h$ is the aggregate demand for ith commodity and τ_i is the ad valorem tax rate applied to this commodity in the initial position. For a revenue-neutral commodity tax reform must be

$$dT = \left(X_t + \sum_i \tau_i \frac{\partial X_i}{\partial q_t} \right) dq_t + \left(X_s + \sum_i \tau_i \frac{\partial X_i}{\partial q_s} \right) dq_s = 0 \tag{45}$$

Solving eq.(45) with respect to dq_t, we have

$$dq_t = -\alpha \left(\frac{X_s}{X_t} \right) dq_s \tag{46}$$

$$\text{where: } \alpha = \frac{1+\frac{1}{X_s}\sum_i \tau_i \frac{\partial X_i}{\partial q_s}}{1+\frac{1}{X_t}\sum_i \tau_i \frac{\partial X_i}{\partial q_t}}.$$

As we can see, a depends on the differences in total consumptions in the initial position and on the different size of the induced revenue effects attributable to particular commodity tax reforms, due to the degrees of substitution and complementarity which tie the two commodities considered (*t* and *s*) to all the others taxed commodities. So we can define it as the "efficiency parameter" of the particular proposed reform. Interpreting a as the ratio of the social marginal costs of an extra dollar raised via the two commodity taxes considered, according to the Ahmad-Stern definition, we can say that: if $\alpha = 1$, the reform does not have effects from the point of view of efficiency; if $\alpha > 1$, the reform causes a deadweight loss in the economy; and if $\alpha < 1$, it causes a net gain to society.

Substituting eq.(46) into eq.(43), and rearranging terms we obtain the general result of Yitzhaki and Thirsk (1990, p.6)

$$dW = \sum_h -\beta^h \left(\frac{x_s^h}{X_s} - \alpha \frac{x_t^h}{X_t} \right) X_s \; dq_s . \qquad (47)$$

If this expression is positive, the reform here considered guarantees an increase in the Bergson-Samuelson social welfare function.

However, at this point, still following Yitshaki and Thirsk, it is possible to give up the dependence of condition (47) on the system of weights β^h implicit in the Bergson-Samuelson social welfare function. If consumers are ordered according to their welfare, beginning from those with the lowest incomes (therefore, also according to the marginal social valuation of their income), a necessary condition for the considered reform to be desirable according to virtually all plausible social welfare functions, is that for the consumer with the lowest income, who consumes the two commodities *t* and *s*, is

$$\frac{x_s^1}{X_s} - \alpha \frac{x_t^1}{X_t} \geq 0.$$

Otherwise, for example, the reform would not be desirable on the basis of a maxi-min social welfare function which, as is well known, only takes into account the welfare of the poorest consumer. In the same way, for the next poorest consumer it must be

$$\frac{x_s^2}{X_s} - \alpha \frac{x_t^2}{X_t} \geq 0.$$

Now, however, we can observe that whatever plausible social welfare function is adopted (expressing a certain degree of aversion towards inequalities) and even if this next poorest consumer were harmed by the reform, social welfare could be considered increased provided that s

$$\frac{x_s^1 + x_s^2}{X_s} - \alpha \frac{x_t^1 + x_t^2}{X_t} \geq 0.$$

Generalizing this reasoning to all the consumers, we reach the rule of Yitshaki and Thirsk (1990, p.7): a reform consisting of an infinitesimal increment in the rate of tax levied on the commodity *t* (the taxed commodity) and of a decrement in the rate of tax levied on commodity *s* (the subsidized commodity), so as to keep revenue constant, is desirable virtually according to all plausible social welfare function if the following condition is satisfied

$$\sum_{h=1}^{k} \left(\frac{x_s^h}{X_s} - \alpha \frac{x_t^h}{X_t} \right) \geq 0, \quad \text{for } k = 1, 2, \ldots H. \tag{48}$$

Keeping in mind that the terms in the expression contained in parenthesis in eq.(48) can be interpreted as the ordinates of the "concentration curves" of the two commodities considered[27], this rule can be reformulated in the following way: a revenue-neutral reform consisting of an infinitesimal increment in the rate of the tax levied on the commodity *t*, and of a decrement in the rate of the tax levied on commodity *s*, is desirable according to virtually all plausible social welfare functions if the concentration curve of the commodity *t*, whose ordinates are multiplied by the "efficiency parameter" α, lies wholly, throughout the entire range of the cumulative distribution of income, below the concentration curve of the commodity *s*.

If for the two commodities *t* and *s* considered the "efficiency parameter" α were equal to one, the empirical verification of condition (48) could be limited to the comparison of the respective "concentration curves", calculated for example according to the method used by Yitshaki and Thirsk (1990, pp.11-18) in their research applied to the Cote d'Ivoire. If the "concentration curve" calculated for commodity *t* lies wholly below the "concentration curve" calculated for commodity *s*, we can conclude that the commodity tax base t "dominates" the commodity tax base *s*. In the sense that a marginal substitution of taxation from commodity *s* to commodity *t* is desirable according to virtually all plausible social welfare functions (which express some degree of aversion towards inequalities). If the "concentration curves"

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[27]Such "concentration curves" are, in effect, similar to more familiar Lorenz curves except that, instead of total income, they compare the fractions of total consumptions attributable to different income groups, when they are arranged starting with the poorest group, according to the size of their income (Yitzhaki and Thirsk, 1990, p.7).

calculated for the two commodities, instead, intersect, one can always find two plausible social welfare functions which rank the two commodities in contradicting order. There would be less possibility, in this case, of establishing a relationship of welfare dominance between the two commodity tax bases[28].

In theory the simplicity of this result is not substiantially reduced by the consideration of the efficiency effects of the reform. If $\alpha > 1$, so the reform considered causes a dead weight loss, the commodity tax base *t* can never be "welfare dominant" for the commodity tax base *s*. Observing eq.(48) we can see that, at least beginning from a certain cumulative level of consumer incomes, the ordinates of the "concentration curve" of the commodity t, multiplied by $\alpha > 1$, must necessarily become equal and then superior (assuming higher values of the unit before reaching the maximum level of the cumulate income) to the ordinates of the "concentration curve" of commodity *s* (which reach value one in correspondence to the maximum level of the cumulate income). On the contrary, if $\alpha < 1$, the gain we obtain by increasing the tax rate on commodity *t* and reducing the tax rate on commodity *s*, so as to keep the revenue constant, constitutes another argument in favour of the reform which we can add to that based on considerations of a distributive nature[29].

7. Conclusions

In the introduction I have referred to the recent work by Slemrod (1990) to underline the good results obtained by the optimal taxation theory. I think that the same can be said also for the less famous tax reform theory. Moreover, as I underlined several times, the less ambitious aim of this approach and its particular "local" logic, have enabled us to better understand the roles played by the efficiency and distributive considerations for the solutions to actual fiscal problems.

In terms solely of efficiency (resorting to the expedient of a single-consumer economy or H identical consumers), we should not underestimate Hatta's rehabilitation of the traditional "uniform commodity taxation doctrine", compromised at a theoretical level by Ramsey's well known optimal taxation rule. This rule has also been confirmed in the field of tax reform theory thanks to the equally well known result obtained by Corlett and Hague. However, as we have seen, this result is valid only in a uniform initial position. The point of "zero-gravity", in which the pulls towards a differentiation of commodity tax rates (due to the differences in the degree of substitution of uniformally taxed commodities for untaxed leisure) are balanced by the pulls in the opposite direction, towards uniformity (due to the degree of

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[28]Neverthless, the tax reform considered could be desirable according to some particular social welfare function, as the general eq.(47) indicates. It is, however, evident that the examination of this condition necessarily requires the specification of the welfare weights β^h, $\forall$ h.

[29]We can observe that, in this case, thanks to the gain in terms of efficiency the marginal commodity tax reform could be desirable according virtually all plausible social welfare functions, even if it were not so on the basis of just the considerations of a distributive nature.

substitution among the same commodities now differently taxed), should not in practice be very distant from the situation of "uniformity".

The hypothesis of a fixed labour income, on the contrary, permits Ahmad and Stern to isolate the pulls towards the differentiaton in the commodity tax rates which, in a uniform initial position, originate from solely distributive considerations. The differentiation in tax rates must, in this case, follow the differences existing in the distributional characteristics of commodities. Or, supposing that a certain degree of aversion to inequality prevails in the society, in a uniform initial position it is possible to increase social welfare reducing the collection of taxes on commodities which appear in greater proportions in the shopping-bag of the lower income earners, and make up for the loss of tax revenue with an increase in taxes on commodities which typically have higher levels of consumption among higher income earners.

However in reality the labour supply is generally not fixed. As a rule we must expect both the efficiency and distributive considerations to be important. In the case of a uniform initial position, as Gordon (1989 a) shows, it is still possible to obtain some useful indications of the right course to take. Whether a departure from uniformity can increase social welfare depends on the differences in the optimal tax characteristics of commodities. As we have seen, these differences still depend on the differences in the distributional characteristics of commodities, but now they also depend on the differences in the marginal propensity to pay tax out of increments in income, and on the differences in the compensated wage-elasticities of demand for the taxed commodities, given the aggregate consumptions in the initial position. In short, from a uniform initial position, the differentiation in the tax rates must follow the pulls caused by efficiency considerations and those of distributive nature, in a more complicated way[30].

On the whole, it seems that we have still to establish the possibility of obtaining in theory some useful indication concerning the direction of desirable reforms in the case of a differentiated tax rates structure in the inital position. At the present stage of research, there is no general answer to this question. However, the works of characterization of tax reforms which are strictly Pareto-improving (Guesnerie, 1977), or increasing a Bergson-Samuelson social welfare function (Diewert, 1978; Dixit, 1979, Yitzhaki and Thirsk, 1990), or desirable according to virtually all plausible social welfare functions (Yitzhaki and Thirsk, 1990), have

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[30]Of course, the problem becomes even more complicated if the cost of administration and implementation of the commodity taxes are also taken into consideration. In a recent article on tax reform via commodity grouping, Gordon (1989 b) points out that these costs restrict, in practice, the possibility of an extreme differentiation in commodity tax rates (as it is usually assumed in theory). So, still starting from a uniform initial position, he determines the conditions for the existence of the directions of the tax reforms which increase social welfare, as long as the number of the tax rates is inferior to the number of the commodities (for which it is necessary to group such commodities togheter so as to subject them to a common tax rate). In short, the rule proposed by Gordon (1989 b, pp 72-77) to form such groupings take into consideration the "connections" existing among the optimal tax characteristics of the commodities (therefore, the existing similitudes in their distributional characteristics, in the aggregate consumption models, and in the compensated wage-elasticities of demands for these commodities).

permitted us to individualise the marginal conditions to submit to empirical verification. In particular, the simplicity of the marginal conditions determined by Guesnerie and recently by Yitzhaki and Thirsk, effectively allows us to be less pessimistic about the possibility of their application than about the possibility of application of the results of the optimal taxation theory.

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THE FISCAL SYSTEM AND THE DYNAMIC REDISTRIBUTION OF INCOME

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1. Introduction

The design of an optimal fiscal system involves the careful analysis of the efficiency and equity implications of the various alternative policies. The focus of our analysis will be the equity implications of the redistribution of income, resulting from the operation of the fiscal system. The net fiscal system operates through the joint system of taxes and benefits. The measurement of the distributional impact of the net fiscal system is a topic of substantial political and theoretical interest.

There exists a considerable literature, reviewed in Lambert (1989), which analyzes the equity implications of the redistribution of income resulting from the operation of the fiscal system. Since Atkinson's (1970) seminal paper on inequality measurement, many researchers have considered in detail the relationship between society's income distribution and the welfare of the individuals. Papers by Dasgupta, Sen and Starrett (1973), Rothschild and Stiglitz (1973), Shorrocks (1983) and Dardanoni and Lambert (1988) provide conditions for the welfare ranking of the set of income distributions under consideration.

When the income distributions to be ranked have the same mean income, the welfare ranking involves the comparison of their Lorenz curves. In this case, Atkinson's theorem states that inequality comparisons are without much normative significance when the Lorenz curves of two income distributions cross. Therefore, numerous authors have investigated the welfare effect of the fiscal system by considering the relationship between the Lorenz curves of the pre-fiscal (i.e. before taxes and benefits) and post-fiscal income distributions. This literature, stemming from the seminal Jacobbson/Kakwani result on the relationship between Lorenz dominance and income tax progressivity, is admirably reviewed in Lambert (1989).

The theoretical and empirical interest of this literature cannot be doubted. However, it has been pointed out (e.g. Kanbur and Stromberg, 1988) that these results refer to "static" comparisons of income distributions; Hart (1980), for example contrasts a "snapshot" income distribution at a given period with a "movie" of the income distribution changing over time.

This paper will consider two aspects of the dynamic welfare ranking of income distributions. After introducing the formal framework to be employed in the analysis in Section 2, Section 3 will consider the dynamic effect of the redistribution of income resulting from the operation of the fiscal system. The analysis is motivated by the belief that static inequality studies pay excessive attention to "snapshots" of the existing income distribution, while a better measure of the opportunities faced by the individuals in society should be

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based on lifetime earnings. Therefore, the distribution of lifetime discounted income (i.e. permanent income) should be the focus of interest for the policy analysis of the welfare effect of the fiscal system. The question considered in Section 3 will be the following: consider a fiscal policy that results in the welfare dominance of the "static" one period post-fiscal distribution over the pre-fiscal one; under which conditions will this imply that the "lifetime" post-fiscal income distribution is also welfare superior to the pre-fiscal one?

Section 4 will consider the effect of social mobility on society's welfare. In an oft quoted passage, Friedman (1962) argued: "Consider two societies that have the same annual distribution of income. In one there is great mobility and change so that the positions of particular families in the income hierarchy varies widely from year to year. In the other there is great rigidity so that each family stays in the same position year after year. The one kind of inequality is a sign of dynamic change, social mobility, equality of opportunity; the other, of a status society. The confusion between the two kinds of inequality is particularly important because competitive free enterprise capitalism tends to substitute the one for the other". In Section 4 we will argue that a proper analysis of the equity implications of different fiscal policies should consider in detail the effect of social mobility on society's welfare. It will be argued that the analysis of the effect of different fiscal policies on the static income distribution should be complemented by the consideration of the welfare effect of social mobility and equality of opportunity. Our aim is to derive a ranking of different social mobility structures with respect to a class of S.W.F. A simple algorithm for the ranking of social mobility mechanisms will be derived, similar in spirit to the Lorenz curve ordering in the static case. Section 5 will contain an empirical application of the derived results using data on social mobility for the U.K. and U.S.A. Concluding remarks are given in Section 6. A more detailed theoretical analysis of the issues treated in this paper is contained in Dardanoni (1991 a,b).

2. The formal framework

Consider a discrete Markov chain of income mobility, and assume there are n income states. Let $P = \| p_{ij} \|$ such that $p_{ij} \geq 0$ and $\sum_j p_{ij} = 1$ for each i be the (nxn) transition matrix, assumed regular (meaning that, for large enough k, P^k is strictly positive), so that the equilibrium probability vector π exists and is the unique solution to $\pi' = \pi'P$. The element p_{ij} is the probability that an individual in state i will be in state j in the following period. We assume that transitions are independent across individuals, and P is constant over time. We let $y' = (y_1, y_2, \ldots, y_n)$ denote a vector whose components denote income in state i = 1,2,...,n, and we adopt the convention that income states are ordered from worst to best, so that $y_1 \leq y_2 \leq \ldots \leq y_n$. The equilibrium distribution of income is the pair (π, y); in equilibrium an individual chosen at random will have income y_i with probability π_i.

For a given regular transition matrix P, we may derive the implied distribution of expected lifetime income for the individuals in a society whose mobility is governed by P and is in a steady state. Consider a society consisting of identical individuals who are born simultaneously and live exactly for T periods. The transition mechanism may be either

intragenerational or intergenerational; in the latter case we may think of the individuals as dynasties. Let $Y^P = (Y_1, Y_2, ..., Y_n)'$ denote a (nx1) vector of expected discounted lifetime incomes, where the typical element Y_i denotes the expected lifetime discounted income of an individual who starts life in income class i, and is given by the i-th element of the vector $Y^P = y + \rho Py + \rho^2 P^2 y + ... + \rho^T P^T y$, where $0<\rho<1$ denotes the discount factor. Y^P will generally depend on the vector y, on the transition matrix P, on the discount factor ρ and on the time period T. Letting $T \rightarrow \infty$, then we have $Y^P = [I - \rho P]^{-1} y$. To simplify notation, we will normalize Y^P as $Y^P = (1 - \rho)[I - \rho P]^{-1} y$ and denote $(1 - \rho)[I - \rho P]^{-1}$ as $P(\rho)$, which is a stochastic matrix, whose typical element $p_{ij}(\rho)$ may be interpreted as the average discounted "lifetime" probability of moving from the initial state i to state j.

A transition matrix is called *monotone* if each row stochastically dominates the row above it. Monotone mobility matrices are defined and analyzed in Keilson and Kester (1977) and Conlisk (1990). In an intergenerational mobility context, a monotone mobility matrix implies that each child at time t is better off, in terms of stochastic dominance, by having a parent from state i+1 than by having a parent from state i. In an intragenerational mobility context, monotonicity implies that an individual who at time t is in class i+1 faces a better lottery, in terms of stochastic dominance, than an individual in class i. If we let f be a (nx1) vector it may be shown that Pf is nondecreasing for all nondecreasing f if and only if P is monotone; and, given that $P(\rho)$ is monotone when P is monotone, it follows that under a monotone chain the expected lifetime utility vector will be nondecreasing. As argued by Conlisk (1990), monotonicity is an ideal assumption to impose on a Markov chain of social mobility, being theoretically plausible and empirically supported. Monotone transition matrices posses several simplifying mathematical properties, reviewed by Keilson and Kester (1977) and Conlisk (1990); and estimated transition matrices are either exactly monotone or within sampling errors from being monotone. Thus, it makes sense to restrict our attention to monotone matrices.

The *reverse Markov chain* for an ergodic Markov chain with transition matrix P and equilibrium vector π is a Markov chain with transition matrix given by $\Pi^{-1} P' \Pi$, where Π denotes the diagonal matrix having π in the diagonal. The typical element of a transition matrix for the reverse Markov chain gives the probability that an individual who is in class i at time t came from class j in the previous period. If the backward and forward transition matrices are equal, i.e. if $P = \Pi^{-1} P' \Pi$, the process in equilibrium will appear the same looked at backwards as forwards: in this case we call the chain *time reversible*. Reverse Markov chains and time reversibility are considered in details in Kemeny and Snell (1976).

The one period Lorenz curve will have horizontal coordinates given by $\pi 1$, $\pi_1 + \pi_2$, ..., $\pi_1 + \pi_2 + ... + \pi_i$, ..., 1, while the vertical coordinates are given by $[\pi_1 y_1, \pi_1 y_1 + \pi_2 y_2$, ..., $\pi_1 y_1 + \pi_2 y_2 + ... + \pi_i y_i$, ..., $\pi' y]/\pi' y$; Note that the "permanent income" vector Y^P is nondecreasing when P is monotone; thus the "permanent income" Lorenz curve has horizontal coordinates given by $\pi 1$, $\pi_1 + \pi_2$, ..., $\pi_1 + \pi_2 + ... + \pi_i$, ..., 1 and vertical coordinates given by $[\pi_1 Y^P_1, \pi_1 Y^P_1 + \pi_2 Y^P_2$, ..., $\pi_1 Y^P_1 + \pi_2 Y^P_2 + ... + \pi_i Y^P_i$, ..., $\pi' Y^P]/\pi' Y^P$.

Before stating our results, we need to define the summation matrix T that will be crucial in the derivation of much of what follows: T will denote the (nxn) upper triangular matrix with zeros below the main diagonal and ones elsewhere. The inverse T^{-1} has ones on the main

diagonal, minus ones on the first superdiagonal and zeros elsewhere. The transpose T' will be lower triangular, and its inverse $(T')^{-1}$ has ones on the main diagonal, minus ones on the first subdiagonal and zeros elsewhere. Note that postmultiplying P by T transforms each row to a cumulative density, premultiplying P by T' takes the cumulative sum of each column, and premultiplying a (nx1) vector y by T^{-1} differences the elements of y. Use of the summation matrix T implies the possibility of writing many of our definitions and results compactly: for example, the condition that P is monotone can be written as $T^{-1}PT \geq 0$ and, given two income state vectors x and y with equal average income (i.e. satisfying $\pi'x = \pi'y$), the condition that the Lorenz curve for x lies nowhere below that for y (i.e. "y Lorenz dominates x") may be written as $T'\prod x \geq T'\prod y$. Here and hereafter, when an inequality symbol involves matrices or vectors, we mean that the inequality is satisfied elementwise.

Having set the main framework to be employed in the analysis, we now turn our attention to the two intertemporal distribution issues discussed in the Introduction.

3. The dynamic analysis of the welfare effects of the redistribution of income

As argued in the Introduction, the distribution of lifetime discounted income is a more policy relevant concept than the "snapshot" distribution of income for welfare analyses. To see the possible relevance of this distinction, consider the following example: assume there are four income classes in the society with equal number of individuals in each class. Assume that in this society the income tax and benefits system is such that the post-fiscal income distribution Lorenz dominates the pre-fiscal one. For example, let gross income (or pre-fiscal income) equal the vector y = (10,80,100,400), and assume that the post-fiscal net income distribution (after taxation and benefits) equals the vector x = (40,50,100,400) so that the Lorenz domination condition is satisfied and average income is not changed by the fiscal policy.

Let the transition mechanism be determined by a transition matrix P:

$$P = \begin{bmatrix} .25 & .75 & 0 & 0 \\ .25 & .25 & .2 & .3 \\ .25 & 0 & .45 & .3 \\ .25 & 0 & .35 & .4 \end{bmatrix}$$

where, for example, the element p_{23} denotes the probability that an individual who at time t is in income class 2 will be in income class 3 in the following period. Note that P possesses the simplifying "bistochastic" property, i.e. every column sums to one, so that in equilibrium there will be an equal number of individuals in each income state. Note also that the matrix is monotone. The distribution of "pre-fiscal permanent income" and "post-fiscal permanent income" may be easily calculated by the formulae $Y^P = (1 - \rho)[I - \rho P]^{-1}y$ and $X^P = (1 - \rho)[I - \rho P]^{-1}x$ respectively. Assuming a discount rate $\rho = .8$, we obtain Y^P = (105,136.6,141.6,206.8) and X^P = (108,130.6,143.1,208.3). Thus, under the transition matrix P, though each period the "static" post-fiscal income distribution Lorenz dominates the

pre-fiscal one, it can easily be calculated that the *lifetime* post-fiscal permanent income distribution does not Lorenz dominate the pre-fiscal one. In other words, there will be some inequality indices that will imply that lifetime inequality is actually increased by the tax design. For example, the Gini coefficient for Y^P equals .176, which is less than the Gini coefficient for X^P, which equals .179. This implies among other things that the government's effort to reduce income inequality with a proper tax design has resulted in an increase in the inequality of lifetime opportunities for the individual in this society, as measured by the Gini coefficient.

It is of interest, then, to consider under which conditions this paradoxical effect of redistributive income taxation does not take place. This is considered in the following:

THEOREM 1: Let P be a monotone regular transition matrix with equilibrium vector π. The following conditions are equivalent:

The post-fiscal permanent income distribution Lorenz dominates the pre-fiscal permanent income distribution for all "single period" post-fiscal vectors whose Lorenz curve lies nowhere below that of the pre-fiscal one, given any discount factor $\rho\varepsilon[0,1)$; (1)

The lifetime transition matrix for the reverse Markov chain is monotone. (2)

PROOF.

[2 implies 1]. Condition 1 may be written as $T'\prod P(\rho)y \geq T'\prod P(\rho)x$ for any y and x such that $T'\prod y \geq T'\prod x$ and $\pi'y = \pi'x$ and for any $\rho\varepsilon[0,1)$. Condition 1.2 may be written as $T^{-1}\prod^{-1}P'(\rho)\prod T \geq 0$, which is equivalent to $T'\prod P(\rho)\prod^{-1}(T^{-1})' \geq 0$. But this implies $T'\prod P(\rho)[y - x] = T'\prod P(\rho)\prod^{-1}(T^{-1})'T'\prod[y - x] \geq 0$ when $T'\prod[y - x] \geq 0$.

[1 implies 1]: We argue by contradiction: Assume the (i,j)th element of $T^{-1}\prod^{-1}P'(\rho)\prod T$ is negative; taking the transpose, this implies that the (j,i)th element of $T'\prod P\prod^{-1}(T^{-1})'$ is negative. Then choose all the elements of x (except the elements i and i+1) equal to y, and let $x_i = y_i - \kappa/\pi_i$ and $x_{i+1} = y_{i+1} + \kappa/\pi_{i+1}$, with κ being a positive constant which does not rearrange the x vector. Then $T'\prod[y - x]$ equals a vector with all elements except the ith equal to zero, while the ith element equals $\kappa > 0$. But this implies that the jth element of $T'\prod P(\rho)[y - x] = T'\prod P(\rho)\prod^{-1}(T^{-1})'T'\prod[y - x]$ is negative, a contradiction. Q.E.D.

A necessary and sufficient condition for ensuring that a "static" reduction in inequality will imply a reduction in lifetime inequality is that the transition matrix for reverse Markov chain is monotone. Intuitively, this means that the "lifetime" lottery that a person in class i has faced dominates, in terms of stochastic dominance, the lottery that has been faced by an individual in class i-1. This seems intuitively plausible; note also that a monotone time reversible Markov chain will trivially have a monotone lifetime reverse transition matrix.

The condition of the Theorem is easy to verify in practice, involving only simple matrix manipulations; thus it should be of considerable aid in formulating a proper tax design which takes account of the dynamic aspect of income inequality as well as the purely static one.

4. Intertemporal fairness and income mobility

4.1. THE FRACTILE CASE

As argued in the Introduction, concentrating on the "static" income distribution to evaluate the welfare implications of different proposed tax schemes may have misleading implications. For example, consider two societies with identical "single period" Lorenz curves, but with differing transition matrices, so that the composition of people in each income state is different every time period. However, under the identity transition matrix each individual in the population stays in the same income group as in the initial situation; on the other hand, if transition is governed by a matrix in which each entry equals to 1/n, each individual will have the same probability of belonging to any of the n income groups regardless of the initial state. Therefore, though the equilibrium ex-post Lorenz curves associated with each of these matrices will look identical each period, social welfare may well be considered different if we take account of "past history" in terms of the earlier position of each individual.

The welfare measurement of social mobility should be an important tool for the design of an optimal fiscal system. Abandoning the restrictive static assumption usually made in this kind of analysis, one wants to consider the extent of intertemporal fairness and equality of opportunity to have a fuller view on the equity implications of the fiscal system. For example, the policy maker may consider a given measured "static" income inequality differently according to the extent of intertemporal social mobility. Moreover, many fiscal measures (e.g. estate taxation) alter the intergenerational mobility among income classes, and the structure of the tax/benefit system may alter the extent of intragenerational income mobility.

To analyze the welfare effect of social mobility, we will consider now the lifetime welfare prospects of the individuals who live in a society governed by a Markov chain of the type considered above. Our first step will be to derive a vector of lifetime expected welfares, similarly to the "permanent income" vector above. Let $u = (u_1,u_2,...,u_n)'$ denote a (nx1) vector of instantaneous utilities, where u_i denotes the utility value of income state i, and $V^P = (V_1,V_2,...,V_n)'$ denote a (nx1) vector of expected discounted lifetime utilities, where the typical element V_i denotes the expected lifetime discounted utility of an individual who starts a life in income class i, and will be given by the i-th element of the vector $V^P = u + \rho Pu + \rho^2P^2u +....+ \rho^TP^Tu$. Analogously to the "permanent income" vector Y^P, we let $T \rightarrow \infty$ and normalize V^P as $V^P = P(\rho)u$.

Suppose now we want to rank transition matrices according to a real valued S.W.F. defined on the vector of lifetime expected utilities V^P. Note that under the stated assumptions the distribution of individuals in each state will be given by the equilibrium vector π, with the typical element π_i indicating the proportion of people in income state i; therefore, different mobility matrices influence social welfare because of the differences in the implied equilibrium income distributions. This is what sociologists call "structural mobility", and is related to the idea that different mobility structures may imply a change in the availability of

positions in higher income classes [2]. However, mobility influences social welfare also through its influence on the intertemporal movement of individuals among the different social classes, given the same equilibrium distribution of the number of individuals in each class; this latter effect is defined by sociologists as "exchange" or "pure" mobility.

To isolate the pure mobility effect, it is often suggested to consider the *fractile* Markov chain (e.g. Geweke, Marshall and Zarkin, 1986 and Kanbur and Stiglitz, 1986). A Markov chain is fractile if for all t and all i = 1,2,...n we have $\pi_i(t) = n^{-1}$. This implies that the transition matrix will possess the bistochastic property, so that column (as well as row) sums are unity. Letting 1 denote the (nx1) vector of ones, we have 1'P = 1' and P1=1. An individual who at time t is in state i may be considered as being in the poorest ith fractile of the population.

Given two bistochastic transition matrices P and Q with identical spot income distribution but different expected lifetime welfare vectors V^P and V^Q, how can we decide which society displays a higher level of social welfare? As a natural starting point, consider the welfare ranking that corresponds to the class of symmetric and additively separable (i.e. linear) S.W.F. $W(V^P) = \sum_i V^P{}_i$ which adds up, for a given u and ρ, the expected lifetime utility of the individuals in the population under the transition matrix P. Given the bistochastic assumption, we have assumed there is one representative individual in each income state. This S.W.F. is equivalent to that employed in Atkinson's (1970) seminal paper on the inequality ranking of static income distributions. Noting that $P(\rho)$ and $Q(\rho)$ are both bistochastic, we have $W(V^P) = 1'V^P = 1'P(\rho)u = 1'u = 1'Q(\rho)u = 1'V^Q = W(V^Q)$, so that given a vector of instantaneous utilities u and a discount factor ρ, any bistochastic transition matrix will be ranked indifferent by the symmetric additively separable S.W.F.'s.

This result, which is also contained in Atkinson (1983) and Kanbur and Stiglitz (1986), may at first be surprising. However, as Atkinson explains, it must be remembered that we are ranking here not mobility as such, but the social welfare implications of each mobility matrix. The symmetric additive social welfare functional implies that movement between income states is irrelevant, and what counts is the spot distribution at each period. As Kanbur and Stiglitz put it, the assumptions of additivity[3] of the S.W.F. and additive separable lifetime welfares remove any influence that exchange mobility may have on intertemporal social welfare.

The above example is similar to Diamond's (1967) example on the fairness of utilitarianism under uncertainty. In fact, additive S.W.F.'s are often criticized for not taking enough account of fairness considerations. Still, it is our opinion that most of the critiques of the "utilitarian" S.W.F. are based on failures of the symmetry assumption, and not of linearity

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[2]Kanbur and Stromberg (1988) derive sufficient conditions under which the steady state income distribution of one transition mechanism Lorenz dominates the steady state distribution of another mechanism, and Dardanoni (1991,a) derives analogous sufficient conditions for first order dominance under monotone transition matrices.

[3] Actually, Kanbur and Stiglitz's (1986, p.11) wording of the proposition is, strictly speaking, not correct, because they refer to S.W.F. which is additive across expected welfares, without mentioning symmetry. As we will see, when symmetry is dropped the result does not hold.

per se. For example, it may be argued that both Diamond's (1967) and Sen's (1973, pp.16-18) examples of the "unfairness" of utilitarian rules may be recast as to critiques of the symmetry assumption[4].

In our context, it may be argued that the perception of fairness associated with each transition matrix does indeed come from rejection of the symmetry of the S.W.F. Under the stated assumptions, the Lorenz curve of the distribution of income will look identical each period under any bistochastic transition matrix, so that any (linear or not) symmetric ex-post S.W.F. defined on the vector of realized utilities will rank the bistochastic matrices indifferent. Yet, under different transition matrices the composition of people in each income state will be different each time period. Therefore, as argued before, though the equilibrium ex-post Lorenz curves associated with each of these matrices will look identical each period, social welfare may well be considered different if we take account of "past history" in terms of the earlier position of each individual.

In the light of these remarks, our proposal is to keep the linearity of the S.W.F., but abandon the symmetry assumption. The symmetry assumption is indeed employed in the literature on ranking "spot" income distributions to guarantee that all individuals in the society are treated equal despite their "labelling", so that the symmetry assumption is also referred to as the anonymity assumption. However, in this dynamic context there is a natural "label" to attach to each individual, namely their starting position in the income ranking. Thus, our specified S.W.F. will be a weighted sum of the expected welfares of the individuals, with greater weights to the individuals who start with a lower position in the society, $W(V^P) = \sum_i \lambda_i V^P{}_i$, where $\lambda = (\lambda_1, \lambda_2, .., \lambda_n)$ denotes a (nx1) nonincreasing nonnegative vector of weights.

The asymmetric treatment obviously corrects for the fact that some individuals start at a lower position. Yet, this makes sense only if it is a disadvantage to start at a lower position. Without any restriction on the mobility matrices, this is not necessarily a disadvantage. There could be a transition matrix such that the lowest states are the preferred starting point in terms of lifetime expected utility. To rationalize our asymmetry assumption, we will consider again the case where the transition matrices are monotone. As argued above, this assumption is empirically supported and theoretically plausible.

If the asymmetric linear S.W.F. with declining weights is adopted for the welfare ranking of the transition matrices, the immediate problem is to decide which is the "right" vector of weights λ. For example, two extreme asymmetric linear S.W.F.'s are found by letting $\lambda_1 = 1$ and $\lambda_i = 0$ for all $i > 1$, which has a somewhat "Rawlsian" flavor; or letting $\lambda_i = 1$ for all i, which of course is the symmetric case. Analogously to the literature on static ranking of income distributions, our aim will be to seek necessary and sufficient conditions on transition matrices for the unanimous ranking of $\sum_i \lambda_i V^P{}_i$ for all nonincreasing positive λ.

We may now state the following:

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[4] See also Harsanyi (1975), Hammond (1983) and Broome (1984) for discussions of the fairness of utilitarian rules under uncertainty.

THEOREM 2: Let P and Q be two bistochastic monotone transition matrices. The following conditions are equivalent:

$$\lambda'P(\rho)u \geq \lambda'Q(\rho)u \text{ for all nonincreasing } \lambda \text{ and nondecreasing } u; \quad (3)$$
$$T'[P(\rho) - Q(\rho)]T \leq 0. \quad (4)$$

PROOF. [3 implies 4] Consider the obvious identity $\lambda'[P(\rho) - Q(\rho)]u = \lambda'(T')^{-1}T'[P(\rho) - Q(\rho)]TT^{-1}u$; then the result follows noting that: i) the last column of $T'[P(\rho) - Q(\rho)]T$ equals the zero vector; ii) λ nonincreasing is equivalent to $\lambda'(T')^{-1} \geq 0$; iii) u nondecreasing is equivalent to the first n-1 elements of $T^{-1}u \leq 0$.
[4 implies 3] Assume the (i,j)-th element of $(T')[P(\rho) - Q(\rho)]T$ is positive. Then choose λ_i = (1,1,...,1,0,.0), u_j = (0,0,...,0,1,.,1) so that λ'_iT^{-1} equals the i-th unit vector and $-T^{-1}u_j$ equals the j-th unit vector, and we obtain the desired contradiction. Q.E.D.

Condition (4) requires the comparison of each element of the cumulative sum of the two matrices, where the cumulative sum is taken from the top left element. When the condition is satisfied, then the "lifetime" transition matrix P(ρ) displays more mobility than Q(ρ) in the following sense: the cumulative probability that an individual who starts in class k or lower will stay in "lifetime" class j or lower is greater under Q(ρ) for all k and j.

If we restrict our attention to monotone bistochastic mobility matrices in steady state and assume that lifetime welfare is reflected by the discounted expected utility, then when condition (4) is satisfied we may deduce that social welfare is superior under the mobility matrix P for any additive asymmetric S.W.F. that gives greater weights to the individuals who start at a lower position in the society. Conversely, if we agree that the social welfare function should belong to the above class, without agreeing on its precise form, then to say that social welfare is higher under the matrix P than under Q implies that P and Q stand in the relation given by (4).

The above necessary and sufficient condition is in effect a first order stochastic dominance result, and may be considered an infinite horizon equivalent to the Atkinson's (1983) ordering of transition matrices for a two period society. Stochastic dominance rules specify unanimous preference for a given class of S.W.F., and, by considering different classes of S.W.F.'s, alternative stochastic dominance concepts may be obtained that imply a trade-off between the hypothesis on the class of admissible S.W.F.'s and the strength of the conditions on the mobility matrices.

It is of course of immediate interest to consider the rankings implied by different classes of S.W.F.'s. A weaker class than the one considered above is analyzed by Kanbur and Stiglitz (1986), where a bistochastic matrix P is preferred to Q if and only if $W(V^P) \geq W(V^Q)$ for all symmetric and quasi-concave real valued W(.) and all utility vectors u. Under monotonicity, the ranking implied by the Kanbur and Stiglitz class is equivalent to the ranking of our additive asymmetric class when it is not required that the utility vector be nondecreasing[5].

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[5]This may be shown by noting, following Conlisk (1989), that the Kanbur and Stiglitz condition is equivalent to $T'[P(r) - Q(r)]u \geq 0$ for all u; if we insist that u be nondecreasing we get our condition 4

Given that our class considers only a subset of all vectors u (i.e., only those nondecreasing), our class is more restrictive and therefore our condition (4) is weaker than Kanbur and Stiglitz's. However, it seems natural to insist on the unanimous preference of only nondecreasing vectors u, and thus it may be argued that we have obtained a finer partial order at almost no cost.

A more interesting possibility is to consider a subset of our S.W.F. class, so to obtain a less stringent partial order. Following the literature on the welfare measurement of income inequality, a natural subset of the additive asymmetric S.W.F. with nonincreasing weights is obtained by considering those S.W.F.'s which: i) satisfy Kolm's (1976) "principle of diminishing transfer", that, in our setting, implies that greater weight is given to greater mobility at the lower income levels so that the system of weights is decreasing at an increasing rate; and ii) insist that the utility vector u should increase at a decreasing rate. Our next theorem will seek the conditions on the transition matrices which insure unanimous preference by all S.W.F.'s in this class:

THEOREM 3: Let P and Q be two bistochastic monotone transition matrices. Then the following conditions are equivalent:

$\lambda'P(\rho)u \geq \lambda'Q(\rho)u$ for all nonincreasing λ with $\lambda'(T')^{-1}$ nondecreasing and nondecreasing u with uT^{-1} nonincreasing; (5)

$(T')^2[P(\rho) - Q(\rho)]T^2 \leq 0$. (6)

PROOF. [5 implies 6] Consider the following identity: $\lambda'[P(\rho) - Q(\rho)]u = \lambda'(T')^{-2}(T')^2[P(\rho) - Q(\rho)]T^2T^{-2}u$ and note that: (i) the last two rows of $(T')^2[P(\rho) - Q(\rho)]T^2$ are equal to each other; (ii) the last two columns of $(T')^2[P(\rho) - Q(\rho)]T^2$ are equal to each other; (iii) the sum of the last two elements of $\lambda'(T')^{-2}$ equals $(\lambda_{n-1}-\lambda_n) \geq 0$ and the sum of the last two elements of $T^{-2}u$ equals $(u_{n-1}-u_n) \leq 0$; (iv) the first n-2 elements of $\lambda'(T')^{-2}$ are nonnegative and the first n-2 elements of $T^{-2}u$ are nonpositive.

[6 implies 5] Assume that the (i,j)-th element of $(T')^2[P(\rho) - Q(\rho)]T^2$ is positive. Then choose $\lambda_i = (i,i-1,.,1,0,.0)$ and $u_j = (-j,-j+1,...,0,..0)$ so that $\lambda'_i(T')^{-2}$ equals the i-th unit vector and $-T^{-2}u_j$ equals the j-th unit vector, and we obtain the desired contradiction. Q.E.D.

By imposing further restrictions on the admissible class of S.W.F.'s, the above Theorem provides a broader condition for unanimous ranking of transition matrices. In effect, condition (6) resembles the second order stochastic dominance result for the bivariate case, and may be compared with Atkinson's (1983) results for the case of two-period societies. However, while in the two-period case the condition requires restrictions on the sign of third and fourth order cross partial derivatives of the two-argument utility function of the representative individual, the advantage of this formulation is the reasonableness of the joint restriction that the system of weights should satisfy Kolm's principle of diminishing transfers and the utility vector should decrease at an increasing rate.

4.2. THE NON-FRACTILE CASE

We consider now societies which follows non-fractile Markov chains, in that the transition matrices are not bistochastic, and do not necessarily have an equal equilibrium probability vector. In this case, different welfare in the societies will result both from the exchange of relative positions, and from the number of available positions in the society over time. Assume we want to rank the implied welfare of two regular transition matrices P and P* with respective equilibrium probability vectors π and π^*. We will show how to derive a welfare ranking of P and P* in the steady state case.

Consider first the case where $\pi = \pi^*$, so the two societies display the same unchanging "spot" income distribution over time. Let $\prod$ denote the (nxn) diagonal matrices with π on the diagonal. Following Kemeny and Snell (1976), we may call $\prod P(\rho)$ the "lifetime exchange matrix". $\prod P(\rho)$ arrays the equilibrium joint density of initial state and "lifetime" state, and their typical element gives the probability of the event (starting position in i, lifetime position in j); note that $\prod P(\rho)$ and $\prod P^*(\rho)$ have the same marginal distributions. In this case, it is not difficult to show that, as in Theorem 2, P will imply greater welfare for the linear asymmetric class of S.W.F.'s if and only if $T'[\prod P(\rho) - \prod P^*(\rho)]T \leq 0$; and the weaker partial ordering considered in Theorem 3 can be written as $(T')^2[\prod P(\rho) - \prod P^*(\rho)T^2 \leq 0$.

When π differs from π^*, both "structural" and "exchange" mobility will influence social welfare. In this case, assume there are $m > n$ individuals living in society P, with n/m integer. We can imagine that the Markov chain (π,P) has been obtained by partitioning the underlying income distribution according to "absolute" income classes. Our approach will be to obtain a new Markov chain with states partitioned according to "relative" income classes.

Consider the (π,P) Markov chain, assumed in steady state. Let $n_i = \pi_i m$ denote the number of individuals in class i according to the "absolute" partition of the income distribution. An "expanded" Markov chain may be created as follows: expand each state i in n_i equal states, and assume that each of the n_i individual in class i faces the same probability p_{ij} to move to class j in the following period. Then the "expanded" bistochastic (mxm) transition matrix $\hat{P}$ is given by

$$\hat{P} = \begin{bmatrix} \hat{P}_{11} & \hat{P}_{12} & . \\ \hat{P}_{21} & . & . \\ . & . & \hat{P}_{nn} \end{bmatrix}$$

where $\hat{P}_{ij}$ denotes the $(n_i x n_j)$ matrix with all elements equal to p_{ij}/n_j.

To obtain a "relative" definition of the income states, we partition the states of the expanded Markov chain $\hat{P}$ into n equal classes. Using standard theory of "lumped" Markov chains (e.g. Kemeny and Snell, 1976), we let U denote the (nxm) matrix whose ith row is the probability vector having (n/m) for the states in i, and 0 for the remaining states and let V be the (nxm) matrix with the jth column a vector with 1's in the components corresponding to states in j and 0 otherwise. The (nxn) transition matrix for this "relative" lumped Markov chain, denoted P_r, is then given by $P_r = U\hat{P}V$. Note that P_r is a bistochastic matrix: this can be seen by premultiplying P_r by 1' to get $1'P_r = 1'U\hat{P}V = n^{-1}1'\hat{P}V = n^{-1}1'V = 1'$.

Given an estimated non fractile transition matrix, under the steady state assumption it is easy to derive a bistochastic transition matrix which considers the relative interchange of positions in society. Our focus on income related differences of opportunities justifies deriving the "relative" bistochastic matrix, and then employing the partial orders considered in section 4.1.

5. Empirical application

In this section we will illustrate the results for the fractile and non-fractile models by employing data on mobility matrices taken from Atkinson (1980) (fractile case), and from Featherman and Hauser's (1978) national surveys of intergenerational occupational mobility in the U.S.A. (non-fractile case). It is worth stressing that the analysis is carried out as an illustration of the theoretical results and not as a fully fledged empirical study of income mobility.

5.1. THE FRACTILE CASE

Consider the matrices A and B, taken from Atkinson :

$$A = \begin{bmatrix} .44 & .23 & .19 & .14 \\ .32 & .26 & .25 & .17 \\ .18 & .36 & .27 & .19 \\ .06 & .15 & .29 & .50 \end{bmatrix}; \quad B = \begin{bmatrix} .48 & .42 & .10 & 0 \\ .25 & .34 & .27 & .14 \\ .19 & .17 & .37 & .27 \\ .08 & .07 & .26 & .59 \end{bmatrix}$$

where A is a father to son, quartile to quartile transition matrix for hourly earnings in U.K., and B is a father to son occupational mobility matrix derived from Goldthorpe (1980) by grouping the original seven classes into four and adjusting each column to enforce bistochasticity. Both A and B are monotone, as expected.

According to Kanbur and Stiglitz's criterion, a transition matrix P is welfare superior to P* for a given discount factor ρ if and only if there exists a bistochastic matrix R such that $P(\rho) = RP^*(\rho)$. The condition may be readily applied by considering the matrix $P(\rho)[P^*(\rho)]^{-1}$ whose rows and columns sum to one, and checking that each element is non-negative. Letting $\rho = 0.75$ we have:

$$B(.75)[A(.75)]^{-1} = \begin{bmatrix} 1.02 & .24 & -.09 & -.17 \\ -.06 & 1.07 & .02 & -.03 \\ .01 & 1.07 & .02 & -.03 \\ .01 & -.17 & 1.08 & .08 \\ .03 & -.14 & -.02 & 1.13 \end{bmatrix}; \quad A(.75)[B(.75)]^{-1} = \begin{bmatrix} .93 & -.15 & .08 & .14 \\ .05 & .93 & -.17 & .03 \\ .02 & .14 & .92 & .08 \\ .01 & .07 & .02 & .91 \end{bmatrix}$$

so that the two matrices cannot be ranked according to the Kanbur and Stiglitz's criterion.

In our case, the condition for a robust welfare ranking is given by Theorem 2. A grid search for ρ between 0 and 1 reveals that $A(\rho)$ may be ranked welfare superior to $B(\rho)$ when $\rho > .67$. When the transition matrices which form the object of the comparison are monotone,

this difference arises because Kanbur and Stiglitz's welfare dominance criterion requires the unanimous ranking for all utility vectors u, while our partial ordering is restricted to nondecreasing utility vectors. Thus, in the above example, there will exist decreasing utility vectors that imply that A is the preferred matrix when $\rho = .75$, so that B cannot be ranked welfare superior. However, given that it is most natural to require the welfare dominance only for nondecreasing utility vectors, we are able to obtain a definite ranking with a welfare criterion hardly less significant.

5.2. NON-FRACTILE CASE

The data came from national surveys performed in 1962 and 1973 by the U.S. Bureau of the Census, reported in Featherman and Hauser (1978). While there are some well known problems in treating social mobility as a Markov chain (e.g. non-stationarity, unrealistic assumptions on the generations etc.), the study of changes in mobility over time reduces greatly the problems associated with inter-country comparisons, namely the differences in data collection and in occupational categories. Specifically, the 1973 survey replicates exactly the previous one, employing identical data gathering techniques and definitions of occupational categories.

To apply the partial rankings derived above, it is necessary to define carefully the occupational groups so that they can be arranged in increasing utility order. We decided to assume that the Markov chain is composed of three states, denoted Lower, Middle and Higher, and decided to rank the original 17 occupational categories according to mean occupational income, and grouped the occupations ranked 1-5 into the Upper state, the occupations ranked 6-10 into the Middle state and the occupation ranked 11-17 into the Lower state. The Upper state includes those occupations called Upper non-manual by Featherman and Hauser; the Middle state includes Lower non-manual and Upper manual and the Lower state includes Lower manual and Farm.

The transition matrices are

$$P^{62} = \begin{bmatrix} .517 & .342 & .141 \\ .243 & .418 & .339 \\ .150 & .282 & .586 \end{bmatrix}; \quad P^{73} = \begin{bmatrix} .463 & .340 & .197 \\ .256 & .364 & .380 \\ .164 & .242 & .594 \end{bmatrix}$$

where columns denote father's state and rows denote son's current state. Obtaining the equilibrium probability vectors, we may calculate the "relative" bistochastic matrices:

$$P_r^{62} = \begin{bmatrix} .53 & .32 & .15 \\ .28 & .39 & .33 \\ .19 & .29 & .52 \end{bmatrix}; \quad P_r^{73} = \begin{bmatrix} .49 & .32 & .19 \\ .30 & .36 & .34 \\ .21 & .32 & .47 \end{bmatrix}$$

Note that the monotonicity assumption is satisfied, as expected; we may then check for the welfare ranking of Theorem 2:

$$T'[P_r^{62} - P_r^{73}]T = \begin{bmatrix} .04 & .04 & 0 \\ .02 & .05 & 0 \\ 0 & 0 & 0 \end{bmatrix} \geq 0.$$

Thus, the condition of Theorem 2 is satisfied on the "single period" transition matrices, and a grid search reveals that this is true for all values of the discount factor. Thus we conclude that the 73 relative mobility matrix may be ranked welfare superior to that for 62 for any chosen discount factor. This result accords with Featherman and Hauser's sociological analysis, where they noted that in the later survey there was a weaker tendency for sons to have current occupations like those of their fathers, and concluded that their findings imply an increase of the opportunities for intergenerational mobility among American men.

6. Conclusions

The proper analysis of the equity implications of different fiscal systems should consider the intertemporal prospects of the individuals in the society. With few exceptions, the theoretical discussions on the optimal design of the fiscal system have concentrated on "static" models. In this paper we have argued that an understanding of the "dynamic" lifetime income prospects gives a more accurate description of income inequality as difference in opportunities.

To start developing the necessary tools for a dynamic investigation of this issue, we have considered an intertemporal Markov chain of social mobility, and used it as a vehicle for the analysis of two dynamic problems: Section 3 considered under which conditions a fiscal policy which results in a more equal distribution of the "single period" income will imply that the "lifetime" post-fiscal income distribution is also welfare superior to the pre-fiscal one. The necessary and sufficient condition found in the analysis gives a simple and intuitive answer to this question; thus it should be of considerable aid in formulating fiscal designs which take account of the dynamic aspect of income inequality as well as the purely static one.

Section 4 considered the effect of social mobility on society's welfare. We have argued that the analysis of the effect of different fiscal policies on the static income distribution should be complemented by the consideration of the welfare effect of social mobility and equality of opportunity. Our aim was to obtain a welfare ranking of mobility matrices by deriving the lifetime welfare prospects under different transition mechanisms and aggregating them with a weighted linear S.W.F. which gives greater weights to individuals starting at a lower position. By considering the unanimous preference for this class of S.W.F.'s we have derived robust partial orderings which emphasize intertemporal equality of opportunity. The multiperiod framework allows the consideration of both intergenerational and intragenerational mobility, and the linearity of the S.W.F. consideration of the ranking of regular transition matrices without necessarily employing the bistochastic assumption. Under linearity, the monotonicity assumption makes the proofs of the Theorems particularly transparent, by using the summation matrix T and summation by parts. Moreover, the derived robust rankings are very easy to apply in practice, essentially involving only simple matrix multiplication.

The welfare measurement of social mobility should be an important tool for the design of an optimal fiscal system. Many fiscal measures (e.g. estate taxation) alter intergenerational mobility among income classes, and the structure of the tax/benefit system may alter the extent of intragenerational income mobility. It is hoped that the derived welfare relevant ordering of transition matrices will be of help for the policy design and analysis of optimal fiscal systems.

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THE EFFECTS OF UNCERTAIN TAX POLICIES ON THE BEHAVIOUR OF FIRMS

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1. Introduction

Several analysis of the effects of recent tax reforms on the economic systems have stressed two major aspects related to the structure and to the recent development of tax systems; the growing complexity of the tax laws and the high frequency of tax changes[2]. The relevance of these phenomena in the past decade[3] has induced a number of economists to challenge the plausibility of the traditional view according to which the structure of the tax system should be considered as given and perfectly known to economic agents.

Having removed this assumption, classical problems such as the tax shifting behaviour of economic agents or the size of the "excess burden of taxation" under different market configurations, should have to be analyzed within a different framework. As Skinner (1988) pointed out, in this context, economic agents will behave correctly if they regard tax policy as one of the uncertain elements of the economic system. It follows that the problem of the behaviour of economic agents, in a world of incomplete information on the parameters of tax policy, should be modelled as one of economic decision under uncertainty[4].

Following this approach, Alm (1988) has recently examined the effects on the individual choices and on social welfare of a Rothschild-Stiglitz increase in the riskiness of the distribution of the random variable, chosen to be, alternatively, the tax rate or the tax base. The results show that uncertain tax policies produce significant allocative effects[5] determining consequences on the efficient allocation of resources[6].

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[1]The author would like to thank M.Marrelli and an anonymous referee for valuable comments and criticisms on an earlier version of this paper, though the usual disclaimer applies.

[2]In a recent article on the effects of the 1986 Tax Reform Act on the top electronic industry taxpayers in the U.S. a lobbyist for the American Economic Electronics Association was quoted to have said "if you talk to the typical company chiefs, they will say that the complexity due to the transition is what strikes them the most, not that they are paying more or less in taxes as a corporation". (Rayner-Stallman, 1988, p.62).

[3]An additional source of uncertainty arises from the difficulties of interpreting correctly the new tax laws; according to a tax expert of a well-known Boston accounting firm "You have to raise the question of whether or not our tax system has gone a little bit haywire if the only way you can get your tax compliance done is buying a computer program". (Rayner-Stallman, 1988, pp.62-63).

[4]Of course this is not the only suitable approach to follow in order to deal with this class of problems. For instance, if one believes that the strategic interaction between tax authorities and taxpayers should be emphasized, the economic effects of taxation could be more properly analyzed within a game theoretic framework.

[5]Alm shows that increased tax uncertainty always produces allocative effects on the choices of economic agents; moreover, the author finds that increases in risk can have opposite effects on the tax revenue

G. Galeotti and M. Marrelli (eds.), Design and Reform of Taxation Policy, 55–68.

The relevance of this problem is further confirmed by a recent development of the classical literature on tax evasion. A series of papers have examined the effects on the tax compliance behaviour of individual economic agents of uncertainty about the results of the assessement of the unreported income made by the auditors. These, as the experience shows, strictly depend-among other things-on the individual characteristics of the auditors and on the precision of the general prescriptions which they have to obey[7]. In a tax system where the complexity of the tax code is growing, the conjecture is that the auditors decisions could not be consistent from one taxpayer to the next. This amounts to saying that taxpayers should correctly regard as a random variable not only the event of auditing but, also, the result of the audit procedure if the audit takes place.

Uncertainty on the tax parameters, being relative to objective factors such as the tax structure or to more subjective aspects such as the auditors'behaviour, seem an important characteristic of the contemporary tax system which becomes more and more relevant as the complexity of the tax code increases. It is therefore interesting to examine how the behaviour of economic agents is affected by randomness in the parameters of the tax system.

Following the original contribution by Alm, Slemrod-Scotchmer and others, this paper aims to extend the analysis of these problems to the behaviour of firms. In particular, Section 2 studies the problems of the effects of an introduction of uncertainty and of a marginal change in the degree of risk of the distribution of the tax parameters on the behaviour of a competitive firm.

The analysis shows that an introduction of uncertainty as well as a Sandmo increase in risk determines a shifting effect which produces undesirable consequences on the allocation of resources.

In Section 3 the analysis is devoted to the effects of uncertain tax policies on the behaviour of oligopolistic firms, in the two alternative regimes of a quantity and of a profit tax. The results show that: i) in the case of a risk-averse competitive firm, uncertain tax policies lead to a reduction in the total output produced by the oligopolistic firms, ii)constant absolute risk aversion is a sufficient condition for a shift in the variance of the distribution of the random tax parameters (the adopted criterion to evaluate an increase in uncertainty) to determine an output reduction in the market; furthermore, the paper establishes sufficient conditions on the firms' market shares which determine symmetric reactions to uncertainty

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depending upon the tax variable which is regarded as uncertain. Namely, if there is a greater tax base risk, the size of the income tax base often increases, while, if there is greater tax rate risk, the effect on the size of the income tax base will always be opposite.

[6]As Alm (1988, p.237) puts it, Weiss (1976) and Stiglitz(1982) had already shown that, under fairly plausible conditions, uncertain tax policies could determine a welfare improvement.

[7]Scotchmer e Slemrod (1989, p.17) quote the results of a survey conducted in the U.S. on the taxpayers' perception of tax assessments randomness. The results show that only 48% of taxpayers "thought that IRS decisions were consistent from one taxpayer to the next".

shifts by non identical productive units thus confirming the well-established results of the the analysis of the oligopoly problem under certainty[8].

Section 4, finally, examines the effects of randomness in tax enforcement on the behaviour of firms in the context of a monopolistic and oligopolistic market. The results show that, given the one sided separability between the output and the tax compliance decision of firms, an increase in the variability of the outcomes of the assessments will determine a reduction of the unreported tax base whereas it will have no effect on the production decision of firms.

2. Uncertainty and the competitive firm

2.1. THE INTRODUCTION OF UNCERTAINTY

This section studies the effects on the output decision of a competitive firm of the introduction of uncertainty on the structure of the tax rates[9].

Let us assume that a firm whose preferences are represented by a Von Neumann Morgenstern utility function of the type $U(\Pi(q))$, with $U_\Pi > 0$ e $U_\Pi < 0$, faces a random tax rate t whose distribution F has a mean μ. The problem for the firm is to choose the output level which maximises the expected utility of profits. It can therefore be written as

$$\max_{q \geq 0} E\big(U(P(q))\big)$$

where $\Pi(q) = Pq - C(q) - tq$ is the (net) profit function, P is the output price, q is the output level and C(q) the cost function which we assume to be convex $C_q(q) > 0$, $C_{qq}(q) > 0$. (Subscripts in the function symbols denote derivatives).

The first order condition for a maximum is given by

$$E[U_\Pi(\Pi(q))\ \Pi_q] = 0 \qquad (1)$$

which can be rewritten as

$$[P - C_q]\ E[U_\Pi(\Pi(q))] = E[U_\Pi(\Pi(q))t] \qquad (2)$$

Subtracting to both sides of equation (2) $E[U_\Pi(.)\ \mu]$, we get

$$E[U_\Pi(\Pi)\ [t - \mu]] = EU_\Pi(\Pi)[P - C_q - \mu] \qquad (3)$$

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[8]Horowitz (1987) and Martina (1989) show that in a duopolistic market with risk averse firms, the comparative static effects of parameters on the market shares of the firms often crucially depend upon differences in the risk propensities of the firms.

[9]The literature on the behaviour of a perfectly competitive firm facing uncertain demand has widely studied the problem of the effects of tax shifting. In particular, Sandmo (1971) showed that an increase in the profit tax rate will determine a reduction (increase) in the output produced if the firm displays decreasing (increasing) absolute risk aversion. Furthermore, Sandmo showed that the output decision of a competitive firm under demand uncertainty will also be affected by a variation in the size of a lump sum tax as well as in the size of fixed costs.

Since, given risk aversion, U_{Π} is decreasing in Π, and the profit function Π decreases with t, we can establish that

$$(E [U_{\Pi}(\Pi) [t - \mu]] > 0 \quad (4)$$

which implies, given $U_{\Pi} > 0$, that at equilibrium

$$P - C_q - \mu > 0 \quad (5)$$

Assuming (as in the standard Sandmo's type of analysis) that E(t) is equal to the tax rate under certainty and recalling that $C_{qq} > 0$, it follows that a risk averse firm will produce under uncertainty a lower quantity with respect to a certainty situation. The introduction of uncertainty thus determines an increase of the "excess burden" of taxation which causes a consumer welfare loss. A reduction in the randomness of the tax laws as well as an improvement in the precision of the tax code, being some of the main sources of uncertainty in taxation, therefore turn out to be socially desirable objectives.

It should be noted, however, that, even under the assumption of risk-aversion, uncertain tax policies do not necessarily imply a shifting effect on firms' output decisions. Consider, for instance, a firm which faces a lump sum tax, regarding it as a random variable; in this case the output produced by the firm will be the same under uncertainty as in a world of certainty. The arguments runs as follows: since the lump sum tax does not affect the marginal profit of the firm, the covariance between the marginal utility of profit and the marginal profit will be zero. The first order condition for a maximum expected utility will then be satisfied at the output level which makes the marginal profit function equal to zero (i.e. at the output level which would have been chosen under certainty).

2.2. AN INCREASE IN UNCERTAINTY

We now consider the effects on the output decision of a firm of an increase in risk. Sandmo (1971) proposed to define a "small" increase in risk as a "stretching of the probability distribution around a constant mean" (Sandmo, 1971, p.67). Following Hey (1981), we can represent a Sandmo increase in risk in the distribution of the random variable t as an increase of the parameter γ in the expression $[\gamma (t - Et) + Et]$. Substituting this expression for the variable t in the first order condition (1), it is possible to study the comparative static effect of a variation of the parameter γ on the choice variable q^*. Given a quantity tax, the marginal profit function is linear in the tax rate t; it follows (Hey, 1981, p.47) that, as γ increases, the output produced by the firm will be reduced if the firm displays decreasing absolute risk aversion (Ishii, 1977). If, however, as will be shown below for the case of an oligopolistic firm, we assume that the variance of the distribution of the random variable represent a more suitable indicator of the riskiness of the distribution, then, even under the assumption of constant risk aversion, an infinitesimal increase in risk will determine a reduction of the output produced by the firm.

The results of this section have shown that uncertain tax policies have non neutral effects on the production decisions of risk averse firms in a perfectly competitive market, determining a reduction of the output levels with respect to a market under certainty. Moreover, following the Sandmo-Ishii's approach, it has been shown that decreasing

absolute risk aversion is a sufficient condition for an increase in risk to determine a further decrease of the output produced, though implying that "uncertain tax policies" can effectively influence the size of "the excess burden of taxation".

3. Uncertainty and oligopolistic firms

This section studies the effects of uncertain tax policies on the behaviour of risk-averse oligopolistic firms. Following the approach proposed by Horowitz (1987), we assume that firms' preferences are represented by a constant absolute risk aversion utility function.

This model allows us to focus on the link between the firms' reactions to shocks in the market parameters and their market shares[10]. The shifting decisions of the duopolistic firms are studied under two fiscal regimes: firstly, we will examine the effects of an uncertain tax rate when an output tax is considered; secondly, the model is extended to evaluate the effects of uncertainty on the quota of deducible cost under a profit tax scheme. In both cases, as shown below, it is found that there exist sufficient conditions on the market shares of the firms which guarantee a similar reaction of differently sized units to marginal shifts in the "degree" of uncertainty in tax parameters.

3.1. QUANTITY TAX

3.1.1. *The introduction of uncertainty*

We consider a duopolistic market where two expected utility maximising firms compete in the product space. Firms preferences are represented by a von Neumann - Morgenstern utility function of the constant absolute risk-aversion type $V^I = - \exp(-b_I \Pi^I)$, where Π^I denotes the profit of the i-th firm and b the coefficient of absolute risk aversion. Firms operate in the market with an identical constant marginal cost function $C^I(q_I) = c_I q_I$ and face a linear inverse market demand function given by $P(Q) = A - B(q_I + q_J)$. First, we

[10] In an oligopolistic market, with no uncertainty, an increase in the tax rate, when the the output tax takes the form $T^I = t\gamma_I q_I$, with $\gamma_I \geq 0$ e $\Sigma \gamma_I = 1$, (Levin 1985), will determine, as in a perfectly competitive market, a reduction in the total ouptut. However, this outcome is compatible with an industry configuration where differently sized firms react to an increase in the tax rate in opposite ways; namely, firms with the smaller market shares can take advantage of the output reduction of the larger firms increasing their own output. In a market with demand uncertainty, an explanation for these asymmetric reactions can be found in the different risk attitudes of the firms other than in the different technological opportunities facing the firms. In particular, as Horowitz shows (1987, p.250) an increase in the profit tax rate,when the duopolistic firms display constant absolute risk aversion, has an ambiguous effect on the output decision of the firms. In order to disambiguate the sign of the comparative static effect it becomes necessary -as shown above- to derive sufficient conditions on the relative market shares of the firms.

suppose that the firms face an output tax and that the effective value of the tax rate, due, for example, to the complexity of the tax code, is regarded by the firms as a random variable at the time when the output decisions have to be made.We further assume that the tax rate is normally distributed with mean $E(t)=\bar{t}$ and a constant variance σ_t^2.The maximisation problem for the i-th firm (i=1,2;i≠j) can then be written as

$$\text{Max } E[V^I] = -E\,[\exp(-b_I(Aq_I - B(q_I + q_J)\,q_I - (c_I + t)\,q_I)]$$

Given the assumption of normal distribution of the random variable, the objective function can be rewritten (Horowitz, 1987, p.248) as

$$E[V^I] = -E[\exp(-b_I(Aq_I - B(q_I + q_J)q_I - (c_I + \bar{t})q_I - b_I\,\sigma_t^2 q_I^2/2] \quad (6)$$

The first order condition for a maximum is then given by

$$\partial E[V^I]/\partial q_I = -b_I E[V^I](A - Bq_I\,(2 + \lambda) - Bq_J - (c_I + \bar{t}) - b_I\,\sigma_t^2\,q_I) = 0 \quad (7)$$

where λ is the conjectural variation parameter.

Given the assumptions of linear demand and of constant returns to scale, the second order conditions for a maximum are satisfied. It is therefore possible to solve the system of equations (7) and find the equilibrium output pair q_I^*, q_J^*, which is given by

$$q_I^* = \frac{A_I H_J - A_J B_J}{H_I H_J - B^2} \quad (8)$$

where

$A_I = A - \bar{t} - c_I$

$A_J = A - \bar{t} - c_J$

$H_I = B(2 + \lambda) + b_I\,\sigma_t^2$

$H_J = B(2+\lambda) + b_J\,\sigma_t^2$

By inspection of (8), it can be easily seen that the output produced by each of the duopolistic firms is lower under uncertainty in the tax rate than under certainty. The presence of the variance does in fact reduce the equilibrium output of each firm and, as a consequence, the total output produced in the industry.It follows that uncertain fiscal policies determine, even in the context of oligopolistic markets,an additional inefficiency in the allocation of resources and thus a consumer welfare loss.

3.1.2. *An increase in uncertainty: comparative statics*

In an oligopoly model characterised by linear demand function and constant returns to scale, it is easy to show (Dixit, 1986 and Seade, 1980) that the condition for the uniqueness and the stability of equilibrium (Horowitz, 1987) are satisfied.It is therefore possible to study the comparative static effects on the firms' output of an increase of the variance of the tax rate. Differentiating (8) with respect to σ_t^2 and assuming, for simplicity, $A_I = A_J$ (i.e. identical cost functions for the two firms), we get

$$\text{sign } dq_I^*/d\sigma_t^2 = \text{sign } b_I H_J (B - H_J) + Bb_J (H_I - B) \quad (9)$$

Rearranging condition (9), it is possible to derive a sufficient condition which guarantees that both firms will reduce their own output following an increase in the variance of the tax rate.

$$b_J (2 + \lambda)) \geq b_I \geq (b_J/(2 + \lambda) \qquad (10)$$

Condition (10) implies that for $dq_I/d\sigma_t^2 < 0$ and $dq_J/d\sigma_t^2 < 0$ the pair b_I, b_J must lie in the open interval $\Omega = \{b_I, b_J : b_I \leq b_J (2 + \lambda) \leq b_I (2 + \lambda)^2\}$ whose size is directly related to the degree of collusion in the market. Namely, as the industry becomes more and more collusive the firms tend to make output adjustments in the same direction as the variance of the effective tax rate varies. If the firms hold Bertrand type conjectures ($\lambda = -1$), they will certainly follow the same adjustment process (Condition 10 is satisfied) only if they are identical (i.e. $b_I = b_J$). If the firms hold Cournot type conjectures, for (10) to be satisfied, the differences in the propension to risk should be limited to the area defined by the lines $b_I = b_J/2$ and $b_J = b_I/2$. On the other side, however, it should be stressed that a relevant difference in the risk attitudes of the firms does not provide a sufficient condition for a reaction of opposite sign of the producers to an higher tax rate variance. As (9) shows, when the variance is "high", the firms, even if they display significantly different risk attitudes, could react to a shift in the variance with a simultaneous reduction of their output levels. Despite the possibility of an asymmetric reaction of the firms, however, it should be stressed that an higher variance will always determine a lower level of the total industry output. From (9), we get

$$dQ/d\sigma_t^2 = [b_I (H_J - B)(B - H_J) + b_J (H_I - B)(B - H_I)] / (H_I H_J - B^2)^2 < 0 \qquad (11)$$

where $Q^* = q_I^* + q_J^*$, thus confirming the previous result that in an oligopolistic market an higher level of uncertainty on tax parameters will be likely to determine an increase in the "excess burden" of taxation and, as a consequence, a welfare loss. Finally, it is worthy of note that, when firms display "significant" differences in risk preferences, if the level of the variance is relatively "low", an increase in the level of uncertainty will create favourable conditions for an expansion of the output level of the smaller firm (the firm with the higher propensity to risk) thus reducing the level of concentration in the industry. A higher level of variance, therefore, will always determine an increase in the "excess burden" of taxation through a reduction in total output, and could soften the tendency to lower concentration which could be enhanced in a "low" variance regime.

3.2 PROFIT TAX

3.2.1. *The introduction of uncertainty*

We now turn our attention to the analysis of the behaviour of a pair of constant absolute risk averse oligopolists facing a profit tax. Let us assume that the appropriate tax base is given by the difference between the total revenue and a percentage of effective total costs which can be deduced for fiscal purposes.On average the whole of the production cost can

be deduced from total revenue; however, because of the complexity of the tax code, the firm is modelled as having a probability distribution on the effective size of the deducible costs.

The expected utility maximum problem for the i-th firm can therefore be written as

$$\max E[V^I] = -E[\exp(-b_I((Aq_I - B(q_I + q_J)q_I)(1 - t) - c_I q_I(1 - \alpha t)$$

where α the random term, is normally distributed with mean $E(\alpha) = \bar{\alpha}$ and variance σ_α^2. The first order condition for a maximum profit for firm i (i=1,2), is given by

$$\partial E[V^I]/\partial q_I = -b_I E[V^I]((A - Bq_I(2 + \lambda) - Bq_J)(1 - t) - c_I(1 - \bar{\alpha}t) - b_I q_I c_I^2 t^2 \sigma_\alpha^2) = 0 \qquad (12)$$

Solving the system of equations (12), we can find an expression for the equilibrium output produced by the duopolistic firms

$$q_I^* = \frac{\bar{A}_I H_J - \bar{A}_J \bar{B}}{H_I H_J - \bar{B}^2} \qquad (13)$$

where

$\bar{A}_I = A(1 - t) - c_I(1 - \bar{\alpha}t)$

$H_I = \bar{B}(2 + \lambda) + b_I \sigma_\alpha^2 c_I^2 t^2$

$\bar{B} = B(1 - t)$

As in the previous case of a quantity tax, the equilibrium output of the pair of constant absolute risk-averse duopolists is smaller than the equilibrium output under certainty. By inspecting expression (13), it can be clearly seen that the presence of the variance term (greater denominator) determines a reduction of the total output produced in the market.

3.2.2. *An increase in uncertainty: comparative statics*

Since the conditions for the uniqueness and stability of equilibrium are satisfied (Dixit, 1986, and Seade,1980), it is possible to perform a comparative static exercise in order to examine the effects on the output decisions of the firms of a variation in the size of uncertainty. Differentiating q_I^* with respect to σ_α^2, and assuming that $c_I = c_J$, we get, as in the case of uncertainty on the tax rate, that

$$\text{sign } dq_I^*/d\sigma_\alpha^2 = \text{sign } b_I H_J(\bar{B} - H_J) + Bb_J(H_I - \bar{B}) \qquad (14)$$

which implies that a sufficient condition for both firms to react to an increase in uncertainty with a simultaneous reduction of their output level is given by

$$b_J(2+\lambda) \geq b_I \geq b_J/(2+\lambda) \qquad (15)$$

It is worthy of note, however, that, as in the previous case, an increase in the uncertainty on the parameters of the tax structure determines a reduction of the total output produced thus provoking undesirable effects on the efficient allocation of resources.

4. Randomness in tax enforcement

The literature on optimal tax enforcement has shown that the frequency of audits is, among other elements, such as the penalty structure and the level of the tax rates, a crucial determinant of the tax compliance behaviour of economic agents. In order to model the effects of auditing, the standard approach has assumed that the outcome of the assessment process would lead to the full disclosure of the unreported tax base. However, as several tax experts have pointed out, the taxpayer perception is that "taxable income as it would be assessed by an auditor is a random variable" (Scotchmer-Slemrod, 1989, p.17). In other words, taxpayers feel that the assessment processes will crucially be affected by differences in the auditors'behaviour (due to objective causes such as the imprecision of the tax code, or to individual differences such as the attitudes of the auditors toward tax evaders), and more generally, by the structure of the auditing process chosen by the Tax Autorithies (i.e. a larger number of simplified audits or, rather, a smaller number of more careful ones). In this context, the taxpayer's choice of the unreported tax base depends on two sources of uncertainty: the probability of being audited, and the probability of undergoing a more or less severe scrutiny.

Adopting this approach, some recent papers by Dardanoni and Marrelli (1988), Beck and Jung (1989) Scotchmer and Slemrod (1989), have examined the effects of uncertainty on the tax compliance behaviour of an individual taxpayer in the assessment process of auditors. Their results show that, under the hypothesis of DARA, an agent will react to an increase in uncertainty by reducing unreported income, thus leading to an increase in tax revenues.

The objective of this section is to verify if this result can be extended from the analysis of the tax evasion behaviour of an individual taxpayer with a given income to the case of the tax evasion behaviour of a firm. In this context, the agent chooses simultaneously the level of tax compliance and the level of output. It follows that uncertainty at the different stages of the auditing process could have an influence on each of the choice variables of the productive unit. However, as will be shown below, in the case of constant probability of detection, the one-sided separability between the output decision and the tax compliance decision (shown by Marrelli (1984) for the monopoly case and by Marrelli-Martina (1988) for the oligopoly case) will imply that the randomness in tax enforcement will have no effect on the production decision of the firm.

4.1. THE MONOPOLY CASE

We start our analysis considering the behaviour of a monopolistic firm. We model a market where a firm, facing a concave inverse demand function and adopting a decreasing returns to scale technology chooses the output level and the size of the reported tax base which maximize the expected utility of after tax profits. Following the standard approach to tax evasion problems, we assume that the firm is audited with a fixed probability p; however (see Scotchmer-Slemrod, 1989), the audit will not necessarily lead to an assessment of the

true tax base. We assume, in fact, that the firm is assessed a tax base $(m + \varepsilon)$ with probability $(1 - \mu)$, and a tax base $(m - \varepsilon)$ with probability μ[11]. To avoid the analysis of the structure of rebates, we assume, following the previous literature, that an audit will always lead to an assessment of an effective tax base which is greater or equal than the reported one. This implies that $(m - \varepsilon)$ will be at least as great as the reported income. In this context, when the firm is audited, if the assessed tax base turns out to be greater than the reported one, the firm will be asked to pay the tax on the assessed amount plus a fine which will depend on the difference between the assessed and the reported tax base. The total amount due by the firm will therefore be larger with probability $(1 - \mu)$ and smaller with probability μ.

Let us define with R(q), C(q), tx e τ, respectively, the total revenue, the total cost, the tax paid by the firm (t is the tax rate and x is the reported taxable income) and the fine rate.

The net profit for the firm will be given with probability $(1 - p)$ by $Y = R(q) - C(q) - tx$ (the firm is not audited), with probability $p(1 - \mu)$ by $Z = R(q) - C(q) - t(m+\varepsilon) - \tau t\,(m + \varepsilon - x)$ (the firm is audited and a high unreported income is assessed) , and, finally, with probability $p\mu$ by $W = R(q) - C(q) - t(m - \varepsilon) - \tau t\,(m - \varepsilon - x)$ (the firm is audited and a low unreported income is assessed).

The maximum problem for the firm can then be written as

$$\max_{x,\,q} EU=[1 - p]\,U(Y) + p[1 - \mu]\,U(Z) + p\mu\,U(W)$$

subject to

$$q \geq 0 \quad e \quad x \geq 0$$

First Order Conditions for the existence of a maximum are given by[12]

$$R_q(q) - C_q(q) = 0 \tag{16}$$

$$\frac{U_Y(Y)}{(1 - \mu)\,U_Z(Z) + \mu U_W(W)} = \frac{\tau p}{1 - p} \tag{17}$$

where $R_q(q) = P(q) + P_q(q)q$ is the marginal revenue, and $C_q(q)$ the marginal cost function. Using the implicit function theorem it is possible to examine the effects of a change in the parameter ε, which provides a measure of the variability in the results of the assessment, on the equilibrium values of the choice variables.

In order to perform this exercise, let us differentiate the system of First Order Conditions. We get

$$J = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} dq/d\varepsilon \\ dx/d\varepsilon \end{bmatrix} = \begin{bmatrix} -a_{1\varepsilon} \\ -a_{2\varepsilon} \end{bmatrix}$$

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[11] Slemrod and Scotchmer (1989, p.19) assume that there exists a maximum value of the parameter ε which is determined by the "imprecision of the tax code".

[12] The reason of the one-sided separability of the output decision from the tax evasion decision of the firm can be seen from the first order condition of the maximum problem. By looking at equations (16) and (17), it can be noted that while (16) determines q -indipendently from the level of x- the opposite is not true; from (17) it is easy to show that the level of x depends upon the marginal utility of profit and is therefore affected by the output decision of the firm.

First, we examine the sign of the determinant Δ of the matrix J to evaluate if the second order conditions for a maximum require (which require that $a_{11}, a_{22} < 0$ and $\Delta > 0$) are satisfied.

From (16) and (17), we get

$$a_{11} = \partial^2 EU/\partial q^2 = 2P_q(q) + P_{qq}(q)q - C_{qq}(q) < 0 \quad (18)$$

$$a_{22} = \partial^2 EU/\partial x^2 = [1-p]U_{YY}(Y) + p[1 - \mu]U_{ZZ}(Z)\tau^2 + p\mu U_{WW}(W)\tau^2 < 0 \quad (19)$$

$$a_{12} = a_{21} = \partial EU/\partial q \partial x = \partial EU/\partial x \partial q = 0 \quad (20)$$

Given the assumption of concavity of the inverse demand function and of convexity of the cost function, the term a_{11} has a negative sign. Furthermore, since the firm isassumed to display risk aversion, a_{22} is similarly negative. Finally, the one sided-separability between the production and the tax evasion decisions implies zero-cross effects and, therefore, a positive value of the determinant Δ.

By Cramer's rule, it is easy to show that, since a variation in the parameter ε has no effect on the marginal profit of the firm, an increase in the parameter ε has no effect on the quantity decision of the firm whereas it determines an increase in the reported tax base. On the other side, since a variation in the parameter ε affects the profit function of the firm and, as a consequence, its utility, a change in ε determines a readjustment of the equilibrium value of x. In particular, we get

$$\text{sign } dx^*/d\varepsilon = \text{sign } a_{2\varepsilon}$$

$$a_{2\varepsilon} = \tau p (t + \tau t)[\mu U_{WW}(W) - (1 - \mu)U_{ZZ}(Z)] \quad (21)$$

A sufficient condition for $a_{2\varepsilon} > 0$ is given by: $\mu / (1 - \mu) < U_{ZZ}/U_{WW}$; which, since $W > Z$, is verified for $\mu \leq 1/2$ when the firm displays decreasing absolute risk aversion (DARA). In the case when $\mu > 1/2$, DARA becomes a necessary condition for $a_{2\varepsilon} > 0$. An increase in the variability of the results of the assessment procedures will therefore determine, under fairly plausible restrictions on the risk preferences of the firms, a reduction in the amount of the unreported tax base. It follows that a Tax Authority aiming at a reduction of tax evasion could organize its auditing procedures in such a way as to favour the taxpayers' perception of non homogeneous results of the tax base assessments.

4.2. THE DUOPOLY CASE

The previous result is confirmed when the analysis is extended to the case of an oligopolistic market. As is known (Marrelli-Martina, 1988), even in this market, the one-sided separability between the quantity decision and the tax compliance decisions of the firms holds. As a consequence, an increased variability of the assessment results does not affect the market shares of the firms whereas it induces an higher reported tax base for each firm which display decreasing absolute risk aversion.

In a duopolistic market, the F.O.C. for a maximum expected utility of profit are given by

$$R_I(q_I + q_J) - C(q_I) = 0 \quad (22)$$

$$\frac{U_Y^I(Y^I)}{(1-\mu)U_Z^I(Z^I)+\mu U_W^I(W^I)} = \frac{\tau p}{1-p} \quad i=1,2 \tag{23}$$

where superscripts denote the firm.

Differentiating the system of F.O.C.'s we can examine the effects of an increased "variability" on the outcome of assessments on the equilibrium pairs x^*, q^*. From (23) we get[13]

$$J = \begin{bmatrix} a_{11} & a_{12} & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 \\ 0 & a_{32} & a_{33} & 0 \\ a_{41} & 0 & 0 & a_{44} \end{bmatrix} \begin{bmatrix} dq_1/de \\ dq_2/de \\ dx_1/de \\ dx_2/de \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ -a_{3e} \\ -a_{4e} \end{bmatrix}$$

Assuming that the market demand function is linear and that the firms operate with a constant returns to scale technology, the elements of the J matrix can be written as

$$a_{II} = \Pi_{II}^I = P_q(2+\lambda) \tag{24}$$

$$a_{IJ} = \Pi_{IJ}^I = P_q q_I \qquad i=1,2\ i \neq j \tag{25}$$

$$a_{33}, a_{44} = \partial^2 EU/\partial x_I^2 \tag{26}$$

$$a_{32} = \partial^2 EU/\partial x_1 \partial q_2 = \Pi_{12}^1[-(1-p)U_{YY}^1(Y^1)+\tau p\ ((1-\mu)U_{ZZ}^1(Z^1)+\mu U_{WW}^1(W^1))] \tag{27}$$

$$a_{41} = \partial^2 EU/\partial x_2 \partial q_1 = \Pi_{21}^2[-(1-p)U_{YY}^2(Y^2)+\tau p\ ((1-\mu)U_{ZZ}^2(Z^2)+\mu U_{WW}^2(W^2))] \tag{28}$$

$$a_{3\varepsilon} = \partial^2 EU/\partial x_1\, \partial \varepsilon = (t+\tau t)\,[\mu U_{WW}^1(W^1) - (1-\mu)U_{ZZ}^1(Z^1)] \tag{29}$$

$$a_{4\varepsilon} = \partial^2 EU/\partial x_2\, \partial \varepsilon = (t+\tau t)\,[\mu U_{WW}^2(W^2) - (1-\mu)U_{ZZ}^2(Z^2)] \tag{30}$$

where λ denotes the conjectural variation term.

Given that the Second Order Conditions are satisfied, the sign of the determinant of the matrix J is positive; it is therefore possible to sign the effects of a variation of the parameter ε on the decision variables of the firms. As in the monopoly case, we will find that, since a_{33} and a_{44} are equal to zero,

$$dq_1/d\varepsilon = (a_{44}a_{33})[(-a_{1\varepsilon}\Pi_{22}^2)-(-a_{2\varepsilon}\Pi_{12}^2)] = 0 \tag{31}$$

$$dx_1/d\varepsilon = [a_{44}(-a_{3\varepsilon})][(\Pi_{11}^1\Pi_{22}^2 - (\Pi_{12}^1\Pi_{21}^2)] > 0 \tag{32}$$

if $a_{33} > 0$, which is assured if the firms display decreasing absolute risk aversion, and $\mu/(1-\mu) < U_{ZZ}^1 / U_{WW}^1$.

As shown by Scotchmer and Slemrod, the economic intuition beyond these results is fairly straightforward. An increase in the parameter ε has a negative effect on the expected profit of the firm in the least favourable state of the world Z, whereas it has a positive effect on the profit in the event of a low assessment of the tax base. Given the separability between the output and the tax compliance decisions, a variation of ε does not induce any effect on

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[13] In order to avoid a more cumbersome notation, superscripts are omitted from the elements of the matrix J.

the output produced by the firms; it follows that all the adjustment needed to achieve a maximum expected utility takes place through the variable x. In particular, as implied by equations (17) if the third derivative of the utility function is positive, following an increase in ε, the effect on the marginal utility of a fall of Z will be greater, in absolute value, than the effect induced by an increase in W. Thus, if firms' preferences display decreasing absolute risk aversion, the effect of an increase in ε on the left hand side of equation (17) will be negative; the equilibrium will then be reestablished through a reduction in the marginal utility in the most preferred state of the world Y which requires a higher x_I .

In a fiscal system where the probability of auditing is constant, Tax Autorithies aiming at a larger tax revenues should prefer to enforce an auditing system which elicits, at no additional cost, through non homogeneous assessments, a higher level of reported income. On the other hand, the reduction of the effects of random factors in tax enforcement could be a socially desirable objective on equity consideration. However, it would involve additional costs and would not generally produce any effect on the process of resource allocation in the firms sector of the economy.

5. Conclusions

The definition of an optimal tax structure is certainly an ambitious, if not an impossible, task. However, in order to define a satisfactory tax policy, even the most averse to theoretical designs would recognize the opportunity of a thorough examination of the allocative and distributive consequences of Government choices in the field of tax policy. The recent flow of research on the economic effects of uncertain tax policies, discussed in this paper, goes in this direction, contributing to our understanding of the implications of implementing tax policies in complex economic systems. These papers have highlighted the existence of a cost in terms of efficiency that society pays when tax-payers perceive the tax laws as uncertain. This cost, which can be measured in terms of "excess burden" of taxation, must be correctly traded against the expected gains of modifying the structure of tax systems when changes appear to be desirable, as well as against the positive effects on welfare which the same uncertainty could produce (Weiss, 1976; Stiglitz, 1982; and Alm, 1988). This and other contributions share the common view that the literature on optimal tax design should be appropriately extended in order to take into consideration the hidden element of uncertainty whose relevant size, according to tax experts, should never be neglected in the study of modern fiscal systems.

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DEMOGRAPHIC CHANGES, PUBLIC SAVING AND TAX POLICIES

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1. Introduction

According to demographic projections the population will tend to decrease and show a significant ageing in most industrialized countries. The reduction in fertility rates, coupled with continuously increasing life expectancy, will generate, over the next decades, a reduction in total population and a marked increase in the number of aged people, both in absolute and in relative terms. Table 1 and Table 2 show the demographic trends expected for Italy in the next decades.

The extent to which this phenomenon will affect the accumulation process through its effects on saving and labour supply has been recently analyzed in a growing number of papers[1]. Almost no attention has been devoted, however, to the links between an ageing population and the public spending. As it will be shown in this paper, non trivial effects are to be expected both for public spending and tax revenues as a consequence of the demographic evolution. As a result of our analysis it emerges that the evaluation of the macroeconomic consequences of ageing cannot disregard the induced changes in public savings. Moreover as the public sector will react to the imbalances induced by the demographic changes, it is interesting to highlight the fact that tax design should take into account the relationship between tax incidence and the age structure of population.

The macroeconomic consequences of ageing cannot in general be unambiguously derived from theoretical models, as they depend inter-alia on wage and consumption age profiles, retirement decisions, intergenerational links, capital market imperfections and so on. To take into account these factors we have based the analysis on a life-cycle simulation model which endogenously determines consumption and labour supply. This allows us to consider the effects of an ageing population by focusing on the time path of saving and consumption. As our intent was to highlight the effects of the demographic changes on life-cycle savings, we ignored the role of bequests. We have also not explicitly considered capital market imperfections; however, we calibrated the model in such a way that the individual financial liabilities are quite small. This is coherent with the Italian case, in which

[1] See for example Auerbach et al. (1989) and Jappelli - Rossi (1989), Paganetto - Quintieri -Rosati (1990) for Italy.

G. Galeotti and M. Marrelli (eds.), Design and Reform of Taxation Policy, 69–92.

the family sector holds a small amount of financial liabilities.

Population ageing is characterized by the shift of the center of gravity of population distribution first towards the middle aged and then towards the elderly. As a consequence the economic effects of ageing can differ according to the phase of demographic change which is taken into account, and for this reason we have considered projections at two different points of time: one at the year 2008, when the centre of gravity will be at about 40 years of age (compared with the current 20 years of age) and the other at 2038, when the centre of gravity will be at about 65 years.

Obviously the results obtained should not be regarded as forecasts, both because of the length of the time horizon considered and because of the uncertainty of the birth rate projections. Rather, the aim of the paper is to give, within the aforementioned limits, an evaluation of the order of magnitude of the effects of the demographic changes.

The plan of the paper is the following. In the next section we illustrate the life-cycle model employed for the simulations, while Section 3 is devoted to parametrization and base simulation. In Sections 4 and 5 the effects on public spending and revenues of the demographic trends are discussed. Section 6 is devoted to the analysis of the relationship between tax incidence and the age structure of population.

TABLE 1
DEMOGRAPHIC TRENDS
The population projections (thousands)

	A	B
1988	57,400	57,400
2028	55,433	56,808
2038	42,764	46,587

A: Decreasing fertility rates (ISTAT, 1989)
B: Costant fertility rates (ISTAT, 1989)

TABLE 2
DEPENDENCY RATIOS

	$\frac{POP>60}{TOT.\ POP}$		$\frac{POP>60}{20<POP<60}$		$\frac{POP>60}{POP<20}$	
	A	**B**	**A**	**B**	**A**	**B**
1988	19.4	19.4	35.3	35.3	75	75
2008	26.0	26.0	46.1	46.1	148	148
2038	43.1	39.8	98.6	88.3	325	264

A: Decreasing fertility rates (ISTAT, 1989)
B: Costant fertility rates (ISTAT, 1989)

2. The model

The individual is assumed to choose a path of consumption and labour such as to maximize the discounted value of the life time utility:

$$\int_o^T e^{-or} U[X(t), L(t)]dt \tag{1}$$

subject to the budget constraint:

$$\dot{A} = (1-tr)rA(t) + (1-tw)W(t)(1-L(t)) - P(t)(1+tp)X(t) \tag{2}$$

and the initial condition:

$$A(o) = Ao \tag{3}$$

where U is a utility function which enjoys the properties of strict concavity and time separability. The interval (0 T) is the time horizon relevant to the individual; σ is the rate of intertemporal time preference; X is the quantity of private goods consumed at the time t; L is the amount of leisure normalized so that $1 \geq L \geq O$; A the financial wealth; r is the rate of interest; W the pre-tax wage per unit of work; P is the price of the consumer goods; tw, tr and tp indicate respectively the proportional rate of tax on labour income, capital and consumption.

Throughout the paper we assume a perfect capital market, i.e. the individual can lend and borrow without constraint at the market interest rate r. However, we will calibrate the model in such a way that the individual financial liabilities are quite small. This is coherent with the Italian case, in which the family sector holds a small amount of financial liabilities. Moreover, as is usual in life cycle models (see for example Heckman [1974], Yaari [1965]) we do not assume r is necessarily equal to σ[2].

To be able to obtain an explicit solution of the model in order to simulate individual behaviour over the life cycle, it is necessary to consider a specific form of the utility function. Following Auerbach and Kotlikoff (1987) we assume that the instantaneous utility function has the form:

$$U_t = \left[X_t^{(1-1/\beta)} + \phi L_t^{(1-1/\beta)} \right]^{(\beta/\beta-1)} \tag{4}$$

The parameter ß determines how responsive an individual's annual labour supply is to that year's wage rate. As was first shown by Arrow et al. (1961), the elasticity of substitution between X_t and L_t is constant and equal to ß. The term gives Φ the household's preferences for leisure relative to consumption. The greater Φ, the less labour the household will supply in order to obtain consumption goods, as it prefers to enjoy a greater amount of leisure instead of acquiring consumption goods. Φ equal to zero implies that households would choose to have no leisure, this implying a fixed labour supply assumption. σ is "pure" rate of time preference. It indicates the degree to which, other things being equal, the household would prefer leisure and consumption in an earlier rather than later periods. The larger σ, the more of its lifetime resources a household will spend early in its life and the less it will

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[2]See Appendix I for the derivation of the demand functions.

save. The remaining taste parameter, μ, can be shown to be equal to the household's intertemporal elasticity of substitution between consumption in different periods. The elasticity of substitution determines the percentage change in the ratio of any two periods' consumption with respect to a percentage change in the relative price of consumption in the two years. The higher μ the higher the responsiveness of households to changes in the incentive to save. The utility function is fairly general, but it nevertheless embodies a set of constraints. First, both the intertemporal and the intratemporal elasticities of substitution, ß and μ, are assumed to be constant over time. Second, the intertemporal elasticity of substitution is assumed to be equal for leisure and consumption. Finally, time separability means that individual decisions at any time depend only on the future; past levels of consumption and leisure will bear on a household's preferred behaviour only so far as they alter the household's current net worth.

We assume that the objective of the individual is to maximize:

$$U = \frac{\mu}{\mu - 1}\int_o^T (1-\sigma)^{(t-1)} U_t^{(1-1/\mu)} \qquad (5)$$

where μ is the intertemporal elasticity of substitution. Maximization of eq. (5) subject to (2), (3) and to the transversality condition gives the following expression for the time path of leisure:

$$L_t = L_{t-1}\left[\frac{Z_t^{\beta-1}+\phi}{Z_{t-1}^{\beta-1}+\phi}\right]^{-\beta/\beta-1} * \left[\frac{1}{1+\sigma} * \frac{W_{t-1}}{W_t} * e^{(1-tr)r}\right] \qquad (6)$$

where

$$Z_t = \frac{W_t(1-tw)}{P_t(1+tp)\Phi}$$

The time path of consumption is linked to the time path of leisure by the following expression

$$X_t = Z_t^{\beta} L_t \qquad (7)$$

Given the initial value of L, obtained by integrating the budget constraint, equations (6) and (7) can be used to derive the individual demand for leisure and consumption over the life cycle.

3. Parametrization of the model and base simulation

In order to simulate the model it is necessary to choose values for the preference parameters, the interest rate, the wage profile and the tax rates. The intertemporal elasticity of substitution μ was set equal to 0.4 which is in the range of the estimated value of this parameter (Auerbach-Kotlikoff, 1987). The intratemporal elasticity of substitution ß was set equal to 1.1. The leisure preference parameter, Φ, was fixed at 0.7. The pure rate of time preference, σ, forwhich hardly any empirical evidence exists, was set at 0.001. Finally we assumed a real interest rate equal to 2%.

In order to evaluate how sensitive the results obtained are to the value of the parameters,

simulations were also run with different parametrizations.

The simulations were run for a time horizon of 55 periods, assuming that the individual becomes "adult" at the age of 21 when he enters the labour market and that he expects, with certainty, to die at the age of 75. As our intent was to highlight the effects of the demographic changes on life-cycle savings, we ignored the role of bequests, therefore wealth will be equal to zero at the beginning and at the end of the life-cycle.

Tax rates were selected to reflect the currently observed Italian tax structure. In particular the rate of "wage" tax, tw, was set equal to 29%, which is approximately equal to the ratio of the sum of direct income tax and social security contributions to Italian G.N.P. net of industrial corporate profits. The indirect tax rate, tp, was fixed at 17%, a value obtained by dividing the revenue from indirect taxation by the value of final household consumption. Finally, because of the difficulty in obtaining a measure of capital income, the rate of capital taxation, tr, was fixed at 20%, a value which is a rough average of the observed legal tax rates on financial assets.

The wage profile was chosen in order to obtain from the model, given an endogenous labour supply, an age income profile similar to that observed for a representative Italian wage earner (Jappelli-Rossi, 1989).

The results of the simulation performed using the described parametrization, which we will refer to as "base" simulation, are shown in Figures 1 and 2. As can be seen, labour supply willshow high values from the beginning, reaching a maximum between 40-45 years and falling to very low levels after sixty years of age, thus generating an endogenous retirement period. The time path of consumption is much flatter, slowly rising until 50-55 and then hardly declining, implying consumption levels at later ages higher then those observed at the beginning of the life cycle. Individual wealth is slightly negative for the first ten years. It then rises to reach a maximum at about fifty seven years and declines thereafter to reach zero by the end of the life cycle. This implies that savings are positive between 27 and 57 years, with heavy dis-savings occurring during the last twenty years of the life cycle. Observe that this behaviour implies a low level of financial liabilities typical of the Italian households.

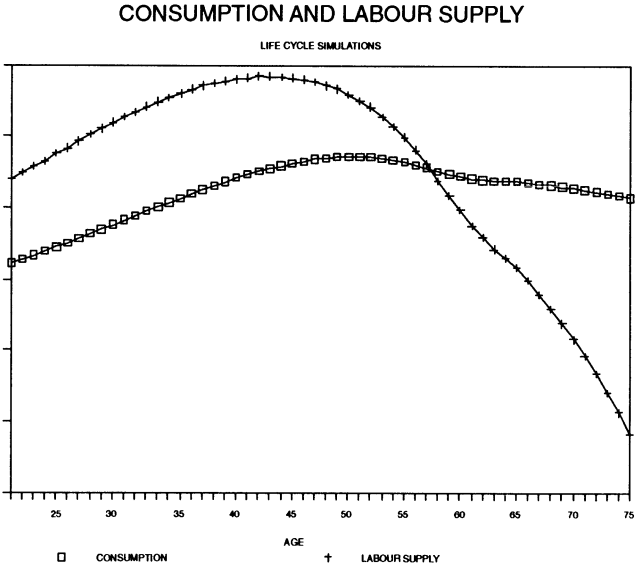

Figure 1

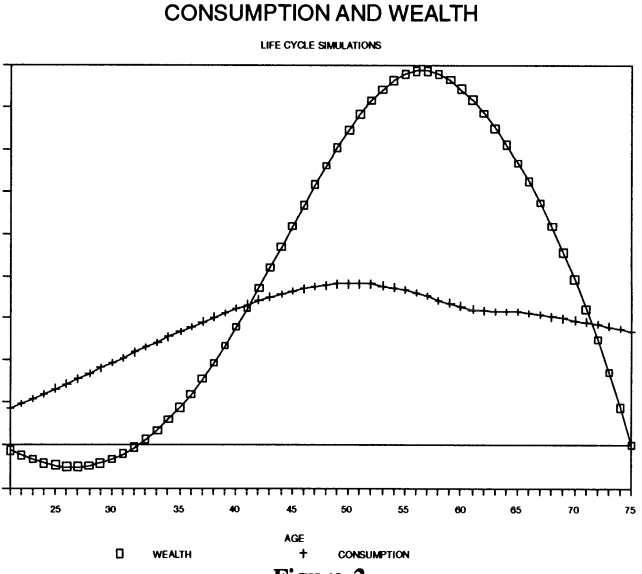

Figure 2

Obviously the results obtained depend on the parametrization adopted. We will show how different values of parameters will modify the results obtained.

4. Budgetary effects of demographic change

The main objective of this section of the paper is to assess if and to what extent the demographic changes expected for the coming years will affect the public spending. Generally speaking the change in the level and in the age structure of the population can be expected to modify both the demand for public spending and the tax revenue, that the government can raise with a given fiscal structure.

In the developed countries younger and older people are the major users of public services, while the middle aged bear most of the fiscal burden. The age structure of the population is therefore of paramount importance in determining the evolution of both public spending and tax revenues.

As far as public spending is concerned, it is important for our purposes to analyze those items that are more heavily dependent on the age structure of the population.

Of course, any attempt to predict long term changes in public spending due to the demographic changes is subject to a high degree of arbitrariness. However, in order to give a quantitative assessment rather than a forecast of the phenomenon, we have made some projections of the items which appear to be most sensitive to demographic changes, i.e. education, health and pensions. In particular we have computed appropriate measures of 1988 per-capita expenditure and projected these up to 2038, making use of the population forecasts discussed above.

To obtain the 1988 per-capita measures we have proceeded as follows. For pensions we have divided the total transfers to the elderly by the number of persons aged above sixty. Spending on education has been divided by the number of people aged below twenty. As far as health spending is concerned, taking the average of the values given by OCSE (1988) and the expenditure survey of Italian households (Bank of Italy, various issues), we have assumed that health spending for older people is twice as large as that for the other age groups.

The results obtained from such a projection are shown in Table 3. While expenditure on pensions is estimated to increase by more than fifty per cent, education expenditure should be less then half by 2038, compared with 1988, under the hypothesis of full flexibility of supply with respect to demand. Notwithstanding the large increase in the number of "old" people, health spending should be slightly reduced by 2038.

To ascertain the impact of such changes on total public spending, however, it is necessary to consider the evolution of the residual part of public spending. Two hypotheses have been formulated: one, which we called "rigidity of non age-specific public expenditure" assumes that the level of public goods supplied is independent from the number of inhabitants, while the other, called "flexibility of non age-specific public expenditure" assumes full divisibility of public goods. Of course, in reality both these assumptions are relevant for the set of goods offered by the government and the values

obtained can therefore be thought of as a range within which public expenditure can be expected to grow. Observe that if public expenditure is fully flexible, total spending will not change significantly as a result of the ageing population. On the contrary, if the level of "age independent" public spending is constant, a 15% increase in total spending is expected to take place in 2038.

In order to highlight the effects on public spending generated by the change in the population age structure the last column of Table 3 shows the expected increase in total expenditure assuming a constant population. Obviously in this case the increase in public spending would be between 20 and 35 per cent higher than in the case in which population is decreasing and the supply of public services is adjusted to the number of citizens.

Let us now turn to the effects that the demographic changes will exert on the revenue side of public finance. In the long run of course both expenditure and revenue will adjust in order to keep the budget balanced. As the gap between expenditure and revenue widens one would expect that measures will be taken to reduce the deficit within the time horizon here considered. Once more, then, our estimates of the revenue gap should be taken as projections aiming to assess the fiscal adjustment that the ageing population will make necessary.

TABLE 3
PROJECTED TRENDS IN PUBLIC EXPENDITURE (1)

	PENSIONS	HEALTH	EDUCATION	TOTAL EXPENDITURE		
						POP.CONST
				A	**B**	
1988	100	100	100	100	100	100
2008	129	102	66	105.1	100.1	107
2038	165	89	38	115.6	100.9	134

(1) - Based on the decreasing fertility hypothesis
A = Hypothesis of rigidity of non age specific public expenditure
B = Hypothesis of flexibility of non age specific public expenditure

Tax revenues are affected by both the changes in the total number and in the age structure of the population. In particular, to evaluate the evolution of tax revenues it is necessary to know the age structure of labour supply, consumption and savings. As these variables are influenced in turn by tax rates and the tax structure, it would appear important to take into account such links between taxation and the tax base.

Life cycle models seem to be the most appropriate instrument for analyzing the relationships between tax rates, the age structure of the population and incentives to work and save, and it is to this aim that the rest of the paper is devoted. Making use of the simulation model previously presented we have computed the individual life cycle tax burden and, by appropriate aggregation, the tax revenue of the economy. On this basis we have simulated, under various hypotheses, the revenue effect of the ageing population.

The tax revenue index has been computed assuming that all individuals are identical and

that their behaviour coincides with that of the representative individual described in the previous sections. Given this assumption, we have aggregated the age specific tax revenues using population related weights.

In performing this simulation over a fifty-year time span we have assumed a stationary economy. Although this assumption may look quite strong, alternative hypotheses appear to be either trivial or intractable. In fact one way to allow for growth is simply to introduce a trend in wages: to follow such an approach would obviously not modify our results. A more satisfactory alternative would be to model the effects of growth on the demand elasticities for public expenditure and the age profile of wages as well, but any attempt in such a direction would appear extremely arbitrary for such a long interval. We have, therefore, kept to our simplifying assumption, which helps to keep things as clear and simple as possible, while the effects of growth can be superimposed on the results presented here.

An index, T, of the tax revenue was obtained using as weights, for aggregating the age specific tax revenue, the number of persons by age groups for the years 1988, 2008 and 2038. Given the assumption of stationarity the index of revenue would change only following the demographic changes. The effects of the demographic evolution on revenue can then be measured by comparing the indexes computed for the different years.

The results of the simulations performed assuming decreasing fertility rates are shown in Table 4, where the tax revenue gap is measured by the percentage difference between the revenue index computed taking into account the demographic change and the revenue index calculated under the hypothesis of an unchanged population. As is shown in the first row of Table 4, the tax revenue gap will be quite substantial in 2038, when the tax revenue will be reduced by about a quarter. However, observe that the ageing population will exert its adverse effects on the budget only in the second phase of the demographic transition. This is the result of the fact that in the next years there will be more people in the "central" age classes for which wages, labour supply and hence tax revenues are higher.

Another useful measure of the revenue gap is based on the revenue index Tf, which can be considered a structural index, as it measures the revenue loss arising from the "pure" effect of ageing[3]. Then, of the 22% revenue gap expected for 2038, 10% could be ascribed to the ageing of the population structure, while the remaining part is the result of the declining number of inhabitants.

Obviously these results refer only to the revenue side of the budget. It is therefore also necessary to consider the expenditure side. As has been previously shown, total expenditure is expected to remain fairly constant assuming flexibility of non age specific public expenditure (case B, Table 3) or to increase by about 15% in the case of rigidity (case A). In the first case the results obtained in Table 4 give the full budget effect deriving from the demographic change, while in the latter case 15% should be added, implying a tax revenue gap of about 35%.

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[3]The index Tf has been calculated by weigthing the age class tax revenue by the age structure of the population.

TABLE 4
TAX REVENUE GAP (per pent)

Revenue index	2008	2038
T	+7.7	-22.2
Tf	0	-10.6

For definition of T and Tf see the text

It should be remembered, however, that this latter case also assumes full flexibility of specific public expenditure for the young, mostly on education. If public expenditure showed downward rigidity in these items too, then an ageing population would produce very large fiscal imbalances.

To sum up: the demographic changes will produce considerable fiscal effects only in the longer run, while for the next twenty years sizable deficits should not be expected. However, the longer term impact will be relevant: not less then 20% of the total tax bill. A fiscal gap will then occur even in the most favorable hypothesis for public spending.

In order not to complicate matters, from now on we will consider only the case of flexibility of non age specific public spending. Then the figures obtained from the revenue index T can be regarded as a measure of the full impact of the demographic change.

5. Revenue gap under different tax structures and preferences

Let us now consider how the results so far obtained will be modified by considering in turn different population projections, tax structures and parameters of the utility function.

In table 5 we compare values of T and Tf under the hypotheses of constant and decreasing fertility rates. Obviously, under the assumption of constant fertility, the tax revenue loss will be lower, while the structural index will remain mostly unchanged[4].

[4]Data for 2008 are not reported in the table as different fertility rates do not affect significantly the budget at that date.

TABLE 5
TAX REVENUE GAP UNDER DIFFERENT FERTILITY RATES (per cent)

		2038
T	- Decreasing fertility	-22.2
	- Constant fertility	-16.0
Tf	- Decreasing fertility	-10.6
	- Constant fertility	-9.3

For definitions of T and Tf see the text

As explained above, the tax rates were selected in such a way as to reproduce as closely as possible the revenue structure observed for the Italian economy. It would be interesting then to see if and to what extent the impact of the demographic change on the revenue would be different under different tax structures. In particular, we have considered different sets of tax rates which would yield the same total tax revenue as the base simulation at year 1988. The results of these alternative tax structures are shown in Table 6. The higher the share of income taxation on total revenue the higher the revenue gap. On the contrary, if indirect taxation were

TABLE 6
TAX REVENUE GAP UNDER ALTERNATIVE FISCAL STRUCTURES (2038)

	A	B	C	D
T	-22.2	-19.2	-21.1	-24.5
Tf	-10.6	-7.0	-9.3	-13.2

A (base simulation): tw = 0.29 tp = 0.17 tr = 0.20
B tw = 0.20 tp = 0.30 tr = 0.20
C tw = 0.28 tp = 0.17 tr = 0.45
D tw = 0.35 tp = 0.08 tr = 0.20

the bigger source of tax revenue then the revenue gap would be reduced by about 3 percentage points.

Finally we consider how the results obtained are affected by changing the value of preference parameters in the utility function. The revenue gap increases when either ß, the intratemporal elasticity of substitution, or μ, the intertemporal elasticity of substitution, are higher. These effects are obviously stronger when both parameters increase as shown by the principal diagonals of Table 7.

The changes in the tax revenue derive from the fact that changes in both ß and

µconsiderably modify the individual time path of labour supply and consumption. To illustrate this point consider that when ß and µ increase consumption demand will be lower in the first part of the cycle and higher in the second, while labour supply will be higher in the first part

TABLE 7
TAX REVENUE GAP: DIFFERENT PREFERENCE PARAMETERS
Percentage changes with respect to 1988

		TOTAL EFFECT		
β		µ 0.1	0.4	0.7
0.6	2008	+7.6	+7.6	+7.4
	2038	-19.8	-20.8	-21.8
1.1	2008	+7.9	+7.7	+7.2
	2038	-21.2	-22.2	-23.5
1.4	2008	+8	+7.5	+7.1
	2038	+21.9	-23.2	-24.5
		STRUCTURAL EFFECT		
		µ 0.1	0.4	0.7
0.6	2008	0	0	0
	2038	-7.6	-8.8	-10.1
1.1	2008	0	0	0
	2038	-9.3	-10.6	-12.1
1.4	2008	-0.2	-0.3	-0.5
	2038	-10.2	-11.6	-13.2

and lower in the second. On the one hand the tax revenue tends to increase when the population becomes older, because of the shift of the consumption at older ages, while on the other hand the yield of direct taxation will tend to decrease following the shift of labour supply toward younger ages. As this last effect outweighs the former, total tax revenue will tend to be lower when the population becomes older, the higher the intertemporal and intratemporal substitutability.

The effect of the pure rate of time preference is, negligible. The same conclusion applies to the interest rate: doubling the real rate of interest from 2 to 4 per cent will increase the revenue gap by only 2 percentage points.

6. Tax incidence and age structure of population

According to the results obtained from the previous section an increase in the tax burden is likely to occur in order to reduce the fiscal gap generated by the demographic change. As is well known, the effects of a tax increase on individual saving and labor supply are ambiguous because of the opposite signs of the "substitution" and "wealth"

effect. However, less attention has been paid to the fact that the aggregate effects also depend on the age structure of the population, as the tax increase can modify the time path of consumption and labour supply.

In Appendix II the theoretical background is developed for the case of the capital income tax, while below we offer a quantitative assessment of the relationship between age structure of population and tax incidence.

As is well known, from a theoretical point of view the effect of a change of capital taxation on saving is ambiguous. The literature has focused mainly on the attempt to solve empirically this theoretical ambiguity, but little attention has been placed to the role of the age structure of the population in determining the elasticity of saving with respect to the interest rate.

The potential role of such a variable emerges clearly when the effects of a change in net interest rate are analyzed within a life cycle model. As can be shown[5] by differentiating the model illustrated in section 2, an interest rate increase has the following effects on the individual behaviour. If the sum of the own price and cross price elasticities of both demand for leisure and consumption is smaller than one, then both consumption and leisure are increased in the first part of the life cycle and decreased thereafter. These effects are shown in Figure 3 and 4 where the time paths of labor supply and saving are plotted for tax rate on capital income equal respectively to 20 and 40 per cent.

As a consequence, individuals will save less when "young" and dissave less when "old". The aggregate effects of an increase in capital taxation will depend, given the preference parameters, on the age composition of the population. The elasticity of saving with respect to interest rate will become smaller the higher the weight of older people in the economy.

In order to highlight the effects of a capital taxation increase on savings under different age structure of population, we have simulated the aggregate effects of an increase in capital taxation from 20 to 40 per cent, utilizing the current age structure of the population and those expected in 2008 and 2038. In this way we were able to verify how the aggregate propensity to save is sensitive to the age composition of the economy. The results are shown in Table 8 where two gross interest rates are considered (2% in Table 8a and 4% in Table 8b). As is apparent from the base simulation, S, the age strucutre has non negligible effects on the net interest rate elasticity of saving. While today, according to the life cycle simulation, the rate of saving would decrease by more then 1 point (with a gross interest rate of 4%), with a much older population structure, like the one expected in 2038, the rate of saving would in fact be increased by almost the same amount.

It emerges how an increase in capital taxation can have opposite effects on saving according to the age structure of the population. This result holds also with different preference parameters, even if the absolute changes in saving rate are obviously different.

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[5]For a proof see the Appendix II.

SAVING AND CAPITAL TAXATION

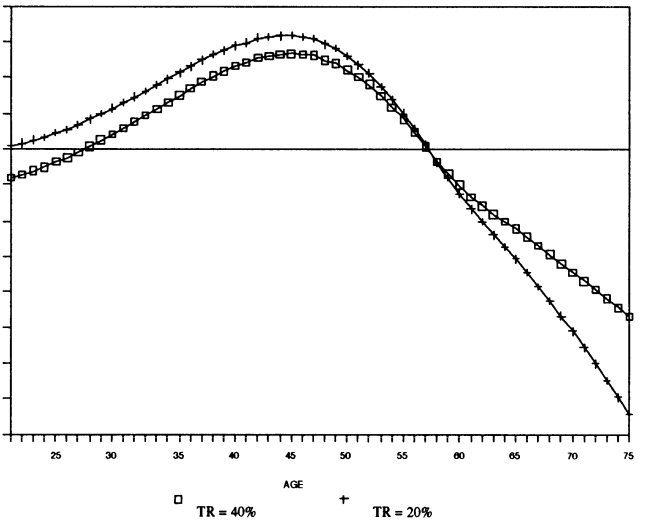

Figure 3

LABOUR SUPPLY AND TAXATION

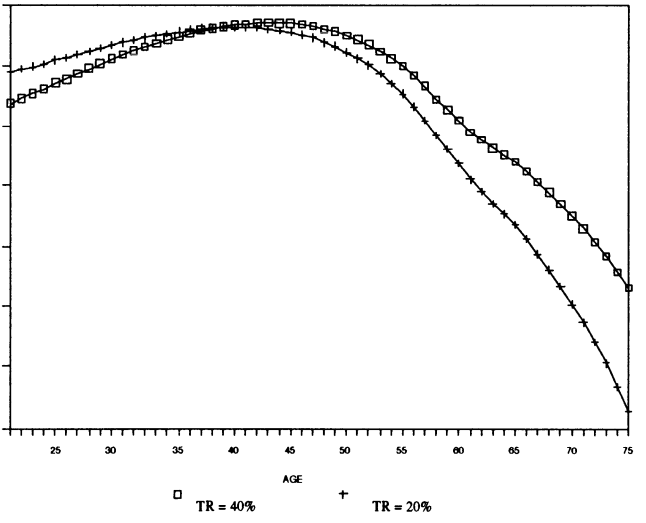

Figure 4

A similar exercise has been performed for the effects of an increase of direct taxation. As is shown in Table 9, an increase in direct taxation tends to reduce the rate of saving when the centre of gravity of population is between 20 and 45 years of age, while it will increase saving for older age structures. On the contrary, the effects on labor supply tend to be stronger the older the population. The neutrality of inderect taxation with respect to savings and labor supply is not modified once different age structures are taken into account.

TABLE 8
EFFECTS ON SAVINGS OF AN INCREASE IN CAPITAL TAXATION
(From 20% to 40%) (Absolute changes)

a) Gross interest rate 2%			
	S	S1	S2
1988			
2008			
2038			
b) Gross interest rate 4%			
	S	S1	S2
1988			
2008			
2038			

S $\mu = 0.4$; $\beta = 1.1$
S_1 $\mu = 0.1$; $\beta = 0.6$
S_2 $\mu = 0.7$; $\beta = 1.4$

TABLE 9
EFFECTS OF AN INCREASE IN DIRECT TAXATION
FROM 29% TO 39%

	SAVING RATE*	LABOUR	SAVING RATE*	LABOUR	SAVING RATE*	LABOUR
1988	-0.5	-0.7	-0.4	+2.7	-0.7	-2.6
2008	-0.5	-0.7	-0.4	+2.7	-0.6	-2.7
2038	+0.7	-0.9	+0.4	+3	+0.9	-3.4

S $\mu = 0.4$; $\beta = 1.1$ * Absolute change
S_1 $\mu = 0.1$; $\beta = 0.6$
S_2 $\mu = 0.7$; $\beta = 1.4$

Finally, Table 10 sets out the change in tax rates required to absorb the fiscal imbalances due to the demographic changes and the effects that such tax rate changes will have on labour supply and savings. In particular, for various hypotheses about individual preferences, it shows the level of tax rate, direct or indirect, necessary to keep the budget balanced while holding the other tax rate constant. The effects of such tax rate changes on wealth, labour supply and saving rate, computed using the 2038 age structure, are also reported in the table. It is clear that the required tax rates changes are quite substantial. In the case of our "base" simulation, for example, the direct tax rate should increase by about 17 points or the indirect tax rate by about 23 points in order to absorb the fiscal imbalances due to the change in the demographic structure. Again, the higher both the intertemporal and the intratemporal substitutabilities are, the higher the tax adjustment required will be. In fact smaller values of ß and μ give rise to a smaller elasticity of labor supply to real after-tax wage rates[6] thus implying that smaller tax increase are required to balance the budget.

As far as incentive effects are concerned, it appears from these simulations that an increase in wage taxation is liable to give rise to strong negative effects on labour supply and wealth, while indirect taxation appears to be much more neutral, especially as far as accumulation is concerned. In particular, observe that the effects on labour supply of an increase in indirect taxation are half as large as those arising from a change in direct taxation, while as far as accumulation is concerned indirect taxation appears to be almost neutral this is also due, obviously, to the strong carry over effect that indirect taxation has on savings, especially when the population is very "aged".

Moreover indirect taxation implies a smaller reduction in consumption compared to direct taxation. This is the result of the fact that consumption shows a smoother time-profile then labour supply. This implies a postponement of the tax payment and therefore a reduction in the individual tax burden due to the positive real interest rate.

---

[6]For the simulation S_1 labour supply turns out to be backward bending.

TABLE 10
INCENTIVE EFFECTS OF BALANCING THE BUDGET IN 2038

		dtw = +0.17	dtp = +0.23
	WEALTH	-24.1%	-0.2%
S	LABOR	-1.7%	-1.2%
	SAVING RATE	+2.8%	-0.1%
		dtw = +0.105	dtp = +0.175
	WEALTH	-13.3%	+1.5%
S_1	LABOR	+3.1%	+2.7%
	SAVING RATE	+1.3%	+0.1%
		dtw = +0.29	dtp = +0.29
	WEALTH	-41.3%	-0.3%
S_2	LABOR	-11.6%	-5.0%
	SAVING RATE	+4.9%	+0.7%

S $\mu = 0.4$; $ß = 1.1$ d = Change in tax rate
S_1 $\mu = 0.1$; $ß = 0.6$
S_2 $\mu = 0.7$; $ß = 1.4$

As far as rates of saving are concerned they are almost unaffected by an indirect taxation increase, while they tend to rise following a direct tax hike. This positive relationship between wage taxation and saving reflects the fact that, in life cycle models, the relationship between gross income and saving also depends on the population's age structure. When the population increases higher income implies higher saving rates. The contrary holds when population decreases. As a consequence an increase in wage taxation in a context of decreasing population will generate a higher saving rate.

APPENDIX I

The Hamiltonian associated with the household problem (2.1) is:

$$H = e^{-\sigma t}U[X(t), L(t)] + h(t)[r(1-tr)A(t) + (1-tw)W(t)(1-L(t)) - (1-tp)P(t)X(t)]$$

where h is the costate variable.

The first order conditions for a maximum are:

$$\dot{A}(t) = \frac{\partial H}{\partial h}$$

$$\dot{h}(t) = \frac{\partial H}{\partial A}$$

$$\frac{\partial h}{\partial X} = \frac{\partial H}{\partial L} = 0$$

$$h(T)A(T) = 0$$

The transversality condition together with the hypothesis of nonsatiation implies A(T) = O. Therefore the necessary conditions for an optimum require, in addition to constraint (2) and initial condition (3), the following equations to be satisfied[7]:

$$\dot{h} = -h(t)r$$

$$\frac{\partial H}{\partial X} = e^{-\sigma t}U_x - (1+tp)P(t)h(t) = 0$$

$$\frac{\partial H}{\partial L} = e^{-\sigma t}U_L - (1+tw)W(t)h(t) = 0$$

from which

$$h(t) = h(o)e^{-\sigma t} \qquad \text{(A1)}$$

$$U_x(t) = h(t)e^{\sigma t}(1+tp)P(t) \qquad \text{(A2)}$$

$$U_L(t) = h(t)e^{\sigma t}(1-tw)W(t) \qquad \text{(A3)}$$

If we utilize eq. (A1) and strict concavity of U, first order conditions (A2) and (A3) may be inverted to reach the following "marginal utility" constant demand functions, h(o), for goods and leisure:

$$X = X[h(o)e^{(\sigma-r)t}(1+tp)\ P(t), (1-tw)W(t)h(o)e^{(\sigma-r)t}] \qquad \text{(A4)}$$

---

[7]The substitution of demand functions (2.7) and (2.8) into the Hamiltonian reveals that the maximized Hamiltonian is linear in the state variable. Therefore the necessary conditions are also sufficient for an optimum. See Arrow - Kurz (1970), p. 45.

$$L = L\left[h(o)e^{(\sigma-r)t}(1+tp)\ P(t),(1-tw)W(t)h(o)e^{(\sigma-r)t}\right] \qquad \text{(A5)}$$

APPENDIX II

To evaluate the effects of a change in capital taxation we will consider changes in the average tax rate on capital income as, given the assumption of perfect capital markets, this is equivalent to a change in taxation on capital assets[8]. By differentiating eq. A5 we get

$$\frac{\partial L}{\partial tr} = \frac{\partial L}{\partial h(o)} \cdot \frac{\partial h(o)}{\partial tr} + \frac{\partial L}{\partial tr}\Big|_{\bar{h}(o)} \qquad \text{(A6)}$$

where $(\partial L/\partial tr)|\ h(o)$ is the intertemporal substitution effect and the first term on the right hand side is the "wealth effect". The intertemporal substitution effect is given by

$$\frac{\partial L}{\partial tr}\Big|_{\bar{h}(o)} = h(o)r\tau e^{(\sigma-r^*)}\left[L_1(1+tp)P + L_2(1-\mu)W\right] < 0 \qquad \text{(A7)}$$

Analogously from the consumption demand (eq. A4) we get

$$\frac{\partial L}{\partial tr}\Big|_{\bar{h}(o)} = h(o)r\tau e^{(\sigma-r^*)}\left[X_1(1+tp)P + X_2(1-\mu)W\right] < 0 \qquad \text{(A8)}$$

a reduction in the real after tax interest rate, due to an increase in capital taxation, implies a flattening of the time path of consumption and leisure. In order to sign the wealth effect we fully differentiate the intertemporal budget

constraint:

$$\begin{aligned}
&\int_o^T r\tau e^{(\sigma-r^*)\tau}(1-tw)W(1-L)d\tau = \int_o^T r\tau e^{(\sigma-r^*)\tau}P(1+tp)Xd\tau + \\
&+\int_o^T r\tau e^{(\sigma-r^*)\tau}(1+tp)Ph(o)e^{(\sigma-r^*)\tau}r\tau\left[X_1(1+tp)P + X_2(1-\mu)W\right] + \\
&+(1-tw)Wh(o)e^{(\sigma-r^*)\tau}r\tau\left[L_1(1+tp)P + L_2(1-\mu)W\right]d\tau + \\
&+\frac{\partial h(o)}{\partial tr}\sum^*
\end{aligned} \qquad \text{(A9)}$$

from which:

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[8]The following analysis draws eavily from Quintieri-Rosati (1990, chap. 5).

$$\frac{\partial h(o)}{\partial tr} = \frac{1}{\sum^*} \int_o^T r\tau e^{(\sigma - r)\tau} \left[\dot{A} - (1 - tr) rA \right] - \frac{Q}{\sum^*} \tag{A10}$$

where Q indicate the second integral on the right of equal side of equation (A9). This integral has a negative sign, as from the assumption of normality it follows that the terms in square brackets are negative. In general it is not possible to unambiguously sign the first integral of equation (A10). The overall effect is then undetermined. However the wealth effect can be unambiguously signed when some restrictions are imposed on the utility function. We can rewrite eq. (A9) as

$$\begin{aligned} &\int_o^T r\tau e^{(\sigma - r^*)\tau} P(1 + tp) X \left[1 + \frac{P}{X}(1 + tp) h(o) e^{(\sigma - r^*)\tau} X_1 + (1 - tw) W h(o) e^{(\sigma - r^*)\tau} \cdot \frac{X_2}{x} \right] d\tau + \\ &+ \int_o^T r\tau e^{(\sigma - r^*)\tau} WL(1 + tw) \left[1 + \frac{P}{L}(1 - tp) h(o) e^{(\sigma - r^*)\tau} L_1 + \frac{W}{L}(1 - \mu) h(o) e^{(\sigma - r^*)\tau} \cdot L_2 \right] d\tau + \\ &+ \frac{\partial h(o)}{\partial tr} \sum^* = 0 \end{aligned} \tag{A11}$$

from which we get:

$$\begin{aligned} &\int_o^T r\tau e^{(\sigma - r^*)\tau} P(1 + tp) X \left[1 + E_{X,1} + E_{X,2} \right] d\tau + \\ &+ \int_o^T r\tau e^{(\sigma - r^*)\tau} WL(1 - twtp) \left[1 + E_{L,1} + E_{L,1} \right] d\tau + \frac{\partial h(o)}{\partial tr} \sum^* = 0 \end{aligned} \tag{A12}$$

where Eij is the elasticity of good i with respect to the argument j of the utility function. If the sum of the own and cross price elasticity is smaller then -1, then:

$$\frac{\partial h(o)}{\partial tr} < 0 \tag{A13}$$

In this case the wealth effect will generate an increase in the demand for leisure and consumption. The overall effect of a change in capital taxation is shown in Figure A1 and A2. The flattening of the time path of consumption and leisure, which follows a reduction in the after-tax interest rate, is shown by L_A toward L_B. The intertemporal wealth effect shifts further the demand curve from X_B to X_C and from L_B to L_C respectively.

If the sum of the own and cross elasticity is smaller then -1, the new and the old path will cross at some point in time, not necessarily equal for consumption and leisure. This implies

that an increase in capital taxation will induce an increase of consumption and leisure early in the life and a reduction in a later part of the life cycle.

As far as the rate of saving is concerned the effects of a change in t_r are given by:

$$\frac{\partial \dot{A}}{\partial tr} = -rA - P(1+tp)\frac{\partial X}{\partial tr} - W(1-tw)\frac{\partial L}{\partial tr} \qquad \text{(A14)}$$

as

$$\frac{\partial X}{\partial tr} \quad and \quad \frac{\partial L}{\partial tr} \qquad \text{(A15)}$$

are positive, at least just following the increase in taxation, and become negative later on, the saving rate will be reduced in the first phase of the life cycle and increased later on.

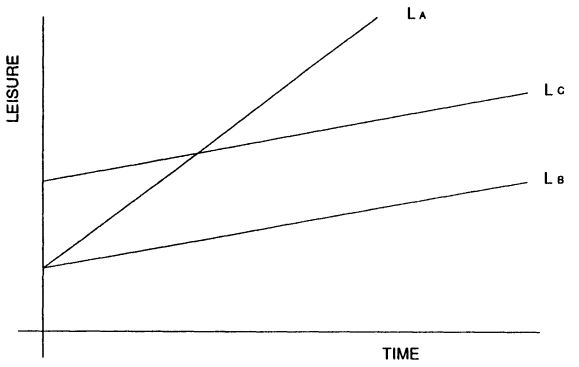

Figure A1

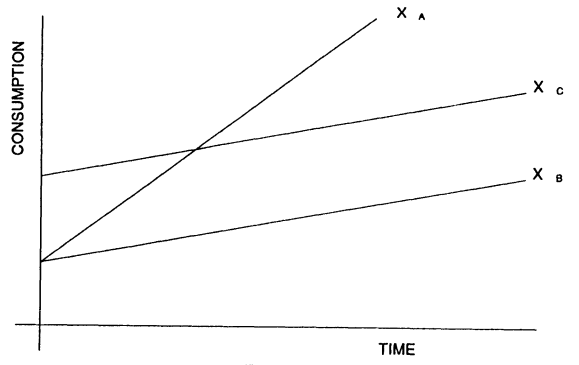

Figure A2

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PART II

Non Marginal Tax Reforms

FROM PERSONAL TO INDIRECT TAXATION: A GENERAL EQUILIBRIUM APPROACH

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1. Introduction

The tax reform that came into force in Italy in 1973-74 was the result of a consistent effort in order to realize a rational scheme founded on certain tax principles, i.e. effective income as a tax base, transparency and progressivity among others[2]. Even if its final outcome was somewhat less ambitious than expected, actually the reform led to a share of direct taxes above 50%, mostly due to the personal income tax (IRPEF), as opposed to the previous Italian fiscal system which was largely founded on the indirect taxes. Nevertheless, the tax reform was achieved in a time of changing ideologies and of upheaval in the economic and social system: after so much effort, it came about just when the principles which it was based upon were coming under discussion. In fact direct taxation was seriously questioned, and under the impulse of changed environmental conditions, opinion moved heavily in the opposite direction away from direct taxation. As far as IRPEF is concerned, its high revenue, paradoxily, was surely responsible for the most critical reflections. Among the specific factors, which contributed in reducing the limits of tolerance of the fiscal burden on those classes actually affected by the tax, one can note:

i) the enormous reduction in the purchasing power of money, which led the real tax rates upwards;

ii) heavy tax erosion and tax evasion, both of them negative features of IRPEF as far as equity is considered: one could perhaps wonder whether IRPEF is now a badly designed special tax rather than a general one;

iii) the urgent need for yield, implied by the dynamics of public expenditure, which until recently prevented even partially recovering fiscal drag.

Even if those perverse aspects of IRPEF made Italian tax-payers particularly sensitive and the experts particularly critical, this problem is affecting all industrialised countries. During the 70s and 80s, international literature was full of the everlasting debate on fiscal principles. A strategy of personal income tax reform took shape, based on the broadening of the tax base, and on the flattening of tax rates. For the USA, in particular, reflections on these questions had their result in Tax Reform Act in 1986, which actually led to a more suitable tax base and to quite a different kind of progressivity.

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[1]This work was undertaken under the auspices of grant number 89.051120.10 from C.N.R. We are grateful to Tom Rutherford for letting us use his MPS.GE algorithm.

[2]See: Stato dei lavori della commissione per lo studio della riforma tributaria, Giuffrè, Milano, 1964.

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IRPEF modifications in the recent years have simply focused on fiscal drag cutbacks obtained through the abatement of legal tax rtes and the revaluation of some tax allowances: i.e, a simple arrest in effective tax progressivity has been realized.

Since the real questions have not been faced, we have deemed to add our contribution to the collective reflection on IRPEF. At first we started probing the progressivity of IRPEF but the simulations performed in our model[3] showed that progressivity is not able to affect the Italian situation, since big changes in its scale are necessary to obtain small changes in the income distribution. In other words, as far as IRPEF is concerned, the main problem is its tax base which is too small and lacks equity, due to tax evasion and tax erosion. We then decided to focus on partial tax reforms directed to shift a certain amount of revenue from direct to indirect taxation, and precisely from IRPEF to value-added tax. In fact the general taxation on exchanges seems the most appropriate in order to replace IRPEF's yield since it allows the greatest theoretical tax base. As far as the methodology is concerned, an applied (computable) general equilibrium model appears to be most appropriate to evaluate the topical measures -such as the above mentioned one- whose effects are the outcome of many variables. In such a case it is extremely difficult, if not impossible, to forecast their direction or dimensions.

In section 2 our model is briefly described, listing its principal features in order to furnish a reference pattern for evaluation of the results of the performed simulations; in section 3 details are reported in as far as the Italian tax system is dealt with in the model. The results of the simulations by which about one third of the IRPEF revenue is replaced by a value-added tax are described and commented on in sections 4 and 5: in the former the ordinary VAT yield is increased, while in the latter an income-type VAT is introduced.

2. The model

ITALIA/GE is a disaggregated competitive general equilibrium model for the Italian economy, essentially designed for evaluation of the effects of total fiscal structure and of single tax or expenditure policy. This model follows the tradition of Walrasian computational models, where primary production factors (capital and labour) are formally in condition of full employment, even if labour supply fluctuates according to wage rates, while capital services are fixed to the level specified by capital incomes in the reference year 1982.

This version of the model is static, because it refers to a single time period and does not consider effects produced by current savings on the future capital stock. Intertemporal choice has been modelled only for the part of consumer's savings that finances the purchase of an investment good, defined as the fictitious output of the last productive sector that changes the goods of different sectors requested as investment into a single homogenous good. The Government deficit as well as the balance of trade deficit are workable in the model by means of the above defined investment good: the balance of this market implies

[3]See: A. Fossati (ed.), Equilibrio generale e simulazioni, F. Angeli, Milano, 1991.

that household savings or foreign investments provide money for the Government and balance of trade deficits.

General equilibrium requires that all markets be in balance and that all subjects satisfy their budget constraints: in the ITALIA/GE model these conditions are verified through a transaction table where each row refers to a market and each column to an economic subject, i.e. a sort of SAM matrix. Since we started from the input-output table, we had to assume more detailed information both for the value-added and for the consumption side. In fact in the input-output table the value-added is usually split between compensation of employees and gross operating surplus, whilst for a general computable model, a more detailed distinction is necessary in order to model the substitution among non-produced factors and to specify the parameters of a value-added production function. In particular, we considered wages and salaries, self-employed labour income and capital and enterprise income.

The most relevant integrations, however, refer to the final use of goods and services, inasmuch as households' final consumptions are imputed to the nine units of consumption defined in the model. That is to say, the production of each sector is imputed to each consumption unit, and similarly each components of value-added for every productive sector is imputed to each consumption unit. There are 44 industries or productive sectors that represent an aggregation of single firms or sub-sectors, denoted solely by their output[4]. The last productive sector represents the supply of collective services. To describe each productive industry a technology represented by a two stages function with constant-returns-to-scale has been used: at the bottom level the value added is obtained combining primary factors (self-employed labour, employees' labour and capital) with a Cobb-Douglas technology; at the top level a Leontief function, with fixed coefficients, combines intermediate goods with the value added; in the second stage, the imported goods for each sector and the comsumption of fixed capital also appear. Inputs and outputs derive from the usual process of profit maximisation, under the constraint of the available technology, while the assumption of constant returns to scale allows distinct specification both of the demand for inputs for each production level and the production scale indicated by a level of activity.

With regard to the consumption side, nine standard consumers have been defined, each of them representing an aggregation of households grouped by their average income; other two sui-generis consumers represent, respectively, the General Government and the Rest of the world. Households belonging to the same income group are considered as individuals, homogeneous in their economic behaviour and with equal preferences; each income class, or consumption group, corresponds therefore to one consumer. The nine consumers differ in their available income and their preferences.

In the basic version of the model, consumers' demand (and labour supply as well) derives from the maximisation of a nested utility function of the Cobb-Douglas/CES kind under the constraint of individual income endowment, including General Government transfers: the latter are allocated as indexed lump-sums in order to take care of price changes occurring in the simulations. At the first stage of the maximisation process consumers allocate their full

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[4]However, these simulations have been performed in an aggregate version whith 17 production sectors.

income[5] between current consumption (UT) and future consumption or investiment good (I)[6]. Later, they allocate UT between the consumption of commodities (G) and leisure (l) according to a Cobb-Douglas sub-utility function. At the last stage the consumption demand is divided into the purchase of single goods by a CES function, the elasticity of which is set to 0.75[7].

In an alternative version a L.E.S. (linear expenditure system) was used: this functional form makes it possible to specify different income elasticities for each commodity, thus overcoming one of the less acceptable constraints of the CES[8].

Nested structures, whilst they permit the overcoming of some of the most restricting features of constant substitution elasticity functions, they do not seem so satisfactory. Then -in a third version of the model- a flexible, non-separable, two stages CES function, suggested by Perroni and Rutherford (1989) has been implemented. Note however that, for the flexible functional forms we adopted, the criterion of adaptability to general equilibrium models is evaluated on the grounds of a more restricted definition of flexibility[9].

The General Government receives the revenue of all taxes, makes the transfers to consumers and demands the output of the last productive sector. Government bonds are considered as perfect substitutes for real capital in households' portfolios and therefore current public deficit has been modeled as a fixed endowment of investment goods belonging to General Government. Payment for public debt interests is represented by a negative endowment of capital services.

As far as the Rest of the world is concerned, capital transfers are not considered, and international trade transactions have been modelled according to three different versions: a basic version, a small open economy and a mixed formulation with fixed prices for imports and variable prices for exports. In the basic version just export demand and import supplies with constant price elasticity are specified for Italy. In this way, it is possible either to use price elasticity values derived from ad hoc econometrical estimations, or to consider particular cases, relevant from a theoretical point of view. According to Armington assumption, import goods are considered different in quality from identical domestic exports. The balance of trade deficit (or surplus) has been dealt with letting the rest of the world buy domestic investment goods up to the deficit value itself.

The provision of collective services is kept constant in quantity, while transfers to consumers have obviously been indexed so that total public expenditure is kept constant in real terms.

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[5]Full income includes monetary evaluation of leisure.

[6]Substitution elasticity between these two components is set to 0.5.

[7]This value should be based on non-compensated demand elasticity. However, because of the deficiency of econometric estimations, it represents the best compromise between the polar cases of constancy in value expenditure shares (unitary elasticity) and constant rates (zero elasticity).

[8]In order to evaluate these elasticities, an "ad hoc" econometrical research has been carried out, using the ISTAT sampling inquiries upon family consumptions during 1982. In order to estimate LES system, we have considered 7 expenditure classes and built a matrix of transiction, with fixed coefficients, between the 16 produced goods and the 7 consumption goods.

[9]Perroni-Rutherford (1989: 10-14).

In order to evaluate the excess burden of different taxes equivalent variations are used, sometimes summed up for all economic subjects. However, since in ITALIA/GE model the nine consumers have different preferences, the use of such an aggregate welfare index doesn't seem justified as a direct measure of collective welfare, because it doesn't consider the marginal social utility of income. Such an index might perhaps be theoretically justified by the so called "Kaldor criterion".

3. The tax system

Problems in modelling the tax system stem from the complexity of the tax structure and the model's stylizations, but available statistical information and economic system features (fiscal evasion) play a substantial role as well. Dramatic simplifications, in particular concerning tax base and rates structure, are usually necessary, which may bias simulation results so that such choices should be accounted for carefully; in this paper, however, just a few hints are provided owing to reasons of space and as the technicalities regarding the Italian fiscal system might seem too demanding.

While minor taxes have been grouped into two residual taxes, "other direct taxes" and "other indirect taxes", ten taxes have been distinctly modelled for over 92% of the General Government total fiscal revenue. Such taxes are: IRPEF (progressive personal income tax), IVA (value added tax), ILOR (tax on capital income), INVIM (tax on capital gains on real estate), IRPEG (corporate income tax), social security contributions, interest withholding tax, motor vehicle tax, mineral oils excise tax and import taxes.

As far as the determination of tax rates is concerned, most of the *ad valorem* tax rates are calculated as the ratio between tax revenue and tax base.

IRPEF is considered by applying an increasing rate to the tax base, so that its tax revenue is formally defined in terms of income (Y, or tax base) as $T(Y) = a + bY + cY^2$. The particular form of T(Y) and its parameters have been interpolated from fiscal data taken from Ministero delle Finanze (1983). Such data, referred to single tax-payers, had to be made consistent with the model's data referred to conventional subjects. IRPEF structure has been drastically simplified, not only for the estimation of the tax rates (quadratic in yield terms), but most of all for the omission *tout court* of all imposition details, from tax deductions to allowable expenses, etc. However, these details have been indirectly considered because the estimation of the T(Y) function was performed on fiscal data inclusive of the effects of such IRPEF structural features. The main reason for this simplification is the impossibility of considering personal aspects of taxation to model the tax with reference to conventional subjects; for this reason we may claim to approach the progressivity of personal income tax with sufficient realism, although in a very simplified form. With this tax scheme, obviously, consumer budget constraint is no longer linear when income changes, because it is:

$$\sum_{n=1}^{n} p_n q_n = \sum_{n=1}^{n} w_n p_n - \left(a + bY + cY^2\right)$$

The problem of making linear the constraint in the presence of a progressive tax, is usually worked out by imposing a linear tax with different rates and deductions for each consumer. With more generality it is here dealt with by applying to all consumers a marginal tax equal to $T_{mg} = b + 2cY$, and by returning as lump sum a fictitious income equal to $YT = cY^2 - a$. Possible shifts due to the simulations effects- of consumers from one income class to another are thus avoided.

ILOR, IRPEG and interest withholding tax are considered as ad valorem taxes on capital use; however, while ILOR is levied on firms, the other two taxes are directly payed by the consumers. Interest withholding tax are imputed proportionally to the total capital income of each class.

The value-added tax (IVA) may be considered as an ad valorem tax on final consumption of domestic and imported goods; in such case, however, important details on the transmission mechanisms of this tax are lost, and owing to the huge tax evasion, the modeled tax appears quite different from the real one, providing biased results of the simulations. On the other hand application of ad hoc rates on final consumption (considering tax evasion) would lead to hypotheses on the distribution of evasion itself.

The assembling of an IVA map with positive and negative rates for the input-output component, which could almost precisely represent tax mechanisms, appeared to be the best solution. The ITALIA/GE model has been therefore designed for the introduction of such a map of IVA[10], but at present, rates have been calculated ad hoc to coincide with the amount of tax paid by each sector (the only data available at the moment).

Actual and imputed social security contributions have been modelled as a tax on the use of labour, levied on productive sectors; consequently the model labor income owed to consumers is evaluated net of any social security contributions.

4. Increase of the existing VAT revenue

The imminence of a single market, to be achieved by 1992 among the EEC member countries, has particularly provoked debate on fiscal harmonization with regard to VAT and other indirect taxes in order to achieve a complete abolition of fiscal barriers. The latter, together with the principle of taxation according to destination country, has until now allowed wide policy margins to fix rates and tax basis. Since VAT and duties harmonization would imply that member countries give up this policy possibility, the Commission of the European Communities, in order to overcome oppositions, suggested discussion topics, summarized in the so called "Cockfield plan", which proposed different solutions for VAT and duties. With regard to the former, it recommended the adoption of the principle of taxation according to the country of origin and the harmonization of rates and tax basis. To maintain a certain taxation power for member countries, the proposals boiled down to reducing the number of the VAT rates to two, and to giving the faculty of fixing them in a

[10]At present such a map is on the way of being elaborated.

restricted range. In particular, the reduced VAT rate had to be fixed between 4% and 9%, while the ordinary rate should be set between 14% and 20% . Even if those proposals are frozen at the moment, they are nonetheless quite interesting. Thus in our first exercise devoted to analysing the effects of a reduction of personal income tax balanced by an increase in VAT revenue we thought it reasonable to conform to the above mentioned proposal of just two VAT rates within the fixed ranges.

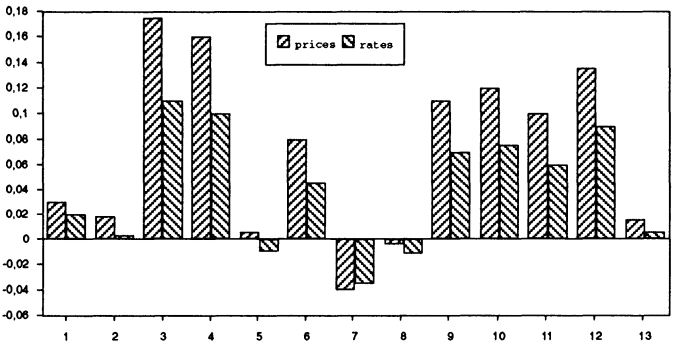
The exercise consists in imposing an exogenous equiproportional lowering of IRPEF rates of 30%, while the two VAT rates are endogenously determined to remain within the above mentioned ranges. With revenue shifting from IRPEF to VAT of 11,500 billion Italian lire, such VAT rates are set to 6% for the reduced rate and to 20% for the ordinary rate. Specifically, the reduced rate affects large consumption commodities and it has been applied to goods produced by sectors 1 (agriculture), 2 (energy materials), 5 (chemical and pharmaceutical products), 8 (food) and 13 (transport). The remaining sectors are charged with the normal rate, with the exception of industries 14, 15 and 16, which correspond to services exempted from IVA (insurance and credit, leasing or renting of real property and collective services).

As a conseguence of the adopted VAT modelling, the obtained rates can hardly be those actually applicable to transactions of different goods, as these are affected by a widespread evasion, which differs among the various productive sectors. The rates of our model are, in fact, generally lower than the actual corresponding ones: the most relevant deviations appear in sectors such as retail trade, hotels and clothing, where huge tax evasion is probably hidden[11]. In evaluating the effects of policy simulation that imply a grouping of all actual rates into only one or two, this feature, however, does not appear able to bias the results obtained.

In comparison with the initial benchmark condition, VAT rates are decreased for goods produced by sectors 5, 7 and 8, while they are increased for the remaining goods; in general, market prices shift in the same direction, since VAT acts as a wedge between producers' costs and market prices. Percent VAT rates and price changes are showed in figure 1; as far as market prices are concerned, they are expressed in terms of employees' labour, which is used as a numerary since in our model we deal with relative prices.

[11]For this reson we have in the simulations preferred to let the two tax rates establish endogenously with the budget constraint rather than to fix them exogenously within the ranges provided by commission proposals.

Figure 1 - Prices and tax rates variations

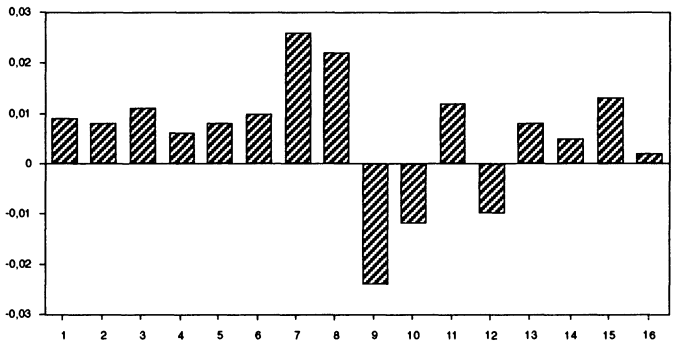


It is interesting, however, to note that the price of sector 5 (chemicals and pharmaceuticals), while it records a small tax rate decrease, it nevertheless receives a price increase. The reason for this behaviour can be sought both in the cost structure and in the demand conditions of the sector considered. As far as inputs are concerned, sector 5 requires a big amount of the commodity produced by sector 3, and it is heavily dependent on imports as well. In fact, the price of sector 3 records the highest cost increase, while import price increased owing to changes in the terms of trade. In regard to the demand side, sector 5 output is more than 50% directed to intermediate consumption, the structure of which is quite inelastic.

The price of sector 3 (minerals and metals) records the highest increase (18%), which is bigger than the maximum VAT rate on gross prices (17%). Perhaps the reason for this price increase lies on the demand side, since more than 80% of its output goes to productive sectors, but sector 3 is largely dependent on the rest of the world as far as inputs are concerned. In this respect sector 2 (energy products) is quite similar: actually the latter gets the highest percent price increase compared with the respective VAT rate increase. Similar considerations hold true for the cost structure and for the demand conditions of sector 4 (non metallic minerals), 12 (retail trade, hotels), 11 (buildings and public works), the output of which is the most important intermediate consumption for the fictitious sector that produces the investment good.

With relation to the sectors 9 (textiles, leathers and clothing) and 10 (manufactures), perhaps their price increases might be explained on the cost side, as both sectors demand a large quantity of sector 12 output (whose price recorded a large increase): in fact sector 12's commodity is their most important intermediate input, and their major cost component as well.

Figure 2 - Variations in activity levels



Changes in the activity levels are showed in Figure 2: they depend upon profit opportunities in the different sectors, which, in turn, depend on prices net of taxes and on production costs. It is remarkable that activity level decreased in sectors 9 and 10, i.e. in the industries whose price increase has been tentatively explained by cost considerations, and that activity level decreased in sector 12 as well, whose output is chiefly employed in the mentioned sectors 9 and 10.

The highest percent increases in activity level are achieved in sectors 7 (motor vehicles and relative motors) and 8 (food), the only two industries whose prices and VAT rates both fell, if compared with the initial benchmark situation. As far as sector 5 is concerned, one could perhaps guess that the price increase did not hamper the increase in activity level owing to the inelasticity of demand, both of final and of intermediate consumptions - which was helped by VAT reduction.

On average, exports increased by 2.7% in value, while imports increased by 3.1% (in quantity, respectively, by 1.7% and 0.9%). In fact, on average, imports prices increased by 2% and the balance of trade deficit increased by 1,268 billion Italian lire, so that the policy effects on foreign exchange do not seem particularly relevant. The price increase of imports seems responsible in the deficit increase, since import demand is inelastic in so far as imported goods are inputs (with fixed coefficients) in the production of the same domestic industries.

As mentioned above, the proposed fiscal policy shifts about 11,500 billion Italian lire from IRPEF to VAT revenue. Turning to welfare changes, the results seem negative, as showed by the data reported in table 1. In fact just the top consumers group gets a welfare gain of about 1,320 billion Italian lire. The other eight income groups record a welfare loss - though quite small for the eighth group. Since tax progressivity is affected both by IRPEF and by VAT (in so far as VAT rates on necessities are increased), this result is not surprising; however, VAT distorts individuals' consumption-leisure decisions more than IRPEF, because it induces larger increases in the prices of necessities.

In performing other simulations with different revenue, these results are confirmed. By shifting a decreasing amount from the initial 11,500 billion Italian lire, the welfare losses of the first income classes notably reduce. The welfare gain of the top consumers group reduces

as well, while the loss for the eighth group increases. On the contrary, shifting an increasing amount from the initial 11,500 billion Italian lire increases the regressive character of this policy, while the loss for the eighth group decreases until it turns into a gain.

The welfare loss of the middle classes (corresponding to medium-high income levels) seems to depend on individuals consumption-saving decisions, that is to say on savings decisions. In particular as far as groups 6 and 7 are concerned, they get small losses or gains as far as consumption-leisure decisions are concerned, while a small positive effect appears on the income side, due to the increase in capital price (about 0.6%), of whom these two classes are the principal holders. This small gain is more than compensated by a depressive effect on savings because of the price increase of the investiment good (about 4%).

As evidenced in table 1, the change in labour supply is small for all the consumer groups; it seems interesting to point out that all classes were stimulated to increase the supply of labour, as this result comes from the reductions in income tax rates that increases the after-tax returns to labour.

Table 1

consumer groups	equivalent variations (billions)	labour supply variations
1	- 165.22	0.20%
2	- 148.50	0.12%
3	- 328.99	0.23%
4	- 278.55	0.20%
5	- 215.76	0.14%
6	- 595.74	0.25%
7	- 427.71	0.31%
8	- 29.54	0.30%
9	1319.70	0.99%

In substance, market commodity prices and tax rates changed in the same direction; to this main effect one might add a cost increase for firms, conveyed by the worsening in the terms of trade and by the consequent price increase of imports. The price of capital raised compared to wages, and the investment good price raised as well.

Because of the changes in relative prices of capital and labour and the general production improvement, demand of labour increased. Total labour supply raised as well; since labour supply increase results from an increment of both employees and self-employed in the same proportions, the price of the self-employed labour must decrease to allocate the excess supply in the market.

As far as welfare effects are concerned, a small regressive feature resulted: the aggregate welfare loss is about 870 billion Italian lire, corresponding to the 0.17% of GNP. The balance of trade deficit recorded a worsening of a quite limited size: however, this result may depend on the imports and exports price-elasticities fixed in the model. Sensitivity analysis

on such parameters confirmed the findings, both for the movements of imported and exported quantities, and for the small increase in the balance of trade deficit. The elasticity values used in the standard model are taken from Biagioli, Chiesa, Gomel and Parmigiani (1983), while those used in the sensitivity analysis were taken from Ricotta (1986): import elasticity ranges from 0.54 to 0.78, and export elasticity varies from 1.38 to 2.23. Moreover, the elasticity values reported by Gandolfo (1981) were checked, since his export elasticity is particularly small (0.63), while his import elasticity value is negative (-0.19): in that case the results are quite different. First, they show a total welfare improvement of about 6,224 billion Italian lire, corresponding to 1.2% of GNP, while all the nine consumers groups get a welfare gain. This result seems explainable by the price increase both of self-employed labour and of capital, while effects on commodity prices are, in general, more limited than those obtained in the previous simulations (i.e. prices decrease for goods produced by sectors 2,5,7,8,14 and 16, while increases for remaining goods are quite small). Finally, the balance of trade deficit is reduced by 1,257 billion It. liras. Clearly, this result depends upon the import elasticity value, since the imports demand growth, related to the general production increase, faces an import supply curve with a negative slope and determines a large decrease in the import prices (5%).

5. Introduction of an income-type VAT

The second simulation regards the differential incidence of a progressive personal income tax and an income-type VAT. The latter's tax base is all the income (i.e. value added) produced by the firms and the tax is formally levied on the producers. However, in this kind of competitive model, the entire income is allocated to the households, so that a proportional tax on income might be levied on the producers or on the consumers indifferently. A proportional tax on households income is then equivalent to a proportional tax on the producers income (value added) provided that all income is taxed. Therefore, the analysis of the shifting between the IRPEF and a proportional income-type VAT, in this context, can only be expected to indicate the distorsions affecting the structure of IRPEF (tax base and rate progressivity). In other words, the exercise should be considered interesting with respect to the removal of the erosion of IRPEF (and evasion as well) and to a partial abatement of its progressivity.

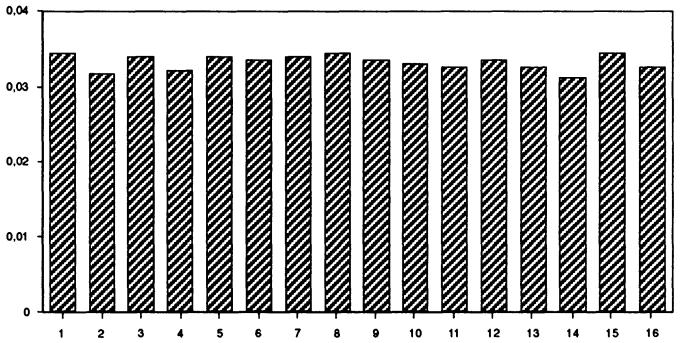
Perhaps the comparison, which seems meaningful on a priori ground, is not quite correct, as in the model the structure of IRPEF considers administrative costs, the proposed income-type VAT cannot deal with this question.

In order to compare the results with the first counterfactual, one has first to bear in mind that the consumption-type VAT has two tax rates, while this income-type VAT has just one tax rate. Secondly, while the usual VAT mimics the real tax (for instance as far as the tax base is concerned), the income-type VAT is highly stylized, so that it is able to tax all incomes.

In real economic systems, an important disparity between the consumption-type VAT and the income-type VAT comes from their different effects on prices. With the consumption-

type VAT, sellers must charge the tax separately to the buyers, and for this reason tax shifting is certain. In the income-type VAT, tax shifting seems less certain: in any case the tax should take longer to pass completely into commodities prices since it is computed on a tax base which the sellers will only know at the end of the fiscal year. However, this important aspect cannot be evidenced in our model, since taxes are just wedges between seller's and buyers's price, and no time processes are allowed for.

Figure 3 - Variations in prices

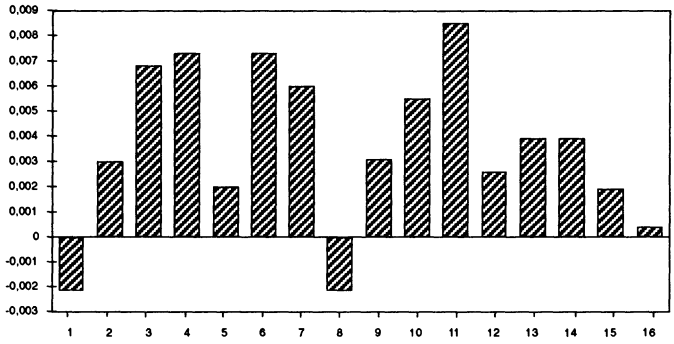


As before, an exogenous equiproportional lowering of IRPEF rates of 30% is imposed, while the income-type tax rate is endogenously determined according to real yield equality constraint. In this case the shifted revenue is roughly 11,700 billion from IRPEF to the income-type VAT, while the new tax rate is set to 4,5%.

Income-type VAT should decrease households income by its revenue, but the correspondent decrease in IRPEF tax rates benefits their final net income. Further effects on commodities prices are induced by distorsions on consumption-leisure choices related to the after-tax returns. However, since the income-type VAT has a broader tax base, it would involve a lower tax rate than that of a consumption-type VAT, and so more limited effects on prices are expected.

Market price changes are showed in Figure 3. Effects on prices are, in general, more limited than those obtained in the previous simulation; moreover, smaller differences result among the productive sectors. Commodity prices are referred to the gross wage rate.

Figure 4 - Variations in activity levels



Activity level changes, showed in Figure 4, record a small cutback just for two sectors, i.e. sector 1 (agriculture) and sector 8 (food). The reason can be sought both in the demand conditions and in the cost structure of the sectors considered.

Sector 8 is largely dependent on the rest of the world as far as inputs are concerned: imports, whose prices rose due to changes in the terms of trade, are in fact its second cost component, even bigger than total labour costs.

Import prices rose on average by 3.8% while the balance of trade deficit increased by 1,104 billion Italian lire: on the whole the impact of this policy change does not seem particularly intense. Exports increased in value, on average, by 4.0% against an average import increase of 4.1% (in quantity, respectively, of 0.7% and 0.3%). The slight worsening of the balance of trade deficit is then mostly due to the import price rises.

As far as welfare changes are concerned, one can first note that the revenue shifting of 11.700 billion Italian lire from IRPEF to the income-type VAT reduces the IRPEF tax burden by about one third of its yield.

Equivalent variations are listed in table 2. They show a net advantage only for the last two income classes of about 2.113 and 172 billion Italian lire respectively, so that the regressive character is made evident. In fact the first three income groups show a worsening in the utility nest which includes consumption expenditures and leisure demand, which in turn, implies a corresponding increase of labour supply.

Table 2

consumer groups	equivalent variations (billions)	labour supply variations
1	- 376.15	0.31%
2	- 293.99	0.21%
3	- 523.18	0.36%
4	- 371.41	0.29%
5	- 218.05	0.17%
6	- 472.44	0.27%
7	- 47.95	0.26%
8	172.47	0.21%
9	2113.09	0.89%

On the contrary, the welfare loss suffered by classes 3, 4 and 5 seems due to distortions on present-future consumption decisions, i.e. mainly in savings decisions: in fact the price of the investment good increases by 3.3%. Welfare and labour supply changes, both showed in table 2, are affected by the IRPEF rates reduction: owing to the equiproportional scaling of IRPEF rates, tax reduction is proportionally bigger for high-income groups. Furthermore, the income-type VAT affects a proportionally larger share of income on the poor and a smaller share on the wealthy, because of the different propensities to consume the various goods at different income levels.

In summary, all market commodity prices have risen, but changes are smaller than those obtained in the previous simulation. The results indicate a further cost increases for firms, due to the worsening in the terms of trade and to the consequent rise of imported goods prices. Self-employed labour and capital prices have fallen compared to wages, while investment good price have risen. As far as welfare changes are concerned the performed policy proved regressive, giving a total welfare loss of about 18 billion Italian lire (0,003% of GDP). Finally the balance of trade showed a relatively small deterioration.

6. Conclusions

The effects of shifting from reliance on the income tax to indirect taxation are considered, both implementing VAT rates consistent with EEC harmonization (Section 4) and introducing a broad base income-type VAT (Section 5) within a general applied equilibrium model for the Italian economy. In performing both simulations public expenditure is kept constant in real terms and the total change in income-tax revenue is the same (about 11,600 billion Italian lire, i.e. 6% of total Government revenue), so that the two counterfactuals are directly comparable.

A first interesting result of the first simulation (implementation of two VAT rates consistent with EEC harmonization) is that VAT harmonization would imply a consistent rise in its revenue, since the VAT rates we obtained are at the middle of the range suggested by the EEC for the reduced rate and at the top level for the normal rate.

Labour supply increased by 0.3%, since net wage rose owing to income tax abatement, while relative price increases for consumption and investment goods were somewhat less substantial. As far as investments are concerned, their quantity increased by 1.2% and their price increased by 4%; on average consumer goods showed a small increase in quantity, more than balanced by a reduction in leisure. On efficiency grounds this tax reform does not seem sound, because all the price movements led to total welfare losses of about 870 billion Italian lire, i.e. 0.17% of GNP. On equity grounds, moreover, since welfare losses are experienced by every income group (apart from the top one, whose welfare gain is about 12% of the change in the income tax revenue), the conclusion is that this tax reform is regressive.

The second counterfactual (introduction of a broad base income-type VAT) apparently proved sounder, since total welfare loss is just 18 billion Italian lire, i.e. it is almost neutral as far as total welfare effects are concerned. In this case, however, just the two top income groups benefit from welfare gains: as a matter of fact, the latter are mainly grouped in the highest income group which almost doubles its gain with reference to the previous counterfactual, and it is now about 18% of the change in the income tax revenue. Moreover, up to the 5th lowest income group, the welfare losses are higher in this simulation than in the previuos one, so that regressivity worsens.

Relative prices of goods rose less than in the previous simulation, while income groups faced the same income tax abatments, so that labour supply increased substantially for all income groups with reference to the previous counterfactual, apart the top three, whose labour supply increased less. As fas as investments are concerned, both in quantity and in price, their increase is just a little smaller, while the general increase in consumption goods is in this case much smaller than in the previous simulation.

Finally, one could perhaps speculate on the possible implications for the 1993 VAT harmonisation. As stated above, for Italy it is to be expected that VAT revenue should increase substantially, even if not as much as in our first counterfactual. In fact, one could lower to the bottom limit our reduced VAT rate in order to have a better performance from the regressivity angle.

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FISCAL SYSTEM AND FISCAL REFORM IN ITALY IN THE 90s[1]

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1.The Tax Reform of 1973-74 and the Current System

The current tax system in Italy is the result of a radical reform carried out during the first half of the 70s.

Conceptually, however, it dates back to studies and debates that took place during the post-war years and that were then summarized and reworked by the Committees studying tax reform in the early 60s[2].

It is not surprising then that the characteristics of the system and the opinions as to its function, which emerged from the scientific and political debates, appear to be consistent with the actual characteristics of the systems that prevailed at the time in most industrialized western countries. The proposals and analyses were strongly influenced by the economic theory of the time, dominated by the idea that it would be possible, and even necessary, to utilize fiscal policy for the "fine tuning" of economic policy,particularly with regards to the control of business cycles and economic growth. In the meantime considerable attention was given to the problem of redistribution expressed through the overall acceptance of the progressive taxation principle which to a certain extent became the accepted fundamental paradigm (even though in practice, systematically derogated,in Italy and abroad)[3].

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[1]I wish to thank dott. Vieri Ceriani, dott. P.A. Vagliasindi and an anonymous referee for their useful remarks on a previous draft of this paper, and dott. Sandro Clementi for his very effective assistance. The present paper has been written during the last months of 1990.

[2]The need for fiscal reform was strongly sustained during the post-war period by Ezio Vanoni and some modifications of the system had already been introduced with the well-known law on fiscal equalization in 1949.For a chronological analysis of the economic problems and the relative political debates that took place during the post-war period, reference can be made to the testimony of Gaetano Stammati who played an important role during the years 1945-1975. See Stammati (1990). Some of the most important studies on the problem of the Italian tax system during the post-war period were carried out by Steve (1945), Scoca(1945), D'Albergo (1949), Cosciani (1950);for the period prior to the reform, reference can be made to the reports published by C. Cosciani in which he exposed the conclusions reached by the Committees studying the reform and chaired by Cosciani.See Cosciani (1963a) (1964) (1965).

[3]See the "Progress Reports" of the Committee for tax reform published by Cosciani (1964) as well as other works by Cosciani (1963b) and (1978); as a reminder of the cultural inspiration that was behind the debates at the time some other fundamental contributions are those of Lerner(1944), Vickrey (1947),and Kaldor (1955) who,inspite of his reproposal of the time-old issue, income taxation versus expenditure taxation, adapted

G. Galeotti and M. Marrelli (eds.), Design and Reform of Taxation Policy, 113–151.

The main feature characterizing the reform of 1973 was the introduction of a single tax on personal income (Irpef) to replace the many schedular taxes existing before then. This new income tax was structured to envisage highly progressive rates, initially coupled with a low average incidence[4].

In the initial proposals it was suggested that there should also be an ordinary wealth tax to increase the progression of the system and to integrate the direct tax system by dividing it into two taxes with different taxable bases. The aim was also to offset and discourage tax avoidance and tax evasion[5]. Subsequently the wealth tax was (inefficiently) substituted by a local income tax (Ilor). Following Irpef and Ilor, a corporate tax (Irpeg) was introduced to replace the old tax on companies, in force since 1954[6], as well as a special tax on dividends,and a tax on bond issues.

The new proportional-rate tax, conceived in the spirit of the "classical" corporate income tax, implied the double taxation of dividends[7]. The system of indirect taxes was greatly simplified with the elimination of the turnover tax (IGE) the local taxes on consumption and a myriad of other taxes,all substituted with the new VAT[8].

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perfectly to the scientific climate of the time which in many ways seems very different from the current one. The cultural synthesis of these positions can be found in the fundamental treatise by Musgrave (1959).

[4]Initially Irpef rates were spread out over 32 brackets; the lowest rate was 10% and the highest was 82%. This structure remained in force with minor variations until 1983. In practice, the marginal rates most commonly applied to incomes declared has always been between 25% and 35% and in effect the progression of rates was more apparent than real being that, due to legal erosion, tax avoidance and tax evasion,very few incomes were (or are) placed in the higher brackets. The income tax rate structure that was then adopted reflected a clear theoretic and political approach as well as the desire for a very carefully graduated application of the progression principle.

[5]See Cosciani (1984), who recalls that a wealth tax had been envisaged both in the Vanoni reform, put before the Senate in June 1948 and again in May 1951, and in the subsequent statements made by Mr. Tremelloni in 1965. The hypothesis of a wealth tax was set aside only during the second stage of the studies carried out by the Committee, when Cosciani decided to leave the chair because he disagreed with some of the "fundamental solutions provided for in the reform" and Mr. Bruno Visentini took over chairmanship.See Cosciani, (1984), pp. 24 and 30.

[6]The corporation tax had been conceived and proposed by Vanoni and was put through Parliament by Tremelloni (L 603/1954) and consited of an 0.75% tax on capital and 15% tax on income in excess of 6% of the capital" so as to prevent the movement of capital or income to reduce the tax burden":Stammati (1990) p. 120.

[7]The first tax reform projects envisaged the concession of a partial tax credit on dividends, but this was subsequently eliminated.See Cosciani (1970) and (1984). The "classical" system was, however, the system adopted at that time by almost all countries.

[8]Cosciani (1975a) According to Cosciani "about 25" indirect taxes were removed. It is worth noting that initially uniform Vat rates were to be applied at levels up to and including wholesale activities, after which a monophase differentiated-rate tax was to be applied when the product was moved from the wholesaler to the retailer, plus a local (retail) sales tax. See Cosciani (1984).

At the same time a special tax, (Invim), on increased value of immovable property, was introduced to replace the tax on building areas.Generalized tax returns, the introduction of a self-assessment mechanism, the systematic recourse to withholding taxes levied at source under the direct responsibility of employers and financial intermediaries -one of the positive aspects of the Italian system- have marked the final changeover to a "mass" taxation system, formally not unlike that of most of the other industrialized countries.

2. Evolution

After 16 years the basic characteristics of the system remain unchanged, although it has been progressively modified in some important points.First of all there have been a number of rate variations which indicate a twofold trend:

a) towards an evident structural simplification,in recent years, by reducing the number of Irpef brackets (Table 1) and the VAT rates (Table 2);

b) towards an increase of the average incidence,notwithstanding a substantial reduction of the higher Irpef marginal rates, which, however, were applicable to very few tax payers.(see Tables 3-6)[9].

Some other important variations also concern:

a) the taxation of family incomes which initially provided for mandatory cumulative assessments of incomes (for family incomes of over 5 million) ,and now assesses incomes separately[10] , and the trend seems to be for a family quotient solution;

b) the elimination of the necessity of going through administrative proceedings for penal offences in matters of taxation[11];

c) the introduction of a full tax credit on dividends distributed by corporations to finally do away with the double taxation of dividends (Irpeg & Irpef)[12], and the subsequent

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[9]As to the personal income tax, the increased incidence was mainly due to the inflationary trend of the 70s. This increased incidence was found to be very high, averaging more than 12 percentage points: see Table 3. The same phenomenon is illustrated in Table 4 with reference to minimum taxable incomes which from 1974 to 1989 were reduced from 54 to 27% of the per capita Gnp for a subordinate worker with no dependents, and from 73 to 42% for married subordinate workers with one child. The trends indicated also exist for taxation of capital income, but with evident contradictions:see Tables 5 & 6.A tendency towards an increase in rates is particularly evident, affecting profits more than interest, as well as towards the equalization of taxes on bonds in recent years. It is interesting to note that in 1980, when Italian companies were in need of reorganization, corporate income taxes were lowered and taxation of newly issued bonds was temporarily suspended. At the same time over-taxation of interest on bank deposits began to take shape in a clearly defined attempt to reduce bank intermediation and ease financing the public debt.

[10]With Law 114/1977.

[11]With Law 516/1982.

[12]With Law 904/1978.

introduction of a supplementary tax for those dividends not subject to the ordinary corporate income tax[13];

d) the use of special instruments to limit tax evasion, for example, the way bill for goods being shipped, the tax receipt, and sealed cash registers[14];

e) changing the Irpef and VAT tax regime for smaller businesses[15] to a forfeit-resime based on turnover, or one based on mean values;

f) the gradual erosion of the taxable base of income tax through the introduction of new deductable expenses[16];

g) the introduction of dozens of micro-tax benefits in many parts of the tax law[17];

h) the progressive extension of tax relief in the south of Italy[18];

i)the exclusion of the capital gains tax realized by individuals from any tax, except for some very limited cases[19];l) some precautionary measures in order to regulate mergers, leasing and the deductability of some costs[20].

The whole matter of direct taxes was rearranged systematically with the Income Tax Consolidation Act (TUIR) of 1986[21]. It introduced a number of legislative modifications to co-ordinate and rationalize the rules, but also some remarkabe innovations[22].

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[13]With Law 649/1983.

[14]By Presidential Decree 627/1978, with Law 249/1976 and subsequent Ministerial Decrees 13.10.1979; 7.1.1980; 2.7.1980; 28.1.1983;and Law 18/1983, respectively.

[15]By Presidential Decree 853/1984 and LawDecree 69/1985.

[16]In Article 10 of the Consolidation Act (TUIR) the classification has already reached the letter "t"; the consequent reduction of the taxable base was estimated to be more than 20,000 billion in 1989, with a loss of revenue of about 7,000 billion.

[17]A study was carried out by the Chamber's Research Office to verify the consequences of tax concessions granted after the summer 1987. It calculated that the tax benefits introduced from July 1987 to January 1989, would mean a loss of revenue of over 4,000 (thousand) billion over the following three year period.

[18]By Presidential Decree 218/1978 and subsequently Law 64/1986.

[19]Article 81 of Presidential Decree 917/1986.

[20]With Law 69/1989 and by Presidential Decree 917/1986.

[21]See Presidential Decree 917/1986.

[22]From the theoretical point of view the modified concept of income as stated in Art. 1 of the Consolidated Act is particularly important. Basically, income is now to be considered only what the legislator has expressly defined as such.This gives no leeway for interpretation on the part of the tax offices and incentivates tax avoidance on the part of the tax payer. Above all, however, it contradicts any serious definition of the concept of income. The immediate consequence of this approach was a reduction of the tax liability on capital income (a sector in which innovation runs parallel to the constant creation of new financial instruments) and for which the residual category, provided for in the Consolidated Act, letter "h" of Art. 41, limits itself to considering taxable all earnings derived from capital investment provided that they are precisely defined ex ante.This is equivalent to excluding from taxation interest on installment payments, credit on compensation for damages, tax refunds, payments for subordinate or occasional work etc. The

3. The limits of the system

The limits of the current system are largely due to the choices made and the opportunites lost at the time of reform.The limits lie with the tax system in general and with some of its specific characteristics.For example, the reform of 1973 neglected the problem of local finance which, however, had been examined by the Committee who had worked out some specific proposals. As a result local bodies have a very limited financial autonomy and virtually no responsibility in expenditure policy, being that the accepted procedure has been to rely on government transfers.

Nor did preliminary studies examine the question of the relationship between the tax system and the payroll tax and the eventual effects of excessive fiscal and contributive incidence on earned income and therefore on production costs, employment and exports. The new inco me tax was extended, by means of the very efficient with-holding tax mechanism by employers, to include the lower-bracket incomes from subordinate employment which, prior to the reform had, in effect, not been subject to direct taxation. From the beginning, some criticism, still valid today, was moved by Cosciani who pointed out that the tax administration was not sufficiently prepared to cope with the changed requirements of the new fiscal system and that this would have serious consequences on the behaviour of the tax payer (evasion) and on the workability of the system23; that the introduction of exceptions to the principle of equal treatment of all income so as to favour incomes from capital, from buildings, from agriculture and to a certain extent business income, would give rise to controversy and resentment, loss of revenue and unacceptable disparity of treatment[24];that the tax payer's position was much stronger than the administration's, a situation "without precedent in the fiscal history of the country"[25]; that the existing incentives, to which others were being added, had not been sufficiently reviewed.

Given these basic characteristics, it is not surprising that the Italian tax system features widespread erosion of taxable bases, unrestrained avoidance and tax evasion against which a weakened and a (still unreformed) administration can do little. The present difficulties can be attributed to the original configuration of the system, but they became more and more evident to the point of being unsustainable as the inflationary trend of the 70s and the

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exclusion of capital gains and the lack of an explicit definition of some capital earnings for tax purposes, for example those deriving from swaps, premiums, etc. - whose classification appears uncertain according to the usual definitions provided for in the Italian tax law which does not uniformly consider all incomes derived from capital, makes it possible for a substantial and increasingly large portion of unearned incomes to avoid taxation in Italy.

[23]See Cosciani (1967) and (1984).

[24]See Cosciani (1975b) and (1984).

[25]See Cosciani (1973).

growing need for revenue to meet the public budget deficit in the 80s caused rates to rise and increased incidence.

The Italian tax system currently finds itself in a situation similar to that of other countries, some of which decided to carry out reform in the 80s.The causes may vary from country to country, but certain characteristics remain identical:a) extensive erosion of the taxable base of all taxes with evident signs of disparity of treatment between sources of income and taxpayers; b) increasingly high rates to obtain higher revenues from a smaller and smaller base; c) ambiguity in the definition of income which alternatively refers to different concepts as product income, comprehensive income[26], ordinary income and consumption income or income spent[27]; d) the complete vulnerability of the system to the effects of inflation, worsened and multiplied by the excessively high rates; e)the slight or nil effects of income equalization, notwithstanding the high rates and apparent progression[28]; f) the astounding disparity of treatment between the different capital incomes, illustrated in Table 7[29],that inevitably causes considerable distortions in the allocation of resources, affects the cost of capital and business financial behaviour,and provides a number of opportunities for avoidance and fiscal arbitrage, thus causing considerable inefficiency which has yet to be aknowledged[30], and affects distribution randomly.

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[26]Originally Presidential Decree 597/1983 assumed Irpef to include all incomes "in money or nature, whether continuative or incidental, derived from any source" and provided for the taxation of capital gains.

[27]A great number of tax facilities for savings have been granted; for example, allocations for severence indemnity for subordinate employees (TFR), or private pension funds, deductable life insurance premiums, generous allowances granted to companies, accelerated depreciation allowances, the advantages envisaged for capital gains realized by companies,etc.

[28]By excluding from full taxation within the Irpef scheme almost all incomes from property,the multitude of tax facilities granted in the assessment of business income in order to tax accrued capital gains, the currently legal, once "de facto" exemption of individual capital gains and the consequent possibilities for avoidance, in fact, most of the wealthier taxpayers' incomes are, tax exempt or subject to soft rates.The picture is complete if we add to this the consequences of widespread evasion -inevitable and tollerated in an overall context of laxism with regards to business and capital incomes. See V. Visco (1984) and Vitaletti (1984).

[29]Table 7 may not account for all of the existing differences.

[30]Disorder reigns in most countries with regards to taxation of unearned income and in recent years this problem has been focused on by economists, for example, King & Fullerton (1984), Giannini (1988), Castellucci & Alworth (1988).Although an analysis of the data presented in Table 7 may give the impression of random choice, it is indeed possible to pinpoint the logic behind the criteria followed that can be summarized as : 1)distrust in market allocation capacity, and the convinction that the allocation of resources must be" programmed"; 2) the need for tax levy mechanisms coherent with the Italian situation characterized by a strong banking sector, the absence of non-bank intermediaries and of an efficient financial market, family-controlled businesses, and the strong presence of public enterprise. Under these circumstances,it is not surprising that the fiscal system has strongly facilitated indebtedness, systematically discriminated against investment sources alternative to the traditional ones, and only in appearance discriminated against corporate

In conclusion,the need for an organic tax reform is felt by economists in Italy and it is on this problem that they are focusing their attention, particularly with regard to the major issue, the taxation of incomes from capital.

4.Economic Theory and Fiscal Reform

During the 70s and the 80s the field of public finance developed new areas of study, particularly with regard to the theory of taxation. It was not only a matter of organically reconsidering the fundamentals of the discipline, but the aim was to rework and rebuild them substantially[31]. There may not be any direct connection between the scientific trend and the concrete intervention on tax policy, but without any doubt, while economic analysts were sharply critisizing some of the basic characteristics of the traditional tax system and stressing the need for reform, the problem of tax reform was being focused on by the governments and Parliaments of many countries. Countries like the United States, Canada, Australia,New Zealand and to a lesser extent the United Kingdom, did carry out reforms, reflecting the conclusions reached during the academic debates, and "tax reform is on the political agenda almost everywhere"[32].

In the last 15-20 years the main theoretical interest of tax research has been the question of tax neutrality. As Harberger recalls[33], there are two different approaches to the concept of tax neutrality written up in past and present economic literature. The first tends to stress the importance of minimizing efficiency losses, the second tends to identify neutrality with uniform taxation.

The first approach gave rise to the extensive literature on Optimal Taxation (O.T.), which stresses that welfare losses and efficiency costs can be high and can seriously affect wealth. Therefore, it is necessary to focus on building a system able to minimize these costs[34].

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self-financing (given the "de facto" or legal exemption on individual capital gains and the many possible ways to avoid taxation on capital gains open to companies),while it has basically contrasted the recourse to equity financing because of the requirement that shares be in registered form and, initially,because of the double taxation of dividends, and because of the higher Irpef rates compared to corporate rates(formal and informal), even after the introduction of the imputation system; 3) the tendency, in recent years, not only to favour corporate indebtedness, but also Treasury borrowing from families.

[31]The debate was first synthesized in the book by Atkinson & Stiglitz (1980), and later in the two volumes published by Auerbach & Feldstein that constitute the Handbook of Public Economy(1985) and (1987).

[32]See Kay (1990).

[33]See Harberger (1987).

[34]The origin of the optimal taxation theory can be found in Dupuit (1844) and then in Ramsey's famous work (1927);subsequently in Hotelling (1938), Pigou (1947) Boiteaux(1956), Corlett & Hague (1953), Lipsey & Lancaster (1956),Harberger (1964), and more recently in Diamond & Mirlees(1971), Mirlees (1971) (1972) (1986), Hahn (1973) Atkinson (1977), Atkinson,Stern & Gomulka (1980), Atkinson & Stiglitz

The O.T.theory results show that uniform taxation is not always neutral and that this is often due to unrealistic hypotheses;the "optimal tax" system that emerges from theoretical work should then consist of a set of differentiated and discriminatory taxes, in a context where "the substitution effects" dominate the scene and become essential as a guide for normative tax policy[35]. As a result the true values and the empirical estimates of elasticities or substitution between work and leisure, consumption and leisure, between different consumer goods, between present and future consumption, etc., became decisive factors.

Basically, O. T. theorizers hypothesize the possibility of a "fine tuning" of public intervention, according to a "social engineering" approach in which the preferences and technology characterizing a given society are explicitly used to determine the relevant fiscal parameters and the variations of these[36].

Is not this the place to discuss or analyze in depth the results of the O. T. theory? There are, however some obvious characteristics that make the applicability of these results seem unfeasible: a) the models are over-simplified and the results are often strongly influenced by the hypothesis made, particularly with regard to the chosen utility functions; b) the preferences and technology are given, so their probable variation in time would require a systematic modification of the optimal tax parameters and as a result the tax system would tend to be unreliable instead of being reasonably stable over time; c) the theoretical models do not consider situations of imperfect competition, increasing returns, the possibility of unemployment, etc. and appear, therefore,unrealistic and of little operational utility;d) our knowledge of the essential parameters for determining "optimal" taxes, for example, elasticity of demand and supply,is incomplete and will presumably remain so.

Furthermore,if we consider that the usual O. T. theory does not take into account, as an integral part of the optimization problem, the level of the costs of administering the tax systems (which would be much higher with differentiated taxation than with uniform taxation), nor is it usually concerned with the problem of the simplication of the tax systems, nor does it provide any useful indications on how to deal with such important practical problems as the eventuality of fiscal arbitrage and tax avoidance in a context of differentiated .pa taxation,it is then understandable why actual reform proposals have considered this part of the theory only indirectly[37], and have concentrated more on the design of systems characterized by uniformity and generality of taxation[38].

(1972) (1976) (1980), Dixit (1970), Deaton (1979), Deaton & Stern (1987), Auerbach (1985) Stern (1976) and (1982), and many others.

[35]These results are in part mitigated if we explicitly
consider the needs for redistribution; see Atkinson & Stiglitz (1976).

[36]See Harberger (1987).

[37]See Slemrod (1989). The clearest effect of the O.T. theory on tax reforms during the 80s appears to be the shift towards an overall reduction of marginal income tax rates; there is some doubt, however, as to whether

It is also true that the contrast between uniform taxation and optimal taxation is, in a sense, more apparent than real. In fact, the current circumstances are such that any hypothesis of reform based on the widening of the tax bases towards a comprehensive definition, plus a reduction of rates, would enable a greater uniformity and equality of taxation and, at the same time, a reduction of existing distortions and excess burdens.

This is probably why economists have unanimously judged the American reform of 1986 favourably.

However,substantial differences remain between the organic tax reform proposals advanced and the message transmitted by the more radical sustainers of the O. T. theory. In fact, in these proposals the fiscal system is viewed as a coherent set of lasting precepts and institutions which should provide those operating in the sector with a stable set of rules so as to prevent or limit through a correct definition of the tax bases, the possibilities of avoidance, successful lobbying,and even arbitrage by the legislator[39].

The theory of optimal taxation has had a certain amount of influence, and not only theoretical, in Italy as well. In fact this theory seems to provide an ex-post justification for the great number of differentiated rates applicable to the different capital incomes (but not only). Compared to the once unanimous conviction that such a practice was unacceptable, today the attitude of the Italian economists is much more cautious. In particular the optimal taxation hypothesis in a context of fiscal competition between different States and volatility of capital may justify proposals for the detaxation of capital incomes which those in Finance in Italy are viewing with greater interest.

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this choice can be attributed to economic efficiency object-ives or the more probable need to simplify managment and administration.

[38]Even after carefully evaluating O.T. results, most economists - mainly those fully aware of the real problemsof the existing tax systems - agree that these problems must be managed in the context of a coherent and systematic view of the tax system. This point of view was clearly espressed by Kay (1990) .."the primary purpose of optimal tax theory is not to allow the computation for numerical estimates of what tax rates should be .... the primary role for the models is to illuminate what Hahn has called "the grammar of arguments": to distinguish between valid and invalid assertions and to distinguish the circumstances in which they do or do not command such validity". And it is not pure chance that all concrete fiscal reform proposals advanced or approved, and the studies that explored, postulated or accompanied them were inspired by hypotheses (even greatly differing ones) of general uniform taxation. See, for example, U.S. Treasury (1977) and (1984) and Meade (1978).

[39]This viewpoint, the one I tend to embrace, does not reject recourse to fiscal incentives, although it limits and restricts the use of this instrument, and is entirely coherent with the discriminatory use of taxation as a means to control externalities.

5. An income base or a consumption base ?

One of the basic results of the O. T. theory is the proof that in any case we need to maintain efficiency in production, in other words, all producers should be confronted by the same vector of prices.This also means that taxation of capital income should be uniform[40]. On the other hand, the supporters of expenditure taxation come to the same conclusion. In fact in such a system, marginal rates applicable to capital income would implicitly be zero.

Uniform taxation of capital income is, therefore, one of the objectives that economists generally agree upon.

However,the basic problem has yet to be solved. Would it be better,and possible, to devise a "true" income tax system, or would it not be better to replace the current hybrid systems with a completely different system, taxing only consumed income? This point is still being debated by economists[41].The merits and limits of the two systems have been discussed elsewhere by the author[42]. The proposal to tax consumption rather than income was first examined by Hobbes[43] and subsequently re-examined and revised by James Mill, John Stuart Mill, Irving Fisher, Luigi Einaudi and Nicolas Kaldor. More recently it has been brought up by A. Andrews, Olaf Lodin and James Meade. Mischievously, it can be said to represent the everlosing approach to direct taxation, although it continues to fascinate academics, even in Italy[44].

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[40]Both economists and "fiscal reformers" have been focusing their attention on "levelling the playing field" (see King-Fullerton (1984)), and this was one of the principles that inspired the American reform of 1986. However,the theoretical models that led to this result are based on rather strong postulations. In fact, Feldstein (1985) showed that while binding constraints exist preventing taxation of some categories of unearned income (for example, income from housing), uniform taxation ceases to be optimal.

[41]It is interesting to note with regards to this that in 1990 two interesting articles appeared in support of the opposite thesis: the first by Pechman, in favour of the income tax and the second by Kay,proposing a changeover to expenditure taxation (see Pechman (1990) and Kay (1990)). The fact that Kay belongs to a younger generation of economists might induce us to think that he may be right when he affirms that the future evolution of fiscal systems will be towards the taxation of consumption. And indeed there are a number of younger generation English and American economists who agree with this point of view.Pechamn, however, is not wrong when he notes that the real evolution taking place, characterizing all the reforms approved in the 80s, consists in the re-inforcement and rationalization of income taxes, with a tendency to move in the direction of the "Comprehensive Income Tax". See also Cnossen and Bird (1990a)(1990b)

[42]See Visco (1982) (1983) (1989).

[43]See Hobbes (1651).

[44]See for example Visco (1982b), (1984) and (1986), Di Majo (1986), Cavazzuti (1988). The only concrete attempts to introduce expenditure taxation were made in Ceylon and India by Kaldor. Both attempts resulted in failures and the governments of these countries quickly gave up the idea, mainly because of administrative problems.

The main and most obvious advantage of expenditure taxation is that exemption of savings (and, therefore, the consequent taxation of dissaving) eradicates all of the difficulties inherent to income tax in relation to the taxation of incomes from capital because an expenditure tax is "neutral", by definition, as persons and businesses would be free to rebuild the capital invested on the basis of personal assessment, and labor incomes would be treated in the same way (exempt if saved, taxed if consumed). In a system thus structured there would be no need to index for inflation and all of the legislation regarding depreciation and the assessment of stocks could be termed unnecessary.

However, it must be stressed that any comparison between an "ideal" expenditure tax and the "actual" and seriously inefficient income tax, does not do justice to the latter. Moreover, an expenditure tax is the expression of a fiscal paradigm that is entirely different from the one we have been used to for more than a century,and is based on particular value judgements which derive from the protestant ethics. This, as Musgrave has so sharply noted, means that saving is viewed positively whereas consumption is almost a sure sign of sin. In this logic the tax would become "... a fine on consumption (the sin of non-accumulation), with equal taxes being paid by equal sinners"[45].

Furthermore, this approach would have serious consequences on distribution because those who saved the most, that is, not only the most parsimonious but also the wealthiest, would be less affected; the elderly would be more affected than the young; and taxpayers earning the same income could find themselves paying widely different taxes on the basis of their propensity to consume. In other words it would mean changing our evaluations of horizontal and vertical equity radically. Even if one could sustain that as consumption is a function of income, it would always be possible to estabilish higher rates on personal consumption equivalent to any income tax rate structure. It would however be an average equivalence.

From a logical point of view, I find some of the characteristics of expenditure taxation very interesting, particularly with regard to business taxation. However, I am skeptical as to the possibility of devising a coherent system of taxation logically alternative to the existing one, given the present situation, and I fear that any such proposals could have perverse effects. Aside from the difficult problems created by transition from one system to another[46], and some other important technical problems, it must be pointed out that: a) Most of the concrete proposals in favour of transition to expenditure taxation consist in pure and simple exemption of capital incomes from any form of taxation, although it is well known that exemption of savings is equivalent to non-taxation of capital incomes only in some cases and under very restricted assumptions, and that the most coherent economists who support this solution tend to assimilate to consumption dissaving and transferred tax-exempt

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[45]See Musgrave (1987)

[46]See Visco (1983)

inheritance[47]. Unfortunately, even if we wanted to adopt such a rigorous solution, we would still have to take into account such unpleasant realities as the free circulation of capital, the persistence of bank and financial secrecy, and the flourishing of tax havens. On the other hand, the disappointing practical application of inheritance taxes in most countries only confirms these difficulties.As a result, taxation on expenditure, even in its most coherent form, would risk becoming a tax exemption on direct taxes for the wealthier classes,a hypothesis that does not seem to be very appealing and acceptable right now, also because this would mean revolutionizing the traditional position according to which income from capital implies a higher ability to pay than earned incomes. From this point of view it could possibly be sustained that the expenditure tax might be the ideal system of taxation in an economy with an equal distribution of wealth, i.e. in a "socialist" economy[48].

Therefore, theorizing about expenditure tax in the present context could have the practical effect of further hybridizing the current income tax system, providing a logical justification for the introduction of further "tax breaks" to be added to those already existing. Nor can it be forgotten that traditionally, the accounting, legal and operating system. And the whole fiscal culture of modern countries are based on income taxation. To abandon a firmly based tradition for new and uncertain rules could be too costly for any reformer.

In fact,an integral part of any tax system are the men, the institutions,the practical procedures, and even the habits that make it work. And it is interesting to note that politicians, who sometimes are not very aware of the technical problems. Though are very sensitive to public opinion, have shown no real sign of support for the expenditure taxation, in Italy or anywhere else. Nor do I think it possible to maintain personal income tax and adopt a cash-flow system for corporations, as has been hypothesized[49], since this would give rise to a clearly unbalanced system as far as distribution is concerned, as only the income accrued by corporations would be tax exempt: in fact it would be very difficult to extend the new system of taxation to small individual businesses. Even if this were possible, it would inevitably lead to the extension of the system to all taxpayers.

In conclusion, it seems inevitable that we will continue to think in terms of reforming the income tax system and rationalizing traditional fiscal systems. Even if the opposite is often maintained, I think that it is quite possible to move in the direction of a fairly workable comprehensive income. Tax, as I will try to demonstrate in the following pages, taking Italy as an example.

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[47]In this regard see for example Kay (1978).

[48]This may be one of the reasons why Meade is one of today's most fervent supporters of the expenditure tax which is perfectly coherent with his idea of a market economy in which wealth is retained and managed by means of "community funds". See for exemple Meade (1983).

[49]See for example Broadway-Bruce-Mintz (1983), Di Majo (1986), and Cavazzuti (1988).

6. Reform of Direct Taxation

Some of the structural characteristics of direct taxation in Italy (including payroll taxes) can be found in Table 8 where we attempt to show the formal incidence of taxation on some income categories[50]. It is easy to see that incomes from subordinate work and pensions are subject to a very large charge, almost double that levied on capital income. It must be noted, however, that within this last sector, corporate income is more heavily taxed (Irpeg & Ilor) than other unearned income, whose tax yield is dominated by the tax on bank depsoit interest which yields the largest revenue. Lastly, the low incidence on other incomes reflects the huge erosion of income from agriculture and housing and the equally considerable evasion of incomes by the self-employment and by small businesses.

On the basis of these data, although incomplete and limited in range, it is clearly evident that the time has come, or at least it would be desirable, to reduce the taxes on earned incomes which should take on the form of a reduction of social security contributions.

As far as the strictly defined, tax system, is concerned, some qualitative and quantitative indications are reported in Tables 9-13, in which estimates on potential taxable incomes (based on national accounting) and actual taxable incomes (involving erosion and evasion) can be compared[51].

6.1 Possibilities of Widening the Tax Base

There are a number of ways to recover the taxable base on the income taxes which would involve virtually all taxes and income categories. With regard to income from subordinate work, Table 9 shows that, apart from allocations for TFR (severence indemnity) which national accounting does not calculate in earned income, erosion is very slight while evasion seems to occur mainly with incomes from irregular subordinate work[52]. As a proposal to tax TFR allocations within the Irpef scheme would be unrealistic, it hardly seems feasible to consider extending the taxable base of earned incomes. It must be noted, furthermore, that the TFR allocations amount to what, in other countries, is paid into pension investment funds

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[50]The data utilized are those obtained from fiscal revenues and national accounting statistics per institutional sector. The levels of disaggregation are those imposed by the fiscal data; for example, it is not possible to distinguish Irpef on incomes other than subordinate work, from Irpef on incomes from agriculture and housing.

[51]The tables refer to the years 1986 and 1987, the last for which the fiscal data were available and where possible, by estimates,to 1989. The 1989 is the last year for which national accounting data have been published.

[52]The estimates in Table 9 follow the criteria indicated by Botarelli (1989) who argues and integrates evaluations by Visco (1983) (1984) and Vitaletti(1984).

which serve to integrate the social security system. Basically, the TFR has, up to now, prevented the development of pension funds in Italy, notwithstanding the advantages provided in the existing fiscal legislation, and it is doubtful that they will ever be able to develop unless the TFR is eliminated.

The lack of pension funds has made it difficult in Italy to even discuss the modalities for the possible taxation of incomes (and rights) deriving from such funds which are a main issue in other countries. It is obvious, however, that the actual situation in Italy with regard to taxation is not so different from that of other countries, except for the fact that businesses and other employers and not the employees reap the benefits of the non-taxation of TFR allocations and the incomes generated[53].

The situation is different for the other income categories. Substantial erosion exists where incomes from agriculture and houses are concerned and this accounts for a large portion of a family's real income. Therefore, even considering sizable tax evasion, the taxable base for the two above mentioned categories could easily be extended bringing in at least 70,000 billion of 1989 lira (Tables 10 and 11).

Almost 33,000 billion, considering taxable real interest only, could be obtained by explicitly (or even indirectly) including in the taxable base of the income tax, capital incomes currently taxed on the basis of a substitute and more favourable regime[54]. A large

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[53]Theoretically,a recovery of revenue could derive from the taxation of the family allowances which are technically paid as a tax credit without any integration with the personal income tax (see Visco (1984)).However, the question is whether such an innovation would find consensus. With regards to the TFR indemnity, it must be noted that the current regime is.certainly questionable from the worker's point of view (the accrued income belongs to the worker). Each year, in fact, employers set aside 7% of the employee's salary which represents a source of self-financing at a very advantageous rate. The employer undertakes to pay back at severence the same amount increased by 1% plus 75% of the rate of inflation for each year worked. Basically the real return is zero for an inflation rate of 6% and positive for lower rates; in no case, however, can the actual return be above 1.5%. A more rational use of these funds could be envisaged, with low costs which could be easily compensated, for businesses, by establishing that, as of a given year, TFR funds would flow into pension funds set up for the purpose, to be managed according to market criteria in the interest of the workers. In this way the problem of setting up new institutional investors would be solved giving support to the financial markets, without creating new sources of fiscal erosion. Given the enormous amount of resources that the funds represent, within just a few years this would determine a substantial transfer of wealth to subordinate workers:after 10 years the consistency of these funds would be around 300-400.000 billion of 1989. It is also obvious that the introduction of new laws would considerably ease the financing of the public debt and reduce interest rates. Furthermore,and this will be exposed more clearly later on, with time even the fiscal regime of pension funds could be made more coherent with the logic of income taxation.

[54]It is obvious, in this hypothesis, that the withholding taxes would be eliminated with a consequent and considerable loss of revenue. A more thorough examination of taxation of capital incomes exposed in the fiscal reform hypothesis illustrated above will be undertaken later. With regard to incomes from agriculture, it would seem appropriate,at this point, to do away with taxation based on land registry values and extend the normal tax criteria, provided for businesses and other economic activities, to this sector as well. The land register could still offer a technical support for the income assessment and the duely corrected estimations

portion,almost 130,000 billion in 1989, of the taxable base in the sectors of self-employment and non-corporate undertakings escapes taxation. As this is mostly due to tax evasion, it would therefore probably be difficult to recover the taxable income by simply modifying tax laws. However, there are wide margins of erosion and avoidance in these sectors which could be reduced or even eliminated by the reform hypothesized.

It has already been mentioned that income tax deductions, within the Irpef scheme, constitute an important source of erosion, which has grown in size over the years. The best, but highly improbable solution, would be not to allow any deductions so as to reduce rates to a minimum. An alternative solution could consist in revising and reducing the deductions allowed and in providing for the remaining deductions to be imputed, first of all, to the lower income bracket and not directly to the top brackets as is usually the case[55]. It must be said, however, that in a context of much lower marginal rates such as hypthesized in our reform, the amount of "fiscal saving" obtained by recourse todeductable expenses would be reduced for the most part as would the loss of revenue[56].

6.1.1 A More Proper Definition of Incomes and Costs. In an income tax system a great deal of attention should be given to the correct definition of deductable costs for the proper assessment of income, and to their attribution and actual pertinence to the economic activity carried out. A lack of well-defined rules may lead to a considerable reduction of the taxable base and substantial loss of revenue, inevitably to be met by increasing the rates.A multitude of deductable costs often relate to expenses sustained by the employer or his employees for

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could play the same role as the estimated co-efficients used for businesses with a business turnover of less than 360 million. As for incomes from housing, it is a matter of assessing as realistically as possible the incomes imputed to home owners. The Finance Ministry has recently completed a revision of estimations which might serve our purpose.
However, in my opinion, a preferable solution would be to consider income a small percentage of the property value in the real estate market and to take that value as the minimum taxable level, even in cases of rented houses. Naturally, assuming that the land office revision is carried out correctly,the two methods would be equivalent.

[55]This is the solution adopted in Bill n. 2991 put before the Chamber of Deputies in the X Legislature on 26/7/1988 by Visco and others. It formally states an important part of the fiscal reform proposal put forward in this paper. Of course, the system proposed for deductable expenses would be identical to the one in effect in a situation of a single-rate income tax. Although this solution would technically be ideal, the probability is that also in the future there will be recourse to a certain number (even if limited) of different brackets and rates. The aforementioned proposal n. 2991 provides for 4 income brackets and the following rates: 10% under 8 million; 26% between 8 and 30; 34% between 30 and 65 and 39% over 65 million. The increased revenue deriving from the modifications brought to deductability of personal expenses envisaged in proposal 2991 amounts to over 4,000 billion.

[56]It should not be forgotten that the elimination of the Ilor provided for in our reform proposal,would alone allow the recovery of almost 2,000 billion in revenue for 1989.

their personal consumption , or costs not directly relatable to the business activity. Consider the aquisition or leasing of company cars to be used by employees or for the personal use of the taxpayer; travel or transfer expenses (which often include the members of the employer's or employee's family); restaurant or vacation expenses[57],or the cost of renting (or buying) real estates to be used (apparently) as guest-quarters; promotion bonuses or expenses for attending meetings[58]; low-interest loans; gifts and overall outlays for public relations; special tax treatment for private pension funds calculated according to the concept of taxation on an expenditure rather than on an income basis; medical insurance for employees, etc.[59]. In many cases these are "fringe benefits" which should be taxed out of the beneficiary's income.

The label "fringe benefits" however does not seem entirely appropriate to describe the phenomenon which involves, in Italy, millions of the self-employed and small business. However, given the inevitable difficulty of interpretation and the administrative problems involved,the most reasonable solution would be to establish that some of these expenses are not deductable or, at least, carefully regulate and restrict their deductability[60].

A similar problem exists for some "intangible"expenses; for example, expenditures for marketing, publicity, professional training, research, etc. which have grown in importance in recent years[61]. It is obvious that these are investment costs whose benefits will flow over a period of years and, therefore, on the basis of a correct definition of income, they should be deducted over a long period of time and not in just one year as is currently done, following a logic typical of a "cash-flow" tax rather than an income tax[62].

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[57]It is surprising to discover how the loss of revenue in connection with some deductable expenses, which at first appear unimportant turns out to be extremely relevent (a typical example would be meals at restaurants).In fact, it is so important that a great deal of attention was given to this specific problem during the preliminary debates over the American fiscal reform. The problem, however, remains unsolved.

[58]These are expenses which, at the start, have the characteristics of an investment (in human capital, or promotion), but instead are entirely deducted in a single year. They have given rise to a flourishing and dynamic business activity which manages to organize so-called study meetings in well-known tourist resorts so that a vacation (with the family) can be tranformed into a production cost.

[59]If the premiums are deductable, then it would be logical to consider the services taxable.

[60]This is the position taken in proposal n. 2991. In this regard,it should be noted that given the link envisaged in the proposal between corporate income tax rates and personal income tax rates,non-deductability and the imputation to the actua! beneficiary represent equivalent choices. It must also be noted that even negligible expenses may constitute on the whole a substantial source of fiscal erosion.On The Taxation of Fringe Benefits see OECD (1988).

[61]For example, Summers(1987) affirms that in 1985 in the United States expenses for "intangible" investments exceeded 200 billion dollars, a much higher amount than was spent on structures.

[62]The boom of these investments is one of the main reasons why Summers(1987) believes that a cash-flow tax would be preferable to the traditional corporate income tax.

It is difficult to find an acceptable solution to this problem, given the present limits in accounting theory and procedures. Nonetheless, a proper solution would envisage deductability over a period of years[63].

It is not easy to quantify exactly how much revenue could be recovered by adopting the measures suggested in this paragraph,but given the current situation in Italy it could certainly be estimated in the order of 5,000 billion lira in 1989.

6.1.2. Reducing Tax Facilities One of the characteristics peculiar to the Italian Tax System is the impressive number of facilities allowed on taxes and social security contributions,regularly granted, integrated and confirmed (never revoked) by Parliament. These are added to the structural erosion of the tax bases in a continual rush to gain consensus. The efficacy of these measures is at least questionable since,for the most part,they are not conceived to have effects at the margin on the taxpayer's behaviour (corporations and individuals), but rather to assure overall rebates with heavy loss of revenue and little promotional effect; this is the case, for example, with the multitude of existing territorial concessions, (starting with that for the South of Italy). A radical revision of the question is necessary with the aim, at least in principle, of eliminating all privileged treatment in order to create space for the reduction of existing rates[64]. In any event, fiscal incentives, because of their very nature, should be temporary and their effects,both on the achievement of the objectives for which they were introduced and on the overall revenue forgone, should be carefully monitored[65].

Not only their elimination, but even a reduction of the number of existing incentives, would increase revenue by thousands of billions[66].

6.2 TAXING CAPITAL INCOME

With regard to the taxation of capital income, neutrality is a fundamental objective of any rational income tax system by reason of economic efficiency,equity and administrative simplification. The objective would be to have equal rates apply to all the different forms of

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[63]This solution is adopted in the above mentioned proposal n. 2991.

[64]Obviously the lower the rates are, the less efficacious and interesting it becomes to obtain tax benefits. Reducing rates is, therefore, in itself a solution to the fragmentation and disaggregation of modern tax systems pressured by sectorial interests.

[65]The problem is so important that I personally feel it should be specifically subjected to revision at the constitutional level in order to explicitly introduce the principle of uniformity and generality of taxation as the backbone of fiscal policy, along with the principle of progression. The abuses, arbitrariness, disparity of treatment and wasted resources which derive from the current incentive policy are very substantial.

[66]In this regard see note 17 on page 7.

capital incomes and enable full integration of the corporate and personal income taxes. Technically, this result can be achieved in a quite simple way by:

a) providing a limited number of personal income tax brackets, (for example, from two to four, following the logic of a modified "flat-tax");

b) establishing a corporate income tax rate equal to the highest personal income tax rate;

c)envisaging for all other capital incomes (interest,capi-tal gains,etc.) either a withholding payment in account of the income tax at a rate equal to the marginal rate of most tax payers[67], or a final payment at a rate equal to the highest personal tax rate (Irpef) which is, in turn, equal to the corporate tax rate (Irpeg)[68].

This way the direct tax system would be structured according to a series of co-ordinated levies, conceptually and in effect constituting a single tax, thus reconciling the needs for systematic rationality and (those of) administrative simplicity, typical of a modern mass tax system. First by limiting the number of personal income tax brackets and lowering the income level for the top bracket[69], it should be possible to include in it most taxpayers with capital incomes, (except bank deposit interest and some incomes from agriculture and housing). As a result, given the equality of the rates, most capital incomes - retained and distributed profits, interests, capital gains, etc. - would be taxed at the same rate as if they were included in the personal income tax base, while the remaining capital incomes would be taxed at the personal rate of the receiver.Secondly it would not be necessary to declare all incomes in the personal income tax return and even the recourse to tax credits on dividends (which would remain full in our system) could become optional for many. The important thing is that no income not analytically declared would be subject to a lower rate than the highest one envisaged[70]. There are obvious administrative advantages to such a simplification. Thirdly the neutrality in the taxation of capital incomes would be guaranteed by the fact that all incomes would be subject to the receiver's own rate, excepting cases in which a tax payer in a low-income bracket should decide to choose the final payment solution at the highest rate. The only compulsory exception to this rule regards retained profits in the improbable case of

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[67] Obviously for the purpose of minimizing rebates or further payments.

[68] Proposal 2991 fixes the withholding rate at 26%, that is the rate of the second Irpef bracket, and the single-rate at 39%, the level established for the Irpeg rate and the highest Irpef rate. In truth, it would be possible to hypothesize a two-bracket Irpef scheme with rates ranging from 25-26% to 33-36%. The latter should also be applied to profits (Irpeg), interest, etc. See below.The system envisaged in the proposal (presented in 1988) appears very similar to the "Simplified Integrated Tax" proposed by Stuerle (1990).

[69] Bill 2991 suggests a top income bracket starting at 65
million.

[70] It must be noted that omitting to file capital income in the tax return does not guarantee fiscal anonymity. In fact, it would always be possible to cross-check data transmitted by intermediaries. From the standpoint of assessment in fact, the most important factor is not a comprehensive declaration but the inability to oppose tax office "secrecy" or confidential agrements.

a shareholder with lower incomes than the minimum envisaged for the top bracket (fixed at a greatly reduced level given the actual income distribution).

The same treatment would apply to capital income derived from institutional investment sources. With regard to investment funds the taxpayer would indicate his ownmarginal rate of tax, otherwise the highest rate would be applied thought in most cases the two rates would be the same. The question of pension funds is more complex as we have already argued, even if at present it is relatively unimportant in Italy, due to the difficulty of imagining the possibility of taxing the payments to the fund. However, even if there are exemptions on payments, if the income generated annually by the fund is taxed and if the profits distributed by the fund are considered ordinary income, the overall levy will basically be equivalent to what it would have been if coherent income tax rules had been applied[71].

Capital gains should be considered income and treated as such. It is important to stress this point because it is fundamental to the achievement of a well-balanced rational income tax system, aimed at reducing the possibilities of considerable and widespread avoidance[72]. Capital gains should be taxed upon realization, which already implies a tax reduction[73] and the tax should be withheld by the intermediary at the time of transaction[74]. Full compensation for losses and the possibility of carrying them forewards or backdating could be envisaged[75].

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[71]Hypothesizing a reserve fund of 100,an interest rate of 10%, a tax rate of 30% and a single period of time, a rigorous application of the income tax principles would result in an initial tax revenue (T_1) = 30; a net saving (S)= 70; a return (R) =7; a tax on return (T_2) = 2.1 and,therefore, a net amount of 74.9. The hypothesis indicated in the text provides : $T_1 = 0$; S = 100; R= 10; $T_2 = 3$, for a yield of 107 which would be subject to a withholding tax of 32.1 so that the net amount received by the investor would still be 74.9%. For this reason proposal n. 2991 provides that pension funds always be set up as corporations.

[72]It is a well-known fact that there are many ways to
transform incomes into capital gains and that a scenario of differentiated rates and freedom to incur debt can easily lead to a lowering of overall incidence through fiscal arbitrage.See Visco (1989).

[73]It would actually be possible to hypothesize mechanisms that would enable taxation of capital gains on an accrual basis (see, for example, Vitaletti (1990)), but it must also be remembered that there is still strong opposition to taxation at realization, therefore, it does not seem realistic to aim for such an ambitious goal for the time being.

[74]With regard to the taxation of capital gains, the
hypothetical administrative difficulties do not, in fact,exist and particularly if financial intermediaries are to be given a precise role. Today, these intermediaries already have at their disposal the data necessary for application of the tax, the same that they communicate periodically to investors in their management reports. However, in a country like Italy where medium-size businesses predominate, the taxation of capital gains mainly regards gains not realized on the regulated markets.

[75]Proposal n. 2991 provides for carrying a foreward of losses over a two year period and a backdating losses for a year, on the condition that losses are declared in the income tax return and restricted to capital gains realized and declared. In truth, it would be possible to allow intermediaries to handle settlement of gains and

Clearly, in the end, all capital gains should be taxed and not only those relative to securities or share-holdings. Thus capital gains on immovable goods (real estate) should be treated the same way as other capital gains in our system[76].

It may be further observed that the solution proposed here for the taxation of capital incomes would seem to be more efficient and rational than the possible alternative of fixing different, although uniform, rates for labor incomes and capital incomes, respectively, limiting the progression to the former. Such an alternative (adopted for example in Denmark), while surely preferible to the disorder that reigns in the taxation of capital incomes in many countries, in effect suggests a discrimination in the fiscal treatment of incomes from work and capital which may be justified in terms of efficiency, but not in terms of equity. It, furthermore, creates the difficult problem of how to identify and separate income generated by work and capital in smaller businesses. None of these problems would arise with the solution suggested here.

6.3 INDEXING

No income tax can function properly, if the tax base is not adjusted to take into account the effects of nominal variations in prices. It is no accident that the crisis in postwar tax systems, all based on the income tax, manifested itself clearly during the great wave of inflation of the 70s. In past years, considerable attention and debate have been devoted in all countries to the problem of the indexing of the tax brackets and deductions. In many countries, including Italy, a form of automatic indexing has been introduced. However the indexing of the personal-income-tax structure is done more for political than for technical reasons: the decision must be made as to whether to allow the incidence of taxation in a country to increase automatically or not, but no distortion takes place as a result of a failure to index. Such is not the case, however, for the indexing of capital income. In this case, the correction of the effects of inflation is purely and simply a technical necessity. If it is not tended to, it can lead to very serious distortions and inefficiencies.

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losses (particularly in cases of portfoglio management), but this would imply an additional administrative cost. Furthermore, it is essential that the possibilities of deducting losses be limited so as to prevent the all-too-easy abuse resulting from the asymetrical treatment of gains, the taxation of which could be postponed ad libitum by the investor, and losses which could be immediately realized and compensated for with incomes of other nature. On the other hand, the deductability of losses is very useful to the markets because it represents the participation of the government in the risks undertaken by investors.

[76]In the case of capital gains on housing, taxation might be temporarily suspended if the houses represent the taxpayer's main place of residence, on the understanding that another place of residence would be bought within a certain period of time. Such a solution is obviously in derogation to the general principles on which our reform is based, but is justifiable if we consider the widespread tendency,in Italy, to invest in housing - also as a result of past fiscal distortions - and might be seen as an incentive to territorial mobility.

As is well known, the problem basically concerns interest charged and interest earned, capital gains, depreciation and stocks[77]. In fact, numerous legislative distortions,deviations from rational taxation principles, tax incentives, tax exemptions ...come out of the necessity to compensate somehow for the effects of inflation on company budgets and on personal incomes. The lack of indexing is in my opinion a primary source of and an explanation for most of the characteristics that make tax systems hybrid today[78]. One has only to think of the laws on accelerated depreciation, those allowing LIFO, the taxation of capital gains by installments or their taxation at reduced rates, or the laws concerning the appreciation of company assets to the current level of prices, the large number of facilities for savings, as well as those regarding relief for company mergers, etc.

The effects of the lack of indexing of interest are particularly significant. As Table 14 shows,even when inflation is low,when real interest rates are realistic, and tax rates do not differ from current ones,the failure of the interest charged, and considerable reduction of to index can easily lead to taxation for more than 100% the real cost of indebtedness (and,at times,a subsidy)[79].

This leads to the unjustified penalization of individuals, considerable relief for companies and all taxpayers who can deduct for tax purposes nominal interest paid.

Apart from the difficult-to-understand cultural opposition to indexing, it is often maintained that it would be difficult to carry out in a practical sense. In reality this does not seem to be the case. As far as the taxation of individuals is concerned, indexing concerns above all interest charged and interest paid as well as capital gains. For the latter, it is sufficient to revalue the purchase cost in accordance with consumer price variations using tables set up for that purpose. For interest, since the real interest rate (ir) is obtained simply by subtracting the price-variation rate (p) from the nominal interest rate (in),it is easy to verify the fact that given ir =in - p,it follows that ir= in (1 - P in). That is to say that real interest can be calculated by means of a simple percentage reduction of nominal interest[80] .

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[77]In fact, if inflation were very high, it would not suffice to index the values indicated. On this subject, see Sadka (1990). On the effects of inflation on the tax system see Tanzi (1977) (1978) (1980) (1981) (1984); Stuerle (1985); Halperin and Stuerle (1988), Visco (1982) (1989).

[78]According to the definition of Haaron-Galper-Pechman(1988)

[79]A great number of the most common tax arbitrages are made possible or facilitated by the possibilities for unlimited deduction of interest. On this subject see Steurle (1985) and Visco (1989). The non-deductibility of a portion of the interest payments can also be justified by the presence of other tax asymmetries (on this subject see for example Auerbach 1988), however the main distortion is surely that coming from failure to index.

[80]This solution is adopted in the previously mentioned Bill 2991 (see also Meade [1978]). There is one problem involved for the deductibility of mortgage interest. It does not in fact seem fair to change the relevant tax laws retroactively. However, for mortgages contracted subsequent to the tax reform, it could be stated: a) the elimination of any quantitative limit or one relative to the nature of the building (first or second

In a country like Italy, which makes ample use of the withdrawal of taxes on capital by the intermediaries, it should not be particularly difficult to effectuate a percentage abatement to calculate the taxable income that savers should enter in their tax declarations, or one on which withholding could be applied, and in fact both p and in are known to the intermediary[81].

As far as corporate income is concerned,indexing should concern capital gains (and losses) (for which the criteria indicated for individuals could be followed), depreciation, stocks and interest paid and receveid. In practice, it would not be necessary to index balance sheets completely, since it would be sufficient to correct just some of the items on traditional balance sheets. In the case of depreciation, the value of the historical cost depreciation should be revalued on the basis of the price variations taking place during the period under consideration [82]. A similar procedure should be followed for the stocks calculated using the FIFO method[83]. As far as interest paid and received is concerned, either the procedure indicated for individuals could be followed, or, on the other hand, the devaluation of debts (that is the product of liabilities times the inflation rate) could be considered taxable, and that of credits deductible; this latter method would appear to be preferable[84].

It is also worth noting that, contrary to what is generally thought, adjustments for the effects of inflation do not involve a reduction of the tax base or tax burden for companies, but rather their increase. In fact, stocks are already indexed now thanks to the LIFO, and, as Table 15 shows, the effect of accelerated depreciation is basically equivalent to that of indexing at a hypothetical annual inflation rate of 5%. Moreover, the effective revenue from capital gains can be considered negligible both because of the division into installments provided for, and by virtue of the numerous laws on the revaluation of company assets or on corporate restructuring, or thanks to the widespread practice of mergers "of convenience",

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home)as far as deductibility is concerned; b) the indexing of interest paid; c)the possibility for deduction of real interest within the limits of the income declared for the building.

[81](P) could also be the programmed rate of inflation.

[82]Naturally,accelerated depreciation should be abolished. In fact, rather than functioning as an incentive, it has the actual function of guaranteeing an adequate level of reserve funds.
With regards to depreciation, the most difficult problem in the context of income tax is, of course, the very concept of true economic depreciation which appears to be more of a logical abstraction than a workable concrete possibility. It is obvious, however, that the difficulty remains both in the presence and in the absence of indexing. From the point of view herein sustained,it would seem advisable to index the historical values defined in a (moderately) permissive way.
This would avoid recourse to accelerated depreciation.

[83]This solution appears systematically more appropriate than that of keeping LIFO which would have equivalent effects.

[84]In fact, with the first method, companies could try to (partly) avoid the tax, making a portion of the financial expenses appear to be an additional cost of the financing. (I am grateful to Prof. P.A. Vagliasindi for bringing this point to my attention); furthermore, for the proper application of the method, it would be necessary either to calculate an average effective rate of interest, or distinguish expenses for interest according to the rate applied, for each financing.

which have, in the past, allowed bringing to the surface of real and monetary capital gains with substantial tax exemptions.

On the other hand, as far as interest is concerned, there would be a considerable increase of the tax base due to the fact that a high percentage of interest paid would no longer be deductible[85]

Adjustment for the effects of inflation is, then, a realistic and practicable goal. And it is good to be aware of the fact that it represents the only instrument capable of making taxation effectively neutral as far as the financial decisions taken by the firms, the allocation of resources and the possibilities for tax avoidance are concerned[86] .

6.4 THE EQUALIZATION OF TAX PAYMENTS

An important problem for any tax system is that of guaranteeing a time profile of payments which does not discriminate between taxpayers and sources of income.

The problem has general implications, but as far as the Italian situation is concerned, there is a clear and considerable disparity between subordinate income and pensions on which the tax is paid monthly by means of withholding tax, and tax payments on other earnings which are substantially postponed despite the payments on account provided for[87]. Theoretically, the rational solution would be to have the entire tax owed for each year paid by June 30,and interest if any would be charged on postponed payments[88].

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[85]The problem is different for banks (and financial intermediaries) and for other companies. In the case of banks, the correction for paid and earned interest turns out to be basically neutral for tax purposes. In 1989, for example, the paid interest of banks turned out to be 97,000 b at an inflation rate (p) = 6.3% and an interest rate ip=6.9%. As a result, with indexing, 89,000 b would have become undeductible, with a greater tax load estimated at approximately 41,300 b. But since earned interest is 176,000 b., and the rate of interest ia=13.6%, the total taxable interest after indexing can be estimated at ca. 82,000 b. corresponding to a smaller revenue of 38,000 b. The positive balance would thus be quite small: around 3000 b. The situation is different for other companies, those which effectively benefit from the possibility for total deduction of nominal interest: in 1989, the paid interest of non-financial enterprises was 82,500 b with ip = 14.2%;indexxing would have made around 37,000 b undeductible, corresponding to a greater revenue at current rates of 17,000 b.Since corporate earned interest was 24,000b (ia=11.0%) the same year, indexing would have involved a loss of revenue of around 6000 b; and a positive balance of over 10,000 b would have been produced.

[86]On this subject see King-Fullerton (1984), Giannini (1988), Castellucci Halworth (1988).

[87]This problem was properly dealt with in the law concerning tax reform (L. 9.10.1071 n. 825 art.10,n.7), but an appropriate solution was not found. Cosciani has brought up this problem many times;see Cosciani (1984).

[88]The objection most commonly raised to this solution is that the taxpayer is not in a position to know his income with precision for the year. Thus, it would be unfair to charge interest on the sums not paid in time. This objection is irrelevant, however, since, in any case,payments postponed after those based on a uniform

In any case other solutions can be conceived : for example, Bill No. 2991 provides for two payments on account in addition to the May payment: the first (optional) equal to 5/12 of the tax due based on the last declaration to be paid by the month of February, and the second - equal to 10/12 of the tax due for the preceeding year as indicated on the declaration presented in the month of May and to be paid by September 30.The time profile of the payments is to be found in Table 16[89]. The effect in terms of revenue from the bill (which should concern Irpef, Irpeg and Ilor) is considerable and for 1989 can be calculated at about 1500b in (permanent) interest savings for the State.

6.5 ELIMINATION OF EXISTING TAXES; INTRODUCTION OF NEW TAXES (THE WEALTH TAX).

The reform of direct taxes outlined in the preceding pages implies the abolition of Ilor[90], Invim, and the substitute tax on interest for an overall revenue loss of around 45,000 b in 1989; furthermore, it would be appropriate to reduce the incidence of the registration (and related) taxes from the present 10% to no more than 3-4%. The elimination of Invim would be substantially compensated for by the proposal for the general taxation of capital gains in connection with the income tax: on the other hand, the introduction of a general wealth tax should correspond with the elimination of Ilor in accordance with the premises on which the 1973 reform are based. This is not the place to illustrate the reasons for the introduction of this tax[91].

However, over and above the traditional arguments, it can be observed: a) that in a system like the Italian one which places a heavy burden on subordinate income by means of

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monthly time profile involve an earning of interest for the taxpayer which, as a matter of principle, is owed to the State, whether or not they refer to earnings that are unforeseen and unforeseeable.

[89]The logic of the bill is that tax prepayments and actual payments are compensated for precisely, as are interest earnings and losses, assuming the invariability over time of the income earned and declared. As is obvious, no delay or advance in payments would take place in the two months (February and September) when the advanced payments were to be made. Furthermore, it is clear that, assuming the invariance of income in the course of time, earnings and losses coming from advanced or delayed payments of the tax with respect to the monthly dates of income would compensate precisely for the first ten months of the year. Since the first advanced payment (which would mean one month's delay and three months' advanced payments)is not compulsory, it is necessary to provide that, if it has not been made or turns out to be less than 5/12 of the tax indicated in the last tax declaration submitted, the difference between the sums paid on account for the recorded payment and those paid on account for the first payment, be increased by a percentage as interest (an increase of 6% would be equivalent to an annual interest rate of 15%). It should be further noted that, in most cases the payment in the year of 10/12 of the tax owed for the preceding year, would, be an advantage for those earning this type of income over those earning income from other sources, and this advantage is enhanced if the total declared income does not remain constant in time.

[90]The abolition of the Ilor would itself bring the tax on corporations to 36% rather than the 46.4% of 1989.

[91]On this subject see Cosciani (1940) and (1950), Muraro (1987),Visco (1987) and Sanford-Willis-Ironside (1975).

withholding income and payroll taxes,a moderate taxation of capital would have the effect of reducing discrimination in the use of factors of production; b)in the context of a sharp reduction in marginal personal and corporate income tax rates the necessity arises for an adjustment of the overall progression of the tax system that cannot be assigned to just one tax; c) in a system which taxes realized and not accrued capital gains, an annual wealth tax would constitute a useful and significant integration of the income tax.

For the technical characteristics of the tax and some specific problems posed by its introduction, one can refer to Visco (1987); at this point suffice it to say that the tax should,in so far as possible, be universal, be basically a real tax[92], with proportional rates that can, by way of orientation, be set at 5 per thousand (average), with a uniform nationally defined tax base[93] on the assumption that the part of the tax on real property goes to local bodies as the primary source of their tax autonomy.

7. Further reform elements: a) the reform of local and regional taxation and the reduction of social contributions; b) the reform of indirect taxation.

The reform of direct taxation is the fundamental core of the reform of the Italian tax system illustrated here. It does not, however, exhaust the necessities and possibilities for appropriate action to create a more rational system. In this paragraph there will be a brief description of how it would be possible to reform the financing of Regions and Local bodies as well as restructure indirect taxation[94].

One of the principal drawbacks to the 1973 reform is that virtually all revenue is centralized at the national level, meaning that the Regions and Local authorities depend on government transfers for funds. The negative impact of such a choice on the public budget, on the local bodies who have lost virtually all administrative responsability, and on the very social structure of the country is well known and has been amply discussed.

What is needed is a radical reform which could be implemented along the following lines: for the Regions, aside from the low-yield taxes already granted, it might be possible to provide for, a) a surtax to be calculated as a percentage, ranging from a minimum to a

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[92]In fact, it would not be impossible to include some elements typical of a personal income tax, for example, a lower tax limit (perhaps only for some assets such as buildings).

[93]As far as companies are concerned (hence stocks and other capital shares), the simplest way to collect is to tax the capital and reserves of the companies. Thus, the introduction of a wealth tax should be preceded by a general, compulsory and tax free reassessment of company balance sheets, and subsequently by the indexing of the tax base.

[94]As most of these proposals were put before the Chamber of Deputies during the X Legislature by Visco et al. for further information we suggest turning to proposal n. 1026 (1987b); n. 4082 (1989b); and n. 5215 (1990b) and the accompanying reports.

maximum, on the incoming revenue from the personal income tax (Irpef) paid by the residents of each Region. The Irpef rates would have to be revised in order to maintain the existing overall revenue (at the national and regional level) once the minimum obligatory percentage has been applied; b) a regional tax on final consumption, to be managed together with VAT so as to avoid the duplication of administrative costs, but calculated on a much wider taxable base. This tax would also be applied to sectors not subject to VAT and there calculated with the direct deduction method. An average 3% rate might be considered which the regions could increase or reduce by half a point and the revenue generated would automatically flow into each single Region. The introduction of such a tax would make it possible to eliminate all of the social contributions that businesses and workers (both employees and self-employed) pay into the National Health Service which, in turn, would be managed directly and only by the Regions, financing the Service with the tax revenue levied on residents (and voters).This system would considerably reduce, by more than 10 points, the cost of labour for business, as well as reducing the fiscal "wedge", estimated to be the largest in Europe, between the cost of labour and net wages in Italy[95].

In the case of Local bodies (Towns and Provinces) the reform should aim to give a certain degree of fiscal autonomy back to residents and local communities which would free them to make their own choices, both political and financial. As a result, local authorities would be able to autonomously decide, at least in part, their own budget constraint which they would submit to the political approval of residents. The effective implementation of financial autonomy of local bodies should be characterized by: a) certainty as to the actual size of residual government transfers; b) the removal of hindrances to employee management (hiring and dismissal) and to free access to credit; c) the introduction of high revenue-yielding local taxes.

One hypothesis put forth in proposal n. 5215[96] might be to give local authorities management of a local real estate tax on land and buildings. This would be a proportional tax with rates, based on real market values, varying from 3 to 5 per thousand. It would, however, provide for a fixed tax credit for the first home. The proposal also envisages a proportional tax on locally produced gross income which would have the same taxable base and would follow the same administrative procedures as the tax on economic activities envisaged for the

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[95]See CER Report n. 2 (1990). It is generally agreed in Italy that the health service should be financed out of the general tax revenue and not through social contributions and this was actually envisaged in Law n. 833/1978 (Art. 76) which set up the National Health Service, and has been asked for repeatedly by the Constitutional Court (for example, in ruling n. 45 of February 1985). The hypothesis of introducing a general and uniform tax on gross income produced (added value) was postulated by Di Majo (1986) and again by CER (1990).The hypothesis envisaged in Bill n. 1026 (Visco, 1987) basically differs from the Di Majo-CER proposal in that it exempts invested capital. The economic effects of these proposals on the level of prices, exports, etc. were examined by Ceriani-Frasca-Paladini-Violi (1989). On the general problem of subtituting social contributions with ordinary taxes see Paladini (1978).

[96]See Visco (1990b)

Regions and would also include invested capital. These rates should range from 0.2 to 0.4 per thousand. Lastly, the mechanism regulating government transfers to the Regions and local bodies, and the size of these, should be revised radically. Such transfers would remain,even if greatly reduced,for equalization purposes and also to assure an autonomous financial basis in which to integrate fiscal autonomy.

The reform would not be a burden on the State budget as the transfers would be reduced in equal measure to revenue generated by applying of the minimum rates of local taxes.

The main indirect taxes in the Italian system are VAT and the tax on mineral oils. These account for the second and third sources of revenue, respectively. The rates applied for these taxes are higher then in other countries and both could be more efficiently rationalized. With regard to VAT, the need to modify it is also related to European integration as Italy has far too many rates which are compared to the other Community countries, the highest in the community. It would therefore probably be wise to take steps towards uniformity, particularly in view of the eventual decision to adopt the principle of taxation in the country of origin. Furthermore, Community harmonization envisages the application of the lowest rate only, or mainly, on some goods, for example foodstuffs, and the ordinary rate on all other goods.

At the start the implementation of the above mentioned hypotheses, which could be done by introducing two rates, 7 and 15-16%, might mean a slight reduction in revenue, but this would be more than compensated for by a revision of the tax on energy products currently in force. In a country like Italy, which lacks energy sources and has, one assumes, given up nuclear energy for the medium/long term, where congestion and pollution are big problems, taxation should foster energy saving in this sector and the use of cleaner products as well as target revenue. From this point of view taxation should be structured to provide for: a) a uniform tax that would not alter the cost/energy ratio of each product; b) a tax proportioned according to the pollutants contained in each product (emission of CO2, sulfur dioxide, etc.).

It ought be noted that should Community harmonization require a reduction in the present excise tax on mineral oils, the revenue could be recovered by converting part of the levy into a regional tax on the environment.

8. An Overall Evaluation

The tax reform outlined in this study, but already largely formalized in several bills before the Chamber of Deputies, is surely not as radical a revision as the one carried out in 1972-73, or what would be represented by passing to a system of expenditure taxation. Basically, it limits itself to supplementing the reform of 17 years ago, recovering some of the ideas that came out then and were subsequently abandoned, and supplementing them with others which arose from the scientific and political debate of the 70s and 80s.

The changes proposed involve essentially direct taxation and consist of a substantial extension of the tax base (more than 100,000 b of 1989 for Irpef alone) and of an equally substantial reduction in personal and corporate rates.

It is clear that this would lead to increased economic efficiency, while the excess burdens and the distortions in individual behaviour would be reduced. These effects would be enhanced by the neutrality in the taxation of incomes from capital and their indexing. All in all the system would become much simpler, more rational and neutral with respect to investment and financing decisions, and much more respectful of market demands than the present one.

Reduction of the rates would not pose problems from the point of view of equity either (the highest marginal rates envisaged would be slightly more than 30%). On the contrary, the progression of the income tax, defined as the share of revenue paid by higher-income earners, would increase considerably since at present, a large portion of the typical income earned by the wealthier classes is exempt, or subject to substitute taxation, or benefits from generous erosions or numerous possibilities of avoidance. Our reform proposal would practically plug up all the present holes, eliminating from the start the possibilities for tax arbitrage, and greatly simplifying administrative tasks. It should be emphasized, in any case, that these results can be obtained quite simply and be managed quite easily[97] since our income tax, in its significant aspects, functions like a flat-rate tax: a traditional system of taxation of income with a more complex rate scale would increase problems of bookeeping considerably, as experience fully demonstrates[98]. The overall progression of the system would be further enhanced by the wealth tax, which, given its low rate, would be paid out of incomes from property. Furthermore,this tax has the well-known and positive feature of creating an incentive for the productive use of capital, as well as neutrality with respect to risk taking and work incentives. It is also an incentive to greater mobility of property assets,and the reduction of the "lock-in effect" in the taxation of capital gains at the moment they are realized.

The indirect tax would be modified for a more rational and stronger use for the purpose of controlling externalities (energy saving and pollution), and to facilitate commerce (reduction of VAT rates); while the tax load on the various production factors would be better balanced.

It is not possible to state with certainty that the reduction of rates could also lead to a reduction of tax-evasion[99], but it is sure that arguments presently made to justify evasion would no longer be acceptable.

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[97]It has been seen that indexing does not present notable practical difficulties either.

[98]In particular, the integration of the personal and corporate income taxes, and the uniform taxation of income from capital would involve extremely complicated bookeeping - probably prohibitively so.

[99]As is well known, the results of the theory on this point are ambiguous. For a succinct review of the theoretical problems involved in tax evasion see Visco (1990a).

The potentialities for revenue increases deriving from the reform proposals are quite substantial. These are outlined in Table 17: even if taxes are eliminated or rates reduced by more than 85,000 b for 1989, the net balance of the operation would nonetheless be positive for about 18,500/27,000 b (1.5-2 gross domestic product points), despite the reduction in rates of all the principal taxes by percentages from 20 to 40%, and the complete restructuring of the Irpef rates[100]. Table 17 gives a clear idea of the enormous present inefficiency and potentialities for more rational organization coming out of our proposal[101]. It must also be borne in mind that the greater revenues are estimated quite conservatively,since basic statistics are not always reliable and quantitative information is generally lacking in our country. Moreover, no proposal for reducing tax-evasion has been put forth, since the curbing of tax fraud is strictly an administrative task. However, since existing estimates for direct taxes and VAT show that evasion is quite high, it can be assumed that further and ample margins for recovery of revenue, probably comparable to what is illustrated in Table 17,would continue to be present. This means that concrete possibilites exist for further reductions in rates,as well as for a structural reduction of the public deficit.

Since the quantitative adjustments would be substantial as a result of the reform (albeit less - as has been said - than those experienced even in the recent past), the reform should be

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[100]This revision is necessary, over and beyond what is already provided for in Bill 2991, because of the inclusion in Irpef of all the income presently not included, and because the system of taxation of family income needs to be revised, as requested by many people. The new rate structure as proposed would be extremely simple: three income brackets (two in actual fact): up to 4 million lire: 0%; from 4 to 50 million: 25%; above 50: 33%; and, apart from the tax credit for salaried income, 252000 lire (1989 values)tax credit for each dependent (including spouse); the same amount would apply to people over the age of 65. Finally, in the case of families with a single source of income, the tax credit should be doubled. The reduced revenue (which would in part compensate the increases provided by our tax reform) is estimated to be 8,800 b in 1989, of which more than 6000 would benefit families. It is advisable to point out that the option of granting a "favor" to families, with a single source of in-come, is a matter for discussion as to whether or not it would be logical. On this subject see: Visco (1991).

[101]This should be carefully considered by some critics of tax reform based on the simultaneous reduction of rates and broadening of the tax base. According to them,proceeding in this manner, there would not be the certainty of an increase in tax equity. This would occurr only if the broadening of the tax base were absolute, which is practically impossible: see Giovannoni (1990). This type of argument however is completely divorced from an assessment of the real situation, the point of departure for what it is in reality, and thus it inevitably appears to be abstract and of little relevance (even theoretically). Moreover, many critics of income tax continue to compare an inadequate,inefficient, but concrete tax on income which has been capable of making all its defects, limits, and problems of functionality explicit in the course of time,with an ideal tax on expenditures which has never actually been tested (except in Ceylon for a very brief period of time). This is not appropriate and can lead to serious errors in assessment.
In fact, an expenditures tax appears to be preferable with respect to an income tax exclusively because it shows itself to be capable of automatically solving the problems connected with the taxation of income from capital. For the rest, the two theoretical models encounter identical or similar difficulties in actual operation as well as a likelihood of the erosion of the tax bases.

carried out gradually[102]. This is especially true for the taxation of capital income, and the wealth tax on the assets pertaining, which should begin to be applied starting from the next bond-emission,as well as the taxation of property income for which the contemporary introduction of the municipal property tax must be taken into account. The graduality in the implementation of the reform would, of course, mean less revenue, but this would be compensated for by a correspondingly gradual reduction of other taxes [103].

It must also be remembered that the estimates refer to 1989, and that certain laws were changed the following year, so some revenue sources might already have been made use of (at least partially:in particular: that of mineral oils).

This would not, however,appear to appreciably change what has been described here. Another problem is the practicability of reforms given the step-by-step integration of the Italian economy into the European system. The problem mainly concerns capital incomes and, more in general, remunerations of the more "mobile" factors of production, such as the professions, management, highly skilled workers, etc. In truth, with regard to interests and capital gains of individuals, the considerable reduction of rates and the indexing provided for in the proposal should reduce the problem or even remove it[104]. In any case, it is obvious that should Europe choose fiscal competition over collaboration and co-ordination, the taxation of capital in all of the countries would tend to converge toward the minimum possible levels, that is toward zero. It is sure, however, that such a result, would not indicate an equilibrium position in a world where the distribution of income and wealth is still very unequal. The hope, therefore, is that Europe will gradually choose other solutions which can be developed according to two alternative hypotheses. The first that the creation of a federal budget and therefore of federal taxes as well as a sopranational body with governing powers, all of which would make fiscal competition between States unnecessary. This solution is surely the most logically coherent with the idea of monetary unification in that the eventual consequences for the single country of a single currency could be offset by a centrally

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[102]The rational solution would be that of approving the entire reform,providing that its individual parts can come into effect at subsequent times (several years).

[103]This is what is stated in Bill 2991.

[104]This is highly likely for capital gains. As for interest, it can be observed that in case of a nominal yield of 6%, and a rate of inflation of 3%, our proposal would (considering the tax on income and the wealth tax together) determine a tax load of 1.5 and an incidence on the nominal value of 25%,while, if inflation were 5% the tax would be 0.8 and the nominal incidence 13.3%. These levels are not high, in fact they are below those existing elsewhere in many cases.
Basically, there would be considerable relief on bank deposits, along with a not-excessive increase in bond taxation (that is to say on the public debt). Furthermore, this result would come about exclusively from the neutrality of taxation and not from a form of discrimination. This should be considered desirable if one agrees that the goal is a policy for financial recovery eliminating the present incentives to public indebtedness (even tax incentives). The reduction of the tax on deposits should, furthermore, help banks resume their role as mediator with families.

decided budget policy. Such a solution is, however, highly unlikely for political reasons. The second hypothesis is that the organization by each single country of efficient mechanisms for the automatic and systematic transmission of data and information concerning the residents of the other countries and their capital incomes (interests, profits, etc.) so as to guarantee each nation the possibility of taxing its own residents under the most suitable system. This would also enable nations to maintain considerable budgetary independence which is necessary, in the absence of a federal budget, to make monetary unification compatible with the individual needs,characteristics and history of each nation[105].

[105]On this subject see Giovannini (1989), Visco (1989c). On the other hand the fact should be noted that in an integrated economy,a corporation tax at a reduced level could provide an incentive to multinational companies to realize profits in a country with a low rate (resulting in an increase in tax revenue),and costs in countries with high rates.

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WELFARE EFFECTS OF TAX PROGRESSIVITY
A normative analysis of some income tax reforms in Italy

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1. Introduction

The purpose of this paper is to show how some normative criteria, theoretically justified, can be used to evaluate the welfare effects of income tax reforms.
In order to compare, on welfare grounds, different tax systems, one might use some indexes of tax progressivity; however it has been shown that these indexes have normative content only in the case of tax progressivity changes which do not affect tax yield. It is known in the literature (Formby,.Smith, and Thistle, 1990) that the most appropriate way to evaluate the welfare effects of different tax progressivity systems is to use a social welfare function expressed in terms of the mean and of an index of inequality of the post-tax income distribution. This function allows one to obtain robust welfare prescriptions also in the case of tax systems with different tax yields. Furthermore, when the inequality index is the generalized Gini coefficient, this welfare function allows one to verify to which extent welfare evaluations of tax progressivity changes are sensitive to inequality aversion.
In the paragraphs 2-5, we deal with the theoretical issues concerning the social welfare ranking of different tax systems. Firstly, we describe the indexes of progressivity based on the Dalton-Musgrave and Kakwani-Suits approaches and we analyze their welfare implications. Then, we report the theoretical results concerning the welfare ranking of income distributions and we stress the relevance of the social welfare function in this context. Particular relevance is given to the theoretical debate concerning the existence of a welfare function, obtained from the aggregation of individual preferences, which rank income distributions in the same way the Gini coefficient does.
The result of this debate justifies the methodology used in the empirical analysis to evaluate different tax reforms.In the paragraphs 6 and 7 of paper we compare the income tax reform introduced in Italy in 1986 with the previous tax system, with the one introduced in Italy in 1989 and with a proposal of tax reform presented to the Italian Parliament in 1988. However it is important to stress that, since the only pre-tax income distribution observable by the Government is the fiscal one (which may differ from the real one because of evasion and elusion), the normative analysis of tax reforms does not shed any light on the true effects of

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changes of tax structures on individuals' welfare; it gives, however, some indications about the objectives which inspired Government's decisions.

2. Indexes of tax progressivity

In this paragraph we discuss the welfare implications of two classes of indexes of progressivity corresponding to the Kakwani-Suits[2] and the Dalton-Musgrave approaches.
The indexes of the first class measure progressivity as departure from proportionality in the distribution of the tax burden.
A well known index of the first class is the Kakwani index of deviation from proportionality, Π^K, which measures the area between the Lorenz curve for pre-tax income distribution, $L_X(p)$, and the concentration curve for tax liabilities, $L_T(p)$. It is defined as follows:

$$\Pi^K = 2\int_0^1 [L_x(p) - L_T(p)]dp = C_T - G_x \qquad (1)$$

where G_X is the Gini coefficient associated with the pre-tax income distribution and C_T is the concentration coefficient for tax liabilities.
The indexes of progressivity corresponding to the Dalton-Musgrave approach quantify the redistributive effect due to the progressivity of the tax system[3]
A well-known index in this class is the one proposed by Reynolds and Smolensky, Π^{RS}, which measures the area between the Lorenz curve for pre-tax income distribution and the concentration curve for post-tax income distribution, $L_{X-T}(p)$, and is defined as follows:

$$\Pi^{RS} = 2\int_0^1 \left[L_{x-T}(p) - L_x(p)\right] dp = G_x - C_{x-T} \qquad (2)$$

where C_{X-T}, is the concentration coefficient for the post-tax income distribution.
The indexes of progressivity, described above, have been at the centre of a debate concerning, in particular, their ability to provide robust welfare prescriptions, i.e. to rank, on welfare grounds, tax progressivity systems. According to some authors (Blackorby and Donaldson, 1984), the Dalton-Musgrave indexes are preferable, on this ground, to the Kakwani-Suits indexes, since, among other things, the latter ones are tax scale invariant, so that proportional changes in average tax rate do not affect their progressivity measures.

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[2]An analysis of the distributive effects of IRPEF has been carried out, using a normalized version of the Kakwany progressivity index, by Violi and Cannari, "Effetti redistributivi dell'imposta personale sul reddito: il caso italiano e l'ipotesi di tassazione secondo il reddito normale" in M. Leccisotti (a cura di) Per un'imposta sul reddito normale, Il Mulino 1990.

[3] This class of indexes can effectively quantify redistributive effects only in the case of no re-ranking of income units, i.e. if there are no changes in the individual's positions in the distribution of original income, due to changes in the progressivity of the tax system.

However, the main reason why the Kakwani-Suits indexes have been criticized (Formby., Smith and Sykes1986, 1987) is that, since they are based on the comparison between tax concentration and pre-tax Lorenz curves, they do not allow the use of the Lorenz dominance criterion for the ranking of tax systems[4] and, therefore, do not provide unambiguous welfare prescriptions.
On the contrary, since the Dalton-Musgrave indexes are based on the comparison between post-tax and pre-tax income Lorenz curves, they provide unambiguous welfare ranking of tax systems with equal tax yields, according to the Lorenz dominance criterion, as long as the post-tax Lorenz curves do not intersect. Recent results, however, have demonstrated (Lambert and Phafler, 1987)[5] that, if the two tax systems yield equal tax revenue, Lorenz dominance between tax distributions implies and is implied by Lorenz dominance between post-tax income distributions; therefore the Kakwany-Suits indexes can provide unambiguous welfare prescriptions under the same conditions of the Dalton-Musgrave ones. In conclusion, both the Kakwani-Suits and the Dalton-Musgrave progressivity measures are not consistent with welfare theory, except in very special cases, and so they are unable, in general, to welfare evaluate tax systems.

3. Welfare ranking of income distributions

The concept of income redistribution is central to the question of global progressivity. This means that the evaluation of tax progressivity systems is based on the distributions of disposable income. Therefore, the problem of ranking tax systems with different tax yields can be solved by using the theoretical results concerning the ranking of income distributions having different means.
The dominance criterion of the generalized Lorenz curves, which are defined by Shorrocks (1983) as the mean times the corresponding Lorenz curves, eliminates the problem of the different sizes of the income distributions, but it does not allow one to obtain robust welfare prescriptions when the generalized Lorenz curves cross. In this case, we need to impose some conditions on the variance of the income distributions and also to restrict the individual utility function to the class of those strictly concave with positive third derivative[6], in order to obtain

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4 By the Atkinson theorem, we know that unambiguous welfare prescriptions can be obtained by applying the Lorenz dominance criterion to the comparison of post-tax income distributions having equal size, if the corresponding Lorenz curves do not intersect. The criticism to K-S. indexes lies on the fact that the application of the Lorenz criterion to tax concentration curves would be justified only if there were a one-two-one relationship between intersections of tax concentration curves and intersections of post-tax Lorenz curves.

5 They show .that , in the case of equal tax yield, the tax concentration curves cross if and only if the post-tax income Lorenz curves cross; it is satisfied, therefore, the condition required to the application of the Lorenz dominance criterion to tax concentration curves.

6 Inequality aversion plays the same role of risk aversion and it is measured by $qu(x) = \frac{-U''}{U'(x)}$, $U''' > 0$ implies $dqu(x)/dx \leq 0$. This restriction also implies that the utility function U must obey the diminishing transfer principle.

unanimous social preferences. However, the restriction imposed on the utility function is not sufficient to ensure unambiguous welfare rankings of income distributions having different means when the corresponding generalized Lorenz curves cross an odd number of times. In these cases the welfare results depend on the degree of inequality aversion of individuals.Indeed, consider the two extremes attitudes to inequality: inequality neutrality ($qu(x) \to 0$) and infinite inequality aversion ($qu(x) \to \infty$) which corresponds to the Rawlsian leximin criterion. Individuals who are indifferent to inequality always prefer income distributions with higher means (efficiency) regardless on how income is shared among people and, therefore, they rank higher the generalized Lorenz curve which is dominant at the end of the scale. On the contrary, the Rawlsian criterion ranks higher the generalized Lorenz curve which is dominant at the bottom of the scale.

Therefore, in order to obtain unanimous preferences for one or the other income distribution, when the corresponding generalized Lorenz curves cross an odd number of times, we will have to restrict the spectrum of attitudes to inequality, excluding either the least or the most inequality averse utilities. In particular, if the variance of the equity superior distribution is sufficiently less than that of the efficient one, the former is preferred by all strictly concave utility functions (with $U''' > 0$) except by the least inequality averse ones[7].

The above results show that, when we compare income distributions of different sizes and there is a contrast between equity and efficiency, it is not possible to determine, unanimously, which income distribution is socially preferred, unless we exclude individuals whose inequality aversion is lower than a positive quantity depending on the mean-variance relationship between the income distributions. This also means that we cannot expect robust welfare results for progressivity changes which, by affecting tax yield, cause post-tax income Lorenz curves to cross an odd number of times. For this reason , the more appropriate way to evaluate the welfare effects of different tax progressivity systems is to use social evaluation functions which can be abbreviated into a social welfare functional of the form :

$$v(x) = V(\mu, I) \tag{3}$$

where x is the income, μ is its mean and $I(x)$ is an index of inequality, such that $I(x)=0$ means perfect equality and $I(x)=1$ maximum inequality of the distribution. Of course we loose the strenght of the unanimous preference by this abbreviation. But this functional, by making explicit the trade-off between equity and efficiency in the distribution of the post-tax income,

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[7]In particular, the restriction on inequality aversion is expressed as follows:

$$q_u(z) \geq \frac{z(\mu_G - \mu_F)}{\left[(\sigma_G^2 - \sigma_F^2) - (\mu_G - \mu_F)(2z - \mu_G - \mu_F)\right]} > 0$$

where $q_u(z)$ is the measure of inequality aversion at the highest income $x = z$ and the mean variance expression is the lower bound of inequality aversion, which permits unanimous preference for F over G by utilities with $q_u(z) = e \in [0, e_0]$.

allows one to obtain unambiguous welfare ranking of tax systems, where unanimous preference is not attainable as in the case of different tax yields.
It is worth to stress that the social evaluation function v(x) belongs to the class of individualistic, symmetric and inequality averse social welfare functions. Indeed v(x) is defined on utility values $U_i(x)$ and it is symmetric so that $v(x)=v(\sigma x)$ for all x and all permutations σ; given individualistic preferences, a common utility of-own-income is imposed, U(x), which is assumed to be strictly concave. The concavity ensures that the resulting social evaluation function will be inequality averse. This approach is different from an interpretation of (3) which sees it as the social evaluation function of a socially concerned and personally disinterested decision-maker which can be written as the product of the mean by the income distribution equality rating reflecting the evaluation of the policy-maker with respect to the inequality of the distribution (cfr. Yaari, 1987).
The definition of a welfare function, such as the one in (3), is equivalent to establishing an ethically founded social evaluation function for the index of inequality, i.e. to admitting the existence of a class of individualistic welfare functions which rank income distributions, having the same mean, in the same way the inequality index does. This social welfare function gives normative content to the index of inequality which, otherwise, would only be a descriptive measure. This position which is held by a large part of the literature (Kondor, 1975; Blackorby e Donaldson,.1978; Ebert, 1987, 1988), contrasts with the axiomatic approach towards inequality, where inequality indexes are constructed in such a way as to incorporate value judgements ab initio (Shorrocks, 1988).
Whatever the origin of such indexes (statistical or prescriptive), howewer, they have to satisfy some conditions in order to make the corresponding welfare function consistent with welfare theory.
In particular, considering a social evaluation function, v(x), abbreviated according to the identity: $v(x)=V(\mu,I)$, for v to be symmetric increasing and inequality averse, and V to be increasing in its first argument and decreasing in the second, the index of inequality I has to satisfy the following conditions:
1) symmetry, in order to conform with impersonal social preferences;
2) Dalton principle, i.e. the index has to be reduced by transfers from higher incomes to lower ones which do not affect the mean of the income distribution.

4. Welfare function corresponding to the Gini coefficient

Much attention has been given in the literature, to the use of the Gini coefficient[8] as the inequality index in the social welfare function defined in (3); indeed, this coefficient is symmetric and it conforms to the Dalton principle.

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[8]As it is well known in the literature, the Gini coefficient can be expressed in continuous terms as:

$$G = 1 - 2\int_0^1 L(p)dp$$

The main question arising from the introduction of the Gini coefficient in (3), concerns the existence of a well defined class of individualistic functions, obtained from the aggregation of the individual preferences, which rank income distributions having equal mean consistently with the Gini coefficient.
In general, the debate developed in the literature (Atkinson, 1970, Newbery 1970, Dasgupta, Sen and Starrett 1973 and Lambert 1975.) reaches the conclusion that such functions do not exist, the only exception, in this sense, being Sheshinski's result (1973), which needs some restrictive conditions.
The first result, worth mentioning, has been given by Atkinson:
-if the Lorenz curves of two distributions $x,y \in \Re$ cross and $G_x < G_y$, then, not every concave utility function $U(x)$, satisfies:

$$W_A[U(x)] > W_A[U(y)] \tag{4}$$

where $\Re$ is the set of the alternative distributions of a fixed income X among n individuals; W_A is any individualistic, symmetric and additively separable social welfare function. The implication of Atkinson's result is that it is always possible to find a concave utility function such that the income distribution with the higher Gini coefficient is preferred.
Newbery strengthened Atkinson's result:
there is no concave and differentiable utility function $U(x)$ such that for:

$$\begin{aligned} &x, y \in R \\ &G_x < G_y \Leftrightarrow W_A[U(x)] > W_A[U(y)] \end{aligned} \tag{5}$$

i.e. the Gini coefficient cannot rank income distributions having the same mean, consistently with any additive and separable social welfare function, if the utility function is strictly concave and differentiable.

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where $L(p)$ is the Lorenz curve and $p=F(x)$ is the percentage of individuals having income x, or, in discrete terms, as:

$$G = \frac{1}{2n^2\mu}\sum_{i=1}^{n}\sum_{j=1}^{n}\left|x_i - x_j\right| =$$

$$= 1 - \left(\frac{1}{n^2\mu}\right)\sum_{i=1}^{n}\sum_{j=1}^{n}\min\left\{x_i, x_j\right\} =$$

$$1 + \frac{1}{n} - \frac{2}{n^2\mu}(x_1 + 2x_2 + \ldots nx_n), x_1 > x_2 > \ldots > x_n$$

Dasgupta, Sen and Starrett generalized Newbery's non existence theorem, to any arbitrary strictly quasi concave welfare function and to a concave utility function U. Firstly, they show that the equivalence established by Atkinson between the ranking of the income distributions according to the Lorenz criterion and that implied by a welfare function holds for any symmetric, increasing and quasi-concave welfare function, and, therefore, it does not depend on the assumptions of additivity and separability imposed by Atkinson on the function itself.
Using a well-known results of the mathematical literature concerning concave functions (Hardy, Littlewood, Polya, 1934), Dasgupta Sen and Starrett extended this equivalence to any function F defined on the income space, which is strictly S-concave[9] This implies that any inequality index $I(x)$ is consistent with the Lorenz dominance criterion if, and only if, it is strictly S-concave in income.
The Gini coefficient satisfies this condition but, since it is linear in income distributions, it cannot rank such distributions consistently with any symmetric and strictly quasi-concave welfare function.
As stressed by Sen (1973), the welfare function implied by the Gini coefficient is such that the marginal rate of substitution between the income received by an individual of rank i and that received by an individual of rank j, is equal to the ratio i/j and so it is independent from the levels of income of each individual.
A different result, in this context, was reached by Sheshinski (1972) who showed that the Gini coefficient has a normative content if we do not assume the welfare function to be strictly quasi-concave; indeed, for each increasing and not necessarily concave utility function $U(x)$, a function W_U can be constructed such that:

$$G_x < G_y \Leftrightarrow W_U[U(x)] > W_U[U(y)] \tag{6}$$

$$W_U[U(x)] = \overline{H}(\mu, G) \tag{7}$$

where $\bar{H}$ is any arbitrary increasing function. The function used by Sheshinski which satisfies (7) is:

$$W_U(U_1, U_2, \ldots, U_n) = H\left\{\sum_{i=1}^{n}\sum_{j=1}^{n} U^{-1}\left[\min\left\{U(x_i), U(x_j)\right\}\right]\right\} \tag{8}$$

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[9] A function is strictly S-concave, if and only if for all bistochastic matrixes Q: $F(Qx) > F(x)$, where a square matrix is bistochastic if all its entries are nonnegative and each of its rows and columns sums to one. So a bistochastic matrix of order n is a convex combination of the set of all permutation matrices of order n.
Given an income distribution, $y = Qx$ is a convex combination of the set of the permutation of x, i.e. obtained from x by income transfers from the richest to the poorest. This implies: $F(y) > F(x)$ for each strictly S-concave.function F.

which is symmetric but not differentiable.
Since:

$$\min\{U(x_i),U(x_j)\} = U\left(\min\{x_i,x_j\}\right)$$

and

$$\min\{x_i,x_j\} = \frac{x_i + x_j - |x_i - x_j|}{2}$$

we have that:

$$W_U(U_1,U_2,\ldots,U_n) = H\left\{n\sum_{i=1}^{n} x_i - \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}|x_i - x_j|\right\} = \overline{H}\{n^2\mu(1-G)\} \qquad (9)$$

Sheshinski still left open the question whether the function in (9), is the only admissible one which satisfies (7).
In this sense a significant contribution was provided by Blackorby and Donaldson (1978) who indicated in its symmetry, quasi-concavity, homotheticity and additivity but non-separability, the properties the welfare function should have, to be consistent with the Gini coefficient:. In particular the condition of homotheticity ensures a one-to-one correspondence between the Gini coefficient and a welfare function W such that:

$$G_x > G_y \Rightarrow W(x) < W(y) \qquad (10)$$

Lambert (1985) has extended the list of properties characterizing the welfare function corresponding to the Gini coefficient, proposed by Blackorby and Donaldson, to include non differentiability.. This depends on the non differentiability of the Gini coefficient in individual incomes. Since differentiability is assumed to be an essential condition for a welfare function (Kondor 1975), this result seems to suggest the impossibility to use the Gini coefficient in this context.
The results of the debate which we have briefly sketched, would induce one to conclude that there is no reasonable normative rationale for the use of the Gini coefficient in a social welfare function (S.W.F). based on individualistic social preferences. However, if we adopt a context which does not take account only of individualistic preferences on income, significant results arise in favour of the use of the Gini coefficient in the welfare function
In particular normative rationales have been provided by Sen (1973) and Lambert (1985) for the following specification of the welfare function defined in (3):

$$V(\mu,G)=\mu(1-G) \tag{11}$$

Sen offers a non individualistic rationale for this function, with the well known "pair-wise maximin" criterion:
-Suppose the welfare level of any pair of individuals is equated to the welfare level of the worst-off person of the two. Then, if the total welfare of the group is identified with the sum of the welfare levels of all pairs, we get the welfare function underlying the Gini coefficient.
Lambert shows that the social welfare function corresponding to the Gini coefficient can arise from the aggregation of identical socially attributed individual utility functions i.e. utility functions which are attributed to individuals according to an ethical norm unanimously accepted.The behavioural utility functions differs from one individual to another, but when social judgements come into the scene the policy-maker should behave as if the individual agents really possessed the socially attributed utility function. In particolar, Lambert assumes that the socially attributed utility functional of the individual does not depend only on his own level of income x, but also on that of the others so that:

$$W_A=\int U(x,F)f(x)dx \tag{12}$$

where F is the income distribution.
Lambert shows that this function corresponds to the one in (11) in the following cases:
a) when individual preferences are assumed to depend on the individual's feeling of deprivation relative to the incomes of others better off than himself;
b) when individual preferences are assumed to depend on altruistic concern for the position of those worst off than himself.
Consider the first case. The deprivation felt by an individual with income towards an individual with income z is defined (Hey and Lambert, 1980) as

$$D(x,z)=\begin{cases} z-x & \begin{cases}\text{if } x<z\end{cases} \\ 0 & \begin{cases}\text{if } x\geq z\end{cases}\end{cases} \tag{13}$$

This definition follows the thinking of Runciman (1966, pag. 19) "*the magnitude of a relative deprivation is the extent of the difference between the desidered situation and that of the person desiring it*" Since the lower the position of an individual in the income distribution, the more the individual feels the deprivation $D(x,z)$, an overall measure is obtained (Hey and Lambert 1980)by weighting $D(x,z)$ by $dF(z)$ which represents the proportion of the society with income z. So we have:[10]

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[10] By substituting 13 in 14 and by integrating by parts(Hey and Lambert,1980) we have:

$$D(x) = \int D(x,z)dF(z) \qquad (14)$$

If the socially attributed individual utility function is assumed to be linear in his own income and in the deprivation such that :

$$U(x,F) = ax - bD(x) \qquad a,b > 0 \qquad (15)$$

the following result can be obtained(Lambert,1985)[11]:

$$D(x) = \int_{x}^{\bar{x}} [1 - F(z)]dz$$

where $\bar{x}$ is such that:F($\bar{x}$)=1.

This expression is equivalent to that used by Yitzhaki(1980) to define the relative deprivation, but with a different interpretation.

Yitzhaki consider each unit of income as an index of the ability to consume a given bundle of goods in the society and the value of having a given bundle of goods as a function of the scarcity of this bundle in the society; so he defines the deprivation felt by an individual as the sum of the values of the bundles of goods in the society he is not able to consume. The degree of relative deprivation on the range (x, x+dx), can be quantified by:1-F(x) which represents the proportion of people with income greater than x. From the (2) Yitzhaki derives an overall measure of the deprivation felt by the society and he shows that this can be expressed as the product of the mean income and the Gini coefficient.(a proof of the relation existing between the the Gini coefficient and the relative deprivation is given by Sen (1976).

This result allows to rank income distributions with the same mean,in accord with the Gini coefficient[11], when the objective is that of minimizing the overall relative deprivation of the society.

Indeed, we have that:

$$W_F = a\mu_F - b\int_0^y \left[\int_x^y (z-x)f(z)dz\right] f(x)dx$$

for any finite y equal to or exceding the highest income;. letting p=F(x),
$x=\mu_F L'(p)$ and substituting, we have:

$$W = \int U(x,F)f(x)dx = \int [ax - bD(x)]f(x)dx = \mu(a - bG) \quad \forall \text{ F} \qquad 16)$$

The ranking of income distributions with a given mean by an additive and separable welfare function, is consistent with that obtained through the Gini coefficient .
In the second case examined by Lambert the socially attributed utility function of an individual depends on his own level of income and on his percentile rank-order in the income distribution, F(x), according to the following moltiplicative form:

$$U(x,F) = x[a - bF(x)] \qquad a > 0 \quad b \neq 0 \qquad (17)$$

the corresponding welfare function is:

$$W = \int U(x,F)f(x)dx = \mu\left[a - \frac{b}{2}(1+G)\right] \quad \forall F \qquad (18)$$

The case that interests us is that of $b>0$ which ensures that, for income distributions with the same mean, a ranking by the welfare function is equal to that by the Gini coefficient.Furthermore, positive marginal utility of income implies: a-bF(x)-bxf(x)>0
This case represents a form of concern for themselves tempered by altruism: personal preferences are such that, given a level of his own income, the individual prefers the income distribution with a smaller proportion of people less well-off than himself.
These results provide a convincent rationale for the following family of social evaluation functions:

$$W = \mu(1 - kG) \qquad (19)$$

with k= a/b

$$W_F = a\mu_F - b\int_0^y \left[\int_x^y zf(z)dz - x\int_x^y f(z)dz\right] f(x)dx =$$

$$= \mu_F\left\{a - b\int_0^1 \left[1 - L_F(p) - (1-p)L_F'(p)\right]dp\right\} =$$

$$= \mu_F\left\{a - b\int_0^1 \left[pL_F'(p) - L_F(p)\right]dp\right\}$$

Integrating by parts and using the formula of the Gini coefficient, the result follows.

The condition of $k<1$ ensures that an increase in the mean of the income distribution does not reduce social welfare.
The relevance of Lambert's results is in the fact that they provide "*a more satisfactory answer than Sheshinski's to the question of the admissibility of the Gini coefficient in the social choice context: in at least two substantial and interesting cases, when the deprivation and position are included in the utility index, the additive and separable social welfare functions accords with the Gini coefficient in ranking alternative income distributions. Thus, Newbery's result is turned around*" (Lambert 1985 pag. 24).

5. Welfare function corresponding to the generalized Gini coefficient

The above results can be extended to the welfare function corresponding to the generalized Gini coefficient defined:

$$\$V(\mu, G(v)) = \mu(1 - G(v)) \tag{20}$$

where the Gini coefficient generalization proposed by Yitzhaki (1983) has the following form:

$$G(v) = 1 - v(v-1)\int_0^1 (1-p)^{v-2} L(p)dp \tag{21}$$

with a Gini coefficient for each value of the parameter v; in particular for $v=2$, $G(v)$ is the ordinary Gini coefficient.
The generalized Gini coefficient can be considered an answer to the criticisms made to the ordinary Gini which weaken its normative relevance. In particular it has been stressed that the weight system, underlying the ordinary Gini coefficient, is sensitive to the difference in rank of individuals without any consideration about their absolute positions in the income distribution. On the contrary, in the case of the generalized Gini coefficient, the weight system:

$$w = v(v-1)(1-p)^{v-1} \quad v > 1 \tag{22}$$

where p =F(x) indicates the pecentile rank-order of an individual whith income x in the income distribution, is a function of the parameter v which represents the inequality aversion. In particular, for $1<v<2$ the weight system increases with the rank; for $v=2$ it does not depend on the rank; for $v>2$ it decreases with the rank. Therefore, the higher the value of v, the higher is the weight attached to the lowest positions in the income distribution and the lower is that attached to the highest positions. For $v \to 1$, $G(v) \to 0$; for $v \to \infty$ $G(v) \to 1\text{-}x_1$ where x_1 is the lowest income in the income distribution with frequence different from zero.

Thus, the use of the welfare function, corresponding to the generalized Gini coefficient in the normative evaluation of tax systems, allows one to verify how the evaluation varies when inequality aversion increases. In particular, when $v=1$, the social welfare function coincides with the mean of the post tax income distribution and so tax systems with equal yield are considered welfare equivalent; when $v \to \infty$ $V(m, G(v))=x_1$, i.e. the welfare function coincides with Rawls criterion, according to which income distributions are ranked on the basis of the income levels of the poorest individual, regardless the size of distribution. The relevance of the parameter v is particularly evident in the case of welfare ranking of tax systems characterized by different yields and different degrees of progressivity; indeed, such ranking can be reversed for increasing values of v, i.e.when one gives more weight to equity in the trade-off between equity and efficiency implied by the welfare function.

6. Empirical analysis

In this section, we show how the normative criteria described above can be used to evaluate on welfare grounds different tax reforms in Italy by comparing the corresponding post-tax income distributions. In what follows we cannot take into account the effects of tax evasion since the real distribution of income is not known; this implies that the measure of the welfare effects we obtain is not necessarly a good "proxy" of the real welfare level. A point of interest of carrying out an empirical analysis, however, lies in the fact that, if one assumes that the Government observes only the fiscal distribution and behaves myopically in the sense of not having expectations on the distribution of evasion, one can infer its revealed preferences on efficiency and equity by examining different tax structures at the light of a generalized S.W.F.

Assuming reranking away, we can resort to the comparison of the post-tax Lorenz curves and of the welfare functions based on the Gini coefficient, to obtain unambiguous welfare prescriptions. The problem which arises in this exercise is due to the fact that pre-tax income distributions are different; we must distinguish, therefore, between the welfare effects due to autonomous changes in pre-tax income distributions and those due to tax reforms. To do this, we, firstly, determine which pre-tax income distribution is socially preferred, then we compare the corresponding post-tax income distributions to verify whether the tax reform has reduced or improved and to which extent welfare[12]. A limit to the comparisons of tax reforms we carry out is due to the fact that we do not take into account the disincentive effects of taxation, i.e. the effects of tax progressivity on labour supply.

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[12] It is important to stress two assumptions we made in the welfare evaluation of tax reforms. Firstly, we are implicitly assuming that the tax system chosen by the government is not a unique optimum and there is room for welfare improving.
Secondly, we are excluding reranking and disincentive effects due to taxation. This implies that changes in pre-tax income distribution are only due to exogenous factors and not to labour supply variations caused by the tax system.

For our purpose, we need to identify the Lorenz curves associated with the pre-tax and post-tax income distributions[13] corresponding to different tax systems. The methodology used consists in the identification of the parameters of the Lorenz curves by estimating a functional form on the data provided by the "MINISTERO DELLE FINANZE" (1985, 1986,1987), relative to 35 income classes.
Among the different functional forms proposed for the Lorenz curve, we choose the one proposed by R. H. Rasche, J. Gaffney, A. Y. C. Koo, and N. Obst (1980),with the following non linear form:

$$< x - T >= \left[1 - (1-p)^{a}\right]^{\frac{1}{b}} \quad 0 < a, b \leq 1 \tag{23}$$

This functional form satisfies the following properties:for$p=0$,$<x\text{-}T>=0$, for $p=1$,$<x\text{-}T>=1$; for $a<1$, the first derivative evaluated at zero is zero and evaluated at one is infinity and, under the same condition, the second derivative is always positive in the range p$\in$ [0,1]. The egalitarian line, $<x\text{-}T> = p$, is generated by the case $a=b=1$.
Hence the function possesses the proper convexity and slope constraints to ensure that it always lies in the lower triangle of the unit square. From these properties it arises that this functional form can cope, for the appropriate values of the parameters, whith two tailed distributions; furthemore, the case of $b=1$ and $a<1$.. gives the Lorenz curve specification corresponding to the Pareto distribution of income .

7. Results of the empirical analysis

In this section, we start by describing the results of the welfare comparison between the tax system in force in Italy until 1986 and the tax system proposed by the tax reform in the same year. Firstly, we compare the two pre-tax income distributions in order to determine which is preferable from a welfare point of view.Following the methodology described in the previous paragraph, we calculate the cumulate proportions of income units p, and the cumulate proportions of the two pre-tax income distributions to estimate[14] the corresponding pre-tax Lorenz curves. The results of this estimate are:

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[13] The data concerning the post-tax income distributions corresponding to the tax system in force in Italy until 1986 and to the one introduced by the income tax reform in 1986, are provided by Ministero delle Finanze(1986,1987). The 1989 and the 1988 post-tax income distibutions are obtained, trhough simulation, by applying the marginal tax rates of each tax system on the pre-tax income distribution of 1987 (Ministero delle finanze, 1988) and cosidering the tax detractions applied in this year. This is due to the fact that, at the moment, the data relative to the 1988 and 1989 pre-tax income distributions are not available and it is reasonable to assume that these distributions are quite similar to the1987 one.

[14] All the regressions in this paper have R2=0.999.

	1985 pre-tax		1986 pre-tax	
	a	b	a	b
Par	0.713	0.655	0.689	0.669
ES	0.014	0.038	0.013	0.34

Since the two distributions have different means and, in particular, $\mu_G(85)=13.9399$; $\mu_G(86)=14.6815$, we need to compare the generalized Lorenz curves (the values are in the appendix) in order to obtain welfare prescriptions.
From this comparison, it arises that the curve corresponding to the post-tax income distribution of 1986 always dominates[15] the other and so it is socially preferred according to the Lorenz dominance criterion. This result is confirmed if we compare the social welfare functions corresponding to the generalized Gini coefficient; as a matter of fact the values of the function associated to the pre-tax income distribution of 1986 are greater than those of the other welfare function, whatever is the value of the inequality aversion parameter v, as we can observe below:

v	$G_{G85}(v)$	$G_{G86}(v)$	$W_{G85}(v)$	$W_{G86}(v)$
2	0.386	0.393	8.554	8.911
3	0.520	0.524	6.684	6.982
4	0.594	0.595	6.657	5.934
5	0.642	0.642	4.985	5.252
6	0.676	0.675	4.503	4.762
7	0.703	0.701	4.135	4.388
8	0.724	0.721	3.843	4.091

Howewer, we can notice that, for lower values of the inequality aversion parameter, the 1985 income distribution is equity preferred to the other (see the generalized Gini coefficients), but this aspect is overcompensated by the greater efficiency of the 1986 income distribution; when the inequality aversion parameter becomes superior to a given value (v>4), the pre-tax income distribution of 1986 results preferable also from a redistributive point of view.
Now we pass to evaluate,on welfare grounds, the 1986 and 1985 post-tax income distributions. The marginal tax rates of the tax system before (1985), and after the reform (1986), are:

[15]If we had individual data we could have worked on the true Lorenz curves. The estimation of the Lorenz curves on 35 data relative to the income classes, would require,. as R. Violi noted, an econometric test to establish if the difference between them is statistically significant. However, this econometric analysis is not necessary for the methodological purpose of this paper. Indeed, we want to show how some normative criteria can be used to evaluate different tax reforms, rather than to draw policy implications. For the purpose of this paper, we could have used hypothetical Lorenz curves, but we have preferred to estimate them to get a more realistic simulation.

Classes of Income*		Marginal tax rates (%)	
1985	1986	1985	1986
0-11	0-6	18	12
11-24	6-11	27	22
24-30	11-28	35	27
30-38	28-50	37	34
38-60	50-100	41	41
60-120	100-150	47	48
120-250	150-300	56	53
250-500	300-600	62	58
>500	>600	65	62

The estimate of post-tax Lorenz curves gives the following results:

	1985 post-tax		1986 post-tax	
	a	b	a	b
Par	0.760	0.665	0.736	0.674
ES	0.011	0.025	0.012	0.028

and the values of the means of the two income distributions are: $\mu_N(85)=11.48$; $\mu_N(86)=12.4397$

From the comparison of the two generalized post-tax Lorenz curves we find, as before, that the 1986 income distribution is preferred to the other; the same is obtained by relating the corresponding welfare functions as we can observe below:

v	$G_{N85}(v)$	$G_{N86}(v)$	$W_{N85}(v)$	$W_{N86}(v)$
2	0.346	0.356	7.501	8.009
3	0.477	0.485	5.999	6.401
4	0.551	0.557	5.145	5.498
5	0.601	0.606	4.576	4.891
6	0.637	0.641	4.162	4.465
7	0.665	0.667	3.843	4.131
8	0.687	0.689	3.587	3.863

By looking at the values of the Gini coefficients, we notice that, whatever the degree of inequality aversion, the 1985 post-tax income distribution is equity superior to the other; however this fact is overcompensated by the greater efficiency of the 1986 post-tax income distribution which,therefore, results welfare preferred. The same result we obtain from the comparison of the pre-tax income distributions, although the difference between the post-tax income means is greater than that between the pre-tax ones;this implies that the tax system

introduced by the tax reform in 1986, gives an average tax yield lower than that obtained before the reform.

These results, howewer do not allow to say which tax system is socially preferable, i.e. which are the welfare effects due to the tax reform, as opposed to those due to autonomous change in income distribution. In order to do this, we compare the ratios between the values of the 1986 post-tax welfare function and those of the correspondig pre-tax function with the same ratios calculated for 1985, for increasing values of the inequality aversion parameter v, to draw welfare implications about the tax reform. Below we show the values of these ratios:

v	ΔW(85)	ΔW(86)
2	0.876	0.898
3	0.897	0.917
4	0.909	0.927
5	0.918	0.933
6	0.924	0.938
7	0.929	0.941
8	0.934	0.944

As we can see, the pre-reform tax system reduces[16] the welfare level of the pre-tax income distribution by a greater percentage than that of the post-reform tax system This result is due to the fact that the latter one, requiring a lower tax yield, reduces the mean of the income distribution by a lower percentage than that of the pre-reform tax system and so it is preferable from the point of view of the efficiency. This overcompensates the lower redistributive effect of the 1986 tax system with respect to the 1985 tax system. This effect arises from the fact that, excluding low degrees of inequality aversion, the values of the Gini coefficient relative to the 1985 pre-tax income distribution are lower than those of1986 income distribution, while this relationship is reversed when we compare the post-tax income distributions.

Therefore, we can conclude that the income tax reform introduced in 1986 satisfies the objective of a government which wants to reduce the tax yield, improving, in this way, the welfare, unlike the negative redistributive impact of the reform on the income distribution.

We compare next the 1986 income tax system with the one introduced by the income tax reform in 1989 which modified the number of income brackets and lowered marginal tax rates on higher income classes. The marginal tax rates of the 1989 reform tax system are

16 From the comparison of the post-tax welfare functions with the pre-tax functions of each income distribution, it can be observed that the latter are always preferable to the firsts. This is due to the fact that the redistributive impact of each tax system isv overcompensated by the greater size of pre-tax income.

Income classes	Marginal tax rates (%)
0-6	10
6-12	22
12-30	26
30-60	33
60-150	40
150-300	45
>300	50

As before, we compare first the two pre-tax income distributions and then the corresponding post-tax income distributions, to welfare evaluate the income tax reform introduced in 1989. The results of the estimates of the Lorenz curves relative to the pre-tax and post-tax income distributions of 1989 and the values of the corresponding means are :

	1989 pre-tax		1989 post-tax	
	a	b	a	b
Par	0.694	0.655	0.736	0.664
ES	0.022	0.059	0.019	0.047

$\mu_G(89) = 15.9797$; $\mu_N(89) = 13.4866$;

From the comparison of the generalized pre-tax Lorenz curves of 1986 and 1989, it arises that the second always dominates the first; the same result is obtained by comparing, for any value of the inequality aversion parameter v, the values of the corresponding social welfare functions, reported below:

v	$G_{G87}(v)$	$G_{G86}(v)$	$W_{G87}(v)$	$W_{G86}(v)$
2	0.391	0.393	9.591	8.911
3	0.534	0.524	7.445	6.982
4	0.607	0.595	6.281	5.934
5	0.654	0.642	5.525	5.252
6	0.688	0.675	4.985	4.762
7	0.714	0.701	4.574	4.388
8	0.734	0.721	4.247	4.091

It is worth to stress that the welfare superiority of the pre-tax income distribution of 1989 is only due to the fact that its mean is higher than that of the other one. As a matter of fact its greater efficiency overcompensates the equity superiority of the pre-tax income distribution of 1986 (see generalized Gini coefficients) which,therefore, results welfare dominated.

Considering, now, the post-tax income distributions, we find that the 1989 income distribution is,again, welfare preferred to the other, both if we compare the generalized Lorenz curves and if we compare the values of the corresponding welfare functions, reported below:

v	$G_{N89}(v)$	$G_{N86}(v)$	$W_{N89}(v)$	$W_{N86}(v)$
2	0.363	0.356	8.586.	8.009
3	0.495	0.485	6.811	6.401
4	0.568	0.557	5.818	5.498
5	0.617	0.606	5.161	4.891
6	0.652	0.641	4.686	4.465
7	0.679	0.667	4.322	4.131
8	0.701	0.689	4.031	3.863

As before, the 1986 post-tax income distribution is equity preferred to the other, but this is outweighted by the greater efficiency of the 1989 post-tax income distribution. Howewer, we can easly verify that the difference between the means of the post-tax income distributions is lower than that between the pre-tax income distributions. and that the 1989 average tax yield is greater than the1986 one, although they constitute the same percentage of the corresponding pre-tax income means. From this we can say that the income tax reform introduced in 1989 satisfies the objective of a government which intends to increase the tax revenue, maintaining the same degree of fiscal burden.

As in the previous case,to evaluate the welfare effects of this tax reform, we compare the ratios between the values of the 1989 post-tax welfare function and those of the corresponding pre-tax function with the same ratios in 1985, for increasing values of the inequality aversion parameter v. Below are reported the values of these ratios:

v	ΔW(86)	ΔW(89)
2	0.898	0.895
3	0.917	0.915
4	0.927	0.926
5	0.933	0.934
6	0.938	0.94
7	0.941	0.945
8	0.944	0.949

From the table above, we can see that, for lower values of the parameter v, the 1989 post-reform tax system reduces welfare by a greater percentage than the one before the reform, but this relationship is reversed for higher values of the inequality aversion parameter v (v>4). The 1989 tax system, therefore is preferred to the 1986 one, if we give a greater weight to equity in the trade-off between equity and efficiency embodied in the welfare function of the generalized Gini coefficient. To better understand this result, we can split the over-all welfare changes into the changes due to variations in the means and variations in the Gini coefficients

of the income distributions. As said before, the 1989 tax system increases the average tax yield, but this constitutes the same percentage of the pre-tax income as that of the 1986 tax system. So the welfare results could be explained by looking at the ratios between the Gini coefficient of each post-tax income distribution and that of the corresponding pre-tax income distribution Indeed it is easily to verify that, while for lower values of the parameter v, the 1986 tax system reduces the Gini coefficient by a sligtly greater percentage than the 1989 tax system, for increasing values of v (v>4), this relation is reversed.

From these results, we can conclude that, if we exclude the cases of low inequality aversion, the income tax reform introduced in 1989 improves the welfare by reducing the inequality of the distribution.

Finally, we examine an income tax reform proposal presented to the Italian Parliament in 1988. This is characterized, with respect to the previous reform, by a reduction in the number of income brackets, a lowering of the marginal tax rates on higher income classes and an extension of the taxable income base which includes also capital gains. However, we are not able to take this latter aspect into account, since the data concerning capital gains belonging to individuals in each income class are not available. Therefore, we limit ourselves to comparing the welfare effects of the new marginal tax rates proposed with the existing marginal tax rates introduced by the1989 tax reform To do this we only need to compare the corresponding post-tax income distributions, since the two pre-tax income distributions are assumed to be equal.

The values of the marginal tax rates of the new tax system proposed (1988) are:

Income classes	Marginal tax rates (%)
0-8	10
8-30	20
30-60	34
>60	39

and the mean of the post-tax income distribution would be $\mu_N(88)==13.9295$.

The estimate of the post-tax Lorenz curve gives the following results:

	1988 post-tax	
Par	0.741	0.654
ES	0.021	0.051

From the comparison of the generalized Lorenz curves associated with the post-tax income distribution of1988 and with that of 1989, we see that the second dominates the first one at the beginning of the income distribution, but in correspondence of the values of p included in the range [0.2, 0.3], this dominance is reversed. These results do not allow one to decide which tax system is socially preferred. As a matter of fact the Rawls criterion, which ranks income distributions according to the income of the poorest, would lead to choose the income

distribution whose curve is dominant at the bottom of the scale, i.e. the tax system introduced in1989; on the contrary, the efficiency criterion would induce to choose the income distribution whose curve is dominant at the top of the income scale.and therefore, the tax system proposed in 1988.This contrast can be solved by using the welfare function corresponding to the generalized Gini coefficient whose values are shown below:

v	$G_{N89}(v)$	$G_{N88}(v)$	$W_{N89}(v)$	$W_{N88}(v)$
2	0.363	0.367	8.586.	8.808
3	0.495	0.501	6.811	6.942
4	0.568	0.576	5.818	5.891
5	0.617	0.626	5.161	5.211
6	0.652	0.661	4.686	4.714
7	0.679	0.689	4.322	4.333
8	0.701	0.711	4.031	4.03

As we can note, the tax system proposed in 1988 results welfare preferable to the 1989 tax system although the second one has a greater redistributive impact; this can be justified by the greater size of the1988 post-tax income distribution. However, the difference between the values of the two Gini coefficients increases as the inequality aversion parameter v increases, i.e. as one gives greater weight to equity in the trade-off between equity and efficiency, so that for v>8, the equity preferred tax system introduced in 1989, becomes also welfare preferred to that proposed in 1988.It is worth to stress that these results are limited by the fact that we do not consider the extension of the tax base in the welfare evaluation of the tax reform proposed in 1988. Indeed this aspect could compensate the lowering of the marginal tax rates on the higher income classes and so it could provide a greater redistributive impact on the pre-tax fiscal income distribution.

8 Conclusions

In this paper we dealt with the theoretical results concerning the welfare ranking of tax systems and we show how some normative criteria can be used to evaluate tax reforms. In particular, from the empirical analysis, it emerges the normative relevance of the welfare function based on the generalized Gini coefficient whose economic rationale has been discussed in this paper. Indeed this function not only allows one to obtain unambiguous welfare results, but it highlights to which extent the degree of inequality aversion affects the trade-off between equity and efficiency in the welfare ranking of tax systems.
The analysis carried out, however, is limited by the fact that we do not take account of the disincentive effect of taxation which implies an inverse relationship between the degree of progressivity of a tax system and the size of the post-tax income distribution, through the elasticity of the labour supply.It could be interesting, from a theoretical point of view, to specify the welfare function based on the generalized Gini coefficient in such a way as to

incorporate the disincentive effect of taxation. This could allow one to determine the relationship between the inequality aversion and the elasticity of the labour supply which maintains the same level of welfare.
A normative analysis of the kind carried out in this paper, could provide useful indications about the tax reforms a government should introduce to reach its objectives in terms of tax revenue and of redistribution of income;.however, this would require the knowledge of the true income distribution to estimate the real effects of changes of tax structures on the individuals welfare.

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APPENDIX

Values of the generalized Lorenz curves associated to the pre-tax income distributios of1985,1986,1987, in the range [0,1] with step 0.1.

1985	1986	1987
0.000	0.000	0.000
0.2509	0.276	0.2780
0.7388	0.7972	0.8245
1.4218	1.5048	1.5755
2.2722	2.3872	2.5231
3.3037	3.453	3.6753
4.5444	4.721	5.0543
6.008	6.2337	6.7082
7.778	8.0704	8.7249
10.036	10.426	11.3168
13.939	14.682	15.9797

Values of the generalized Lorenz curves associated to the post-tax income distributios of1985,1986,1988,1989, in the range [0,1] with step 0.1.

1985	1986	1988	1989
0.000	0.000	0.000	0.000
0.2422	0.2649	0.2659	0.2713
0.7025	0.7571	0.7847	0.7874
1.3202	1.4148	1.4944	1.4852
2.0859	2.2257	2.3829	2.3522
2.997	3.1916	3.4535	3.3911
4.0673	4.3258	4.7218	4.6169
5.3175	5.6561	6.2204	6.0609
6.7961	7.2385	8.0135	7.7849
8.6145	9.207	10.254	9.9374
11.48	12.4397	13.929	13.4866

FISCAL AUTONOMY, GRANTS-IN-AID AND EXPENDITURE OF LOCAL GOVERNMENTS

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1. Introduction

The antithesis between autonomy and control lies at the heart of the relationship between different tiers of government both for policy and efficiency reasons[2]. Local governments should be free to set the amount of services they provide because of their ability of being informed about local needs and preferences, but this policy might be in contrast with Central Government objectives and its need to control indirect expenditure. As concerns Public Finance, simulating local government expenditure reactions to changes in the grants distributed by Central government has received growing attention in the light of the reforms that have been proposed for local government finance. Most of the theoretical and econometric models[3] in this literature usually assume that local authorities' behaviour is restricted to a static, within period optimization. Bennett (1982), Smith (1987) and Levaggi (1991a,b) represent some of the very few attempts to model local government behaviour in a multiperiod context. In particular Levaggi (1991b) showed the dramatic differences in expenditure responses to changes in the parameters of the budget constraint derived by alternatively using a static and a dynamic model. This article, by using a general utility function, shows the effects of alternative methods to finance local government expenditure within an intertemporal - life cycle - model. The work will be organized as follows: section one describes the model, section two is devoted to showing local governments reactions to changes in the parameters of alternative grant formulas while section three is devoted to comparing and discussing the results and to presenting some simulation exercises.

2. The model

This model work is an adaptation of the pioneering work by Modigliani and Brumberg on life cycle theory of consumption to describe local authorities behaviour over the period for which their administrators are elected. The model proposed here relies on Blundell's (1986) and MaCurdy's (1981) contributions to life cycle labour supply in the presence of taxation, with some important modifications which allow description of the behaviour of a collective organization.

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[2]On this point see Fossati (1973).

[3]For a review of the theoretical models see King (1984). The empirical estimates of local governments responses to changes in the grant system has been carried out, with reference to Britain, by Barnett (1986) and Barnett et al. (1990;19991a,b,c,d).

G. Galeotti and M. Marrelli (eds.), Design and Reform of Taxation Policy, 179–207.

The model presented here, assumes that a representative local authority behaves *as if* it were maximising a generic pseudoutility social welfare function defined over two commodities -X-a composite private commodity and -T- per capita taxation[4]. The Social Welfare Function for a generic period t and for our representative local authority can then be written as the following concave, twice differentiable function:

$$W_t = W(X_t, T_t, C_t) \tag{1}$$

$$\frac{\partial W}{\partial X} > 0 \quad \frac{\partial^2 W}{\partial X^2} < 0 \qquad\qquad \frac{\partial W}{\partial T} < 0 \quad \frac{\partial^2 W}{\partial T^2} < 0$$

where C_t is a vector of characteristics of any authority and for the purpose of this analysis contains two elements: A_t , a measure of fiscal capacity[5] and B_t is the level of to be granted in order to accomplish previous administrations' long-term plans or, in general terms, any non discretionary expenditure level[6]. The pseudoutility function is assumed to be separable in the two commodities such that the Hessian for each period is a diagonal negative semi definite matrix. Because of the peculiar economic agents studies it is important to note that this analysis uses the term utility in a broad sense, i.e. it is assumed that local authorities behave as if the possess an utility function but it does not imply they have an utility function at all. Equation (1) shows that one of the arguments in the function, namely taxation, is, from the point of view of economic theory, a bad and this causes important alterations in the indifference map. The choice of taxation as an argument in the utility function allows us to link this model to the political economy literature[7] which points out that electors are quite sensitive to taxation and indeed a low taxation per head might be the key to secure reelection. The neoclassical approach to utility maximisation allows use of this approach or of the traditional one based on two goods alternatively and in this work I have decided to follow this non conventional approach in order to eventually extend the model and insert political variables in the maximisation process.

Perfect foresight is assumed in the analysis and this rules out the possibility of reoptimsation during the life cycle. The life cycle[8] of the local authorities is defined in political-administrative terms: I will assume that the local government maximises its utility over the period for which the council is elected and in this paper I will assume that an election is held every five years. This behaviour is justified on the ground that, from a political point

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[4]These are the same assumptions characterizing some of the most important contributions on fisical federalism like those of Courant and Wilde.

[5]Fiscal capacity is defined as the maximum that can be reised from taxation in a region. The limit on expenditure can be determined either by economic reasons or by the legislation.

[6]In the Italian context B_t could capture, to some extent, expenses for civil servants whose salary is determined at national level and on whom local government has almost no hiring and firing autonomous power.

[7]As an example we can recall the work of Black (1958) and Borooagh and Van der Ploegh (1985).

[8]This aspect characterizes most of the models developed in the literature aimed at formalizing consumer's behaviour.

of view, the objective of the councilors whose behaviour is aimed at reelection should coincide with the maximisation of social welfare. The model assumes the existence of a constant discount factor on utility, ρ. This assumption could be criticized by considering that social welfare maximisation through the political life of each government should be informed to a long-run welfare perspective hence the pseudo utility achieved in each period should have the same weight.

Political scientists would argue that local government might be interested in doing its best to increase utility in the last year which coincides with reelection. This aspect could be inserted in the analysis by using different weights on the utility function of each period but it has not been considered in the work presented here.

The pseudoutility function is assumed to be separable in the two commodities and separable and additive through time such that the Hessian is a diagonal negative semi definite matrix. Lifetime utility may then be written as the following discounted sum of a concave, twice differentiable period by period utility indices W_S

$$W = \sum_{t=1}^{5} e^{-\rho(t-1)} W_t\left(X_t, T_t, C_t\right) \tag{2}$$

In the absence of any grant from Central Government the constraint to the maximisation of the previous utility function is represented by the simple budget equation in which wealth is transferred from each period by issuing yearly bonds[9].

$$X_t + \Delta BL_t = T_t + BL_t \quad t = 1, 5 \tag{3}$$

where:

$BL_t = \Delta BL_{t-1}\, e^r$ This term is equivalent to revenue from the sales of bonds issued at time t-1 and it will be negative if bonds are issued.

ΔBL_t = budget balance in period t.

r is the interest rate.

Both r and ρ are assumed to be constant through time to simplify the notation in the following analysis. Local authorities neither receive nor desire to leave balances to future administrations then the conditions [10]:

$$BL_0 = 0$$

$$BL_5 = 0$$

must hold.

In the presence of a perfect capital market with no rationing on borrowing and lending the budget constraint can be written as:

$$\sum \left(X_t - T_t\right) e^{-r(t-1)} = 0 \tag{4}$$

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[9]The issue is negative if the balances carried forward are positive.

[10]Local administrator could be tempted to leave a budget deficit to the new administration. This possibility is ruled out by assuming that the system by which the budget balance rule is enforced is powerful enough to secure this requisite at least within the life cycle.

Local government behaviour is in actual fact more complicated than this simple model: long-term expenditure plans create a strong link between different cohorts of local councilors and cause overlapping in expenditure decisions. It must however be noted that the large majority of long-term investments are subsidized by specific grants from Central government and then the assumption of no overlapping combined with the presence of B_t in the utility function, is not so restrictive. The optimal expenditure decisions for this life cycle model can be obtained by solving the following problem:

$$\text{Max } W = \sum_{t=1}^{5} e^{-\rho(t-1)} W_t\left(X_t, T_t, C_t\right) \qquad (5)$$

$$\text{s.t. } \sum_{t=1}^{5}\left(X_t - T_t\right)e^{-r(t-1)} = 0$$

This problem can be solved by using a standard Lagrange approach. The Lagrangean for the problem can be written as:

$$\mathcal{L} = \sum_{t=1}^{5}\left(e^{-\rho(t-1)} W_t(X_t, T_t, C_t)\right) - \lambda\left(\sum_{t=1}^{5}(X_t - T_t)e^{-r(t-1)}\right)$$

and the First Order Conditions can be summarized as follows:

$$e^{-\rho(t-1)} W_T\left(X_t, T_t, C_t\right) = -\lambda e^{-r(t-1)} \qquad t=1,5$$

$$e^{-\rho(t-1)} W_X\left(X_t, T_t, C_t\right) = \lambda e^{-r(t-1)} \qquad t=1,5$$

$$\sum_{t=1}^{5}\left(X_t - T_t\right)e^{-r(t-1)} = 0 \qquad (6)$$

The F.O.C. presented above are a simultaneous equation system comprising 11 equations and 11 unknown, but 1 can be eliminated by substitution:

$$e^{-\rho'(t-1)} W_T\left(X_t, T_t, C_t\right) = e^{-\rho'(n-1)} W_T\left(X_n, T_n, C_n\right) \qquad t=1,4$$

$$e^{-\rho'(n-1)} W_X\left(X_n, T_n, C_n\right) = -e^{-\rho'(n-1)} W_T\left(X_n, T_n, C_n\right)$$

$$e^{-\rho'(t-1)} W_X\left(X_t, T_t, C_t\right) = e^{-\rho'(n-1)} W_X\left(X_n, T_n, C_n\right) \qquad t=1,4$$

$$\sum_{t=1}^{5}\left(X_t - T_t\right)e^{-r(t-1)} = 0$$

where $\rho' = \rho - r$

In the absence of any grant and assuming constant fiscal capacity and functional form for utility the optimal allocation is determined by ρ-r, the difference between the intertemporal

preference and the interest rate. For $\rho=r$ the expenditure would be spread equally over time[11].

The responses of X and T to changes in the other parameters of the system can be obtained using different methods. A possible alternative consists of assigning a functional form to the utility function, deriving the demand equations and evaluating the derivatives. This approach is quite restrictive because the results would depend on the functional form assumed for utility. In this work a more general method has been adopted; the system of F.O.C. has been totally differentiated[12] allowing us to directly obtain the derivatives of X and T with respect to any other variable. For example, the derivative of X for a generic period i for a change in A_j is equal to:

$$\frac{\partial X_i}{\partial A_j} = -e^{-\rho'(i-j)} \frac{a_j}{h_i} \frac{\upsilon_j}{\sum\left(1/h_i + 1/q_i\right)q_j} > 0$$

where:

$$W^t_{xx} = h_i \leq 0$$
$$W^t_{TT} = q_i \leq 0$$
$$W^t_{xA} = a_i \geq 0$$
$$W^t_{xB} = b_i \geq 0$$
$$e^{-\rho(t-1)} = \varepsilon_i$$
$$e^{-r(t-1)} = \sigma_i$$
$$\upsilon_i = \frac{\sigma_i}{\varepsilon_i} = e^{(\rho-2r)(i-1)}$$

An increase in the fiscal capacity in period t allows an increase expenditure in any other periods. The actual allocation depends on ρ-r. If this ratio is equal to one the increase in fiscal capacity has a greater effect on expenditure in the first periods and if $\rho=r=0$ the increase in expenditure will be spread evenly.

It might be intereating to note that the marginal effect of the introduction of a lump-sum in the budget constraint would have led to the same derivative, up to a constant[13]: this result confirms the conventional fiscal federalism theory which predicts the lump-sum to have a similar effect to increase in resources available. The derivative of X_j with respect to B_j and B_j are defined as:

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[11]From the system of demand equation it is possible to note that the first derivative for X_i and T_i must be constant through time.

[12]This technique is widely described in appendix one.

[13]For a formal proof see appendix one.

$$\frac{\partial X_i}{\partial B_j} = -\frac{b_i\left[\sum \upsilon_i\left(\frac{1}{h_i}+\frac{1}{q_i}\right)-\frac{\upsilon_i}{h_i}\right]}{h_i\left[\sum \upsilon_i\left(\frac{1}{h_i}+\frac{1}{q_i}\right)\right]} > 0$$

$$\frac{\partial X_i}{\partial Bj} = e^{\rho'(i-j)}\frac{b_j}{h_i}\frac{\upsilon_j}{\sum\left(\frac{1}{h_i}+\frac{1}{q_i}\right)h_j} < 0$$

An increase in non discretionary expenditure boost up service provision in the period in which it occurs, but it decrease expenditure in the other periods. Again the relative importance of these changes depends on the functional form assumed for the utility and on ρ-r.

If ρ=r=0, the interest rate and the intertemporal utility plays a neutral role on the results obtained; if ρ>r the absolute value of the derivative would be progressively increasing through time[14]. Finally, an increase in the interest rate leads to the following derivative:

$$\frac{\partial X_t}{\partial r} = -\frac{\sum_{t=1}^{5}\left(X_t - T_t\right)\upsilon_t(t-1)}{\varepsilon_t h_t\left[\sum \upsilon_t\left(\frac{1}{h_t}+\frac{1}{q_t}\right)\right]}$$

from which it follows that if the budget constraint was balanced every year, as the law requires, the variation in r would be irrelevant, as we should have expected. These results are quite general and apply to all the variations on the basic model I will present in the next sections, even if the focus will then be on expenditure reactions to changes in the parameters that characterize the budget constraint.

3. Local governments' expenditure decisions under alternative grants-in-aid distribution formulas.

Let us now examine Local government reactions to the introduction of grant-in-aid from Central Government. The basic grants I will consider here are a lump-sum which increases local income or a matching grant, a per unit expenditure subsidy by which the cost of the service is partly matched by the subsidizer. In this analysis these two basic elements will be

[14]The opposite effect would be obtained for ρ<r.

combined in different ways in order to obtain quite general allocation rules whose peculiar characteristics will allow to obtain quite different allocations and responses. To start with the most simple functional form will be introduced. The distribution form in this case fallow for the provision in each period of Ls_t, a lump-sum and $(1-g_t)$ a unit matching grant and the grant can be written as:

$$G_t = (1-g_t)X_t + Ls_t$$

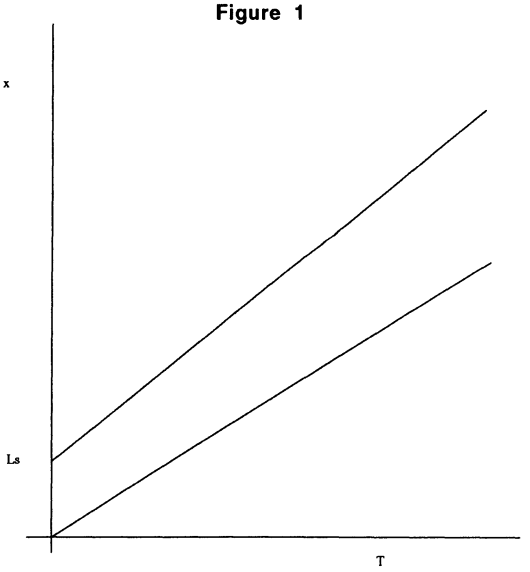
i.e the unit matching grant is independent of the level of expenditure and there are no intertemporal links between grants paid out to the local government in each period. The literature on grants-in-aid suggests that this form of subsidy should be used for equity reasons: the lump-sum represents the need equalization element while the matching grant should pursue resource equalization.

This formula is fully effective only if a number of conditions are met[15] and especially if Central Government is able to observe needs and resources of any local government. The budget for a generic period t will be then described by the following equation:

$$g_t X_t + \Delta BL_t = T_t + Ls_t + BL_t \tag{7}$$

and can be depicted as in diagram 1 which has been drawn under the assumption that balances from previous years are equal to zero.

Figure 1



[15]For a formal proof see Levaggi (1991).

As it can be noted from the above figure in the case of a lump-sum grant the intercept of the budget constraint shifts up from 0 to Ls while in the case of a matching grant the price ratio is reduced to g with Central Government offering to pay (1-g) for each unit of expenditure. The problem faced by Local Government after the introduction of the grant can be formalized as follows:

$$\text{MAX } W = \sum_{t=1}^{5} e^{-\rho(t-1)} \; W_t\left(X_t, T_t, C_t\right) \tag{8}$$

$$\text{s.t.} \sum_{t=1}^{5} e^{-r(t-1)} g_t X_t - \sum_{t=1}^{5} e^{-r(t-1)} \left(T_t + Ls_t\right) = 0$$

and can be solved using a standard Lagrangean approach whose F.O.C. can be written as :

$$e^{-\rho(t-1)} W_T\left(X_t, T_t, C_t\right) = -e^{-r(t-1)} \lambda \qquad t=1,5$$

$$e^{-\rho(t-1)} W_X\left(X_t, T_t, C_t\right) = \lambda e^{-r(t-1)} g_t \qquad t=1,5$$

$$\sum_{t=1}^{5} e^{-r(t-1)} g_t X_t - \sum_{t=1}^{5} e^{-r(t-1)} \left(T_t + Ls_t\right) = 0 \tag{9}$$

The F.O.C. presented above are a simultaneous equation system comprising 11 equations and 11 unknown, but λ can be eliminated by substitution:

$$e^{-\rho'(t-1)} W_T\left(X_t, T_t, C_t\right) = e^{-\rho'(n-1)} W_T\left(X_n, T_n, C_n\right) \qquad t=1,4$$

$$e^{-\rho'(n-1)} \frac{W_X\left(X_n, T_n, C_n\right)}{g_n} = -e^{-\rho'(n-1)} W_T\left(X_n, T_n, C_n\right)$$

$$e^{-\rho'(t-1)} \frac{W_X\left(X_t, T_t, C_t\right)}{g_t} = e^{-\rho'(n-1)} \frac{W_X\left(X_n, T_n, C_n\right)}{g_n} \qquad t=1,4$$

$$\sum_{t=1}^{5} e^{-\rho(t-1)} g_t X_t = \sum_{t=1}^{5} e^{-r(t-1)} \left(T_t + Ls_t\right)$$

where $\rho' = \rho - r$

If the fiscal capacity, the lump-sum, the matching grant and the functional form for utility are constant through time, the optimal allocation is determined by ρ-r and for ρ=r=0 the

expenditure would be spread equally over time. In order to obtain the responses of X and T to changes in the other parameters of the system the total differential approach has been used again and the results for anticipated changes in the parameters of the budget constraint are summarized in table 1.

TABLE 1

Anticipated changes in the parameters of the budget constraints

PARAMETERS	Δ EXP AT I	D EXP AT J
Ls_i	+	+
g_i	--	-

An anticipated, ex ante, decrease in the matching grant occurring in period t reduces expenditure throughout the life cycle: in period t the effect is even greater because it is equivalent to a price increase while in the other periods the reduction in expenditure is caused by an indirect income effect. An increase in the lump-sum grant boosts up expenditure throughout the life span of the representative local authority; if the functional form is constant[16] the increase is spread according to the matching grant received in each year and to ρ-r.

From the derivatives reported in appendix 2 we can also note that:

$$\left|\frac{\partial X}{\partial g}\right| > \left|\frac{\partial X}{\partial Ls}\right|$$

provided fiscal capacity is greater than g[17] as predicted by the theory of grants-in-aid[18]. If we compare the results reported in appendix 1 and 2 we can note that the lump-sum is more effective in increasing expenditure in the presence of a matching grant. Other things being equal, the price reduction caused by the matching grant make expenditure more attractive and allows the acquisition more units of services with the same sacrifice[19].

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[16] i.e. $W_i = W^*$.

[17] This condition should be met unless the local authority has no resources at all!.

[18] As noted before, the lump-sum is equivalent to an income increase while the change in the matching grant has the same effect as price fluctuation. This results has been found to be empirically valid in Barnett (1991).

[19] In this context sacrifice is defined as the units of taxation necessary to obtain a unit of expenditure.

Let us now examine some alternative functional forms to be used to distribute grants-in-aid. The first one examined assumes that the lump-sum grant is related to the level of expenditure in the previous year as follows:

$$Ls_t = M_t + k_t X_{t-1}^{20} \qquad t=1,5 \qquad k_1 = 0 \tag{10}$$

This form can be used in a context characterized by Central Government inability to observe each local governments characteristics with accuracy. In this case Central Government's uses the previous level of expenditure as a signal for the need for local services provision.

It must be noted that, although the lump-sum is introduced as a fixed amount independent of current expenditure, because of maximisation through the life cycle, the grant plays a matching role by reducing the implicit price for expenditure in the previous period. This aspect is very important from a policy point of view since in this case the effect of the lump-sum will be higher than what the standard fiscal federalism theory would predict. The assumption of utility maximisation through the whole life-cycle allows local authority to exploit any opportunity open to them: in particular, they can see the effect of their expenditure decisions through time. In the model presented here, this accounts for the increase expenditure in period t in order to increase the total size of the grant in the whole life cycle. The budget balance for a generic period t under the new assumption can be written as:

$$g_t X_t - k_t X_{t-1} + \Delta BL_t - T_t + BL_t + M_t = 0$$

In this case the unit matching grant is still paid out as a fixed proportion of the unit cost while the lump sum grant has two element: a fixed part, M_t and a variable elements $k_t X_{t-1}$ which depends on the lagged expenditure. The budget constraint for the entire life cycle can be written as:

$$\sum_{t=1}^{5} e^{-r(t-1)} g_t X_t - \sum_{t=1}^{5} e^{-r(t-1)} \left(T_t + M_t + k_t X_{t-1}\right) = 0 \quad ; \quad k_1 = 0 \tag{11}$$

The problem faced by Local Government after the introduction of the grant can be formalized as follows:

$$\text{MAX} \quad W = \sum_{t=1}^{5} e^{-\rho(t-1)} W_t\left(X_t, T_t, C_t\right) \tag{12}$$

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[20] An alternative method could consists in making the lump-sum directly proportional to expenditure in the previous year, i.e.: $M_t = k_t X_{t-1}$
I have preferred to use equation (19) because it is more general.

$$\text{s.t.} \sum_{t=1}^{5} e^{-r(t-1)} g_t X_t - \sum_{t=1}^{5} e^{-r(t-1)} \left(T_t + M_t + k_t X_{t-1}\right) = 0$$

and can be solved using a standard Lagrangean approach whose F.O.C. can be written as :

$$e^{-\rho(t-1)} W_T\left(X_t, T_t, C_t\right) = -e^{-r(t-1)}\lambda \qquad t=1,5$$

$$e^{-\rho(t-1)} W_X\left(X_t, T_t, C_t\right) = e^{-r(t-1)}\lambda\left(g_t - k_{t+1}\right) \qquad t=1,5$$

$$\sum_{t=1}^{5} e^{-r(t-1)}\left(g_t - k_{t+1}\right)X_t - \sum_{t=1}^{5} e^{-r(t-1)}\left(T_t + M_t\right) = 0 \qquad (13)$$

The F.O.C. presented above are a simultaneous equation system with 11 equations and 11 unknown, but λ can be eliminated by substitution:

$$e^{-\rho'(t-1)} W_T\left(X_t, T_t, C_t\right) = e^{-\rho'(n-1)} W_T\left(X_n, T_n, C_n\right) \qquad t=1,4$$

$$e^{-\rho'(t-1)} \frac{W_X\left(X_n, T_n, C_n\right)}{g_n - k_{n+1}} = -e^{-\rho'(t-1)} W_T\left(X_n, T_n, C_n\right)$$

$$e^{-\rho'(t-1)} \frac{W_X\left(X_t, T_t, C_t\right)}{g_t - k_{t+1}} = e^{-\rho'(t-1)} \frac{W_X\left(X_n, T_n, C_n\right)}{g_n - k_{n+1}} \qquad t=1,4$$

$$\sum_{t=1}^{5} e^{-r(t-1)}\left(g_t - k_{t+1}\right)X_t = \sum_{t=1}^{5} e^{-r(t-1)}\left(T_t + M_t\right)$$

where $\rho' = \rho - r$

Using the total differential approach described in the appendix it is possible to obtain as usual the expenditure responses to changes in the parameters of the grant-in-aid. The most important results are summarized in table 2.

TABLE 2

Anticipated changes in the parameters of the budget constraint

PARAMETERS	Δ EXP AT I	Δ EXP AT J
M_i	+	+
g_i	--	-
k_i	+	+

An anticipated variation in k_t affects expenditure throughout the whole life cycle but it has a great impact on service provision in the period immediately before the increase. The explanation of this result is rather intuitive: by increasing expenditure at time t-1 the local government will consiogrably increase its grant at time t. This increase, however, depends on the absolute and relative value of the matching grant at time t-1. If the matching grant is lower than in other periods the expansionary effect produced by k will be reduced; as concerns the other periods the change in k brings about an indirect income effect produced by the larger grant received at time t. The actual increase will clearly depend on the relative importance of the matching grant for that period and, as usual, on ρ-r.

As it has been suggested before, k plays a matching role in the model: this is formally shown in appendix 3 from which we can derive that:

$$\left|\frac{\partial X_t}{\partial g_t}\right| = \left|\frac{\partial X_t}{\partial k_{t+1}}\right|$$

If we compare the results reported in appendix 2 and 3 we can note that the for the new model also the lump-sum variation[21] is more effective: the result has again an intuitive explanation: rearranging equation (11) it is possible to show that the price for expenditure at time t is equal to g -k . The formula presented above has clearly expansionary, undesired effects on expenditure that could be in contrast with Central Government willingness to avoid spending above predetermined thresholds. The balance between equity and avoiding overspending is quite difficult, especially in a context dominated by uncertainty and

[21]In this model the lump-sum grant is rapresented by M_t.

asymmetry of information. A possible solution to the problem could be represented by a distribution arrangement that penalizes local authorities spending more than a stated amount while still relating the lump-sum grant to the previous year's expenditure. The aim of this formula is to reduce overspending caused by greed without having to penalize local authorities whose large expenditures are caused by real need[22].

The form of the grant-in-aid I will adopt can be described as[23]:

$$G_t = -\alpha_t\left(X_t - X^*\right)^2 + \left(1 - g_t\right)X_t + M_t + K_t X_{t-1} \tag{14}$$

After the introduction of the grant the lifetime budget constraint for the representative local authority will be modified as follows:

$$\sum_{t=1}^{5} e^{-r(t-1)}\alpha_t\left(X_t^2 - X^*\right) + g_t X_t = \sum_{t=1}^{5} e^{-r(t-1)}\left(T_t + M_t + k_t X_{t-1}\right) \tag{15}$$

The previous equation can be rewritten as:

$$\sum_{t=1}^{5} e^{-r(t-1)}\left[\alpha_t\left(X_t^2 - X^*\right) + X_t\left(g_t - k_{t+1}\right)\right] = \sum_{t=1}^{5} e^{-r(t-1)}\left(T_t + M_t\right) \quad k_6 = 0 \tag{16}$$

This formula is a simple generalization of the previous budget constraint, the novelty is represented by a, a parameter that penalizes overspending by reducing the amount of grant paid to the representative local authority if its expenditure is in excess of X^*. The new maximisation problem can be written as:

$$\text{MAX } W = \sum_{t=1}^{5} e^{-\rho(t-1)} W_t\left(X_t, T_t, C_t\right)$$

$$\sum_{t=1}^{5} e^{-r(t-1)}\left[\alpha_t\left(X_t^2 - X^*\right) + X_t\left(g_t - k_{t+1}\right)\right] = \sum_{t=1}^{5} e^{-r(t-1)}\left(T_t + M_t\right) \quad k_6 = 0$$

from which it is possible to derive the following F.O.C.:

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[22]The rationale for using this formula is fully explained in Levaggi (1991b).

[23]This formula, to be more complete, should provide for the hypothesis that local governments run out of grant by probably not allowing negative grants to be paid. Equation (14) should then be written as:

$$-\alpha_t X_t^2 + \left(1 - g_t\right)X_t + M_t + K_t X_{t-1} \quad ; \quad 0 \le X_t \le \frac{\left(1 - g_t\right) + \sqrt{\left(1 - g_t\right)^2 + 4\alpha_t M_t K_t X_{t-1}}}{2\alpha_t}$$

$$0 \quad ; \quad X_t > \frac{\left(1 - g_t\right) + \sqrt{\left(1 - g_t\right)^2 + 4\alpha_t M_t K_t X_{t-1}}}{2\alpha_t}$$

the budget balance is then piecewise linear. The problem could still be solved by using Hall (1973) method.

$$e^{-\rho(t-1)}W_T\left(X_t,T_t,C_t\right) = -e^{-r(n-1)}\lambda \qquad t=1,5$$

$$e^{-\rho(t-1)}W_X\left(X_t,T_t,C_t\right) = e^{-r(t-1)}\lambda\left(2\alpha_t\left(X_t - X^*\right) + g_t - k_{t+1}\right) \qquad t=1,5$$

$$k_5=0$$

$$\sum_{t=1}^{5} e^{-r(t-1)}\left[\alpha_t\left(X_t^2 - X^*\right) + X_t\left(g_t - k_{t+1}\right)\right] = \sum_{t=1}^{5} e^{-r(t-1)}\left(T_t + M_t\right) \quad k_6 = 0 \qquad (17)$$

Substituting for 1 the system of equations can be rewritten in the standard 10 equations formulation as follows:

$$e^{(r-\rho)(t-1)}W_t\left(X_t,T_t,C_t\right) = e^{(r-\rho)(n-1)}W_t\left(X_n,T_n,C_n\right)$$

$$e^{(r-\rho)(t-1)}\frac{W_X\left(X_t,T_t,C_t\right)}{2\alpha_t x_t + g_t - k_{t+1}} = -e^{(r-\rho)(n-1)}\frac{W_X\left(X_n,T_n,C_n\right)}{2\alpha_n x_n + g_n - k_{n+1}} \qquad (18)$$

$$W_T\left(X_n,T_n,C_n\right) = \frac{W_X\left(X_n,T_n,C_n\right)}{2\alpha_n x_n + g_n - k_{n+1}}$$

$$\sum_{t=1}^{5} e^{-r(t-1)}\left[\alpha_t x_t + X_t\left(g_t - k_{t+1}\right)\right] = \sum_{t=1}^{5} e^{-r(t-1)}\left(T_t + M_t\right) \quad k_6 = 0$$

where $x_t = (X_t - X^*)$

Again use of the total differential technique allows to obtain the following results of comparative statics. Table 3 reports a brief summary of the results obtained in appendix 4.

TABLE 3

Anticipated changes in the budget constraint

PARAMETERS	Δ EXP AT I	Δ EXP AT J
M_i	+	+
g_i	--	-
k_i	+	+
α_i	--	-

From table 3 and appendix 4 we can note that k plays the same role as in the previous model but, if by comparing the derivatives in the appendices, it appears that the expansionary effect is now dampened by the presence of a and by X itself. An increase in a causes a reduction in expenditure which is more important at time t for which it has a strong price effect; in the other periods the reduction is the usual result of a (negative) income effect. The deflationary effect on expenditure caused by the increase in a is partially reduced by k; if k was zero the increase in a would have had a bigger impact on the expenditure system. The presence of a, by increasing the price paid for expenditure makes the lump-sum grant less effective, as we should have expected.

4. Simulations

The analysis so far has shown that the system by which local governments are financed affects both the level of expenditure and the likely reactions to anticipated changes in the budget constraint. The use of a generic utility function allows to obtain general results but has a drawback in giving qualitative rather than quantitative responses.

In order to give an idea of the order of magnitude of the reactions of local government to the change in the parameters of their budget constraint, I will present some simulation exercises based on the assumption that the generic pseudoutility function can be represented by a pseudo Stone Geary in which important changes have been made to allow T to enter as a bad.

Utility function in the Stone Geary class are particularly handy to describe local government behaviour because they allow us to separate non-discretionary expenditure form choices determined by greed and give priority to "need"[24]. The utility function used in the simulation exercise will be represented as follows:

$$W = (1-\beta)\sum e^{-\rho(t-1)} \ell n\left(A_t - T_t\right) + \beta \sum \ell n\left(X_t - B_t\right) \tag{19}$$

which has to be maximised subject to the budget constraint represented by equations (11) and (16). Those budgets have been chosen because they represent the forms most close to the one used by Central Government. In both cases it would be possible to solve the maximisation problem, derive the demand equation and evaluate the derivatives, but this procedure involves quite a lot of calculus when the constraint is represented by equation (16). Since the scope of this exercise is just to give an idea of the changes, I will present a numerical example based on the solution of the system of F.O.C.

The simultaneous system is highly nonlinear, but can be numerically solved and for the purpose of this analysis I have written an ad hoc programme in Fortran using the N.A.G. algorithm C05NCF to derive the solutions presented in the next paragraphs. In order to

[24]The term need has here a broad meaning since it comprises all non-discretionary expenditure.

highlight the effects deriving solely by the alternative grant formula both the time preference and the interest rate are assumed to be zero. The parameters used are summarized as follows:

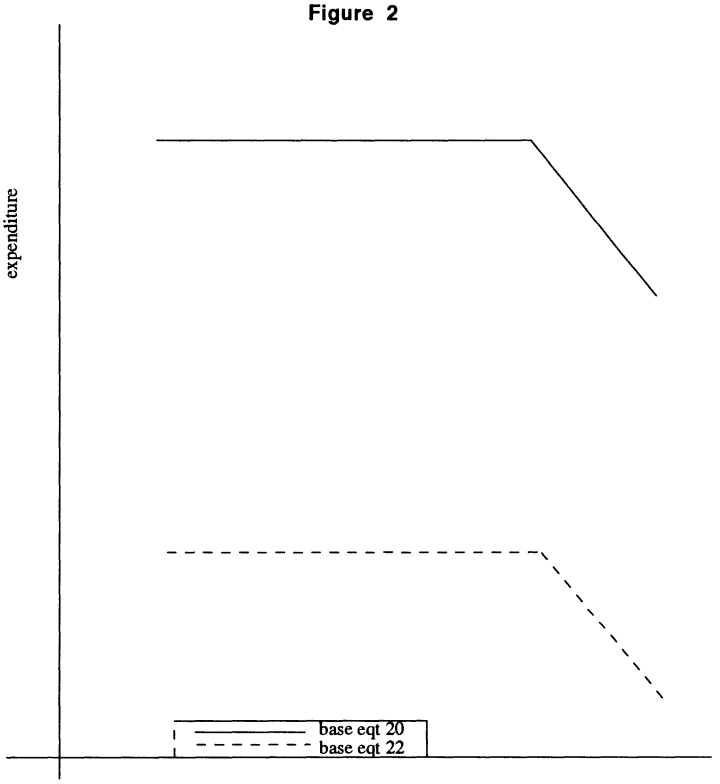
$$a_{1t} = 400 \; ; \; a_{2t} = 100 \; g_t = .8 \; k_t = .05 \; M_t = 200 \; \rho = 0 \; r = 0 \; t = 1,5$$

for equation (11) and:

$$a_{1t} = 400 \; ; \; a_{2t} = 100 \; g_t = .8 \; k_t = .05 \; \alpha_t = .001 \; M_t = 200 \; \rho = 0 \; r = 0 \; t = 1,5$$

for equation (16); the optimal expenditure decisions are reported in figure 2.

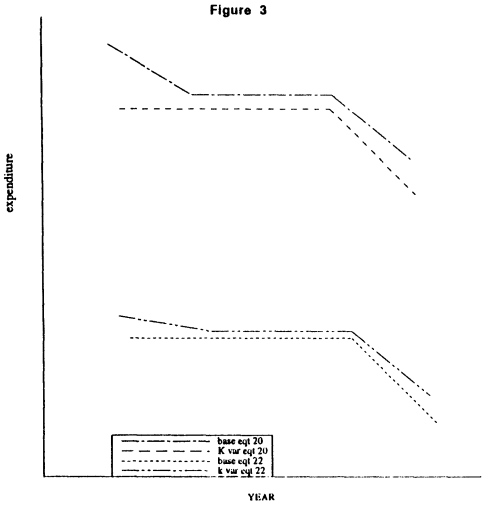
Figure 2



Let us now simulate the effect of a variation in the parameters. An increase in k causes an increase in expenditure in period t-1 and a uniform increase, although less important in the expenditure of all the other periods. The uniform increase derives from having assumed constant parameters and a zero rate of interest and intertemporal substitution and its absolute magnitude depend on the value for α.

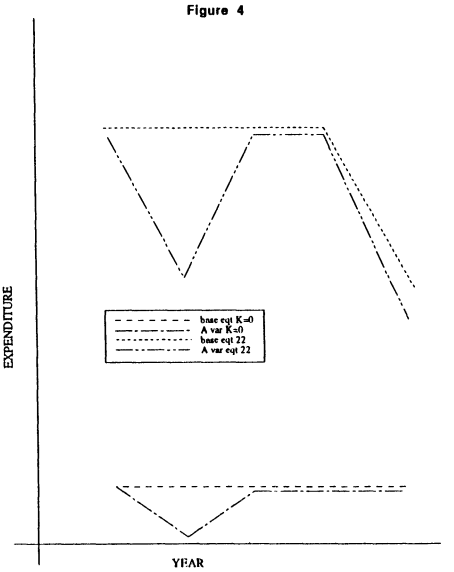
A 2% increase in k always boosts expenditure up, but this increase is more important if a is equal zero, as shown in figure 3.

Figure 3



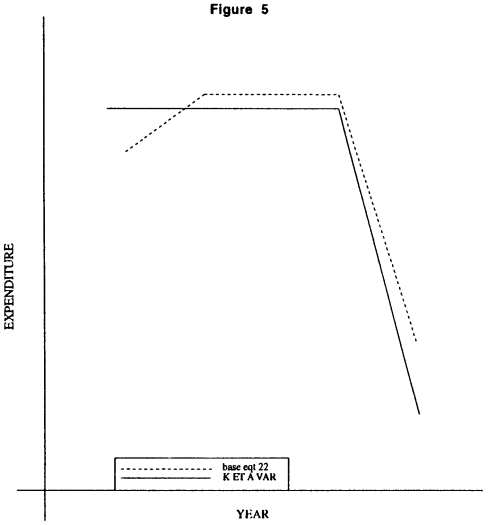
The decrease in a causes a substantial decrease in expenditure at time t. This reduction is depicted in figure 4 in which the increase in α_2 is equal to 2% and this variation causes a decrease in X_2 equal to 4.6%. Expenditure decrease is dampened by k: if k was equal zero the reduction would have been 5.2%.

Figure 4



Finally, I will show an example of the effects of combined parameters changes on expenditure. Figure 5 shows how the simultaneous increase in k and α_{t-1} causes a reduction in expenditure at time t-1, but this reduction is less dramatic: in this second case expenditure decrease is 4%, 0.6% less than in the previous case.

Figure 5



5. Conclusions

Predicting local government reactions to changes in the parameters of their budget constraint is a quite interesting problem that probably has not yet received the attention that it deserves in the light of its policy implications and of the proposed local government finance reforms. This article presents some alternative grant forms and the reactions of local government in an intertemporal context. Local government are assumed to behave as if they were maximising an intertemporal utility function and in this context the impact of the grant system is assessed. Although most of the results are similar to the standard grant-in-aid theory, I have shown that some grants behaves differently from how the standard theory would predict when the local government maximisation horizon is not restricted to a single period. Finally the simulations shows that the structure of the grant, combined with the intertemporal maximisation assumption, give rise to dramatically different responses when the parameters are varied.

This exercise could be extended in an operations research framework by setting the budget constraint parameters in the light of specified expenditure objectives, but this analysis is not very important from an applied point of view because it is highly parameters sensitive and it is probably impossible to obtain efficient estimates for all the required parameters. The last and quite important remark is concerned with the information structure of the model: all this analysis is bases on perfect foresight and symmetric information: in actual fact either or both these conditions might not be met and in this case the problem of the optimal allocation of resources needs to be solved by using a quite different approach[25].

[25]See Levaggi (1990).

APPENDIX N.1

From the First Order Conditions it is possible to derive the following system of total differentials. In order to simplify the notation it will be assumed that the second derivative of a generic variable y at time t is equal to W^{t}_{yy} and:

$$\rho' = \rho - r$$

$$e^{-\rho'(t-1)} = \varepsilon_i$$

$$e^{-r(t-1)} = \sigma_i$$

$$\begin{bmatrix}
\varepsilon^1 W^1_{TT} & 0 & 0 & 0 & -\varepsilon^5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & \varepsilon^2 W^2_{TT} & 0 & 0 & -\varepsilon^5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \varepsilon^3 W^3_{TT} & 0 & -\varepsilon^5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \varepsilon^4 W^4_{TT} & -\varepsilon^5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \varepsilon^5 W^5_{Tx} & 0 & 0 & 0 & 0 & \varepsilon^5 W^5_{xx} \\
0 & 0 & 0 & 0 & 0 & \varepsilon^1 W^1_{xx} & 0 & 0 & 0 & -\varepsilon^5 W^5_{xx} \\
0 & 0 & 0 & 0 & 0 & 0 & \varepsilon^2 W^2_{xx} & 0 & 0 & -\varepsilon^5 W^5_{xx} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \varepsilon^3 W^3_{xx} & 0 & -\varepsilon^5 W^5_{xx} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \varepsilon^4 W^4_{xx} & -\varepsilon^5 W^5_{xx} \\
-\sigma_1 & -\sigma_2 & -\sigma_3 & -\sigma_4 & -\sigma_5 & \sigma_1 & \sigma_2 & \sigma_3 & \sigma_4 & \sigma_5
\end{bmatrix}
\begin{bmatrix} dT_1 \\ dT_2 \\ dT_3 \\ dT_4 \\ dT_5 \\ dX_1 \\ dX_2 \\ dX_3 \\ dX_4 \\ dX_5 \end{bmatrix}$$

$$\begin{bmatrix}
\varepsilon^1 W^1_{TA} & 0 & 0 & 0 & -\varepsilon^5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & \varepsilon^2 W^2_{TA} & 0 & 0 & -\varepsilon^5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \varepsilon^3 W^3_{TA} & 0 & -\varepsilon^5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \varepsilon^4 W^4_{TA} & -\varepsilon^5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \varepsilon^5 W^5_{TA} & 0 & 0 & 0 & 0 & \varepsilon^5 W^5_{xB} \\
0 & 0 & 0 & 0 & 0 & \varepsilon^1 W^1_{xB} & 0 & 0 & 0 & \varepsilon^5 W^5_{xB} \\
0 & 0 & 0 & 0 & 0 & 0 & \varepsilon^2 W^2_{xB} & 0 & 0 & \varepsilon^5 W^5_{xB} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \varepsilon^3 W^3_{xB} & 0 & \varepsilon^3 W^5_{xB} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \varepsilon^4 W^4_{xB} & \varepsilon^4 W^5_{xB} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\begin{bmatrix} dA_1 \\ dA_2 \\ dA_3 \\ dA_4 \\ dA_5 \\ dB_1 \\ dB_2 \\ dB_3 \\ dB_4 \\ dB_5 \end{bmatrix}$$

$$\frac{\partial X_i}{\partial A_i} = \frac{dA_i}{dX_i} \qquad \frac{\partial X_j}{\partial A_i} = \frac{dA_i}{dX_j}$$

$$\frac{\partial X_i}{\partial B_i} = \frac{dB_i}{dX_i} \qquad \frac{\partial X_j}{\partial B_i} = \frac{dB_i}{dX_j}$$

Defining:

$$W^t_{xx} = h_i \leq 0$$

$$W^t_{TT} = q_i \leq 0$$

$$W^t_{xA} = a_i \geq 0$$

$$W^t_{xB} = b_i \geq 0$$

$$\upsilon_i = \frac{\sigma_i}{\varepsilon_i} = e^{(\rho'-r)(i-1)}$$

the r.h.s. determinant can be written as:

$$\prod \varepsilon_i q_i \prod \varepsilon_i h_i \begin{vmatrix} 1 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -1 \\ \upsilon_1 & \upsilon_2 & \upsilon_3 & \upsilon_4 & \upsilon_5 & \upsilon_1 & \upsilon_2 & \upsilon_3 & \upsilon_4 & \upsilon_5 \\ \hline q_1 & q_2 & q_3 & q_4 & q_5 & h_1 & h_2 & h_3 & h_4 & h_5 \end{vmatrix}$$

Substituting column V with the sum of the first 4 and to X the sum of columns 6 to 9 and subtracting the new column V to column X it is possible to obtain a diagonal determinant whose solution is equal to:

$$\prod_1^5 \varepsilon_i q_i \prod_1^5 \varepsilon_i h_i \left(\sum_1^5 \left(\frac{\upsilon_i}{h_i} + \frac{\upsilon_i}{q_i} \right) \right) < 0$$

In order to obtain the effect of the change it is sufficient to apply Cramer's rule to solve simultaneous equation. For example , to obtain the effect of the change in B on X the new determinant to solve will be equal to:

$$\begin{bmatrix}
\varepsilon_1 W^1_{TT} & 0 & 0 & 0 & -\varepsilon_5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & \varepsilon_2 W^2_{TT} & 0 & 0 & -\varepsilon_5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \varepsilon_3 W^3_{TT} & 0 & -\varepsilon_5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \varepsilon_4 W^4_{TT} & -\varepsilon_5 W^5_{TT} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \varepsilon_5 W^5_{TT} & 0 & 0 & 0 & 0 & \varepsilon_5 W^5_{xx} \\
0 & 0 & 0 & 0 & 0 & \varepsilon_1 W^1_{xB} & 0 & 0 & 0 & -\varepsilon_5 W^5_{xx} \\
0 & 0 & 0 & 0 & 0 & 0 & \varepsilon_2 W^2_{xx} & 0 & 0 & -\varepsilon_5 W^5_{xx} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \varepsilon_3 W^3_{xx} & 0 & -\varepsilon_5 W^5_{xx} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \varepsilon_4 W^4_{xx} & -\varepsilon_5 W^5_{xx} \\
-\sigma_1 & -\sigma_2 & -\sigma_3 & -\sigma_4 & -\sigma_5 & 0 & \sigma_2 & \sigma_3 & \sigma_4 & \sigma_5
\end{bmatrix}$$

and its solution is equal to:

$$\prod_1^5 \varepsilon_i q_i \prod_1^5 \varepsilon_i h_i \varepsilon_1 b_1 \left(\sum_1^5 \upsilon_i \left(1/h_i + 1/q_i \right) - \frac{\upsilon_1}{h_1} \right)$$

then:

$$\frac{\partial X_i}{\partial B_i} = -\frac{b_i \left[\sum \upsilon_i \left(1/h_i + 1/q_i \right) - \dfrac{\upsilon_i}{h_i} \right]}{h_i \left(\sum \upsilon_i \left(1/h_i + 1/q_i \right) \right)} > 0$$

since $\varepsilon_i = \varepsilon_j e^{-\rho'(i-j)}$

$$\frac{\partial X_i}{\partial B_j} = e^{\rho'(i-j)} \frac{b_j}{h_i} \frac{\upsilon_j}{\sum \left(1/h_i + 1/q_i\right) h_j} < 0$$

$$\frac{\partial X_i}{\partial A_j} = -e^{\rho'(i-j)} \frac{a_j}{h_i} \frac{\upsilon_j}{\sum \left(1/h_i + 1/q_i\right) q_j} > 0$$

$$\frac{\partial X_i}{\partial Ls_j} = \frac{\upsilon_j}{h_i \left(\sum \upsilon_i \left(\frac{1}{h_i} + \frac{1}{q_i} \right) \right)} e^{\rho'(i-j)} > 0$$

$$\frac{\partial X_i}{\partial r} = -\frac{\sum_{t=1}^{5} \left(X_t - T_t \right) \sigma_i (t-1)}{\varepsilon_i h_i \left(\sum \upsilon_i \left(\frac{1}{h_i} + \frac{1}{q_i} \right) \right)} =< 0$$

APPENDIX N.2

Using the same approach described in the previous section, we can obtain the following results:

$$\frac{\partial X_i}{\partial Ls_j} = \frac{\upsilon_j}{\frac{h_i}{g_i}\left(\sum \upsilon_i\left(\frac{g_i^2}{h_i}+\frac{1}{q_i}\right)\right)} e^{\rho'(i-j)} > 0$$

$$\frac{\partial X_i}{\partial g_i} = \frac{\frac{W_x^i}{g_i^2}\left[\sum_{j\neq i}^{5}\left(\frac{\upsilon_j}{q_j}+\frac{\upsilon_j g_j^2}{h_j}\right)+\frac{\upsilon_i}{q_i}-\frac{\upsilon_i g_i^2}{W_x^i}\right]}{\frac{h_i}{g_i}\sum_{1}^{5}\upsilon_i\left(\frac{1}{q_i}+\frac{g_i^2}{h_i}\right)} < 0$$

$$\frac{\partial X_j}{\partial g_j} = e^{\rho'(t-1)}\frac{\frac{W_x^j}{g_j^2}\upsilon_j\left[\frac{g_j^2}{h_j}-\frac{g_j^2}{W_x^j}\right]}{\frac{h_i}{g_i}\sum_{1}^{5}\upsilon_i\left(\frac{1}{q_i}+\frac{g_i^2}{h_i}\right)} < 0$$

APPENDIX N.3

$$\frac{\partial X_i}{\partial M_j} = \frac{\upsilon_j}{\dfrac{h_i}{g_i - k_{i+1}}\left(\sum \upsilon_i \left(\dfrac{\left(g_i - k_{i+1}\right)^2}{h_i} + \dfrac{1}{q_i}\right)\right)} e^{\rho'(i-j)}$$

$$\frac{\partial X_i}{\partial g_i} = \frac{\dfrac{W_x^i}{\left(g_i - k_{i+1}\right)^2}\left[\sum_{j\neq i}^{5} \upsilon_j \left(\dfrac{1}{q_j} + \dfrac{\left(g_j - k_{j+1}\right)^2}{h_j}\right) + \upsilon_j \left\{\dfrac{1}{q_i} - \dfrac{\left(g_i - k_{i+1}\right)^2}{W_x^i}\right\}\right]}{\dfrac{h_i}{g_i - k_{i+1}}\left(\sum \upsilon_i \left(\dfrac{\left(g_i - k_{i+1}\right)^2}{h_i} + \dfrac{1}{q_i}\right)\right)}$$

$$\frac{\partial X_i}{\partial k_{i+1}} = -\frac{\partial X_i}{\partial g_i}$$

$$\frac{\partial X_i}{\partial g_j} = e^{\rho'(i-j)} \frac{\dfrac{W_x^j}{\left(g_j - k_{j+1}\right)^2} \upsilon_j \left[\dfrac{\left(g_j - k_{j+1}\right)^2}{h_j} - \dfrac{\left(g_i - k_{i+1}\right)^2}{W_x^i}\right]}{\dfrac{h_i}{g_i - k_{i+1}}\left(\sum \upsilon_i \left(\dfrac{\left(g_i - k_{i+1}\right)^2}{h_i} + \dfrac{1}{q_i}\right)\right)}$$

APPENDIX N.4

The first necessary condition to obtain a maximum for the problem at hand is to check that the budget balance is convex. It can be easily shown that this is the case if:

$$\frac{\partial T}{\partial X} > 0 \quad \text{and} \quad \frac{\partial^2 T}{\partial X^2} > 0 \qquad \text{(i)}$$

$$\frac{\partial T}{\partial X} = 2\alpha_t X_t + g_t - k_{t+1}$$

If $k_{t+1} < g_t$ (i) holds for any $X > 0$

If $k_{t+1} < g_t$ (i) holds for any $X > \frac{k_{t+1} - g_t}{2\alpha}$

In the numerical example g_t and k_t have been chosen such that $k_{t+1} < g_t$ and from an economic point of view this is a quite reasonable assumption .
Defining:

$$\Psi^i_{xx} = \varepsilon_i\left[W^i_{xx}\left(2\alpha_i\left(X_i - X^*\right) + g_i - k_{i+1}\right) - W^i_x 2\alpha\right] < 0$$

$$\gamma = 2\alpha$$

$$x = X_t - X^*$$

$$\begin{bmatrix}
W^1_{TT} & 0 & 0 & -W^4_{TT} & 0 & 0 & 0 & 0 \\
0 & W^2_{TT} & 0 & -W^4_{TT} & 0 & 0 & 0 & 0 \\
0 & 0 & W^3_{TT} & -W^4_{TT} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & W^4_{TT} & 0 & 0 & 0 & \dfrac{\Psi^4_{xx}}{\left(\gamma_4 x_4 + g_4 - k_5\right)^2} \\
0 & 0 & 0 & 0 & \dfrac{\Psi^1_{xx}}{\left(\gamma_1 x_1 + g_1 - k_2\right)^2} & 0 & 0 & -\dfrac{\Psi^4_{xx}}{\left(\gamma_4 x_4 + g_4 - k_5\right)^2} \\
0 & 0 & 0 & 0 & 0 & \dfrac{\Psi^2_{xx}}{\left(\gamma_2 x_2 + g_2 - k_3\right)^2} & 0 & -\dfrac{\Psi^4_{xx}}{\left(\gamma_4 x_4 + g_4 - k_5\right)^2} \\
0 & 0 & 0 & 0 & 0 & 0 & \dfrac{\Psi^3_{xx}}{\left(\gamma_3 x_3 + g_3 - k_4\right)^2} & -\dfrac{\Psi^4_{xx}}{\left(\gamma_4 x_4 + g_4 - k_5\right)^2} \\
-\sigma_1 & -\sigma_2 & \sigma_3 & -\sigma_4 & \sigma_1\left(\gamma_1 x_1 + g_1 - k_2\right) & \sigma_2\left(\gamma_2 x_2 + g_2 - k_3\right) & \sigma_3\left(\gamma_3 x_3 + g_3 - k_4\right) & \sigma_4\left(\gamma_4 x_4 + g_4 - k_5\right)
\end{bmatrix}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -\dfrac{W_x^4}{(\gamma_1 x_4 + g_4 - k_5)^2} & 0 & \dfrac{W_x^4}{(\gamma_4 x_4 + g_4 - k_5)^2} \\ 0 & 0 & \dfrac{W_x^1}{(\gamma_1 x_1 + g_1 - k_2)^2} & \dfrac{W_x^4}{(\gamma_4 x_4 + g_4 - k_5)^2} & \dfrac{2xW_x^1}{(\gamma_1 x_1 + g_1 - k_2)^2} & \dfrac{2XW_x^4}{(\gamma_4 x_4 + g_4 - k_5)^2} \\ 0 & 0 & 0 & \dfrac{W_x^4}{(\gamma_4 x_4 + g_4 - k_5)^2} & 0 & -\dfrac{2xW_x^4}{(\gamma_4 x_4 + g_4 - k_5)^2} \\ 0 & 0 & 0 & \dfrac{W_x^4}{(\gamma_4 x_4 + g_4 - k_5)^2} & 0 & -\dfrac{2XW_x^4}{(\gamma_4 x_4 + g_4 - k_5)^2} \\ 0 & 0 & 0 & \dfrac{W_x^4}{(\gamma_4 x_4 + g_4 - k_5)^2} & 0 & -\dfrac{2XW_x^4}{(\gamma_4 x_4 + g_4 - k_6)^2} \\ \sigma_1 & \sigma_4 & \sigma_1 & \sigma_4 & \sigma_1 2X_1 & \sigma_4 2X_4 \end{bmatrix} \begin{bmatrix} dM_1 \\ \cdot \\ \cdot \\ \cdot \\ dM_4 \\ dg_1 \\ \cdot \\ \cdot \\ \cdot \\ dg \\ d\alpha_1 \\ \cdot \\ \cdot \\ \cdot \\ d\alpha_4 \end{bmatrix}$$

Note: The derivatives w.r.t. k have not been reported.

$$\frac{\partial X_i}{\partial M_j} = \frac{\sigma_j}{\dfrac{\Psi^i_{xx}}{(\gamma_i X_i + g_i - k_{i+1})^2}\left(\sum \sigma_j \left(\dfrac{(\gamma_i x_i + g_i - k_{i+1})^3}{\Psi^i_{xx}} + \dfrac{1}{q_i}\right)\right)} e^{\rho'(i-j)} > 0$$

$$\frac{\partial X_i}{\partial \alpha_i} = \frac{\dfrac{4X_i^2 W_x^i}{(\gamma_i x_i + g_i - k_{i+1})^2}\left[\displaystyle\sum_{j\neq i}^{5} \sigma_i \left(\frac{1}{q_j} + \frac{(\gamma_j x_j + g_j - k_{j+1})^3}{\Psi^j_{xx}}\right) + \sigma_i \left(\frac{1}{q_i} - \frac{(\gamma_i x_i + g_i - k_{i+1})^3}{4X_i^2 W_x^i}\right)\right]}{\dfrac{\Psi^i_{xx}}{(\gamma_i x_i + g_i - k_{i+1})^2}\left(\sum \sigma_i \left(\dfrac{(\gamma_i x_i + g_i - k_{i+1})^3}{\Psi^i_{xx}} + \dfrac{1}{q_i}\right)\right)} < 0$$

$$\frac{\partial X_i}{\partial \alpha_j} = e^{\rho'(i-j)} \frac{\dfrac{4X_j^2 W_x^i}{\left(\gamma_j x_j + g_j - k_{j+1}\right)^2}\left[\dfrac{\left(\gamma_j x_j + g_j - k_{j+1}\right)^3}{\Psi_{xx}^j} + \dfrac{\left(\gamma_i x_i + g_i - k_{i+1}\right)^3}{4X_i^2 W_x^i}\right]}{\dfrac{\Psi_{xx}^i}{\left(\gamma_i x_i + g_i - k_{i+1}\right)^2}\left(\sum \sigma_i \left(\dfrac{\left(\gamma_i x_i + g_i - k_{i+1}\right)^3}{\Psi_{xx}^i} + \dfrac{1}{q_i}\right)\right)} < 0$$

$$\frac{\partial X_i}{\partial g_i} = \frac{\dfrac{W_x^i}{\left(\gamma_i x_i + g_i - k_{i+1}\right)^2}\left[\displaystyle\sum_{j\neq i}^{4} \sigma_i \left(\frac{1}{q_j} + \frac{\left(\gamma_j x_j + g_j - k_{j+1}\right)^3}{\Psi_{xx}^j}\right) + \frac{1}{q_i} - \frac{\left(\gamma_i x_i + g_i - k_{i+1}\right)^3}{W_x^i}\right]}{\dfrac{\Psi_{xx}^i}{\left(\gamma_i x_i + g_i - k_{i+1}\right)^2}\left(\sum \sigma_i \left(\dfrac{\left(\gamma_i x_i + g_i - k_{i+1}\right)^3}{\Psi_{xx}^i} + \dfrac{1}{q_i}\right)\right)} < 0$$

$$\frac{\partial X_i}{\partial g_i} = \frac{\dfrac{W_x^i}{\left(\gamma_i x_i + g_i - k_{i+1}\right)^2}\left[\dfrac{\sigma_j\left(\gamma_j x_j + g_j - k_{j+1}\right)^3}{\Psi_{xx}^j} + \dfrac{\sigma_i\left(\gamma_i x_i + g_i - k_{i+1}\right)^3}{W_x^i}\right]}{\dfrac{\Psi_{xx}^i}{\left(\gamma_i x_i + g_i - k_{i+1}\right)^2}\left(\sum \left(\dfrac{\left(\gamma_i x_i + g_i - k_{i+1}\right)^3}{\Psi_{xx}^i} + \dfrac{1}{q_i}\right)\right)} e^{r'(i-j)}$$

$$\frac{\partial X_i}{\partial k_{i+1}} = -\frac{\partial X_i}{\partial g_i}$$

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ERRATUM

DESIGN AND REFORM OF TAXATION POLICY

G. Galeotti and M. Marrelli (Eds.)

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Appendix to the article *Fiscal System and Fiscal Reform in Italy in the 90s* by Vincenzo Visco (pp. 113-151): the Tables 1 to 15.

Tab. 1 A - PERSONAL INCOME TAX (IRPEF) RATES IN FORCE FOR THE PERIOD 1974 - 1989

Income brackets (millions)				1974 Rates	1975 Rates	1976 - 82 Income brackets (millions)				Rates	1983 - 88 Income brackets (millions)				Rates	1986 - 88 Income brackets (millions)				Rates
up to	2			10	- *	up to	3			10	up to	11			10	up to	6			18
from	2	to	3	13	- *	from	3	to	4	13	from	11	to	24	27	from	6	to	11	22
from	3	to	4	16	- *	from	4	to	5	16	from	24	to	30	35	from	11	to	20	27
from	4	to	5	19	- *	from	5	to	6	19	from	30	to	38	37	from	20	to	50	34
from	5	to	6	22	- *	from	6	to	7,5	22	from	38	to	60	41	from	50	to	100	42
from	6	to	7	25	- *	from	7,5	to	9	25	from	60	to	120	47	from	100	to	150	48
from	7	to	8	27	- *	from	9	to	11	27	from	120	to	250	56	from	150	to	300	53
from	8	to	9	29	- *	from	11	to	13	29	from	250	to	500	62	from	300	to	600	58
from	9	to	10	31	- *	from	13	to	15	31	over	300			65	over	600			62
from	10	to	12	37	32	from	15	to	17	32										
from	12	to	14	38	33	from	17	to	19	33										
from	14	to	16	44	43	from	19	to	22	34										
from	16	to	18	45	35	from	22	to	25	35										
from	16	to	20	46	36	from	25	to	30	36										
from	20	to	25	48	38	from	30	to	35	38										
from	25	to	30	50	40	from	35	to	40	40										
from	30	to	40	52	42	from	40	to	50	42										
from	40	to	50	54	44	from	50	to	60	44										
from	50	to	60	56	46	from	60	to	80	46										
from	60	to	80	58	48	from	80	to	100	48										
from	80	to	100	60	50	from	100	to	125	50										
from	100	to	125	62	52	from	125	to	150	52										
from	125	to	150	64	54	from	150	to	175	54										
from	150	to	175	66	56	from	175	to	200	56										
from	175	to	200	68	58	from	200	to	250	58										
from	200	to	250	70	60	from	250	to	300	60										
from	250	to	300	72	62	from	300	to	350	62										
from	300	to	350	74	64	from	350	to	400	64										
from	350	to	400	76	66	from	400	to	450	66										
from	400	to	450	78	68	from	450	to	500	68										
from	450	to	500	80	70	from	500	to	550	70										
over	500			82	72	over	550			72										

(*) Rates up to 10 millions have not changed in 1975 with respect to 1974

(**) Since 1989 income brackets are adjusted for inflation

B - IRPEF TAX CREDITS IN FORCE FOR THE PERIOD 1974-1989 (for a taxpayer with income twice pro-capita GNP (thousands of lit.))

	1974	1975	1976/79	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Employee (single)	120	132	138	222	282	294	306	331	351	492	492	516	552
Employee with a wife and one child	163	211	260	366	498	546	582	635	675	948	1008	1074	1200
Self Employed	36	36	36	36	36	36	36	36	36	===	===	===	===
Self employed with a wife and one child	79	115	158	180	252	288	312	340	361	456	516	558	648

Tab. 2 VAT RATES IN FORCE FOR THE PERIOD 1973-90 (*)

73	74/75	76	77	78/79	80	81	82	83	84	85/ 86	87	88	89	90
1**	1	1	1	1	1	0	0	0	0	0	0	0	0	4
3**	3	3	3	3	2	2	2	2	2	2	2	2	2	9
6	6	6	6	6	3	8	8	8	8	9	9	9	4	19
9**	9	9	9	9	6	18	10	10	10	18	18	18	9	38
12	12	12	12	12	8	35	15	15	15	38	38	19	19	
18	18	18	14	14	9		18	18	18		20***	38	38	
	30	30	18	18	12		20	20	20		22***	20***		
		35	30	35	14		35	38	30			22***		
			35		15		38		38					
					18									
					35									

* No consideration has been made for reduced rates in force in disaster areas.
** Rates introduced in December 1972.
*** Additional 2 or 4 points on products subject to 18%.

Tab. 3 INCIDENCE OF IRPEF (for an employee without dependents and a subordinate worker with a wife and one child, calculated for different years hypothesizing an income equal to the per capita Gdp or multiples of the per capita Gdp)

A - WORKER WITHOUT DEPENDENTS

Reassessment coefficients per capita Gdp	1974	1980	1989
1	4,88	10,91	17,53
2	11,02	19,01	23,69
5	21,09	28,6	32,21

B - WORKER WITH DEPENDENTS

Reassessment coefficients per capita Gdp	1974	1980	1989
1	2,94	8,98	14,39
2	10,05	18,05	22,12
3	20,07	28,22	31,59

Tab. 4 INCOME EXEMP FROM IRPEF OWING TO TAX CREDITS IN PERCENT OF PER CAPITA Gdp

	Employee without dependents	Employee wife and child
1974	54,13	73,52
1980	39,9	55,54
1989	26,69	42,20

Tab. 5 WITHOLDING TAX ON SOMECAPITAL INCOMES

		1974	1980	1989
Government bonds and similar		-	-	12,50
Bonds:	a)	10,8	-	12,50
	b)	21,6	-	12,50
	c)	30	30	30
	d)	20	-	12,50
Difference between bond issue and redemption		-	-	12,50
Deposits		15	18/20	25/30
Non standardised securities		15	15	30
Bank acceptancies		15	15	15
Shares		10	10	10

a) issued by specialized credit Institutions or special sections of banks
b) issued by States-participation companies
c) issued by non-resident subjects
d) Convertibles

Tab. 6 ILOR AND IRPEG RATES

	Ilor	Irpeg	Irpeg + Ilor (corporations)
1974	14,2	25	39,2
1980	15	25	36,25
1989	16,2	36	46,368

Tab. 7 INCIDENCE OF TAXATION ON CAPITAL INCOME FOR INDIVIDUALS, 1989

Dividends	variable with a minimum of 16,2	Irpef + Ilor (Irpef advance payment 10%)
Dividends savings shares and voting rights	54,4128	Irpeg + Ilor + 15% final payment
Undistributed Profits	46,368	Irpeg + Ilor
Dividends to not residents	63,7448	Irpeg + Ilor + 32,4 final payment (4)
Interest on postal deposits and on registered deposits with 3 months committment	25	Final tax
Other interests on deposits	30	Final tax
Interest on government bonds and equalized (1) a) issued in Italy b) issued abroad	12,5	Final tax
Interest on Bonds and similar securities (including the difference between reimbursement and price at issue) (2)(3)	12,5	Final tax
Interest on Bonds and similar securities including the difference between reimbursements and prices at issue not issued by banks, Bodies managing PPSS (state shareholding) or quoted companies	30	Final tax
Convertible bonds	12,5	Final tax
Interest on convertible bonds not issued by banks, Bodies managing PPSS (state shareholding) or quoted companies	30	Final Tax
Bank acceptancies	15	Final Tax
Proceeds from non standardised securities	30	Final Tax

Proceeds from mutual funds		0,10 0,25	Wealth Tax (no recovery of advance payments on capital incomes)
Proceeds from foreign mutual funds		0,5	
Interests to cooperative shareholders		12,5	Final Tax
Dividends to cooperative shareholders		10,2	Final Tax (Irpeg + Ilor at reduced rate) (5)
Dividends to savings popular banks shareholders			Irpef + Ilor (advance Irpef payment 10%) Irpeg + Ilor + 15% final Tax (6)
Capital Gains :			
	real property	variable	Invim (on conventionl values) or Irpef in case of sale within 5 years or in case of apportionment
	stocks, bonds, ecc.		
non standardised securities		6	Advance payment of witholding tax (7)
	unquoted shares	variable	Irpef for holdings above certain percentages (2, 5, 15%) if sold before five years
Proceeds from capitalization insurance savings		12,5	Final tax

1) Interests on government bonds issued before 30.9.1986, are exempt, and interests on public bonds issued between 30.10.1986 e il 30.9.1987 are subject to 6,25% tax

2) It must be kept in mind that as far as bonds are concerned the situation described in the table concerns the present emissions, whereas the situation as it has become stratified over time is far more complicated. In fact, emission of specialised banks dating from the 31.7.80 to 30.9.82 period, as well as all the emissions of the period 31.12.80 - 30.9.82, are exempt; and are exempt the greater value coming from indexation clauses of bonds issued by land-credit insitutions in the period 5.8.78 - 30.9.82, emissions of the same institutions issued before 3.7.80 are subject to 10,8% as well as those issued in teh period 1.1.0.82 - 31.12.83; whereas bonds issued by private firms or institutions before 1.1.84, and different from those before mentioned are subject to a 21,6% rate

3) Formally the ordinary official rate is 30% whereas the 12,5% rate appears as an incentive

4) Tax credit up to a maximum of 2/3 of 32,4 is not inclused

5) If the conditions exist

6) Optional, see art. 32 DL 990/88

7) Concerns issuer only

Tab. 8 PERCENT INCIDENCE OF DIRECT TAXES ON SOME CATEROGIES OF INCOME

	1986	1987	1988
Withholding + social contribution (Employees) / Incomes + pensions (Employees)	40,7	41,4	41,7
IRPEF + ILOR (other incomes) / Incomes+incomes from agriculture+incomes from housing (not from subordinate income)	13,8	13,7	14,0
Witholding tax on interests + withholding on dividends / interests + dividends	21,7	22,0	22,0*
IRPEG + ILOR (corporation) / Business profits	25,4	27,2	24,0*

* Estimate

Tab. 9 POTENTIAL AND ACTUAL TAXABLE INCOMES FOR INCOME FROM SUBORDINATE WORK (BILLION LIRE)

	1986	1987
1. Regular Subordinate Work	256.742	281.151
2. Irregular Subordinate Work	35.161	38.603
3. Unemployment benefits	4.129	3.367
4. Taxable Social Services	4.232	4.476
5. Family Allowance	5.018	5.168
6. TFR Funds	16.315	18.339
7. Social Contributions	21.673	23.740
8. Gescal	717	796
9. Arrears from subordinate work	12.364*	12.675
10. Potential tax base (1+2+3+4+5-6-7-8-9)	286.843	313.893
11. Exempted incomes	3.118	3.200
12. Family Allowances	5.018	5.168
13. TFR Funds	16.315	18.339
14. Actual tax base for subordinate work (10-11-12-13)	262.392	287.186
15. Declared tax base	231.206	254.370*
16. Erosion (10-14)	24.451	26.707
17. Evasion (14-15)	31.186	32.816
18. Erosion (%) (16/10)	8,5	8,5
19. Evasion (%) (17/10)	11,7	11,3

*Estimate

Tab. 10 POTENTIAL AND ACTUAL TAXABLE INCOMES FOR INCOMES FROM AGRICULTURE

	1986	1987	1989
1. Family incomes from Agriculture	18.990	19.727	17.884 (*)
2. Declared incomes from Agriculture	1.688	1.674	2.000
3. Erosion + Evasion (1-2) (3:1%)	17.302 (91,1)	18.053 (91,5)	15.884 (88,8)
4. Hypothesized evasion equal to 1/3 total income			
a) Evasion	5.767	6.018	5.295
b) Erosion	11.535	12.035	10.589

(*) Stime

Tab. 11 POTENTIAL AND ACTUAL TAXABLE INCOMES FOR INCOMES FROM HOUSING

	1986	1987	1989
1. Incomes from houses belonging to families	66.102	73.212	88.538
2. Incomes from declared houses	12.588	13.413	15.700*
3. Erosion + evasion (1-2)	53.514	59.799	72.838
(3:1%)	(81)	(81,7)	(82,3)
4. Hypothesized evasion equal to 20% of totale income			
a) Evasion	10.703	11.960	14.568
b) Erosion	42.811	47.839	58.270

* Estimate

Tab. 12 POTENTIAL AND ACTUAL TAXABLE INCOMES FOR INCOME FROM SELF-EMPLOYMENT

	1986	1987	1989
1. Family incomes	172.737	193.221	229.567
2. Declared income from self-employement business + minor businesses + passive investment	71.277	78.494	99.862*
3. Evasion + erosion + avoidance	89.890	101.858	129.705
(3:1%)	(55,8)	(56,5)	(56,5)

* Estimate

Tab. 13 POTENTIAL AND ACTUAL TAXABLE INCOMES FOR CAPITAL INCOMES

	1986	1987	1989
1. Family incomes			
Interests	40.413	35.525	45.540
	37.305	41.704	53.460
Dividends	4.617	5.155	6.444*
	82.335	82.384	105.444
2. Declared incomes	4.246	5.424	6.600*
3. Erosion + evasion	78.089	79.960	98.844*
(3:1%)	(94,8)	(97,1)	(93,7)
HYPOTHESIS OF INDEXED INTEREST			
1.FAMILY INCOMES			
Interests	13.622	11.672	4.450
" on pubblic bonds	17.998	23.437	28.377
Dividends	4.617	5.155	6.444
	36.237	40.264	39.271
2. Indexed incomes in % of nominal incomes	44,0	48,9	37,2
3. Declared incomes	4.246	5.424	6.600
4. Erosion + Evasion	31.991	34.840	32.671

* Estimate

Tab. 14 A - ACTUAL REAL RATES OF TAXATION (%)

Rate of inflation	Tax rate 10% real interest rates			Tax rate 20% real interest rates			Tax rate 30% real interest rates			Tax rate 50% real interest rates		
	1	3	5	1	3	5	1	3	5	1	3	5
2	30	16,6	14	60	33,3	28	90	50	42	150	83,3	70
5	60	26,6	20	120	53,3	40	180	80	60	300	133,3	100
10	100	43,3	30	220	86,6	60	330	130	90	550	216,6	150

B - ACTUAL REAL RATES OF INDEBTEDNESS, NET OF TAXES (%)

Rate of inflation	Tax rate 10% real interest rates			Tax rate 20% real interest rates			Tax rate 30% real interest rates			Tax rate 50% real interest rates		
	1	3	5	1	3	5	1	3	5	1	3	5
2	0,7	2,5	4,3	0,4	2,0	3,6	0,1	1,5	2,9	-0,5	0,5	1,5
5	0,4	2,2	4	-0,2	1,4	3	-0,8	0,6	2,0	-2,0	-1,0	0
10	-0,1	1,7	3,5	-1,2	0,4	2	-2,3	-0,9	0,5	-4,5	-3,5	-2,5

Tab. 15 DEPRECIATION RATES FOR A 10-YEAR CAPITAL ASSET WITH AN INITIAL VALUE OF 1,000, BASED ON THE ADOPTION OF DIFFERENT DEPRECIATION METHODS

Years	Straight line	Accelerated (A)	Accelerated (B)	DPR 597/72	Consolidated Act	Current legislation
1	100	200	182	250	125	100
2	100	160	164	250	250	200
3	100	128	145	250	250	200
4	100	102	127	100	100	100
5	100	82	109	100	100	100
6	100	66	91	50	100	100
7	100	65,5	73	-	75	100
8	100	65,5	55	-	-	100
9	100	65,5	36	-	-	-
10	100	65,5	18	-	-	-
	1.000	1.000	1.000	1.000	1.000	1.000
a) Current value of rates (discount rate 10%)						
	614	686	702	780	733	691
- Current value straight line indexed rates (annual inflation 5%)						
	762					
b) Current value of rates (discount rate 14%)						
	522	606	622	714	657	608
- Current value straight line indexed rates (annual inflation 5%)						
	639					