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## Joint Labour Supply of Married Couples: Efficiency and Distributional Effects of Tax Reforms

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# Taxes, Transfers, Labor Supply and Household Welfare\*

## 11.1 MOTIVATIONS FOR STUDYING LABOR SUPPLY AND TAXATION

There are important links between female labor supply and taxes. First, income taxation affects labor supply. Also, labor supply generates the basis for tax revenue. Secondly, married women are the most responsive component of the labor force with respect to changes in incentives. As we illustrate in this chapter, their behavior turns out to be crucial in designing and evaluating tax-transfer policies.

Taxes are collected in order to finance government spending. Many trends contribute to increasing demand for government spending. The fact that individuals are living longer, and that cohorts born in the late 1940s and 1950s were rather large, imply that in the coming decades there will be an increasing number of ageing individuals. In addition to the expected increase in government spending on pensions, one should also expect a sharp increase in the government spending on a variety of health issues, ranging from hospital services, elderly homes and pharmaceuticals. Disability pensions and unemployment benefits are two other government programs that have increased recent government spending in EU-countries due to high and persistent unemployment over many years. In recent years there has thus been a growing concern in western societies regarding the increase in government spending and hence about the costs of taxation, that is to say, the loss in efficiency due to disincentives and distortions on worker behavior caused by taxation. The perceived disincentives on labor supply appeared to be the major justification for reducing marginal tax rates in many European nations during the 1980s and the early 1990s where the marginal tax rates faced by top earners dropped from 70–80 per cent to around 40–50 per cent (see e.g. Blundell, 1996).

Taxes and transfers are also implemented with the direct aim of changing incentives and distribution of resources. There is a growing interest in

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reforming the welfare system, or the various institutions devoted to supporting incomes or the consumption of disadvantaged households. While this last issue is in principle distinct, there is an obvious connection with the former: both call for a redesign of the 'tax-and-benefit' system with the aim of implementing a new configuration of incentives that could eventually lead to more efficiency—not more inequality, given total tax revenue.

In order to be able to undertake tax reforms that enhance the efficiency of the economy, one needs to know how taxes and transfers affect behavior. Here we will concentrate on labor supply. Labor supply consists of participation and hours worked in the labor market, given participation. Economists assume that individuals make their labor supply choice based on preferences that depend on the outcome of working, that is, earnings, and foregone leisure. Preferences can be represented by a function that increases with income and leisure (the utility function). It is assumed that individuals choose their labor supply so that utility is maximised, given a budget constraint and given their perceived opportunities in the labor market. The budget constraint transforms time allocated to labor into, and then—through the tax rule—gross income into net income.

Most of the individuals are married or cohabiting. Therefore, to address the labor supply decisions in a population properly, we have to account for the interaction between spouses. Thus in most cases below the 'utility function' relates to households with household consumption and leisure of the spouses as the main arguments in the utility function.

Most tax reforms involve a change in marginal tax rates. As a first approximation, reform effects can be discussed in terms of labor supply responses to changes in marginal tax rates. A reduction in marginal tax rates, for example, has two opposing effects on labor supply. First, lower tax rates on the margin makes it more profitable to supply more labor. This is called the substitution effect of tax rate changes. Secondly, lower tax rates make it possible to reduce labor supply and still enjoy the same level of consumption. This is called the income effect of tax rate changes. It is the net of these two effects that determine whether a cut in tax rates may increase labor supply. Substitution and income effects vary across households, depending on their taste for leisure and how interesting and challenging their jobs are, on their economic situation before taxes are changed, and whether the jobs they have, or can move to, are flexible enough to meet their preferences for working longer hours. An important part of empirical labor supply is to identify those individuals who are the most responsive to tax rate changes. If the top earners are the most responsive ones, then tax reforms should be targeted at cutting tax rates at the top. However, many of those having high wage incomes often occupy jobs from which they derive a lot more than income. They work long hours because they may enjoy their jobs. Thus, their responses to economic incentives are weakened. Tax reforms must take this into account. If the enhancement of efficiency is the main concern of the authorities, they must

target the tax cuts towards those who respond most strongly to economic incentives, not necessarily cutting tax rates for the individuals paying the highest marginal tax rates.

Economists tend to picture the trade-off between equality and efficiency as inescapable. In a widely used textbook in public economics, Stiglitz (1986, p. 481), the reader is warned that the price of redistributing income is a loss in economic efficiency. If this is true, then tax reforms that enhance the efficiency of the economy will imply more inequality. However, if high-income earners are less responsive than low-income earners to economic incentives, then a tax reform that enhances efficiency and reduces inequality may be available. To get an adequate answer to this question, a microeconomic empirical analysis is required.

## 11.2 SOME EVIDENCE IN EUROPE AND THE US

There have been numerous studies of the impact of tax reforms on labor supply in the United States and the United Kingdom. In most of these studies male workers are found to respond very little to changes in tax rates, while the labor supply of married women and lone mothers are found to be far more responsive, Pencavel (1986), Blundell (1997), Blundell, Duncan and Meghir (1998) and Blundell and MaCurdy (1999). We can look at the labor supply decision as consisting of two steps: the 'participation' decision, that is to say, the decision whether to work (or look for work), and the hours decision, that is to say how much to work, conditional on participation. Of these two choices, participation tends to be the most responsive to changes in economic incentives.

Most of the males in the relevant age intervals are participating in the labor market, while in many countries the labor market participation among married women has been rather low. For married women the reasons are twofold. In the first place, to take care of small children implies that less time can be devoted to working outside the home. How difficult it is to combine the raising of children and participation in labor market activities, depends on the availability of childcare centers, maternity leave programs and the wage level of child carers in private markets. In the United States and the United Kingdom there are fewer childcare centers and the maternity leave is less generous than in the Scandinavian countries. Thus, as we should expect, the labor market participation of married women in the United States and the United Kingdom has been less than in the Scandinavian countries, but higher than in countries like Italy and France. The reasons for the latter could be cultural, or the fact that the wage structure is even less in the United States and the United Kingdom. The latter may imply that the wage level of a nanny is so low compared to the wage that the married women can get that she can afford to hire a nanny and participate in the labor market. It should be noted that the change in fertility in Europe would make the female labor

force more like the male labor force in Europe. Thus in the coming years the whole labor force in Europe will most likely become less responsive to changes in tax rates.

The second reason why the married female labor market participation is lower than among males is the role of the husband as the main breadwinner with a higher potential income than the female. The higher the income is that the married female can enjoy without working, the less the probability is that she will work. This is due to the income effect in labor supply.

Lone mothers' labor market participation is negatively affected by having small children they have to look after. Moreover, the government benefit paid to lone mothers may have a strong negative impact on labor supply, at least in Europe, and including the United Kingdom. For many people, a reduction in government benefit if they are working, comes at the top of a marginal tax on wage income. Thus the effective marginal tax is much higher than the ordinary marginal tax rate, and the disincentive to participate in labor market activities is rather strong, Walker (1990).

Although there are strong disincentives to participate in the labor market activities among married women and lone mothers, there is of course room for increasing labor supply in these groups provided that the improvement in the economic incentives are strong enough. It should be noted that males and females approaching the retirement age also are facing a discrete labor market choice, namely to continue working or to retire. Hence, we should expect individuals in these age groups to be more responsive to changes in economic incentives than younger individuals.

Devanzo *et al.* (1973) was one of the first studies to point out that most of the wage- and income-responsiveness in labor supply was concentrated at, or near, zero hours of work. Later studies on the labor supply of married women both in the United States and the United Kingdom gave strong support to this finding, Borjas and Heckman, (1978); Cogan (1981); Hausman and Ruud (1984); Blundell *et al.* (1988); Ilmakunnas and Pudney (1990) and Dickens and Lundberg (1993).

The tax policy reforms in the United Kingdom in the 1980s raised the marginal tax rate for some individuals, reduced it for others, while some were not exposed to any change at all. These reforms provide the researchers with good opportunities for studying the impact of tax reforms on labor supply. On repeated cross-sections set covering the period 1978–1992, with a focus on married women and with employed husbands, Blundell *et al.* (1998) estimated the impact of these tax reforms on female labor supply. Results are reported in the form of 'after-tax-wage' elasticities. The authors conclude that although the uncompensated wage elasticities are smaller than the wage elasticities reported for US women, they are moderately sized and clearly significantly different from zero. Income elasticities are estimated to be negative, and the compensated elasticities are thus positive and high enough to lead to the following conclusion: 'Our conclusion is that major tax reform should take into account

behavioral effects since our compensated elasticities suggest that the welfare effects are not eligible.’

An important issue to consider is how changes in economic incentives affect labor supply for individuals with different potential income. The higher the wage rate, the higher one would expect that the potential income would be, and/or is. One of the first to study this problem was Break (1957). Based on interviews with a group of lawyers and accountants in the United Kingdom he found that the majority of these affluent men were not affected in their labor supply by the strong disincentives embedded in the British tax system at the time. Across the Atlantic, Moffit and Wilhelm (1998) found similar weak effects of a tax reform in 1986 on the labor supply of the affluent American men. The authors found no evidence of change in hours of work in response to the marginal tax rate cuts in the 1986 reform. On US data, Dickens and Lundberg (1993) report that labor supply responds more strongly to changes in economic incentives in households with low income than in households with high income. For the households with the highest income, they report that the labor supply curve is even backward bending.

Notwithstanding the above reservations on lowering the marginal tax rates on high incomes, this choice has prevailed in the United States, the United Kingdom and most of Europe. Besides the (dubious) efficiency motivations, there might of course be other good reasons for flattening the marginal rates profile, such as simplifications, reducing incentives to evade taxes, coping with mobility of highly-skilled labor and fiscal competition. Given that choice, in the last decade, has been taken for granted policy and research focus has shifted towards more finely-tuned issues such as redesigning the mechanisms for low-income support, strengthening the incentives to work for the poor, and reconciling work and childbearing (e.g. Duncan and McCrae 1999; Keane 1995; Eissa and Liebman 1996; Blundel 2000). Overall, the results of these studies confirm that behavioral responses—and particularly those from married women—are strong enough to get some efficiency and/or equality return from the effort spent in redesigning incentives and institutions. Some representative studies and their results are summarized in Table 11.1.

### 11.3 FISCAL AND SOCIAL POLICIES: MODELING THE BEHAVIORAL RESPONSES

Most of the empirical and policy analysis of labor supply and taxes up until the beginning of the nineties are very close to the textbook presentation of the labor supply decision. The consumer commands a fixed wage rate on the labor market, which reflects her marginal productivity. She is free to choose any number of hours of work at that wage. She satisfies her needs by combining earned income (+ eventually other incomes from different sources, e.g. transfers) with ‘leisure’ time (i.e. the time not sold on the market). She chooses the allocation of time that best meets her needs or preferences. The empirical model

Table 11.1. Empirical evidence regarding the relationship between labor supply elasticities and income or wages

Authors	Coverage	Methodological approach/type of data	Results
Devanzo <i>et al.</i> (1973)	United States. Men.	Labor supply model, estimated on micro data, including information about participation/non-participation and hours.	Virtually all of the labor supply wage- and income responsiveness is found at or near the zero-hours point.
Borjas and Heckman (1978)	United States. Men.	Labor supply model, estimated on micro data, including information about participation/non-participation and hours.	Labor supply estimates are more responsive to wages and incomes when participation decisions are accounted for than when only hours of work, given participation, were used in estimating labor supply. The estimated total labor supply elasticity for married women is 2.03, out of which 1.41 is driven by participation decisions.
Arnufat and Zabalza (1986)	United Kingdom, 1974. Married women.	Micro data based on the General Household Survey. Labor supply model, with husbands' labor supply treated as exogenous.	The estimated total labor supply elasticity is on average around 3, out of which approximately 1.4 is driven by participation decisions.
Dagsvik <i>et al.</i> (1988)	France, 1979. Women.	Labor supply model, estimated on micro data collected from the INSEE survey 'Budgets des Familles 1978-1979'. The data include information about participation/non-participation and hours.	The participation decision is more elastic for workers with low wages (or low potential wages). For example, the estimated partial labor supply elasticities are approximately five times higher for workers in the 1-10 percentile than for workers in the 61-100 percentile of the wage distribution.

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<p>Aaberge <i>et al.</i> (1995)</p>	<p>Norway, 1979. Married couples.</p>	<p>Labor supply matching model, estimated on micro data collected from the Level of Living Sample Survey.</p>	<p>Both participation and hours elasticities are higher the lower is household income. For example, for all men (women) the estimated uncompensated labor supply elasticity is 0.45 (1.82) out of which 0.29(0.83) is due to participation. For the 10 per cent poorest, the corresponding numbers are 2.23(3.09) and 1.89 (1.85). For Italy see next entry. For Norway the simulated direct uncompensated labor supply elasticities for all men (women) are 0.28 (0.91) out of which 0.17 (0.37) is due to participation. For working couples in Sweden in 1981 the simulated direct labor supply elasticities are -0.02 for men and 0.07 for women.</p>
<p>Aaberge <i>et al.</i> (2000)</p>	<p>Married couples in Italy (1987), Norway (1986) and Sweden (1981)</p>	<p>Participation decisions as well as hours of work (for Sweden only working couples). Accounts for non-convex budget sets and restrictions on hours offered in the market.</p>	<p>The simulated uncompensated direct elasticities for men (women) are 0.05 (0.74) out of which 0.04(0.65) is due to participation. For the 10 per cent poorest the corresponding numbers are 0.08 (3.44) and 0.05 (2.84). The labor supply of high-income men is inelastic with respect to the marginal tax rate. There is no evidence of changes in hours of work in response to the marginal tax rate reductions legislated in the 1986 Tax Reform Act.</p>
<p>Aaberge <i>et al.</i> (1999)</p>	<p>Italy, 1987. Married couples.</p>	<p>Labor supply matching model estimated on data from the Survey of Household Income and Wealth.</p>	<p>The simulated uncompensated direct elasticities for men (women) are 0.05 (0.74) out of which 0.04(0.65) is due to participation. For the 10 per cent poorest the corresponding numbers are 0.08 (3.44) and 0.05 (2.84). The labor supply of high-income men is inelastic with respect to the marginal tax rate. There is no evidence of changes in hours of work in response to the marginal tax rate reductions legislated in the 1986 Tax Reform Act.</p>
<p>Moffitt and Wilhelm (1998)</p>	<p>United States, 1983–1989. Affluent men.</p>	<p>Data is collected from the Survey of Consumer Finances (SCF) and used to evaluate hours of work responses to the 1986 Tax Reform Act.</p>	<p>The labor supply of high-income men is inelastic with respect to the marginal tax rate. There is no evidence of changes in hours of work in response to the marginal tax rate reductions legislated in the 1986 Tax Reform Act.</p>

Source: Røed and Strøm (2002).

AQ: Please confirm the abbreviation SFC.

at this point consists in specifying a functional relationship between the labor supply decision on the one hand, and wage rate and other incomes on the other:  $h = h(w, y)$ . With observations on  $h$ ,  $w$  and  $y$ , one can estimate this function and use it to simulate new decisions given new values of  $w$  and/or  $y$ . Taxes complicate the picture but the basic framework does not change. However the same framework imposes serious limitations. For example not all the tax rules can be easily represented. Simultaneous household decisions are cumbersome to model. The same holds for modeling constraints as for choice of hours.

During the last two decades, a different framework has become more popular, where the consumer is assumed to choose among jobs (i.e. 'packages' of hours requirements, wages and other characteristics), rather than along a continuum of hours for a fixed wage rate. Also, the empirical analysis consists in directly estimating the preferences as revealed by the observed choices, rather than going through the specification of a 'labor supply function'. This different approach accounts for the fundamental heterogeneity of the alternative job packages that form the consumer's opportunity set, and simplifies enormously the representation of complex tax rules, of simultaneous household decisions and of constraints on hour choices.<sup>1</sup> In most of this chapter we rely on a modeling framework that belongs to this approach. In particular it is a simultaneous model of household labor supply of both spouses, it allows an exact representation of the budget sets independent of how complex they are, and it accounts for quantity constraints and limitations in the choice of hours of work. An outline of this modeling framework is provided in Appendix A.<sup>2</sup>

#### 11.4 MEASURING SOCIAL WELFARE: EFFICIENCY AND EQUALITY

In order to choose between alternative tax policies, one needs a criterion for aggregating household incomes, or welfare, into social welfare. Using household welfare rather than income as the informational basis of the social welfare function means that not only income but also the value of leisure are taken into account. A social welfare function is essentially a weighted sum of individual households' incomes or welfare indexes, where the weights reflect the social (e.g. the planner's) attitude towards inequality. For example, if the planner cares at all about inequality, she/he should give more weight to the poor than to the rich. The particular form of social

<sup>1</sup> The foundations of this new approach reside in McFadden's work on discrete choice (e.g. Manski and McFadden, 1981). Important extensions are Ben-Akiva and Watanatada (1981) and Dagsvik (1994).

<sup>2</sup> An interesting recent development consists in representing the household as a set of agents that bargains or plays some sort of game, rather than acting as a unit of decision. The empirical implementation of these models is more problematic. Among others, examples are provided by Hearnés *et al.* (2003) and Chiuri and Longobardi (2002).

welfare function that we use is such that it can be expressed as the product of an efficiency index (namely the simple average of individual incomes or welfare levels), times an index of equality (closely related to the well-known Gini inequality index):

$$\text{Social Welfare} = \text{Efficiency} \times \text{Equality}$$

As a consequence, the effect of a given policy upon social welfare can be approximately expressed as:

$$\begin{aligned} \% \text{ Variation in Social Welfare} &= \% \text{ Variation in Efficiency} \\ &+ \% \text{ Variation in Equality} \end{aligned}$$

Instead of using the total (or average) amount of income or welfare as a measure of efficiency, one might want to use different criteria. Recently, criteria inspired by the ‘equality-of-opportunity’ philosophy have been developed. The idea is that in weighting individual incomes or welfare levels one should care only about that part of inequality that is due to different exogenous opportunities, and not to the residual part due to, say, different effort. According to the approach proposed by J. Roemer (1993, 1998), for example, it turns out that the equality-of-opportunity criterion essentially amounts to using the average income or welfare among the least favored (opportunity-wise, e.g. those with lowest parental income or education) as the efficiency index: the implications being using the standard concept of efficiency versus the equality-of-opportunity concept as developed by J. Roemer. In what follows, we will present simulation exercises where alternative policies are ranked according to their effects on efficiency and on equality. More details on the computation and use of efficiency and equality indexes can be found in Appendix B.

### 11.5 THINKING ABOUT TAX SYSTEM REFORMS: AN EXERCISE FOR ITALY

At least since the end of the sixties two basic ideas have informed the debate on tax-transfer systems reforms. The first idea is concerned with *efficiency* (the size of the pie). Since the late seventies, the progressive tax systems prevailing in most advanced economies have been criticised for giving bad incentives and paying too high a price for income equalization. Suppose, now, that I live in a country with a very progressive tax system and my marginal tax is 50 per cent. Suppose I am offered 5000 euros (gross) to write a report, so that I could earn 2500 euros net of taxes. To keep things simple, let us assume I am the only one endowed with the skills to do the job. Say I decided not to do it. But suppose now there is a change in taxes, and from my current income level, my marginal

tax is lowered to 20 per cent. I would now earn €4000. So this time I might decide to do it. I would be better off. Even more importantly, the government would now collect €1000 more from me in additional taxes, which means that someone else down the line could also be made better off through larger transfers or lower taxes or better public services. If policy makers believe that such opportunities for being more productive concern mostly high-income people, the implication is that tax rates should be made less progressive. This basic scheme embodying the idea of improving efficiency by reducing progressivity—together with other appealing features such as simplicity—is the so-called 'Flat Tax', namely, a proportional tax. Every one pays, let us say, 20 per cent of gross income. As said above, the advocates of this reform more or less explicitly assume that the rich are more responsive than the poor. It is expected that the FT would lower marginal taxes for the rich and increase them for the poor, and possibly also for average income people. To promote this as a good reform efficiency-wise, most FT supporters tend to think that the good incentives given to the rich outweigh the bad incentives given to the poor. During the eighties and nineties, in particular, the United States, and most European countries, made significant moves towards the FT by reducing the number of brackets and/or the progressivity of the bracket marginal rates, besides, in some cases, reducing the average tax rate (Røed and Strøm 2002). Analyses by Hausman and associates (Hausman 1980, 1981; Burtless and Hausman 1978; Hausman and Ruud 1984) have been very influential both from the point of view of the political debate and from that of the evaluation methodology. It should be added that a pure FT is equivalent to an expenditure tax. What one says about the FT is therefore directly relevant in view of the debate on income taxation versus expenditure taxation.

The second idea is mainly concerned with *distribution*. The various policies implemented to help the poor and the needy (tax exemptions, subsidized prices, in-kind benefits etc.) have long been criticized for being costly, chaotic and possibly iniquitous. Maybe we can think up something more direct, simple and transparent? Suppose you define a minimum guaranteed income. If you happen to be above that level in your own right, that's all right. If not, you will receive a transfer just sufficient enough to push your income up to the guaranteed level. On any income above the guaranteed level you will need to pay taxes (according to some rule). This system is called 'Negative Income Tax' (NIT). In the most radical formulation, the NIT mechanism replaces any other redistributive policy. Between the end of the sixties and the middle of the seventies in the United States, many econometric analyses and social experiments were performed in order to evaluate NIT-like mechanisms.

Both ideas have a number of versions and variations. They can also be combined. For example, we can have the NIT combined with a FT above the guaranteed minimum income (we call this rule the NIT + FT). More recently, especially in the United States and the United Kingdom, other NIT low-income support mechanisms have become more fashionable, where wage subsidies to

the working poor are used to supplement their income, or where the transfer envisaged by the NIT is made conditional upon some minimum labor effort (or such like, e.g. participating in a training program). These alternative income support schemes are sometimes labeled as ‘Workfare’ (WF).

The above ideas—together with some implementations—have been circulating for more than three decades as elements of the social and economic policy debate and of the empirical economic research. During this time, theorists were developing sophisticated models for characterizing optimal tax rules. The two strands of research have proceeded with very little interaction. In what follows, we will first discuss some simulation exercises based on a microeconomic model of household labor supply, aimed at comparing hypothetical reforms inspired by FT or NIT or WF schemes. Then we will discuss some further analysis where we establish an explicit connection between microeconomic research and inquiry into optimal taxation.

Before entering the details of these exercises, we draw attention to what is probably the easiest way to characterize the behavioral implications of the model that we are going to use, namely computing labor supply elasticities with respect to wages. They are computed through microsimulation, that is to say, the wage is increased, and the individual responses are simulated and then averaged. They are illustrated in Figures 11.6a and 6b (see p. 219), which show marked differences among spouses and a strong inverse relation between elasticity and household income. In a sense, it tells us that all responses come from among the poor and average-income households and in particular from among the women living in those households. Figures 11.6a, b must be kept in mind as a polar star, since they suggests that:

- the effects of any simulated reform will be driven by this pattern of elasticities
- the design of an optimal—in some sense—tax rule should properly exploit the same pattern of elasticities.

### 11.5.1 *Comparing three reform proposals*

In Italy, a consideration of the above ideas from the perspective of reforming the tax-transfer system has emerged with some delay compared to the United States or the United Kingdom. It is interesting to note that the fiscal platforms proposed by the two coalition parties running the 2001 Italian Parliamentary any elections contained reform proposals very close to the FT (Casa delle Libertà, right coalition), and to the NIT + FT or the WF + FT (Ulivo, left coalition) respectively.<sup>3</sup> We comment here on a simulation exercise that compares a FT, a NIT + FT and a WF + FT rule, as an alternative to the

<sup>3</sup> We are making a loose analogy between theoretical schemes and actual fiscal platforms. A more detailed and specific presentation and analysis of the platforms can be found in a CHILD working paper by Baldini and Bosi (CHILD WP 03/2001). See also CHILD WP 03/2002 by Chiuri and Longobardi.

AQ: Please check 11.6a and 11.6b are combined here. There is no separate mention of 6b further on.

current system. Figures 11.1a–1c provide an illustration of the three systems compared to a standard progressive rule qualitatively similar to the current Italian one.

In order to simulate the effects of the three hypothetical reforms we use a microeconomic model (see Appendix A) that we developed previously. The effects are estimated using a sample of about 2200 Italian households (extracted from the 1993 Survey of Household Income and Wealth by the Bank of Italy). It is essentially an algorithm that allows you to compute gross and net incomes for every household given a certain tax-transfer rule. The model takes into account the decisions of household members: whether to work or not, and how much. These decisions depend on various personal and family characteristics, on job and earning opportunities and on the tax-transfer rule. In other words, it represents, down to the micro-decisions level, the process by which the pie is being baked and sliced. More technical details can be found in Aaberge *et al.* (1998). Previous exercises applied to Italy have adopted non-behavioral

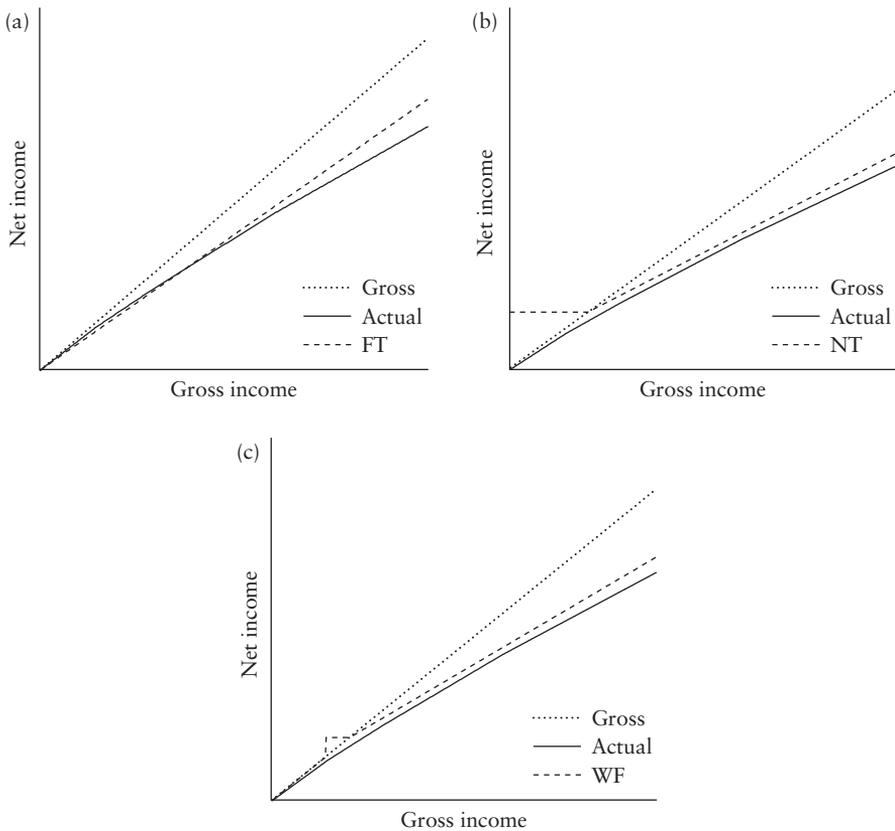


Figure 11.1. (a) FT rule; (b) NT + FT rule; (c) WF + FT rule

simulations for evaluating reforms similar to the ones mentioned above.<sup>4</sup> When account is not taken of behavioral responses, the dimension of the (gross) ‘cake’ is obviously fixed. However, the crucial issue in efficiency–equality evaluation resides precisely in the possibility that the dimension (along with the distribution) of the cake *may* change. Less distortionary tax rates *may* generate a larger amount of resources available for redistribution; a better designed redistribution and income support system *may* not only foster equality but also improve the configuration of incentives and by this route contribute in its turn to efficiency. In this paper we use a model of household labor supply to evaluate stylized versions of the above reform ideas. A behavioral model might reveal the possibility of improving both efficiency and equality.

Our model accounts for quantity constraints and ‘involuntary’ unemployment: for example some individuals might have a choice set that does not contain any job opportunities, or maybe only very unattractive ones (see again Appendix A, and the background papers for more details). Therefore not every individual looking for a job with standard conditions will be able to find one. On the other hand, while running the simulations, we keep the opportunities fixed: gross wage rates and hours characterizing the various opportunities in the choice set. In principle this is certainly a drawback, since a different level and composition of labor supply might in turn induce a change in wages and hours available on the market. In practice—at least in a partial equilibrium perspective—the drawback might be minor, since the overall changes in labor supply obtained in the simulations are sufficiently small to assume that opportunities is constant likely to be a reasonable approximation.<sup>5</sup>

When we simulate the working of a particular tax-transfer rule, we adjust its parameters (for example the fixed tax rate in the case of the FT) so that the total net tax revenue collected by the government is equal to the current one. To simplify things, the guaranteed income level of the NIT + FT and of the WF + FT systems is set in advance equal to three-quarters of the poverty line (adjusted for household size). The minimum amount of hours worked in the year (by the household as a whole) to qualify for the transfer in the WF + FT system is set equal to 1000. It turns out that in order to generate the same total

<sup>4</sup> Baldini and Bosi (2001) use a static microsimulation model to evaluate the effects on income distribution and on net tax revenue of the two reforms contained in the electoral platforms of the two opposed coalitions, and conclude that they both are undesirable. The (almost) flat tax proposal—proposed by the centre-right coalition—would, according to the results of Baldini and Bosi, entail a major loss in revenue; to keep revenue constant, an unbearably high rate would be required. On the other hand, the ‘social dividend + flat rate’ reform, proposed by the centre-left coalition, would have positive effects on redistribution, but again would require an exceedingly high flat rate to keep the revenue constant. Another example of non-behavioral simulation analysis of this type of reforms is provided by Bourguignon *et al.* (1997).

<sup>5</sup> Of course one might want to account for General Equilibrium effects. We are currently working with Norwegian data on matching the microeconomic model with a Computable General Equilibrium model (Aaberge, Colombino, Holmøy and Wennemo 2003).

net tax revenue the three reforms require the marginal and average tax rates reported in Table 11.2. Note that all the reforms imply a lower average tax rate than the current system. Since the total tax revenue (the numerator) is kept constant, the total gross income (the denominator) must have increased and therefore household choices must have changed.

We stressed the ability of the model to represent behavior and choices, so what are the new choices once a new tax-transfer system is implemented? Figures 11.1–11.5 illustrate some of the results. We can summarize as follows:

- (a) all three reforms bring about more (gross and net) income;
- (b) the larger amount of income is due to a larger (and/or more productive) labor supply concentrated among the low- and average-income household;

Table 11.2. *Tax rates of various tax reforms*

<i>Tax rule</i>	<i>Marginal tax rate</i>	<i>Average tax rate</i>
Current (1993)	27.0 (*)	20.4
FT	18.4	18.4
NIT + FT	28.4 (**)	19.5
WF + FT	27.3 (**)	19.8

Key: (\*) Marginal tax rate faced by the average income individual.

(\*\*) Marginal tax rate faced by individuals with income above the guaranteed level.

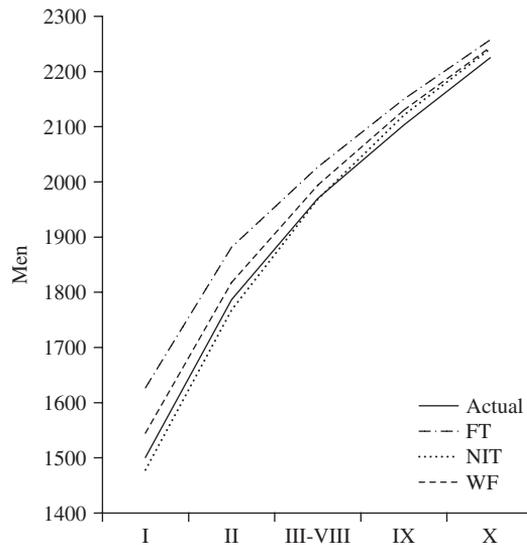


Figure 11.2. *Labor supply (annual hours) under alternative tax reforms, by income decile*

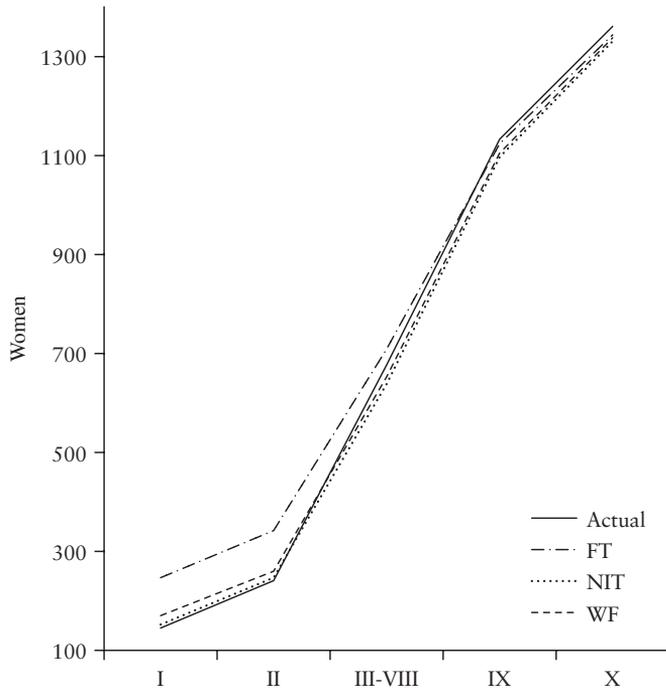


Figure 11.3. Labor supply (annual hours) under alternative tax reforms, by income decile

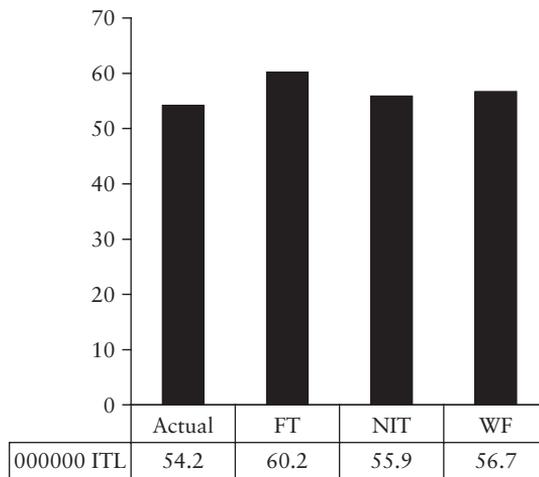


Figure 11.4. Gross household income under alternative tax reforms, by income decile

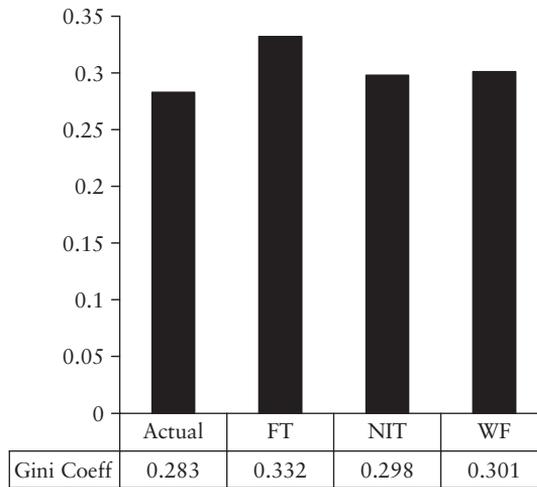


Figure 11.5. *Gini coefficient of net household income under alternative tax reforms*

- (c) the increased labor supply is proportionally more significant among women;
- (d) the NIT + FT and the WF + FT rules seem to escape the much feared risk of reducing labor supply among the low-income households;
- (e) all three reforms imply a more unequal household income distribution, notably so for the FT rule.

Probably (b) and (d) are the most striking results. Result (a) supports the view that by flattening the marginal rates profile one can obtain efficiency gains. However (b) tells us that those gains come from an unexpected source: namely, not the high-income households but rather the low- and average-income households. This is clearly due to a pattern of labor supply elasticities that vary markedly with respect to household income (and gender)—see Figures 11.6a, b. Result (d) looks somewhat paradoxical. Take the NIT for example. From Figures 11.1 it would seem that low-income households have lower incentive to supply labor. This conclusion is driven by the comparison between income when one does not work and income when one works one hour (or maybe a few hours). However, our model takes into account that there are not many jobs requiring one hour (or just a few hours) a year. The relevant comparison is rather between zero hours and some significant amount of hours. Since the average tax rate is lower under NIT than under the current rule, it may well be the case that the incentives to supply labor to the market are reinforced, even for the (originally) low-income households. It is worthwhile noting that the above result would not show up with the use of a traditional model that assumes all type of jobs are equally available. On the other hand, if the

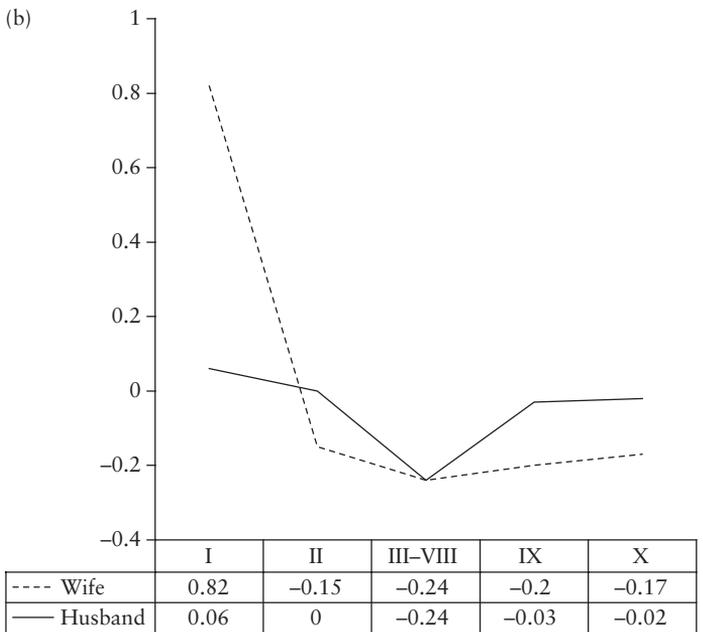
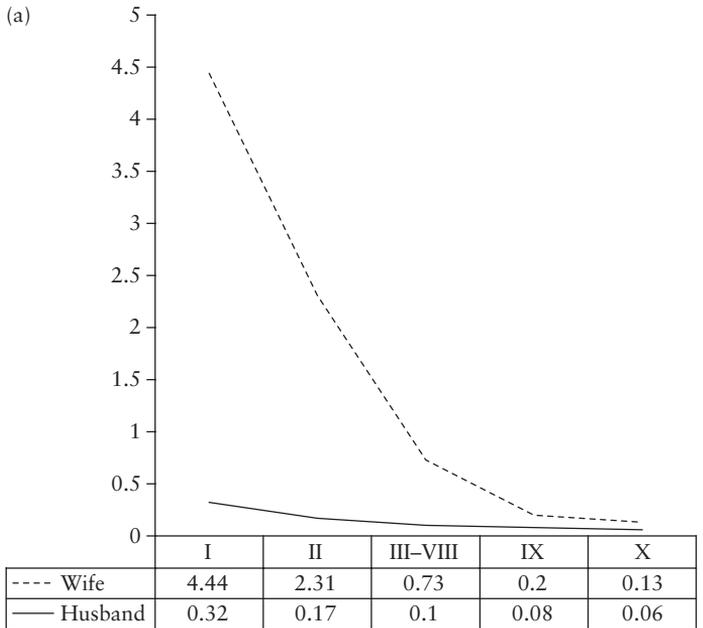


Figure 11.6. (a) Labor supply elasticity with respect to own wage by household income decile and (b) Labor supply elasticity with respect to partner's wage by household income decile

opportunity set were more uniformly dense with alternative hours, then one should indeed expect a significant negative effect on participation from NIT-like mechanisms. It must be added, however, that even in the last case, the effect could be mitigated by lowering the marginal tax rate that phases out the transfer (which is equal to 100% in the version we simulate).

A more sophisticated step consists in using welfare instead of income for evaluating the reforms. Essentially this operation amounts to taking into account not only income but also the value of leisure as reflected by the utility function. Since through the model we get estimates of household utility functions, we can derive the money equivalent of utility levels. Such a measure can be used in various ways depending on whether we are willing to make inter-household comparisons or not. If we prefer to avoid such comparisons, an interesting application consists in identifying the households who are better off (winners) or worse off (losers) after a reform. Figure 11.7 reports the percentage of winners for each reform. All three reforms bring about a majority of winners. A tentative implication is that any of them would win against the current system in a referendum; also, WF + FT does better than NIT + FT, which in turn does better than FT. The aggregate percentage of winners, however, masks large differences between income deciles, as illustrated in Figure 11.8. It seems that the reforms have very different distributional implications.

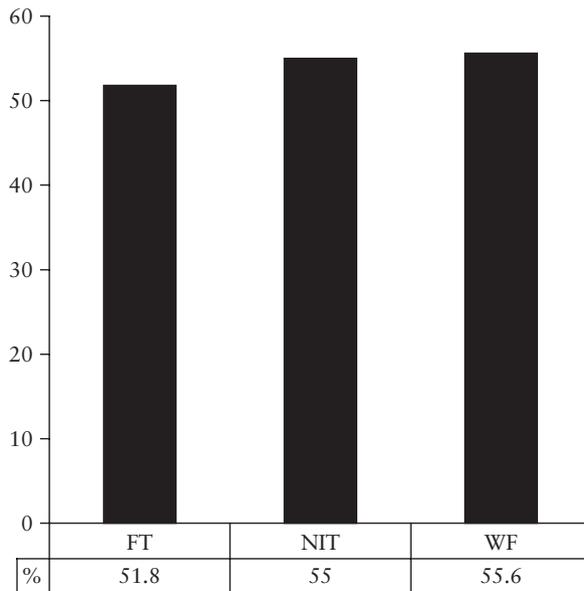


Figure 11.7. *Percentage of welfare winners*

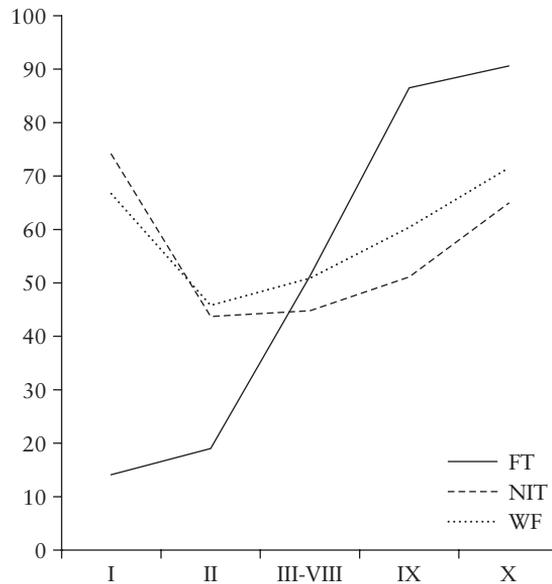


Figure 11.8. Percentage of welfare winners by household income decile

Can we put together efficiency effects and distributional effects into a synthetic index? Section 11.4 and Appendix B explain how to obtain measures of individual welfare, make them comparable, aggregate them into a social welfare measure and disentangle efficiency and equality effects. A particularly useful result is that the index of social welfare can be expressed as the product of the average individual welfare (a measure of efficiency, the average size of the ‘cake’) times an index of equality of the welfare distribution, which depends on the inequality aversion parameter. For a particular value of the inequality aversion parameter ( $k = 2$ ) the index of equality turns out to be equal to 1—the familiar Gini index of the welfare distribution. Figure 11.9 uses the above criterion to illustrate the percentage variation of social welfare and of its components under the three reforms. All reforms are *more efficient* than the current system. The FT implies *less equal* slices. But the NIT + FT and WF + FT imply *more equal* slices. So we did find tax-transfer rules that bring about a bigger pie *and* more equal slices too.

### 11.5.2 Looking for the best

Are there better ideas than those considered above? More generally, what’s the best tax-transfer rule? This is the object of inquiry of a very sophisticated branch of economic analysis, called ‘Optimal Taxation.’ This literature,

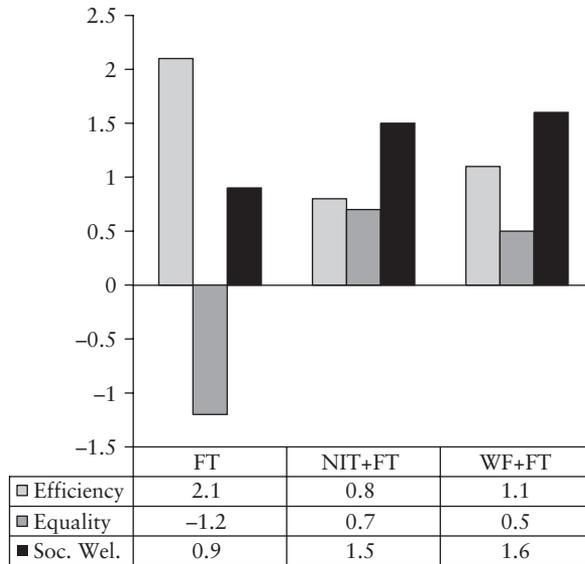


Figure 11.9. Reform effects on social welfare and its components

however, is mainly theoretical. Here we present a rather uncommon type of inquiry, whereby an estimated empirical model (the same used in the previous subsection) is applied to real data in order to find an optimal tax-transfer rule according to some social welfare criterion. We limit ourselves to the class of tax-transfer rule defined by a lump-sum transfer plus two marginal tax rates, namely:

$$x = \begin{cases} c + (1 - t_1)y & \text{if } y \leq \bar{y} \\ c + (1 - t_1)\bar{y} + (1 - t_2)(y - \bar{y}) & \text{if } y > \bar{y} \end{cases}$$

where

- $c$  = lump-sum transfer
- $t_1, t_2$  = marginal tax rates
- $x$  = disposable income
- $y$  = gross income
- $\bar{y}$  = average individual gross income

We run the model (simulating the new household choices) until the social welfare criterion also used in the previous section is maximised with respect to  $c, t_1$  and  $t_2$  under the constraint that total net tax revenue is kept equal to the current one. The exercise is repeated for many different values of the inequality

Table 11.3. Participation rates, annual hours of work, gross income, disposable income and taxes for married couples under alternative tax regimes by deciles of disposable household income under 1993 taxes

Tax regime	Decile	Annual hours of work						Households, 1000 ITL 1993		
		Participation rates, per cent		Given participation		In the total population		Gross income	Taxes	Disposable income
		M	F	M	F	M	F			
1993-tax rules	1	95.6	14.1	1571	1030	1501	145	15221	525	14695
	2	97.5	19.9	1832	1209	1787	241	24372	2109	22263
	3-8	98.9	43.8	1991	1546	1970	677	48187	8960	39227
	9	99.3	65.5	2117	1731	2103	1133	85135	19983	65152
	10	99.4	74.4	2237	1828	2225	1361	128396	34365	94032
	All	98.5	43.7	1972	1590	1943	694	54225	11074	43150
FT	1	95.4	19.6	1706	1264	1627	247	22933	4219	18714
	2	97.8	24.4	1924	1397	1882	342	31761	5845	25917
	3-8	99.0	44.7	2048	1585	2027	709	54142	9961	44181
	9	99.4	64.5	2162	1741	2150	1124	89459	16460	72999
	10	99.5	73.2	2267	1834	2257	1344	132888	24452	108435
	All	98.6	45.0	2036	1623	2008	731	60189	11074	49115
NIT	1	95.28	14.44	1551	1056	1478	152	16404	-1952	18356
	2	97.13	19.91	1820	1240	1768	247	26199	2537	23662
	3-8	98.63	41.42	1996	1540	1969	638	49801	9538	40263
	9	99.21	63.29	2138	1733	2121	1097	86985	20218	66767
	10	99.49	72.59	2252	1832	2241	1331	130581	32714	97867
	All	98.29	41.87	1976	1589	1942	665	55897	11074	44823
WF	1	95.32	15.19	1621	1117	1545	170	17655	-247	17902
	2	97.45	20.28	1866	1285	1818	260	27280	2956	24324
	3-8	98.82	42.20	2018	1548	1994	653	50669	9487	41182
	9	99.31	63.56	2145	1738	2130	1105	87455	19569	67885
	10	99.49	72.96	2256	1833	2244	1338	131013	31538	99476
	All	98.45	42.52	2001	1597	1970	679	56742	11074	45668

aversion parameter. Some results are summarized in Table 11.3 at the end of the chapter. Here we exclude negative values of  $c$ , namely, lump-sum taxes. We just mention that by allowing lump-sum taxes the optimal tax rule turns out to be the pure lump sum for any value of  $k > 0.3$ . At first sight the results look rather surprising, since they imply lower marginal tax rates on higher incomes. However notice that the rules are still progressive: the progressivity is introduced through the lump-sum subsidy rather than through progressive marginal rates. In fact, the optimal tax rules turn out to be close to NIT-like rules, where the starting marginal rate is not necessarily 100 per cent but still significantly lower than the next one. It is interesting to observe that this shape of the tax

rule is close enough to the ones recently computed by Saez (2001) by feeding optimal taxation formulae into a calibrated model. The resulting rule envisages a lump-sum transfer, high initial marginal tax rates, which then rapidly decrease. The only important difference is, that for higher incomes, Saez obtains marginal tax rates that increase again.

Of course, we must remember that in the simulation exercise previously mentioned, we constrained the tax rule to contain only two marginal rates. This was done in order to ease the computational burden. It might well be the case that if we search within a more general class of tax rule we get a profile even closer to Saez's. Indeed the pattern of labor supply elasticities illustrated in Figures 11.2 and 11.3 supports such a conjecture. The elasticity in the highest deciles is essentially zero. Recall the argument used above to motivate the desirability—efficiency-wise—of the FT (which also apply to NIT + FT and to WF + FT). Is it true that the rich are more responsive, and by working more and exploiting better opportunities, they contribute to a bigger pie? Well, the answer is no. Our model says that the rich hardly move: they simply collect a larger slice thanks to lower taxes. A large part of the contribution to the bigger pie comes instead from lower- and middle-income households (and especially from their female members). Even though most of them face a higher marginal tax rate, by supplying more labor they can access jobs that are better paid than before, since the average tax rate is lower than before. The efficiency gain attached to the FT mechanism (whether associated or not with the NIT or the WF) apparently comes from an unexpected direction. The reforms perform better than the current system not because they lower the marginal tax rate for the rich, but because they lower the average tax rate, and this may also open better opportunities for the not-so-rich and the poor. Our simulations suggest that by flattening the tax rates profile, we do indeed have an efficiency gain. However, the behavioral responses that generate the gains are very different from those commonly assumed and suggest that the proposed reforms might be improved upon by reducing progressivity, not so much in favor of the very high-income deciles but rather in favor of the low- and average-income deciles. Higher marginal taxes imposed on high-income brackets would simply extract a rent and would hardly imply any loss in efficiency.<sup>6</sup>

In Appendix B, we also present an alternative social welfare function that takes into account the so-called 'Equality of Opportunity' criterion. In Table 11.5 we report the results of some simulations using the EOp criterion. Income

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<sup>6</sup> This conjecture might turn out to need some qualification. For example it might happen that very high marginal tax rates imposed on high incomes discourage current average income people to jump to higher income levels. We are currently exploring the performance of more complex tax rules. Optimising with respect to general tax rules with the use of a behavioral microeconomic model—instead of representative agents or simple assumptions on the distribution of types as in the theoretical literature on optimal taxation—although logically straightforward, imposes a high computational burden.

Table 11.4. EO-optimal and EOp-optimal tax rules (income based)

<i>k</i>	EO			EOp		
	<i>c</i>	<i>t</i> <sub>1</sub>	<i>t</i> <sub>2</sub>	<i>c</i>	<i>t</i> <sub>1</sub>	<i>t</i> <sub>2</sub>
∞	0	0.31	0	0	0.31	0
3	0	0.31	0	0	0.11	0.35
2	0	0.31	0	2500	0.25	0.53
1	2000	0.30	0.18	12500	0.86	0.78

Table 11.5. EO-optimal tax rules (welfare based)

<i>k</i>	<i>c</i>	<i>t</i> <sub>1</sub>	<i>t</i> <sub>2</sub>
∞	1000	0.37	0.00
1	1000	0.37	0.00
0.5	2740	0.37	0.13
0.4	10000	0.76	0.56

instead of welfare was used in this case. However we are able to compare these results with others that also are based on income but with the standard EO criterion. Since (comparing Table 11.4 with Table 11.5) it turns out that the EO results are rather close, either using income or welfare, we can speculate that the same might happen under the EOp criterion. The most striking result is that EOp implies optimal tax-transfer rules that are much more progressive than those implied by EO<sup>7</sup>. The result is somewhat surprising since EOp is commonly thought to be a less interventionist philosophy with respect to EO.

A general lesson to be drawn from the above microeconomic exercises, inspired by the optimal tax literature, is that it may make a large difference whether one allows or not for a rich heterogeneity of response across the population.

### 11.5.3 The reforms and female participation and fertility

There is a long tradition of evaluating reforms on the basis of their effects on labor supply. A sharp departure from this tradition is done by Hausman (1981), who notes that the welfare effects of taxes might be (and actually are in his exercise) fairly large, notwithstanding minor behavioral effects. He recommends that policy makers should not worry so much about labor supply effects, and instead should focus on welfare effects. The message is important but it should be received with some caution and flexibility. In this contribution

<sup>7</sup> To be more precise, what we call here EOp is in fact a combination of the (pure) EOp criterion with the EO criterion, which is applied to the distribution within the least favored group. When *k* = ∞, the criterion collapses to the pure EOp.

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we use a social welfare function to scale reforms since it is a theoretically well-founded way to summarize the reform effects (actually a sort of 'compressing' utility). However it is still useful to complement the information compressed into a social welfare function with other details. Both the utility function adopted in the model and the social welfare function used in the evaluation provide only an approximation to what might be important to the households and the policy makers. For example, the policy maker might judge that female labor market participation per se is important for dynamic efficiency considerations that are not fully taken into account by the model (e.g. more participation today might imply a higher productivity tomorrow). Fertility might also be important per se if one thinks that the number of children is not a pure private good but rather something with public good and externality components. What happens then to female participation and fertility, under the above reforms? We have already seen the general picture of labor supply effects of FT, NIT and WF in Figures 11.2 and 11.3. Table 11.3 shows some more details. Overall female labor supply does not move much. We observe a modest increase under FT and modest reductions under NIT and WF. However, important changes are going on below this calm surface:

- first, all the reforms induce a larger supply from the poorest deciles, and a smaller supply from the richest deciles. Recall that all the reforms imply an increase in the average net wage. Therefore the result can be interpreted as due to a substitution effect prevailing among the low deciles and a wealth effect prevailing among the high deciles. A role is probably played also by cross-elasticities (see Fig. 11.6b). We find that labor supply from women living in poor households increases rather elastically, not only with respect to their own wage but also with respect to their partner's wage. That is to say, at low levels of household income, partners' incomes are complements rather than substitutes. Since as a consequence of the reforms the average net wage increases for both partners, this reinforces incentives to participate for women living in low-income households;
- secondly, under all reforms, household income increases much more than (female and male) labor supply. Besides the modest increase in the average net wage due to less progressive rates, the increase in income must therefore be due to a change in the composition of participants. More productive individuals move in and less productive ones move out. The process might have some interesting implications in terms of intra-household time allocation, matching of partners and so on, that we cannot fully pursue here.

As to fertility, in principle, one could argue that child 'production' and care are components of leisure and therefore induce the effects of changes in the budget sets on fertility from basic estimates of labor supply responses. However, the model used above for reform evaluation is estimated under the assumption that the number of children is exogenous. We can make some

suggestive speculations based on another modeling exercise where labor supply and number of children are both treated as simultaneous choice variables (Colombino, 2000).<sup>8</sup> This model does not allow a detailed representation of the tax-transfer regime. We can only infer some implications of the reforms if we approximate them as changes in the average tax-rate and in exogenous income. It turns out that essentially all the three reforms can be approximated as a lowering of the average tax rate and an increase in exogenous income. When we feed the model with these changes, we get a slight positive effect on the number of children, that is to say, a prevalence of the income effect (not only the exogenous income effect, but also the income effect embodied into the wage effect).<sup>9</sup>

## APPENDIX A

### *Modeling household labor supply*

To give a brief outline of the modeling framework we will, for expository reasons, focus on the labor supply of single individuals. The extension to the labor supply of married couples is however straightforward. The individuals are assumed to choose among jobs. Each job is characterized by a wage rate  $w$ , hours of work  $h$  and other characteristics  $j$ . Examples of these other characteristics are commuting time to work, fringe benefits in terms of free parking, hygiene, etc. The individuals are assumed to choose the job that maximizes his or her utility, given a budget constraint that transforms gross income into net income, and given the opportunity set of the individual. Formally, the labor supply model looks like the following:

$$\begin{aligned}
 & \text{Max } U(C, h, j; Z) \\
 & \text{with respect to } \{h, w, j\} \\
 & \text{given,} \\
 & C = f(wh, I) \\
 & \{h, w, j\} \in S
 \end{aligned} \tag{1}$$

<sup>8</sup> This other model is not completely comparable to the previous one, not only because it treats fertility as endogenous but—among other things—because it uses an ‘average tax rate’ linear approximation to the true budget constraint. Moreover it is a model of wife’s decisions (labor supply and number of children), given husband’s supply decision (exogenous). However, the dataset used and the basic methodology are similar.

<sup>9</sup> In Colombino and Di Tommaso (1996), the own wage effect upon fertility is negative. However, that effect is measured keeping constant the intertemporal wealth. On the other hand, increase in intertemporal wealth (as reflected in cohort effects) due for example to increasing wages, would have a positive effect on fertility. Therefore the results in Colombino and Di Tommaso (1996) can be reconciled with those derived from Colombino (2000).

Here  $U$  is the (ordinal) utility level,  $C$  is net income equal to after-tax income,  $f(\cdot)$  is a function that transforms gross income into net disposable income (i.e. the tax-transfer rule),  $I$  is non-wage income and  $S$  is the opportunity set that the individual faces.  $z$  is a vector that contains variables that affect preferences, like age, number of small children etc. Some of these variables are unobserved by the analysts. Non-working is of course an alternative. In that case  $h = w = 0$ . The opportunity set also covers non-market opportunities.

To the analyst both preferences and opportunity sets are random. At best the analyst can derive the probability for the observed and assumed optimal choice of the individual, that is, a job of type  $\{h, w\}$ . To obtain an expression for that probability, one has to assume how the random element enters the utility function and how this random variable, a taste-shifter, is distributed across jobs for a given individual, and across individuals, given the job. Moreover we also have to deal with how opportunities should be specified and how the random elements here are distributed.

In the first place, we assume that the utility function can be factorised as:

$$U(C, h, j; Z) = \nu(C, h, z_1) \varepsilon(h, w, j) \quad (2)$$

where  $\nu(\cdot)$  is the deterministic part of the utility function,  $Z$  is the vector of observed characteristics and  $\varepsilon(\cdot)$  is the random variable measuring job or household characteristics unknown to the analyst.  $\varepsilon(\cdot)$  is assumed to be identical and independent, distributed across jobs and individuals. The distribution function is assumed to be the extreme value distribution function of type I. If the variance of  $\varepsilon$  is infinitely large, to the analysts the choices of the individuals seem to have been made at pure random. The economic variables entering the deterministic part of the utility function will then explain nothing of what we observe. At the other extreme, if the variance  $\varepsilon$  is close to zero, then to the analyst all choices made by the individuals can be explained entirely by the deterministic part of the utility function. The individuals then make their labor supply choice according to what maximises their deterministic utility function. This latter extreme case is actually the approach taken in the so-called Hausman tradition, Burtless and Hausman (1978); Hausman (1980, 1981, 1985); Blomquist (1983, 1992); Hausman and Ruud (1984); Arrufat and Zabalza (1986). In this literature the functional form of the utility function is specified so that hours supplied becomes a convenient function of the marginal wage rate and of an income variable. To get a stochastic relationship, a parameter in the corresponding deterministic utility function is assumed to be random, with the justification that there is some unobserved heterogeneity in the individual labor supply responses.

Next, we represent the opportunity sets by a probability density function. One can interpret this as follows. Imagine that an individual has access to jobs that can be given a three-dimensional description—like a box. Inside the box there are many cells, each of them characterized by three sides, which reflect

AQ: Please check the reference Burtless and Hausman 1978 not in reference list.

offered hours, the wage rate and ‘other’ attributes of a job. We assume that the individual knows his or her ‘box’ containing job opportunities. But as analysts we do not. The probability density representation of the opportunity set is then like folding a wet blanket over the ‘box’. Now, there are many individuals, each with a different number of available jobs and of different types. The best skilled may have a much bigger ‘opportunity box’ to choose from than the less skilled. To capture this, we represent the choice set  $S$  by imposing a probability density on the choice set  $S$ . Let  $p(h, w; q)$  denote the probability density of jobs of type  $(h, w)$ .  $q$  is a vector of observed variables, like education and working experience, which reflects that the opportunities of individuals differ. The  $q$ -variables affect the moments in the probability distribution.

Our representation of opportunities allows for the fact that jobs with offered hours in a certain range are more likely to be found than other jobs. The clustering of offered hours in certain intervals may be due to the production technology of firms (in car production the workers have to be together at the same time, they cannot come and go as the wish), or due to the outcome of negotiations between employers and employee organisations. Many individuals are observed to rush to and from work at the same time. It would be strange to assume that this is due to preferences.

Moreover, our representation of opportunities also allows for wages to vary across jobs for the same individual. In the ‘Hausman approach’, and also in studies closer to ours such as Dickens and Lundberg (1993) and van Soest (1995), the individual has a fixed wage rate. Thus in these studies human capital endowments of the individual determine entirely his or her wage rate. This does not accord with more recent labor market theories, in which job-specific wage rates are due to efficient wages and wages determined in negotiations between the employers and employee associations. Wage dispersion among observationally identical workers seems also to be empirically supported (Krueger and Summers 1988 and Edin and Zetterberg 1992).

We observe the chosen  $h$  and  $w$ . From the assumptions made above, we can derive the probability of the chosen job with these characteristics,  $(h, w)$ .

Let  $\varphi(h, w; I, z_1, q)$  denote this probability and let us use the definition  $\nu(C, h; z_1) = \nu(f(wh, I), h; z_1) = \psi(h, w; z_1)$ . Then we obtain:

$$\varphi(h, w; I, z_1, q) = \frac{\psi(h, w; I, z_1)p(h, w; q)}{\sum_{x \geq 0} \sum_{y \geq 0} \psi(x, y; I, z_1)p(x, y; q)} \quad (3)$$

For the proof we refer to Aaberge, Colombino and Strøm (1999).

Expression (3) is analogous to a multinomial logit model with the exception that the deterministic part of the outcome function of a particular choice,  $\nu(f(wh, I), h; z)$  is weighted by the probability density of jobs with the

characteristics  $(h, w)$ , i.e. by  $p(h, w; q)$ . The intuition behind expression (3) is that the probability of the optimal choice,  $\varphi(h, w; I, z_1, q)$ , can be expressed as the relative attractiveness of jobs of type  $(h, w)$ , weighted by a measure of how available this type of job is, i.e. by  $p(h, w; q)$ . To proceed with estimation one has to specify the functional form of the deterministic part of the utility function, that is, the functional form of  $v$ , and hence  $\psi$ , and the probability density  $p(h, w; q)$ .

With regard to the functional form of the utility function we have employed (in all works referred to above) a rather flexible functional form. Depending on the value of the parameters, the deterministic part of the utility function can be linear in consumption and leisure as well as log-linear in these two variables. Moreover, again depending on the parameters, it also allows for a labor supply that is backward bending. The latter means that the higher the wage rate is, the less the labor supply will be. If so, the income effects dominate over the substitution effects. In fact, the functional form specification allows for the responses on wage rate to vary a lot across individuals, depending on their economic situation (the magnitude of  $w$  and  $I$ ) and the characteristics  $z_1$ . The functional form can also yield a linear labor supply curve. As mentioned above, this is the only form that the Hausman approach applies. The problem with a labor supply curve, which is linear in the wage rate is that by assumption the labor supply elasticity tends to increase with the wage rate. The linearity assumption thus implies that the more highly skilled, with high wage rates, are more responsive than those with lower skills, and hence lower wage rates (see Røed and Strøm (2002) for further discussion).

In the specification of the probability density of opportunities, we will assume that offered hours and offered wages are independently distributed. The justification for this is that offered hours, in particular normal working hours, are typically set in rather infrequent negotiations between employers and employee associations, while wage negotiations are far more frequent in which the hourly wage tends to be set independently of working hours. Offered hours are assumed to be uniformly distributed, except for hours related to full-time jobs. Thus, this opportunity density for offered hours implies that it is far more likely to find jobs with hours that accord with a full-time position than jobs with other working loads. To account for the fact that the availability of any job at all may vary across, say, regions, the proportion of market opportunities may depend on where the individual lives for example, in the north or the south of Italy. The wage rate is assumed to be lognormal distributed, with the expectation depending on individual characteristics.

It is beyond the scope of this chapter to go into detail about specifications of the model, estimation methods and estimation results. Instead we refer to Aaberge, Colombino and Strøm (1999) and Aaberge, Colombino, Strøm and Wennemo (2000), where the modeling and estimation method is explained and where empirical results for labor supply among married couples in Italy are

AQ: Please check the year for: I. Aaberge, Colombino and Strøm, and Aaberge, Colombino Strøm and Wennemo.

given. In Aaberge, Colombino and Strøm (2000) similar estimation result for Norway, Sweden and Italy are also given and compared.

APPENDIX B

*Social welfare functions*

The standard approach in evaluating tax systems is to employ a social evaluation or welfare function as the basic evaluating instrument. This function is commonly used to summarize the changes in (adult-equivalent) income/welfare resulting from introducing various alternatives to the actual tax system in a country. The simplest way to summarize the changes that take place is to add up the income/welfare differentials, implying that individuals are given equal weights in the social welfare function independently of whether they are poor or rich. However, if besides total welfare we also care about the distributional consequences of a tax system, then an alternative to the linear additive welfare function is required. In this study we rely on the rank-dependent social welfare functions that have their origin in Mehran (1976) and Yaari (1988),<sup>10</sup> and are defined by:

$$W_k = \sum_{i=1}^n p_k\left(\frac{i}{n}\right) X_{(i)} \quad k = 1, 2, \dots \tag{4}$$

where  $X_{(1)} \leq X_{(2)} \leq \dots \leq X_{(n)}$  are the ordered income (or—more generally—welfare) levels of a sample of size  $n$  of the population, and  $p_k(i/n)$  is a positive decreasing weight function.<sup>11</sup> A preliminary problem to solve consists in computing income or welfare measures that can be compared across households. We use money-metric utility measures as explained in King (1983) and Aaberge, Colombino and Strøm (2001). The inequality aversion exhibited by  $W_k$  decreases with increasing  $k$ . As  $k \rightarrow \infty$ ,  $W_k$  approaches inequality neutrality and coincides with the linear additive welfare function defined by:

$$W_\infty = \frac{1}{n} \sum_{i=1}^n X_{(i)} \tag{5}$$

<sup>10</sup> Several authors have discussed rationales for this approach, see e.g. Sen (1974), Hey and Lambert (1980), Donaldson and Weymark (1980, 1983), Weymark (1981), Ben Porath and Gilboa (1992) and Aaberge (2001).

<sup>11</sup>

AQ: Sen (1974) not in reference list. Please check.

$$p_k(t) = \begin{cases} -\log t, & k = 1 \\ \frac{k}{k-1} (1 - t^{k-1}), & k = 2, 3, \dots \end{cases}$$

It follows by straightforward calculation that  $W_k \leq W_\infty$  for all  $k$  and that  $W_k$  is equal to the mean  $W_\infty$  for finite  $k$  if, and only if, the distribution function is the egalitarian distribution. Thus,  $W_k$  can be interpreted as the equally distributed level of income (or welfare). As recognised by Yaari (1988) this property suggests that  $I_k$ , defined by:

$$I_k = 1 - \frac{W_k}{W_\infty}, \quad k = 1, 2, \dots \quad (6)$$

can be used as a summary measure of inequality. Actually,  $I_1$  is equivalent to a measure of inequality that was proposed by Bonferroni (1930), while  $I_2$  is the Gini coefficient.<sup>12</sup>

### EQUALITY OF OPPORTUNITY AS A BENCHMARK FOR EVALUATION OF SOCIAL POLICY

For a given sum of income, the standard social welfare functions take their maximum value when everyone gets the same income and may thus be interpreted as equality of outcome (EO) criteria when employed as measures for judging between alternative policy regimes, for example tax systems. However, as indicated by Roemer (1998) the EO-criterion is controversial and suffers from the drawback of receiving little support among citizens in a nation.<sup>13</sup> This is simply due to the fact that differences in outcomes resulting from differences in efforts are in general considered ethically acceptable and thus should not be the target of a redistribution policy. An egalitarian redistribution policy should instead seek to equalize those income differentials for which the individuals should not be held responsible, because they were beyond their control. Problematic life conditions or events—whether concerning employment, health, housing etc.—typically originate from a mixture of bad opportunities, bad luck and ‘wrong’ decisions. Social policies can affect the number and the quality of opportunities, the probability of unlucky events, and also the appropriateness of decision-making by providing information upon available choices, and counseling on good procedures for learning and processing information. In order to design good social policies one has to disentangle as far as possible the contribution of opportunities, chance, preferences and decision-making ability to the individual labor market successes. Thus, not only the outcome, but its origin and how it was obtained, matters. This is the essential idea behind Roemer’s (1998) theory of equality of opportunity where people are supposed to differ with respect to ‘circumstances’. Circumstances are attributes of the environment of the individual that influence the earnings

<sup>12</sup> For further discussion of the family  $\{I_k: k=1, 2, \dots\}$  of inequality measures we refer to Mehran (1976), Donaldson and Weymark (1980, 1983), Bossert (1990) and Aaberge (2000, 2001).

<sup>13</sup> See also Dworkin (1981), Arneson (1989, 1990), Cohen (1989) and Roemer (1993).

potential of the individual, and which are ‘beyond his control’. Thus, as distinct from the standard utilitarian EO approach, Roemer’s (1998) EOp approach is non-‘welfarist’; one needs to know the efforts expended by the individuals, and not simply the outcomes they enjoy under them.

Assume that  $X_t(i/n_t)$  is the income (or welfare) level of the individual with rank  $i$  in the income distribution of type  $t$ , where:

$$i = 1, 2, \dots, n_t \quad \text{and} \quad t = 1, 2, \dots, r,$$

$$\text{i.e. } X_t\left(\frac{1}{n_t}\right) \leq X_t\left(\frac{2}{n_t}\right) \leq \dots \leq X_t\left(\frac{n_t-1}{n_t}\right) \leq X(1) \quad \text{for } t = 1, 2, \dots, r$$

The differences in incomes within each type are assumed to be due to different degrees of effort for which the individual is to be held responsible, whereas income differences that may be traced back to circumstances are considered to be beyond the control of the individual. As indicated by Roemer (1998) this suggests that we may measure a person’s effort by the quantile or relative rank ( $i/n_t$ ) of the income distribution where he is located. Next, Roemer declares that two individuals in different types have expended the same degree of effort if they have identical relative positions (relative rank) in the income distribution of their type. Thus, an EOp (Equality of Opportunity) tax policy should aim at designing a tax system such that  $\min_t X_t(q)$  is maximised for each quantile  $q$ . However, since this criterion is rather demanding and in most cases will not produce a complete ordering of the tax systems, a weaker ranking criterion is required. To this end Roemer (1998) proposes to employ as the social evaluation function the average of the lowest income at each quantile,

$$\widetilde{W}_\infty = \frac{1}{\min_t n_t} \sum_q \min_t X_t(q) \tag{7}$$

Thus,  $\widetilde{W}_\infty$  ignores income differences *within* types and is solely concerned about differences that arise from differential circumstances. By contrast, the EO criteria defined by (4) does not distinguish between the different sources that contribute to income inequality. As an alternative to (4) and (7) we introduce the following extended family of EOp welfare functions,

$$\widetilde{W}_k = \sum_q p_k(q) \min_t X_t(q) \tag{8}$$

where  $p_k(q)$  is defined by (5).

The essential difference between  $\widetilde{W}_k$  and  $\widetilde{W}_\infty$  is that  $\widetilde{W}_k$  gives increasing weight to the welfare of lower quantiles in the type-distributions. Thus, in this respect  $\widetilde{W}_k$  captures also an aspect of inequality within types. As explained above, the concern for *within* type inequality is greatest for the most

disadvantaged type, that is, for the type that forms the largest segment(s) of  $\{\min_t X_t(q) : q \in [0, 1]\}$ .

We may decompose the EOp welfare functions,  $\widetilde{W}_k$ , as we did with the EO welfare functions  $W_k$ . Accordingly, we have that

$$\widetilde{W}_k = \widetilde{W}_\infty(1 - \tilde{I}_k), \quad k = 1, 2, \dots \quad (9)$$

where  $\tilde{I}_k$  defined by

$$\tilde{I}_k = 1 - \frac{\widetilde{W}_k}{\widetilde{W}_\infty}, \quad k = 1, 2, \dots \quad (10)$$

is a summary measure of inequality for the mixture distribution  $\tilde{F}$ . Expression (9) demonstrates that the EOp welfare functions  $\widetilde{W}_k$  for  $k < \infty$  take into account value judgments about the trade-off between the mean income and the inequality in the distribution of income for the most EOp disadvantaged people. Thus,  $\widetilde{W}_k$  may be considered as an inequality within a type adjusted version of the pure EOp welfare function that was introduced by Roemer (1998). As explained above, the concern for *within* type inequality is greatest for the most disadvantaged type, that is, for the type that forms the largest segment(s) of the mixture distribution  $\tilde{F}$ . Alternatively,  $\widetilde{W}_k$  for  $k < \infty$  may be interpreted as an EOp welfare function that, in contrast to  $\widetilde{W}_\infty$ , gives increasing weight to individuals who occupy low effort quantiles.

Note that the EOp criterion was originally interpreted as more acceptable—from the point of view of individualistic conservative societies. Our extended EOp welfare functions can be considered as a mixture of the EO welfare functions and the pure EOp welfare function; they are concerned about inequality between types as well as inequality within the worst-off distribution. EOp looks at what happens to the distribution formed by the most disadvantaged segments of the intersecting type-specific distributions. Moreover, the pure version of the criterion only looks at the mean of the worst-off distribution. By contrast, EO takes into account the whole income distribution. For a given sum of incomes, EO will consider equality of income (everyone receives the same income) as the most desirable income distribution. The pure EOp will instead consider equality in mean incomes across types as the ultimate goal. Since the extended EOp combines these two criteria, transfers that reduce the differences in the mean incomes between types as well as the income differentials between the individuals within the worst-off distribution are considered equalizing by the extended EOp. Thus, in the case of a fixed total income also the extended EOp will consider equality of income as the most desirable distribution. However, by transferring money from the most advantaged type to the most disadvantaged type, EOp inequality may be reduced. Whether it is more 'efficient' to reduce inequality between or within

types, depends on the specific situation. When labor supply responses to taxation are taken into account, the composition of types in the worst-off distribution will change and depend on the chosen welfare function ( $\widehat{W}_k$ ) as well as on the considered tax rule. Thus, the large heterogeneity in labor supply responses to tax changes that is captured by our model(s) makes it impossible to state anything on EOp- or EO-optimality before the simulation exercises have been completed.