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Redistributive Taxation and Social Insurance*

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Abstract

This paper studies the role of social insurance as a redistributive mechanism in presence of an optimal (linear or general) income tax. It considers a second-best setting with two unobservable individual characteristics: ability, measured by the wage rate and risk, measured by the probability of incurring a loss. It shows that both tax progressivity and the optimal level of social insurance crucially depend on the correlation between ability and risk.

Key words: JEL classification: H23, H50, redistributive taxation, social insurance.

1. Introduction

The integration of European insurance markets has several important implications. In some countries, the domestic insurance sector is increasingly challenged by foreign competitors who are often more efficient and less costly. In addition, it is more and more possible for individuals to shop around and buy insurance policies from companies in other European countries. This makes it difficult for national governments to enforce redistributive regulations, such as the requirement to provide insurance at a *uniform rate* when individuals differ in their probability of incurring a loss, without making insurance compulsory.

In most countries it has traditionally been illegal to differentiate individuals according to characteristics such as gender, occupation or genetic background. This form of regulation has two objectives: to reduce adverse selection related inefficiencies and to effect a more equitable outcome. Alternatively, one may achieve these aims by resorting to direct uniform public provision through a system of social insurance. The financing of such social insurance, however, raises problems of its own. In particular, because of tax competition, it may be impeded by European integration just as much as redistributive insurance regulation.

Whatever the difficulties of sustaining redistributive regulation within the insurance market or of financing social insurance may be, it is interesting to assess their contribution to social welfare. We believe that this is an important issue for, at least, two reasons. First, studying the role of social insurance is crucial for understanding the design of redistributive policies.

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Such an analysis is related to the recent literature on in-kind transfers, which it extends to a different form of public provision.[1] Second, it provides additional insight into the impact of European integration on redistributive policies.

In this paper, we explore the conditions under which regulation of insurance markets or provision of social insurance are desirable in a setting where there is also an optimally designed income tax. Furthermore, we determine the optimal level of social insurance and analyze the interaction between social insurance and optimal taxation. We show that in a number of cases, relaxing insurance regulation or decreasing the share of social insurance, whatever the reasons, lead to a simple dilemma: achieve less redistribution or increase tax progressivity.

In what follows we shall, for the sake of simplicity, refer to the two considered policies as "social insurance."[2] For the interpretation of our results, it is however, important to keep in mind the equivalence of the two types of policies.

Our paper is very much inspired by Rochet (1991) who analyses the desirability of social insurance in a second-best setting with linear and non-linear income taxation. Unlike Rochet, however, we do not assume quasi-linear preferences. In addition, we deal with a number of questions, including the structure of income taxation and its interaction with social insurance, which could not be dealt with in his setting.

2. The model

We use a simple model with two goods, consumption, c, and labor, L, and two individuals ($i = 1, 2$) differing in ability, w, and in their probability, p, of incurring a loss, D.[3]

In the absence of redistributive taxation and of insurance, the ith individual's budget constraint is

$$c_i = \begin{cases} w_iL_i - D & \text{in case of a loss,} \\ w_iL_i & \text{otherwise.} \end{cases}$$

Preferences are represented by a concave utility function

$$u(c_i, L_i). \tag{1}$$

Social insurance covers a fraction α of the potential loss at a rate $\alpha\bar{p}D$ where $\bar{p}$ is the average probability. Social insurance is mandatory and the fraction α is a policy instrument of the government. In addition, there is an actuarially fair insurance market through which the individual may cover the remaining fraction $(1 - \alpha)$ of the loss at the rate $(1 - \alpha)p_iD$. It is clear that under the assumption of risk aversion each agent will choose full insurance. In that case, one obtains the same level of consumption whether or not there is a loss:

$$c_i = w_iL_i - d_i,$$

where

$$d_i \equiv [\alpha\bar{p} + (1 - \alpha)p_i]D. \tag{2}$$

3. Optimal linear income tax

Let us now introduce redistributive taxation. First assume that the tax is linear[4] and purely redistributive. Accordingly, the government's budget constraint is given by

$$\tau \sum_{i=1}^{2} w_i L_i n_i = T \sum_{i=1}^{2} n_i, \tag{3}$$

where τ is the tax rate, T a uniform lump-sum transfer, and n_i the proportion of type i individuals. Further, assume that the objective of the government is to maximize a utilitarian social welfare function. Thus, the problem for the government is

$$\max_{\tau,T,\alpha} \Lambda = \sum_{i=1}^{2} n_i u(c_i, L_i) + \gamma \left[\tau \sum_{i=1}^{2} n_i w_i L_i - T \sum_{i=1}^{2} n_i \right], \tag{4}$$

where γ is the Lagrange multiplier associated with the budget constraint and where c_i and L_i maximize the utility of individual i subject to

$$c_i = (1 - \tau)w_i L_i + T - d_i.$$

In addition, it is required that $0 \leq \alpha \leq 1$ and $0 \leq \tau \leq 1$.

Differentiation of (4) yields the following expressions:

$$\frac{\partial \Lambda}{\partial \tau} = -\sum_{i=1}^{2} n_i \delta_i w_i L_i + \gamma \sum_{i=1}^{2} n_i w_i L_i + \tau\gamma \sum_{i=1}^{2} n_i w_i \frac{\partial L_i}{\partial \tau}, \tag{6}$$

$$\frac{\partial \Lambda}{\partial T} = \sum_{i=1}^{2} n_i \delta_i - \gamma \sum_{i=1}^{2} n_i \left[1 - \tau w_i \frac{\partial L_i}{\partial T} \right], \tag{7}$$

$$\frac{\partial \Lambda}{\partial \alpha} = -\sum_{i=1}^{2} n_i (\bar{p} - p_i)\delta_i - \gamma \sum_{i=1}^{2} n_i \tau w_i \frac{\partial L_i}{\partial T}(\bar{p} - p_i), \tag{8}$$

where δ_i is the individual's marginal utility of income (the Lagrange multiplier associated with (5) in the individual's problem).

These expressions can be simplified in the traditional way. In particular, define

$$b_i \equiv \frac{\delta_i}{\gamma} + \tau w_i \frac{\partial L_i}{\partial T},$$

as the net social marginal valuation of i's income. Next introduce the Slutsky decomposition[5]

$$\frac{\partial L_i}{\partial \tau} = -w_i S_i - w_i L_i \frac{\partial L_i}{\partial T}$$

in (6), and denote the compensated elasticity of labor supply by $\epsilon_i \equiv w_i S_i / L_i$. From (6), (7) and (8), one then shows that an interior solution requires:[6]

$$-\operatorname{cov}(wL, b) - \tau \sum_{i=1}^{2} n_i w_i L_i \epsilon_i = 0 \tag{9}$$

$$\bar{b} = 1 \tag{10}$$

$$\operatorname{cov}(p, b) = 0 \tag{11}$$

where cov(•, •) is the covariance.[7] Expressions (9) and (10) are rather standard. However, while cov(wL, b) is (normally) negative in the traditional setting, this is not necessarily true here (especially if one imposes a given value of $\alpha < 1$). If low-ability individuals are a much better risk (and with D large) the covariance may well be positive in which case one obtains $\tau^* = 0$ (no income tax). Expression (11) generalizes the results derived by Rochet (1991) for the case of quasi-linear preferences in quite an intuitive way. Social insurance, as measured by the size of α, acts as a linear tax in itself. It has no deadweight loss and should be increased as long as this is beneficial for redistribution. Indeed, if cov(p, b) is always positive, one obtains $\alpha^* = 1$.

An interior solution for α is, however, also possible. Assume for instance that p and w are negatively correlated and that D is large. For $\alpha = 0$ the risk is then the most important factor of inequality; hence, increasing α reduces inequalities. However, as α gets larger the spreading of the risk will become less important relative to the differences in abilities. Further increases in α are not desirable as they would imply redistribution form low to high w's.

For the sake of illustration we shall, for the remainder of this section, use a specific utility function, which yields even simpler expressions. Assume that u is given by

$$u(c_i, L_i) = \log c_i - L_i. \tag{12}$$

and that m, $zm_q z½$

If $\alpha = 1$, one obtains the standard tax formula:

$$1 - \tau = \frac{4}{w_1 + w_2} \left(\frac{1}{w_1} + \frac{1}{w_2} \right)^{-1}, \tag{13}$$

so that τ increases with the difference between w_1 and w_2. Let us now determine the optimal value of α in the case where p_i's increase with α. In other words, there is some moral hazard in the sense that the probability of incurring a loss increases with the share of social insurance. We obtain:

$$\frac{\partial \Lambda}{\partial \alpha} = \left[(p_1 - p_2)\left(\frac{1}{w_1} - \frac{1}{w_2} \right) - \sum_{i1}^{2} \left(\alpha \frac{\partial \bar{p}}{\partial \alpha}(1 - \tau) + (1 - \alpha)\frac{\partial p_i}{\partial \alpha} \right) w_i^{-1} \right] \frac{D}{1 - \tau}.$$

Without moral hazard, full social insurance is optimal ($\alpha = 1$) if $w_1 < w_2$ and $p_1 > p_2$. Since low-ability individuals are also the ones with the highest probability of incurring a loss, social insurance implies redistribution from high- to low-wage individuals and this tends to increase social welfare. In addition, unlike income taxation, social insurance does not imply any deadweight loss. However, with moral hazard, social insurance also has an efficiency cost: it tends to increase loss probabilities. An interior solution, striking a balance between the positive (redistributive) and the negative (efficiency) effects, is thus likely. However, in extreme cases it is even possible to have $\alpha = 0$.

Finally, let us consider the impact of an (exogenous) change in α on the optimal level of taxation. Differentiating the first-order condition for an interior tax rate,[8] one gets:

$$\frac{d\tau}{d\alpha} = \frac{D(\bar{p} - p_1)\left(\frac{1}{w_1} - \frac{1}{w_1} \right)}{2 - (1 - \tau)(w_1 + w_2)\left(\frac{1}{w_1} - \frac{1}{w_2} \right)} < 0. \tag{15}$$

From the second order condition for optimal taxation the denominator is positive and, given our assumptions on p_i's and w_i's, the numerator is negative. This illustrates the point raised in the introduction. If economic integration makes the regulation of the insurance market, or alternatively the financing of social insurance, more difficult the tax system must be made more progressive.

4. Optimal non-linear taxation

We now turn to the more general setting of non-linear taxation. The government observes neither w_i, L_i, nor p_i, but can use any tax schedule on (observable) labor income $y_i = w_iL_i$. Accordingly, the government can choose the level of disposable labor income, $z_i \equiv y_i - T_i$, with T_i being the person's tax bill. In addition, it can set the proportion of social insurance, α.

It is convenient to express an individual's utility as a function of the variables which are observable or controllable. Accordingly, we define

$$v^i(z_i, y_i; \alpha) \equiv u(z_i - d_i, y_i/w_i) \tag{16}$$

where $v^i_\alpha = u^i_c(p_i - \bar{p})$, $v^i_z = u^i_c$ and $v^i_y = u^i_{L/w_i}$. Assuming a purely redistributive tax, the government's resource constraint is given by

$$\sum_{i=1}^{2} n_i (z_i - y_i) = 0.$$

Note that unlike in the previous section, the assumption that we have just two types of individuals appears to be more restrictive here.[9] Throughout this section, we consider two cases:

(i) $p_1 = p^h$ and $w_1 = w^l$
$p_2 = p^l$ and $w_2 = w^h$
(ii) $p_1 = p^l$ and $w_1 = w^l$
$p_2 = p^h$ and $w_2 = w^h$

where $w^h > w^l$ and $p^h > p^l$.

In case (i), ability and risk are *negatively* correlated. Accordingly, type 2 is the more able and also the better risk. The *laissez-faire* situation,[10] then necessarily implies $c_2 > c_1$. Furthermore, two sub-cases depending on whether or not the difference in w is relatively more important than that in p. In case (ia), the difference in p is small and one obtains the standard result that $y_2 > y_1$. In case (ib), the difference in p is so large that the *laissez-faire* solution implies $y_2 < y_1$. In other words, the income effect on leisure is so large that high-ability individuals earn less *labor* income than low-ability individuals.

In case (ii), ability and risk are *positively* correlated: type 2 is the more able but also the worse risk. Once again, two sub-cases are to be distinguished. In case (iia), the risk differential is small relative to the ability differential and the *laissez-faire* situation implies $c_2 > c_1$ and $y_2 > y_1$: high-ability individuals earn more labor income and have a higher consumption level than low ability individuals (i.e., the standard result). The maximization of a utilitarian social welfare function then calls for redistribution from type 2 to type 1. In case (iib) the risk differential is large relative to the ability differential and one obtains $y_2 > y_1$ and $c_2 < c_1$. With a utilitarian welfare function, redistribution is here reversed, going from 1 to 2.

Before treating these four cases analytically, let us sketch the underlying intuition through a graphical representation of the incentive problem. In the first three cases, optimality calls essentially for redistribution from type 2 towards type 1. The binding incentive constraint thus prevents type 2 from mimicking type 1. In the last case (iib), on the other hand, type 1 has to be prevented from mimicking type 2.

The four cases are summarized in Table 1 and depicted in Figures 1–3 in the plane (z, y). In each case, we start off with a zero value for α (no social insurance) and examine whether or not it is socially desirable to increase it. The slope of the relevant indifference curves, $-(dz/dy) = -(V_y/V_z)$, is equal to $1 - T'(y)$, where $T'(y)$ is the marginal tax rate implied by the implementing income tax function.[11] We will use the notation $t_i = T'(y_i)$. When $t_i = 0$, the marginal rate of substitution between y and z is equal to 1 which is also a first-best condition.

In these figures, F is chosen by type 1 and E by type 2 individuals. Figure 1 corresponds to cases (ia) and (iia) which are exactly similar to the standard optimal income tax problem [Stiglitz (1982)]. Type 2 individuals end up in E which provides them with same utility

Table 1.

	w_1	p_1	w_2	p_2	*laissez-faire* allocation		t_1	t_2	$dW/d\alpha$ at $\alpha = 0$
Cases									
ia	w^l	p^h	w^h	p^l	$y_2 > y_1$	$c_2 > c_1$	+	0	+
ib					$y_2 < y_1$	$c_2 > c_1$	−	0	+
iia	w^l	p^l	w^h	p^h	$y_2 > y_1$	$c_2 > c_1$	+	0	−
iib					$y_2 > y_1$	$c_2 < c_1$	0	−	+

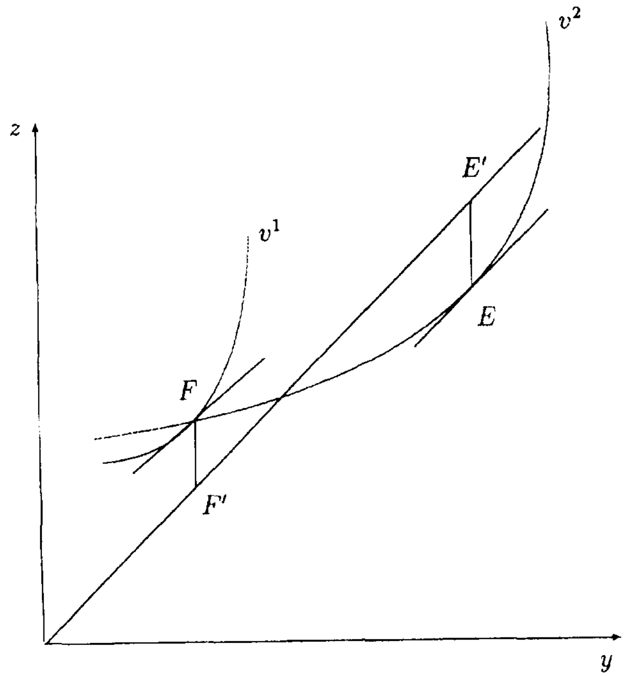

Figure 1. Cases ia and iia.

level as F, the choice of type 1 individuals. In other words, the incentive constraint is binding. In E, the slope of the tangent is equal to 1 (zero marginal tax) and in F, it is less than 1 (positive marginal tax). Assuming $n_1 = n_2$ one obtains $FF' = E'E$.

Figure 2 is also close to the standard case where the marginal income tax of the more able individuals is zero. There is one important difference, however. Type 1 individuals now have steeper indifference curves (at any point) than type 2 individuals. Their choice of F implies a *negative* marginal tax. This is because the risk difference implies that type 2 individuals end up earning a lower *labor* income than the less able individuals of type 1.

Figure 3 represents the case where the utilitarian optimum involves redistribution from type 1 towards type 2. Now F and E are on the same indifference curve for type 1 whose marginal income tax rate is 0.

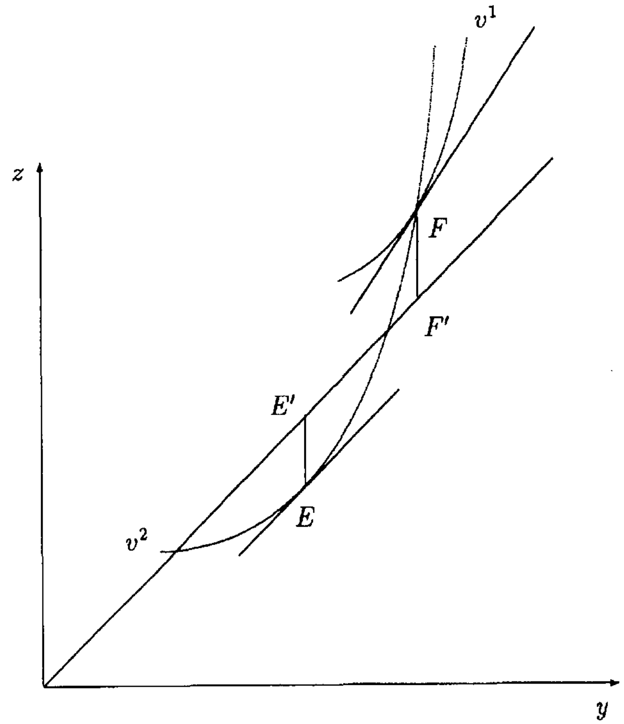

Figure 2. Case ib.

We now turn to the analytics of the problem. Consider first the optimization problem of the government when the binding self-selection constraint prevents type 2 from mimicking type 1. Recall that this situation arises in cases (ia), (ib) and (iia).

$$\max \Lambda = \sum_{i=1}^{2} n_i v^i(z_i, y_i; \alpha) + \lambda[v^2(z_2, y_2; \alpha) - v^2(z_1, y_1; \alpha)] - \gamma \sum_{i=1}^{2} n_i(z_i - y_i) \quad (17)$$

where λ is the Lagrange multiplier associated with the self-selection constraint of type 2 individuals while γ is the multiplier associated with the revenue constraint. The first-order conditions are:

$$(z_2) \quad v_z^2(n_2 + \lambda) - \gamma n_2 = 0 \quad (18a)$$

$$(y_2) \quad v_y^2(n_2 + \lambda) + \gamma n_2 = 0 \quad (18b)$$

$$(z_1) \quad v_z^1 n_1 - \lambda \tilde{v}_z^2 - \gamma n_1 = 0 \quad (18c)$$

$$(y_1) \quad v_y^1 n_1 - \lambda \tilde{v}_y^2 + \gamma n_1 = 0 \quad (18d)$$

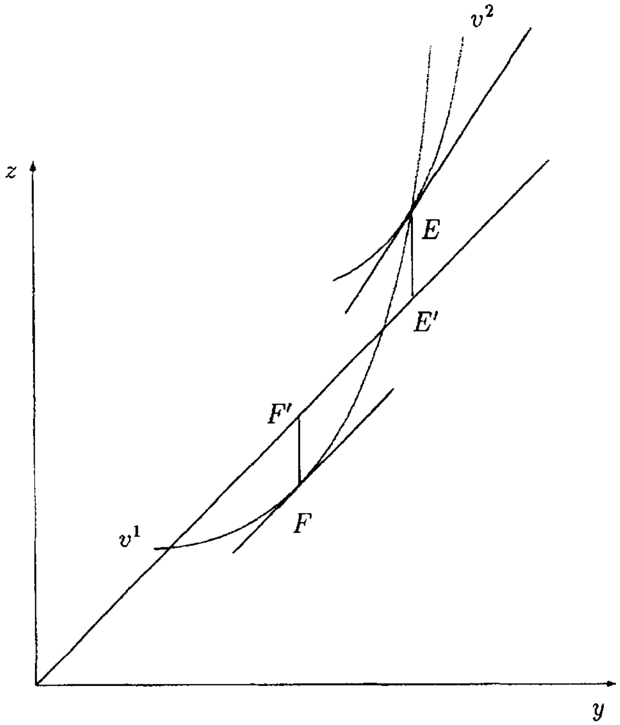

Figure 3. Case iib.

where

$$\tilde{v}_z^2 = \frac{\partial v^2(z_1, y_1; \alpha)}{\partial z_1} \text{ and } \tilde{v}_y^2 = \frac{\partial v^2(z_1, y_1; \alpha)}{\partial y_1}.$$

Using the envelope theorem, the impact on welfare of an (infinitesimal) variation in α is given by:

$$\frac{\partial \Lambda}{\partial \alpha} = \sum_{i=1}^{2} n_i v_z^i (p_i - \bar{p}) D + \lambda (p_2 - \bar{p}_2) D (v_z^2 - \tilde{v}_z^e). \tag{19}$$

To simplify (19), one can use (18a) and (18b. This yields

$$\frac{\partial \Lambda}{} = (p_1 - p_2)\lambda \tilde{v}_z^2. \tag{20}$$

Further, combining (18a) and (18b), one obtains:

$$-\frac{v_y^2}{v_z^2} = 1 = 1 - t_2. \tag{21}$$

Expression (20) shows that a marginal increase from zero in α is welfare improving if $p_1 > p_2$ [i.e., in cases (ia) and (ib)]. On the other hand, if $p_2 > p_1$ [i.e., in case (iia)], social welfare decreases as α increases.

Turning now to case (iib), it implies the following optimization problem:

$$\Lambda = \sum_{i=1}^{2} n_i v^i(z_i, y_i; \alpha) + \mu[v^1(z_1, y_1; \alpha) - v^1(z_2, y_2; \alpha)] - \gamma \sum_{i=1}^{2} n_i(z_i - y_i),$$

where μ is the multiplier of the self-selection constraint associated with type 1 individuals not mimicking type 2. From the first-order conditions, one can derive the results given in the last row of Table 1 assuming that the self-selection constraint is binding ($\mu > 0$). In particular, a marginal increase from zero in α is welfare improving.

So far, we have considered infinitesimal increases in α from zero. Expression (20) and its counterpart in case (iib) can, in principle, also be used to determine the optimal value of α. However, some precautions have to be taken in addressing this problem. One must recognize that as α increases the risk differential decreases and one is likely to shift from one sub-case to another. When there is a negative correlation between risk and ability, a shift from (ib) to (ia) occurs if (ib) prevails at $\alpha = 0$. Such a shift implies a transition from a negative marginal tax on type 1's earnings to a positive marginal tax. It does not, however, affect the sign of (20). Consequently, *under negative correlation full social insurance is always optimal.*

On the other hand, when high ability is associated with bad risk (high p) and when case (iia) prevails for $\alpha = 0$, *no social insurance ought to be provided.*[12] However, under positive correlation, it is also possible that at $\alpha = 0$ the risk advantage dominates the ability advantage implying a redistribution from the individuals with good risk and low productivity to the other type of individuals (case iib). Yet, as α increases this redistribution becomes less and less desirable (and it is definitively not desirable anymore if α is sufficiently close to one). Consequently, for some *interior* value of α, redistribution is not anymore necessary and the allocation is a first-best optimum; see Section 5.2 for an illustration of this result.

To summarize, in the case of negative correlation between risk (p) and ability (w), the optimal value of α is always 1 even though to achieve it one may go through a shift of regimes. In the case of positive correlation, there are two possibilities. In case (iib), there is an interior optimum for α that is a first-best. In case (iia), the optimal value of α is zero.

To illustrate these findings and, in particular, to see how the shift from case (ib) to case (ia) occurs, we turn to a numerical example.

5. Numerical example

5.1. Cases (ia) and (ib)

Assume $n_1 = n_2$ and let

$$v^i = \ln(z_i - d_i) + \ln(1 - y_i/w_i)$$

where $d_1 = 4\alpha + 8(1 - \alpha)$, $d_2 = 4\alpha$ (so that $d_1 + d_2 = 8$), $w_1 = 10$ and $w_2 = 14$.[13]
One may easily check that the no-tax solution for a given level of $\alpha \geq 0$ yields:

$$y_i = z_i = \frac{w_i}{2} + \frac{d_i}{2}.$$

If $\alpha = 0$, one has $y_1 = 9 > y_2 = 7$; if $\alpha = 1$, $y_1 = 7 < y_2 = 9$, and if $\alpha = 1/2$, $y_1 = y_2 = 8$. As expected, $c_2 > c_1$ for all values of α. The question raised by this example concerns $\alpha = 1/2$ and the transition from a subsidy to a tax on type 1 individuals' earnings.

Let us now introduce redistributive taxation. Table 2 provides the solution to the optimal tax problem (17) for a number of values of α, ranging from no social insurance to full social insurance.

In this table WNT is the utilitarian social welfare if there is no income taxation,[14] whereas W^* is the second-best social optimum. The marginal tax rate for type 2 individuals is not reported because $t_2 5 = 0$, regardless of the value of α. The cases $\alpha = 0.525, 0.75$ and 1 correspond to case (ia) which is illustrated on Figure 1. What is of particular interest is the intermediate case where the second-best optimum coincides with the no income-tax solution: for $\alpha < 1/2$, $t_1 < 0$ and for $\alpha > 1/2$, $t_1 > 0$. Graphically, both indifference curves are then tangent to the 45° line at the point (8, 8), with that of type 1 individuals being flatter than that of type 2 individuals.

If α thus happens to be equal to 1/2, no redistribution is possible. In other words, any attempt to redistribute would violate the self-selection constraint. However, at this point, there is a need for redistribution as witnessed by the inequality $c_2 = 6 > c_1 = 2$. This being noted, there is a continuous transition between regime (ib) to regime (ia) with the global optimum at $\alpha^* = 1$.

5.2. *Cases (iia) and (iib)*

To illustrate these two cases, we keep the same example as above except for: $d_1 = 4\alpha$ and $d_2 = 4\alpha + 8(1 - \alpha)$.[15] The outcome $\alpha = 1$ has already been considered above; $\alpha \leq 1$

Table 2. Optimal taxation and allocation for alternative value of α.

α	0	0.25	0.475	0.5	0.525	0.75	1
y_1	8.98	8.55	8.061	8	7.937	9.3	6.52
y_2	7.16	7.54	7.951	8	8.05	8.56	9.25
z_1	9.31	8.64	8.062	8	7.938	7.42	7.01
z_2	6.84	7.45	7.943	8	8.04	8.44	8.75
c_1	1.31	1.64	1.962	2	2.038	2.42	3.01
c_2	6.84	6.45	6.049	6	5.94	5.44	4.75
t_1	-0.29	-0.13	-0.01	0	0.01	0.10	0.13
WNT	-1.05	-0.39	-0.0059	0.03	0.0608	0.30	0.47
W^*	-0.8	-0.34	-0.0055	0.03	0.0611	0.032	.053

covers the case of a positive correlation between ability and risk. Clearly, one expects that decreasing α from 1 coupled with taxation should increase social welfare. However, one can reach a level of α at which redistributive taxation is not anymore needed or feasible. Conversely, by increasing α from an initial level of zero, one expects to increase social welfare and to reach a value of α at which distortionary taxation is no longer needed or feasible.

Within our example, one can show that if $\alpha \leq 0.75$, so that $d_1 \leq 3$ and $d_2 \geq 5$, neither one of the two incentive compatibility constraints is binding; consequently, first-best redistribution can be implemented. The solution is

$$y_1 = 6, \quad z_1 = 4 + d_1 \text{ and } c_1 = 4;$$

$$y_2 = 10, \quad z_2 = 4 + d_2 \text{ and } c_2 = 4.$$

For these values, the self-selection constraint pertaining to type 2 mimicking type 1 individuals is not binding. Also, the self-selection constraint pertaining to type 1 mimicking type 2 individuals is not binding either.

One can thus divide the range of values of α into 4 parts:

- If $\alpha > 0.75$, regime (iia) prevails with second-best income taxation, and it is desirable to decrease α.
- If $0.75 \geq \alpha > 0.5$ redistribution is first-best optimal from type 2 to type 1 individuals.
- If $\alpha = 0.5$, the competitive equilibrium solution solves the optimal tax problem; consequently, the solution is a first-best optimum.
- If $\alpha < 0.5$, (first-best) optimal redistribution occurs from type 1 to type 2 individuals.

Welfare is constant for $\alpha \leq 3/4$; it decreases with $\alpha > 3/4$.

These results depend on the specification adopted in our numerical example. In general, however, one ought to expect that for low values of α the binding incentive constraint prevents type 1 individuals from mimicking type 2 individuals, and social welfare will increase with α until the first-best solution is achieved.

6. Concluding remarks

This paper has studied the role of social insurance used along with optimal income taxation by a welfare maximizing government. It has considered a simple setting where individuals differ in two unobservable characteristic: ability and risk (as measured by the probability of incurring some loss). It has shown that both tax progressivity and the degree of social insurance coverage depend on the correlation between those two characteristics. In the empirically appealing case where high productivity individuals tend to be "good" risks, full social insurance is socially desirable. It operates redistribution without involving a deadweight loss; under linear income taxation rates are then lower than they would be without social insurance. On the other hand, when high productivity agents are "bad" risks, the optimum can imply partial social insurance coverage and no distortionary income taxation. In that case, social insurance alone is sufficient to achieve optimal redistribution.

Our approach calls for the following qualifications. First, we only consider two types of agents which has a significant impact on the non-linear taxation problem. It should be pointed out, though, that as long as we restrict ourself to the case of *perfect* (positive or negative) correlation between ability and risk, our results are quite robust and can be extended to the case of a continuous distribution of types.[16] Dropping the perfect correlation assumption, on the other hand, would constitute a much more serious departure from our setting.[17] Second, to keep the problem tractable, we have to a large extent ignored the very relevant problem of moral hazard, which would clearly tend to mitigate our results regarding the desirability of full social insurance coverage. A rigorous analysis of this aspect constitutes a research agenda on its own. Third, it is undeniable that our paper falls short of providing a comprehensive study of the threat that economic integration represents for redistributive taxation and social insurance. The possibilities of buying insurance from foreign (possibly unregulated) companies and/or of moving to another country to avoid redistributive taxation would modify our analysis. To properly account for such a threat, a multi-jurisdictional setting with strategic interaction amongst governments (of both the same and different levels) appears to be called for—but this is clearly another story. Our paper only captures part of the international aspects that are involved. In particular, it illustrates that if the only threat concerns shopping abroad for cheaper insurance, national governments have to resort to more progressive taxation.

Finally, we have assumed that the risk is unrelated to work capacity. In other words, we have ignored the insurance role played by (labor) income taxation in itself which has been stressed in the literature.[18] While the problem of social insurance *per se* and the problem of "insurance through taxation" bear some apparent similarities, they are effectively of a rather different nature. Specifically, the existing contributions which deal with taxation under uncertainty rely on the premiss that the risk cannot be covered through (private) insurance markets. Our specification, on the other hand, allows for the presence of complete insurance markets (offering actuarially fair contracts). Consequently, taxation does not provide any insurance benefits *per se*. In addition, the *ex ante* heterogeneity of individuals is a crucial ingredient in our setting whereas the other contributions concentrate on *ex post* inequalities.[19] Though quite different, the two approaches nevertheless appear to be to a large extent complementary: they each concentrate on a specific aspect of a more general problem. A fully satisfactory study of social insurance and its interaction with other redistributive policies clearly calls for a setting which encompasses both perspectives.

Notes

1. See e.g., Guesnerie and Roberts (1984), Cremer and Gahvari (1996), Boadway and Marchand (1995), Boadway and Keen (1993), who show that in a second-best setting, it may be socially optimal to publicly provide some (essentially) private goods or services.
2. As will become clear below, social insurance *per se* and insurance regulation requiring a uniform rate are formally equivalent within our setting.
3. Individual risks are *independent* and there is a large number of individuals of each type.
4. Blomqvist and Horn (1984) have studied a problem which bears some similarity with this one.
5. Defining $S_i \equiv \partial L_i^c / \partial w_i^n$, where L_i^c is compensated labor supply while $w_i^n \equiv w_i(1 - \tau)$ denotes the net wage rate.

6. Because of the restrictions imposed on α and τ a completely rigorous treatment of the government's requires the analysis of Kuhn-Tucker conditions. To keep expressions simple, we refrain from this exercise, keeping however in mind the possibility of corner solutions.
7. For instance,

$$\text{cov}(p, b) = \sum_{i=1}^{2} (p_i - \bar{p})(b_i - \bar{b})n_i = \sum_{i=1}^{2} p_i b_i n_i - \bar{p}\bar{b}.$$

8. Which, with the specific utility function (12), is given by

$$2(1 - t) + D[\alpha\bar{p} + (1 - \alpha)p_1]/w_1 + D[\alpha\bar{p} + (\pi\alpha)p_2]/w_2 = \left(\frac{1}{w_1} + \frac{1}{w_2}\right)[(1 - t^2(w_1 + w_2)/2 + \bar{p}D)]$$

9. See Section 6 for a more detailed discussion of this point.
10. That is the competitive equilibrium with no government intervention so that $T_i = 0$ ($i = 1, 2$) and $\alpha = 0$.
11. When the implementing tax function is not differentiable, which is necessarily the case at one point in a two-group model, we continue to refer to $1 + (V_y/V_z)$ as the marginal tax rate. This terminology is by now standard in the optimal income tax literature; see e.g., Stiglitz (1987).
12. It is easily established that λ will remain positive as α increases.
13. This corresponds to $p_1 = 1$, $p_2 = 0$ and $D = 8$.
14. But where social insurance is provided according to the value of α.
15. In other words, we switch the probabilities of a loss and assume $p_1 = 0$ and $p_2 = 1$.
16. The case of negative correlation is straightforward to deal with and results are essentially the same (in particular, full social insurance coverage remains optimal). The case of positive correlation is technically more difficult ot handle and can give rise to a number of solution patterns (possibly with "bunching" on some interval). our results pertaining to the social insurance coverage, however, remain valid. In particular, full insurance is not optimal.
17. One would then face a full-fledged two-dimensional adverse selection problem involving technical difficulties which puts it beyond the scope of the current paper.
18. The pioneering contribution in this area are due to Eaton and Rosen (1980a, 1980b, 1980c), Varian (1980) and Diamond, Helms and Mirrlees (1980). More recent contributions include Mirrlees (1990) and Cremer and Gahvari (1995a, 1995b).
19. An exception is Eaton and Rosen (1980) who deal with *linear* income tax when individuals face different *distributions* of the (random) wage.

References

Blomqvist, A. and H. Horn (1984) "Public health insurance and optimal income taxation," *Journal of Public Economics*, 24, 352–371.

Boadway, R. and M. Keen, (1993) "Public goods, self-selection and optimal income taxation," *International Economic Review*, 34 463–478.

Boadway, R. and M. Marchand (1995) "The use of public expenditures for redistributive puposes," *Oxford Economic Papers* 45–59.

Cremer, H. and F. Gahvari (1995a) "Uncertainty and optimal taxation: In defense of commodity taxes," *Journal of Public Economics*, 56, 291–310.

Cremer, H. and F. Gahvari (1995b) "Uncertainty, optimal taxation and the direct versus indirect tax controversy," *Economic Journal*, 95, 1165–1179.

Cremer, H. and F. Gahvari, (1996), "In-kind transfers, Jself-selection and optimal tax policy," (forthcoming) *European Economic Review.*

Diamond, P.A., L.J. Helms and J.A. Mirrlees, (1980). "Optimal taxation in a stochastic economy: A Cobb-Douglas example," *Journal of Public Economics*, 14, 1–29.

Eaton, J. and H.S. Rosen (1980a), "Labor supply, uncertainty, and efficient taxation," *Journal of Public Economics*, 14, 365-374.

Eaton, J. and H.S. Rosen, (1980b), "Optimal redistributive taxation and uncertainty," *Quarterly Journal of Economics*, 94, 357-364.

Eaton, J. and H.S. Rosen (1980c) "Taxation, human capital, and uncertainty," *American Economic Review*, 70, 705-715.

Guesnerie, R. and K. Roberts, (1984) "Effective policy tools and quantity controls," *Econometrica*, 52, 59-86.

Mirrlees, J.A. (1990). "Taxing uncertain incomes," *Oxford Economic Papers*, 42, 34-45.

Rochet, J.-C. (1991). "Incentives, redistribution and social insurance," *The Geneva Papers of Risk and Insurance*, 16, 143-165.

Stiglitz, J.E., (1982) "Self-selection and Pareto efficient taxation, *Journal of Public Economics*, 17, 213-240.

Stiglitz, J.E. 1987 "Pareto efficient and optimal taxation and the new new welfare economics," *Handbook of Public Economics* Auerbach, A. and M. Feldstein, Amsterdam: North-Holland, 1991-1042.

Varian H.R., (1980) "Redistributive taxation as social insurance," *Journal of Public Economics*, 14, 49-68.