Forced Saving, Redistribution and Nonlinear Social Security Schemes

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Abstract

This paper studies the design of a nonlinear social security scheme in a society where individuals differ in two respects: productivity and degree of myopia. Myopic individuals may not save "enough" for their retirement because their "myopic self" emerges when labor supply and savings decisions are made. The social welfare function is paternalistic: the rate of time preference of the far-sighted (which corresponds to the "true" preferences of the myopics) is used for both types. We show that the paternalistic solution does not necessarily imply forced savings for the myopics. This is because paternalistic considerations are mitigated or even outweighed by incentive effects. Our numerical results suggest that as the number of myopic individuals increases, there is less redistribution and more forced saving. Furthermore, as the number of myopic increases, the desirability of social security (measured by the difference between social welfare with and without social security) increases.

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1 Introduction

Social security systems typically fulfill several functions. They force myopic individuals (who are inclined to save less than what is reasonable given their life expectancy) to save an appropriate amount. They also contribute to redistributing resources. Finally, they provide insurance, in particular for the longevity risks by providing an annuity.

In this paper we focus on the first two functions. The "forced saving" argument is rarely disputed. What is disputed is whether one needs social security to ensure that everyone saves enough; after all the government needs only to require that individuals save the desired amount. This would be a valid objection if first-best redistribution were available. However, in a world of asymmetric information, where productivity and degree of myopia are not publicly observable there may well be a case for a social security scheme that pursues both functions.

We adopt a two-period model: individuals work in the first period and retire in the second. They save part of their earnings for their consumption in retirement. Individuals differ in two respects, productivity on the one hand and degree of myopia on the other hand. Myopic individuals may not save "enough" for their retirement because their "myopic self" emerges when labor supply and savings decisions are made. In other words, they use a discount factor which does not reflect their "true" preferences.[1] When they retire, they regret their earlier decisions. Consequently, if they could be forced to save a certain amount, they would be in favor of such an imposed commitment. We assume that the government has a paternalistic view and wants to help these individuals to overcome their myopia problem; in measuring social welfare it uses the rate of time preference of the individuals whose myopic self never emerges. *Ex post*, myopic individuals will be grateful to the government for such forced saving.

In our model, both productivity and time preference are not observable. The government will design a tax transfer policy based on what is observable: gross earnings, disposable income and saving.

Anticipating the results, we show that the paternalistic solution does not necessar-

[1] For earlier work on this, see Feldstein (1985), Imrohoroglu *et al.* (2003) and recently Diamond and Koszegi (2003).

ily imply forced savings for the myopics. This is because paternalistic considerations are mitigated or even outweighed by incentive effects. In other words, the interaction between paternalism and redistribution is rather complex and may bring about results which are in contradiction to conventional wisdom. Our numerical results suggest that as the number of myopic individuals increases, there is less redistribution and more forced saving. Furthermore, as the number of myopic increases, the desirability of social security (measured by the difference between social welfare with and without social security) increases.

This paper is part of an ongoing research on social security and myopia. It focuses on non-linear schemes. In companion papers, Cremer *et al.* (2007a, 2007b), we study the same problem using a linear schedule and taking both a normative and a positive viewpoint.[2]

The rest of the paper is organized as follows. The basic model is introduced in the next section. Then the second-best optimum is discussed. Finally, Section 4 provides numerical simulations.

2 The model

2.1 Myopic and farsighted individuals

Individuals' utility is given by

$$U(c_i, d_i, l_i) = u(c_i) + \beta u(d_i) - v(\ell_i), \tag{1}$$

where c_i and d_i are first- and second-period consumption while ℓ_i is labor supplied in the first period. Observe that we can think of ℓ_i as the retirement age. Gross earnings are given by $y_i = w_i \ell_i$ and are obtained in the first period. Individuals differ in their wage rate, $w_i \in \{w_L, w_H\}$ with $w_L < w_H$. Individuals can save part of first period income at a zero intererest rate.

For all individuals the "true" time-discount factor is given by β. However not all individuals will make their labor supply and consumption decisions according to this

[2]While we were completing this paper, we came across a related paper by Tenhunen and Tuomala (2006) who also design an optimal social security non-linear scheme where far-sighted and myopic coexist.

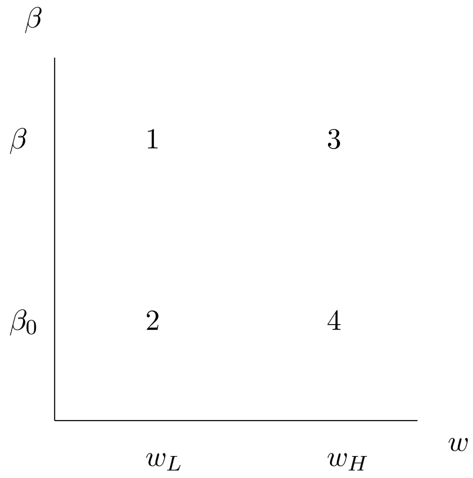

Figure 1: Types of individuals

parameter. For some individuals, their "myopic self" emerges when labor supply and saving are chosen. They take all decisions according to a time discount parameter $\beta_0 < \beta$. Formally, savings and labor supply are chosen according to

$$U_i(c_i, d_i, l_i) = u(c_i) + \beta_i u(d_i) - v(\ell_i). \tag{2}$$

For myopic individuals we have $\beta_i = \beta_0$, while $\beta_i = \beta$ holds for the far-sighted.

To sum up, there are four types of individuals as represented on Figure 1. Type-1 and type-3 individuals' are the far-sighted with low and high abilities respectively. Type-2 (low ability) and type-4 (high ability) individuals on the other hand are myopic. Total population size is normalized at one and the proportion of type $i = 1, \ldots, 4$ individuals is denoted by π_i.

2.2 First-best solution

We take a paternalistic approach and consider the utilitarian optimum *based on individuals' true preferences*. The corresponding Lagrangian expression is given by

$$\mathcal{L}_{FB} = \sum_i \pi_i \left[u\left(c_i\right) + \beta u\left(d_i\right) - v\left(\frac{y_i}{w_i}\right)\right] - \mu \sum_i \pi_i \left(c_i + d_i - y_i\right).$$

This yields

$$
\begin{aligned}
c_1 &= c_2 = c_3 = c_4, \\
d_1 &= d_2 = d_3 = d_4, \\
\ell_1 &= \ell_2 < \ell_3 = \ell_4.
\end{aligned}
$$

With separable preferences the utilitarian solution implies that consumption levels are equalized across types and periods and that the able individuals work more than the unable. This first-best allocation can be decentralized by using two instruments. First, we need lump-sum transfers to redistribute from high to low productivity individuals. In addition a "Pigouvian" (corrective) subsidy at rate $1 - \beta_0/\beta$ on the savings of the myopics is required to induce them to save the appropriate amount. As an alternative to the savings subsidy, one can also use a pension scheme to force myopics individuals to save.

3 Second best solution with nonlinear schemes

In reality this solution may not be feasible because some key variables are not publicly observable. We adopt the standard assumption in the Mirrlees' model of optimal income taxation according to which an individual's wage and labor supply are not observable, while gross earnings $y_i = w_i\ell_i$ are observable. In addition we assume that an individual's degree of myopia is not observable either. We assume for simplicity that saving is observable so that the (possibly nonlinear) pension benefits scheme is based on both y_i and s_i. The case where saving is not observable is more complicated but yields the same main results.[3]

To interpret the properties of the optimal allocations derived below, let us now look at the problem of implementing a given allocation.

[3] A technical appendix analyzing this case is available from the authors (or can be found on Helmuth Cremer's webpage at www.idei.fr). Yet another specification is to assume that the tax on savings is restricted to be linear (because only anonymous transactions are observable). One can show that any allocation that can be achieved with observable savings can also be implemented with a linear tax. To do this it is sufficient to set a very high tax rate so that *private* savings is completely crowded out and to control second period consumption through the pensions scheme.

3.1 Implementation

Recall that the government observes s_i and y_i and can tax the individuals non-linearly on the basis of these two variables. The policy instruments are $T(y_i, s_i)$ and $p(y_i, s_i)$ corresponding to the payroll tax and the pension benefit, respectively. Taking these two policy instruments into account the individual problem is given by

$$\max_{y_i, s_i} u(y_i - s_i - T(y_i, s_i)) + \beta_i u(s_i + p(y_i, s_i)) - v\left(\frac{y_i}{w_i}\right),$$

with the first-order conditions

$$\frac{u'(c_i)}{u'(d_i)} = \beta_i \frac{1 + p_s(y_i, s_i)}{1 + T_s(y_i, s_i)}, \tag{3}$$

$$\frac{v'(l_i)}{u'(c_i)} = w_i \left(1 - T_y(y_i, s_i) + \frac{1 + T_s(y_i, s_i)}{1 + p_s(y_i, s_i)} p_y(y_i, s_i)\right). \tag{4}$$

Define

$$\Theta_i = 1 - \frac{1 + p_s(y_i, s_i)}{1 + T_s(y_i, s_i)} = \frac{T_s(y_i, s_i) - p_s(y_i, s_i)}{1 + T_s(y_i, s_i)}, \tag{5}$$

$$\Gamma_i = T_y(y_i, s_i) - \frac{1 + T_s(y_i, s_i)}{1 + p_s(y_i, s_i)} p_y(y_i, s_i), \tag{6}$$

which represent the implicit marginal tax (or subsidy) on savings and on labor implied by the tax and pension schemes. When $\Theta_i < (>) 0$ type-i individual faces a marginal subsidy (tax) on savings. When $\Gamma_i > 0$ type-i individual faces a marginal tax on income.

These two wedges have been widely discussed in the theoretical and empirical literature on social security. Early retirement that is observed in many OECD countries is often explained by a positive Γ_i called the implicit tax on prolonged activity. Recall that ℓ_i can be considered here as determining the activity rate or even the retirement age of type i individuals.[4] Insufficient saving for retirement is also often explained by the presence of an implicit tax on saving and the aim of tax breaks for retirement saving is to generate a negative Θ_i.

In this paper we are interested by the design of a social security system summarized by the functions T and p. Such a system can be approached in two ways. First, we

[4] In other words, people would work for ℓ years and would retire thereafter.

can look at net lifetime benefit which are given by $-T(y_i, s_i) + p(y_i, s_i)$.[5] Alternatively, we can concentrate on (dis)incentives to work and save and study the sign of marginal taxes Θ_i and Γ_i. Analytically, we can only deal with the latter. To study the former, we will have to resort to numerical examples.

3.2 Second-best solution

With the considered information structure feasible allocations must satisfy a set of incentive constraints that take the following form

$$u(c_i) + \beta_i u(d_i) - v\left(\frac{y_i}{w_i}\right) \geq u(c_j) + \beta_i u(d_j) - v\left(\frac{y_j}{w_i}\right), \tag{7}$$

The Lagrangian (Kuhn-Tucker) expression associated with the second-best problem is given by

$$\begin{aligned}\mathcal{L}_{SB} = &\sum_i \pi_i \left[u(c_i) + \beta u(d_i) - v\left(\frac{y_i}{w_i}\right) - \mu(c_i + d_i - y_i)\right] \\ &+ \sum_{i \neq j} \lambda_{ij} \left[u(c_i) + \beta_i u(d_i) - v\left(\frac{y_i}{w_i}\right) - u(c_j) - \beta_i u(d_j) + v\left(\frac{y_j}{w_i}\right)\right],\end{aligned}$$

where $\lambda_{ij} \geq 0$ are the multipliers associated with the self-selection constraints where the first subscript denotes the mimicker and the second the mimicked.

The FOCs for this problem are

$$\frac{\partial \mathcal{L}_{SB}}{\partial c_i} = \left[\pi_i + \sum_{j:i\neq j} \lambda_{ij} - \sum_{j:i\neq j} \lambda_{ji}\right] u'(c_i) - \pi_i \mu = 0, \tag{8}$$

$$\frac{\partial \mathcal{L}_{SB}}{\partial d_i} = \left[\beta \pi_i + \sum_{j:i\neq j} \beta_i \lambda_{ij} - \sum_{j:i\neq j} \beta_j \lambda_{ji}\right] u'(d_i) - \pi_i \mu = 0, \tag{9}$$

$$\begin{aligned}\frac{\partial \mathcal{L}_{SB}}{\partial y_i} = &- \left[\pi_i + \sum_{j:i\neq j} \lambda_{ij}\right] v'\left(\frac{y_i}{w_i}\right) \frac{1}{w_i} \\ &+ \sum_{j:i\neq j} \lambda_{ji} v'\left(\frac{y_i}{w_j}\right) \frac{1}{w_j} + \pi_i \mu = 0.\end{aligned} \tag{10}$$

[5] Recall that the interest rate is zero.

Note that to have an interior solutions for c_i and d_i we need

$$\pi_i + \sum_{j:i\neq j} \lambda_{ij} - \sum_{j:i\neq j} \lambda_{ji} > 0, \tag{11}$$

$$\beta\pi_i + \sum_{j:i\neq j} \beta_i\lambda_{ij} - \sum_{j:i\neq j} \beta_j\lambda_{ji} > 0. \tag{12}$$

to be satisfied. We will need these conditions for our further analysis.

The FOCs can be rearranged to yield

$$\frac{v'\left(\frac{y_i}{w_i}\right)}{u'(c_i)} = w_i \frac{\pi_i + \sum_{j:i\neq j} \lambda_{ij} - \sum_{j:i\neq j} \lambda_{ji}}{\pi_i + \sum_{j:i\neq j} \lambda_{ij} - \sum_{j:i\neq j} \lambda_{ji} \frac{v'\left(\frac{y_i}{w_j}\right)\frac{1}{w_j}}{v'\left(\frac{y_i}{w_i}\right)\frac{1}{w_i}}},$$

$$\frac{u'(c_i)}{u'(d_i)} = \beta_i \frac{\pi_i + \sum_{j:i\neq j} \lambda_{ij} - \sum_{j:i\neq j} \frac{\beta_j}{\beta_i}\lambda_{ji}}{\pi_i + \sum_{j:i\neq j} \lambda_{ij} - \sum_{j:i\neq j} \lambda_{ji}} + \frac{\pi_i\left(\beta - \beta_i\right)}{\pi_i + \sum_{j:i\neq j} \lambda_{ij} - \sum_{j:i\neq j} \lambda_{ji}}.$$

When individuals differ in more than one characteristic, nonlinear taxation problems are often rather difficult. This is due to the difficulty of knowing *a priori* which are the incentive constraints that bind. One possible approach is to solve the model without making any assumptions about the pattern of binding incentive constraints and analyze the general formulas obtained; this strategy has been adopted by Cremer *et al.* (2001) within the context of commodity taxation. Our approach here is different. We concentrate on specific patterns of binding incentive constraints, namely on those that arise in the numerical simulations provided below.[6] In addition, we assume for the time being that $\pi_2 = 0$. In other words there are no myopic low-wage individuals in the economy.[7] This assumption can once again be justified by the simulation results which show that the optimal utilitarian allocation always pools type-1 and type-2 individuals ($c_1 = c_2$, $d_1 = d_2$ and $\ell_1 = \ell_2$).On the basis of the numerical simulations, we consider the two patterns of binding incentive constraints that have emerged:

1. $\lambda_{34} > 0$, $\lambda_{41} > 0$ and $\lambda_{31} > 0$, while $\lambda_{ij} = 0$ for all other constraints,

[6]We have run a large number of simulations and we have not been able to find a counter-example (which does of course not imply that such a counterexample does not exist).

[7]We can also think of an alternative three types case in which we have myopic and far-sighted low-ability individuals on the one hand and far-sighted high-ability individuals on the other hand. In this case the problem is equivalent to the Atkinson-Stiglitz problem (at least with a utilitarian objective).

2. $\lambda_{34} > 0$ and $\lambda_{41} > 0$, while $\lambda_{ij} = 0$ for all other constraints.[8]

When the binding incentive constraints are those associated with the Lagrange multipliers λ_{34}, λ_{41} and λ_{31} one easily checks (by combining the three constraints) that $d_4 = d_1$. In the other case, when the binding incentive constraints are associated with λ_{34} and λ_{41}, we have $d_1 < d_4$. In both cases the first order conditions (8)-(10) can be rearranged as follows (with $\lambda_{31} = 0$ for the second case)

$$\frac{v'(\ell_3)}{u'(c_3)} = w_H, \tag{13}$$

$$\frac{u'(c_3)}{u'(d_3)} = \beta, \tag{14}$$

$$\frac{v'(\ell_4)}{u'(c_4)} = w_H, \tag{15}$$

$$\frac{u'(c_4)}{u'(d_4)} = \beta_0 \frac{\pi_4 + \lambda_{41} - \frac{\beta}{\beta_0}\lambda_{34}}{\pi_4 + \lambda_{41} - \lambda_{34}} + \frac{\pi_4(\beta - \beta_0)}{\pi_4 + \lambda_{41} - \lambda_{34}}, \tag{16}$$

$$\frac{v'(\ell_1)}{u'(c_1)} = w_L \frac{\pi_1 - \lambda_{31} - \lambda_{41}}{\pi_1 + [\lambda_{31} + \lambda_{41}] \frac{v'(y_1/w_H)}{v'(y_1/w_L)} \frac{w_L}{w_H}}, \tag{17}$$

$$\frac{u'(c_1)}{u'(d_1)} = \beta \frac{\pi_1 - \lambda_{31} - \frac{\beta_0}{\beta}\lambda_{41}}{\pi_1 - \lambda_{31} - \lambda_{41}}. \tag{18}$$

From these expressions we can conclude that the marginal (labor) income taxes satisfy the usual properties: zero marginal tax rates for both high ability individuals ($\Gamma_3 = \Gamma_4 = 0$) and positive income marginal tax rate for low ability individuals ($\Gamma_1 > 0$). This is not surprising and not directly related to this paper's main focus.[9]

Our main focus is on the marginal taxation of savings. This distortion can be interpreted in two ways depending on the way the solution is implemented. The implementation considered in Subsection (3.1) relies on a nonlinear taxation of *private* saving which is in line with standard optimal tax models. However, one can also think about a direct control of second period consumption d through the pension benefits (with no private savings at all). And of course any intermediate scheme between these two extremes is conceivable. Now, when we adopt the pension scheme interpretation,

[8] Recall that in a Kuhn-Tucker problem $\lambda_{ij} > 0$ means that the associated constraint is binding.

[9] It might appear surprising at first that $\Gamma_4 = 0$ even though $\lambda_{34} > 0$. In other words, type 4 is not a "top" individual in the usual sense (an incentive constraint toward 4 is binding). However, types 3 and 4 have the same wage, so that nothing can be gained by distorting the mimicked type's labor supply.

a marginal subsidy on "savings" effectively means that the pension system forces individuals to save more than they would otherwise do. One would expect such a forced saving to occur for the myopic individual. However, the results show that the problem is more complex and that there may be several contradicting effects.

Using the FOCs for the second best solution (14, 16 and 18) and the equations that define Θ_i (3 and 5), we obtain the following expressions:

$$\Theta_3 = 0 \tag{19}$$

$$\Theta_4 = \frac{\beta - \beta_0}{\beta_0} \frac{\lambda_{34}}{\pi_4 + \lambda_{41} - \lambda_{34}} - \frac{\beta - \beta_0}{\beta_0} \frac{\pi_4}{\pi_4 + \lambda_{41} - \lambda_{34}} \tag{20}$$

$$\Theta_1 = -\frac{\beta - \beta_0}{\beta_0} \frac{\lambda_{34}}{\pi_1 - \lambda_{31} - \lambda_{41}} \tag{21}$$

Conditions (11) and (12), which are needed to have an interior optimum imply that the denominators of all fractions in the previous expressions are positive. This is useful to study the sign of the marginal taxes faced by type-4 and type-1 individuals.

Equation (19) means that high-ability far-sighted individuals face no distortion on their savings (they face a zero marginal tax rate). Equation (21) implies $\Theta_1 < 0$ which means that low-ability (far-sighted) individuals' savings are subsidized.

Turning to the myopic (type 4), the analysis of Θ becomes much more interesting. Intuitively, one might expect $\Theta_4 < 0$ so that the system forces these individuals to save. Interestingly, however, it turn out that Θ_4 can be positive as well as negative as can be seen from (20). Which case occurs depends on the sign of $\pi_4 - \lambda_{34}$; when $\pi_4 - \lambda_{34} > (<) 0$ Θ_4 is negative (positive). This can be understood by subjecting the first order conditions to closer scrutiny. Consider the two terms in the right hand-side of (20). The first term is equivalent to the capital income tax term that appears in a setting in which the government is not paternalistic (for instance Cremer *et al.*, 2003 or Stiglitz, 1985) and is an incentive related distortion (intended to relax an otherwise binding self-selection constraint). With $\beta > \beta_0$ it follows that this term is positive so that a non-paternalistic planner would *tax* savings of the high-ability myopic individual. Put differently, this term calls for a downward distortion on second period consumption of the myopic individual.

The second term captures the paternalistic motive of the planner. It can be seen as a Pigouvian (corrective) term and with $\beta > \beta_0$ it calls for a subsidy (reduced tax) on savings. Observe that this term vanishes when $\beta_0 \to \beta$ in which case individuals are no longer myopic. This second term captures the intuitively expected forced-saving aspect of pensions but the overall effect is ambiguous because there is a conflict with the incentive terms.

At this point we have shown that (20) has two conflicting terms that may imply taxes or subsidies on savings of the high-ability myopic individuals. To show that the expression is ambiguous we also have to show that both cases are effectively possible. To make this point numerical examples are sufficient and this is done in the next section. However an analytical argument is also useful in that it provides some extra intuition. In fact what is important to show is that a subsidy can really take place since Cremer *et al.*, 2003 have already shown the possibility of taxing the savings of the myopic (with a non-paternalistic planner).[10]

To prove this we show that $\Theta_4 < 0$ when $\beta_0 \to 0$. This is because as $\beta_0 \to 0$, $\beta(\pi_4 - \lambda_{34}) \geq 0$[11] which in turn implies $\Theta_4 < 0$. This is not surprising. When the bias towards present consumption is such that myopic individuals simply would not make any savings (if left to their own), it is always desirable to force these individuals to save. In this case the Pigouvian term always dominates.

The numerical simulations in the next section confirm this and show that a positive Θ_4 may take place when β_0 is high. Observe that in any case the under-savings problem of the myopics is never fully corrected; *i.e.* we always have $u'(c_4)/u'(d_4) < \beta$.

4 Numerical results

We now turn to numerical simulations. They provide illustration of the analytical results. In addition, they are useful to study some issues that cannot be dealt with analytically. In particular, they show how the presence of myopic individuals (and a

[10] A continuity argument regarding the degree of paternalism would be enough to show that in our setting taxing the savings of the myopic is possible.

[11] This follows from (12) which in this case implies $\beta(\pi_4 - \lambda_{34}) \geq -\beta_0\lambda_{41}$ and from noticing that the right hand side tends to zero when β_0 tends to zero.

Table 1: Basic parameters

	$w_L = 4$	$w_H = 8$	Relative share
$\beta = 1$	type-1	type-3	$1 - \delta$
$\beta_0 = 0.2$ or 0.8	type-2	type-4	δ
Relative share	0.6	0.4	1

variation in their share) affects welfare and the design of the tax and pension system. The comparison between an all myopic and an all far-sighted society should not be too difficult. One expects that the role of the government is more important in the all-myopic case because it then pursues two objectives: achieving more equality and fostering savings. In a far-sighted society, on the other hand, the role of the government is purely redistributive. At the same time, the task of the government is more difficult in the all myopic case. Can we expect monotonicity between those two polar cases?

The simulations are based on the following utility function

$$u(c_i, d_i, \ell_i) = \sqrt{c_i} + \beta_i \sqrt{d_i} - (\ell_i)^2,$$

with a distribution of types as indicated in Table 1.

The scenarios we consider differ in the share of myopic individuals (in total population). Observe that the share of high-ability individuals is constant and the same for the myopic and the far-sighted groups. Productivities are given by $w_H = 8$ and $w_L = 4$. The far-sighted have a $\beta = 1$ and the myopic a $\beta_0 = 0.2$ or 0.8. When $\beta_0 = 0.2$, we expect that the difference in time preference dominates that in productivity and when $\beta_0 = 0.8$, the productivity gap should dominate.

Tables 2 and 3 show the *laissez-faire* solution and the paternalistic first-best. In the *laissez-faire* we distinguish the case of $\beta_0 = 0.2$ and 0.8. In the paternalistic first-best the time discount factor of the myopic does not count. In these tables, we distinguish two levels of utility for the myopic: the utility perceived in the first-period with β_0 (denoted by U_i) and the *ex post* utility with β (denoted by $\widetilde{U}_i$).

Figures 2 and 3 depict the level of social welfare in the *laissez-faire* as a function of

Table 2: Laissez-faire

$\beta_0 = 0.2$					
Type	c_i	d_i	ℓ_i	U_i	$\widetilde{U}_i$
1	1.587	1.587	0.794	1.890	1.890
2	2.455	0.098	0.638	1.222	1.473
3	4.000	4.000	1.000	3.000	3.000
4	6.186	0.247	0.804	1.940	2.338

$\beta_0 = 0.8$					
Type	c_i	d_i	ℓ_i	U_i	$\widetilde{U}_i$
1	1.587	1.587	0.794	1.890	1.890
2	1.812	1.160	0.743	1.656	1.871
3	4.000	4.000	1.000	3.000	3.000
4	4.566	2.922	0.936	2.628	2.970

Table 3: First-best

Type	c_i	d_i	ℓ_i	U_i $\beta_0 = 0,2$	U_i $\beta_0 = 0,8$	$\widetilde{U}_i$
1	2.685	2.685	0.610	2.905	2.905	2.905
2	2.685	2.685	0.610	1.594	2.577	2.905
3	2.685	2.685	1.221	1.788	1.788	1.788
4	2.685	2.685	1.221	0.477	1.460	1.788
Welfare	2.458					

the proportion of myopic individuals. Not surprisingly, it decreases particularly when $\beta_0 = 0.2$.

We now turn to the second-best solution for different values of δ. Keeping in mind that the first-best welfare is independent of δ, we see from Table 5 and Figures 2–3 that social welfare decreases with δ, particularly with $\beta_0 = 0.2$. The relation between δ and the gap between welfare in the Second-best and in the *Laissez-faire* is also instructive; the same figures show that this gap increases as δ increases showing that the desirability of social security increases with δ. When δ increases, the difference between second and first-period consumption $(d_i - c_i)$ of both types of poor individuals and of the myopic rich individuals steadily increases. In other words, myopia not only brings about forced saving, but the degree of forced saving also increases with the share of myopics.

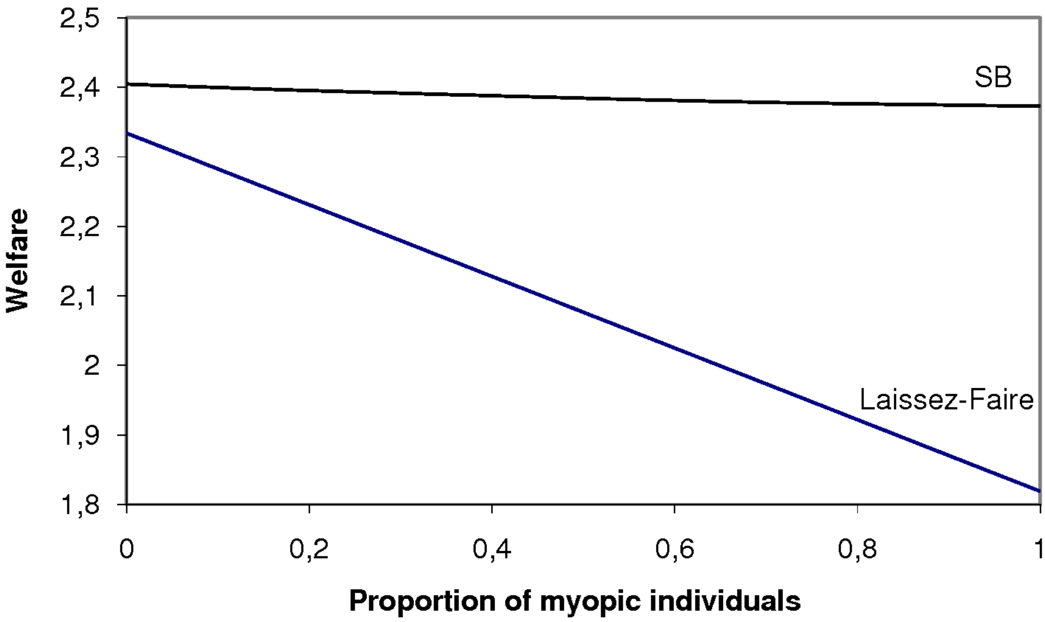

Figure 2: Welfare as a function of δ when $\beta_0 = 0.2$

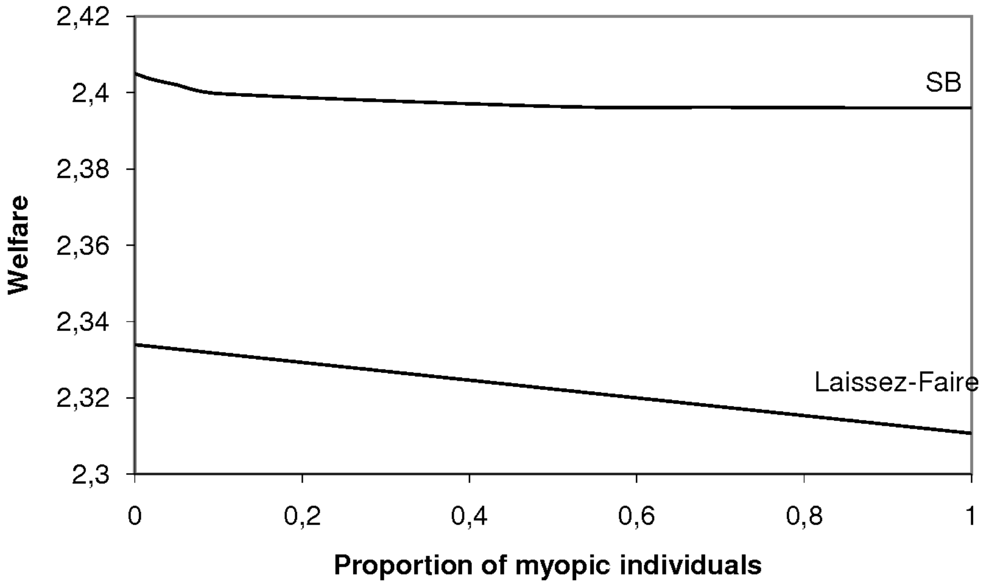

Figure 3: Welfare as a function of δ when $\beta_0 = 0.8$

Table 4a: Second-best solution with $\beta_0 = 0.2$

	Type	c_i	d_i	ℓ_i	$-T_i + p_i$	U_i	$\widetilde{U}_i$	Γ_i	Θ_i
δ=0	1	1.838	1.838	0.662	1,028	2.273	2.273	0.102	0.000
	3	3.503	3.503	1.069	-1,546	2.602	2.602	0.000	0.000
δ=0.1	1	1.771	1.904	0.667	1,007	2.266	2.266	0.113	-0.037
	2	1.771	1.904	0.667	1,007	1.163	2.266	0.113	-4.184
	3	3.501	3.501	1.069	-1,550	2.600	2.600	0.000	0.000
	4	4.471	1.904	0.946	-1,193	1.496	2.600	0.000	-2.263
δ=0.5	1	1.569	2.122	0.681	0,967	2.245	2.245	0.147	-0.163
	2	1.569	2.122	0.681	0,967	1.080	2.245	0.147	-4.816
	3	3.493	3.493	1.070	-1,574	2.593	2.593	0.000	0.000
	4	4.285	2.122	0.966	-1,321	1.428	2.593	0.000	-2.519
δ=0.9	1	1.448	2.140	0.691	0,824	2.188	2.188	0.168	-0.216
	2	1.448	2.140	0.691	0,824	1.018	2.188	0.168	-5.079
	3	3.564	3.564	1.059	-1,344	2.653	2.653	0.000	0.000
	4	4.116	2.547	0.986	-1,225	1.376	2.653	0.000	-2.933
δ=1	2	1.430	2.132	0.693	0,790	1.008	2.176	0.172	-5.105
	4	4.087	2.641	0.989	-1,184	1.368	2.668	0.000	-3.020

Table 4b: Second-best solution with $\beta_0 = 0.8$.

	Type	c_i	d_i	ℓ_i	$-T_i + p_i$	U_i	$\widetilde{U}_i$	Γ_i	Θ_i
δ=0.1	1	1.772	1.894	0.667	0,998	2.263	2.263	0.113	-0.034
	2	1.772	1.894	0.667	0,998	1.988	2.263	0.113	-0.292
	3	3.507	3.507	1.068	-1,530	2.605	2.605	0.000	0.000
	4	4.393	2.014	0.954	-1,225	2.321	2.605	0.000	0.154
δ=0.5	1	1.728	1.855	0.670	0,903	2.228	2.228	0.120	-0.036
	2	1.728	1.855	0.670	0,903	1.955	2.228	0.120	-0.295
	3	3.560	3.560	1.060	-1,360	2.650	2.650	0.000	0.000
	4	3.733	3.201	1.035	-1,346	2.292	2.650	0.000	-0.158
δ=0.9	1	1.722	1.850	0.670	0,892	2.223	2.223	0.120	-0.036
	2	1.722	1.850	0.670	0,892	1.951	2.223	0.120	-0.296
	3	3.566	3.566	1.059	-1,340	2.655	2.655	0.000	0.000
	4	3.662	3.363	1.045	-1,335	2.288	2.655	0.000	-0.198
δ=1	2	1.722	1.850	0.670	0,892	1.951	2.223	0.120	-0.296
	4	3.653	3.383	1.046	-0,877	2.288	2.656	0.000	-0.203

Table 5: Welfare and utility gap in the second-best

	$\beta_0 = 0.2$		$\beta_0 = 0.8$	
δ	Welfare	$\widetilde{U}_3 - \widetilde{U}_1$	Welfare	$\widetilde{U}_3 - \widetilde{U}_1$
0,02	2,4035	0,3296	2,4035	0,3296
0,05	2,4021	0,3310	2,4021	0,3310
0,10	2,3997	0,3332	2,3997	0,3418
0,20	2,3953	0,3374	2,3977	0,3906
0,50	2,3843	0,3482	2,3964	0,4220
0,70	2,3784	0,3922	2,3961	0,4281
0,90	2,3744	0,4648	2,3960	0,4316
0,95	2,3736	0,4790	2,3960	0,4323
0,98	2,3731	0,4870	2,3960	0,4326

Concerning redistribution, we observe that the utility gap between the poor and the rich individuals increases with δ as it is shown by Table 5. Similarly the net lifetime benefits that the poor individuals receive are also decreasing in the proportion of myopic individuals as the column $-T_i + p_i$ in Tables 4a and 4b show. Consequently, the poor workers are penalized by the presence of myopic individuals. In other words, myopia implies a less redistributive tax and pension system. Not surprisingly those effects are stronger with $\beta_0 = 0.2$ (when myopia is more severe) than with $\beta_0 = 0.8$.

Marginal taxes are consistent with the analytical results. Consider first the distortion in labor supply (measured by Γ_i). There is no such distortion for types 3 and 4, namely the productive individuals. For types 1 and 2, the unskilled workers, there is a positive and identical marginal tax which increases as δ decreases. Turning to the saving choice, things are different. First, only type 3, the far-sighted skilled workers, are not subject to distortion. The others are subject to a subsidy that is particularly high for type 2 (myopic and unskilled) when $\beta_0 = 0.2$. When $\beta = 0.8$, that is when the degree of myopia is small, the implicit subsidies are also small. Types 1 and (to a more significant extent) 2 are subject to a subsidy but for $\delta = 0.10$, type 3 is subject to a tax. Observe that the tax-subsidy rate is different for all types.

5 Conclusion

This paper has studied the design of an optimal non linear social security scheme in a setting where individuals differ in both productivity and myopia and where the government acts paternalistically in attributing to all individuals the same far-sighted time preferences. The main analytical result we obtain is that the paternalistic utilitarian solution does not necessarily imply forced savings for the myopics. While the Pigouvian (corrective) term calls for such forced saving, it is mitigated (or outweighed) by an incentive term which calls for a tax on savings (inducing a reduction in savings). Our numerical results suggest that as the number of myopic individuals increases, there is less redistribution and more forced saving. Furthermore, as the number of myopic agents increases, the desirability of social security (measured by the difference between social welfare with and without social security) increases.

In two companion papers, we have examined the same issue restricting government intervention to linear schemes studied both from a normative point of view (Cremer *et al.* 2007b) and in a political economy setting (Cremer *et al.* 2007a). Each of these studies sheds light on the same underlying issue but from a different perspective. A basic lesson that emerges from the three papers is that the interplay between redistribution and forced saving is both complex and interesting. In the absence of myopia, the problem would be "straightforward" (we have a standard Mirrlees problem); without heterogeneity in wage, it would be trivial (the first-best can easily be achieved). Combining these two features brings about an intricate interaction which yields some rather counterintuitive results.

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