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Abstract

This paper reviews a number of recent contributions that study pension design with myopic individuals. Its objective is to explore how the presence of more or less myopic individuals affects pension design when individuals differ also in productivity. This double heterogeneity gives rise to an interesting interplay between paternalistic and redistributive considerations, which is at the heart of most of the results that are presented. The main part of the paper is devoted to the issue of pension design when myopic individual do not save "enough" for their retirement because their "myopic self" (with a high discount rate) emerges when labor supply and savings decisions are made. Some extensions and variations are considered in the second part. In particular we deal with situations where labor disutility or preferences for consumption are subject to "habit formation" and where sin goods have a detrimental effect on second period health. Myopic individuals tend to underestimate the effects of both habit formation and sinful consumption, which complicates public policy.

Keywords: myopia, dual self, pensions, sin goods, habit formation.

JEL Classification: E6, H55, D91

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1 Introduction

Myopia and redistribution are probably two of the most convincing rationales for the existence of social security systems.[1] Myopic individuals may not save enough given their life expectancy, and public pensions force them to save an appropriate amount. In most countries, public pension systems also contribute to redistributing resources. The standard approach in the literature treats these two functions separately, and the underlying issues are by now well understood. Treating them together is less easy! The interplay between myopia and redistribution leads to a number of difficulties that have been dealt with in the literature surveyed here.

Not everyone agrees with these two rationales. Concerning the redistributive function, the question is whether one needs social security to ensure a better income distribution. Why not instead just redistribute incomes at the start of lifetime and let people save what they want? This objection, though at first sight well taken, neglects a real world fact: societies are more willing to redistribute resources in old age than in earlier stages of life.[2] The paternalistic notion of "forced saving" argument was often rejected because it rested on differences in discount rates between citizens and governments. More precisely, governments were assumed to be more future-oriented and more patient than their citizens. A more modern view of paternalistic forced saving rests on a gap between individuals' long-run goals and their short-run behavior.[3] This position appears to be more widely accepted.

Recent empirical research has underlined various inadequacies of the standard discounted utility model as a descriptive representation of behavior. In particular, it appears that discount rates are not invariant over different horizons. Indeed, as already noted by Strotz (1956), agents appear to discount the future relative to the present more rapidly than they discount between different dates in the future. According to

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[1] In this survey the terms "public pensions" and "social security" are used indifferently to designate the retirement branch of social insurance.

[2] In any event the underlying theoretical issue, namely that optimal age-related taxation has not been solved yet.

[3] In Pestieau and Possen (2008) public pensions are desirable not only because of myopia, but also because of "prodigality". This phenomenon induces middle income individuals not to save at all, knowing that they will be bailed out in the old age by a "Good Samaritan" government.

this hypothesis, people are impatient at present, but claim to be patient in the future. To understand the consequences of this type of preferences, Laibson (1997) adopted a discrete time discount function.[4] With these so-called hyperbolic preferences, events in the near future are discounted at a higher discount rate than events in the distant future. Put differently, hyperbolic preferences are time-inconsistent, in the sense that preferences at time t are inconsistent with preferences at time $t + 1$. As a consequence, hyperbolic agents report a gap between their long-run goals and their short-run behavior. This has important implications for their economic choices and leads to phenomena like procrastination and undersaving.

This gap between long-run and short-run preferences leads to the important conceptual question of whether the government should give priority to the long-run time preferences, at the expenses of instant tastes. In other words, should the present individual's choices be corrected to make them time consistent. In this survey we adopt the view that the government should paternalistically give priority to long term concerns.[5] So doing we are aware that the direct relation between market equilibrium and social welfare optimum becomes blurred. Let us repeat that the discrepancy between government's and individuals' preferences is *not* due to differences in discount rates (future-oriented governments imposing their view on citizens seeking instant gratification). This is what can be called the "old paternalism" in the line of Musgrave's merit goods. With hyperbolic preferences individuals will *ex post* be grateful to the government for having forced them to act according to their long-run concerns. This is what is now called the "new paternalism".

To keep the presentation of ideas and work as clear as possible we had to restrict the scope of this survey in two main directions.[6] First, we adopt a two-period model: in the first period, individuals work and save part of their earnings for their consumption in retirement and retire in the second. So doing, we do not use hyperbolic preferences *per se* but we keep the spirit of the concept that is the duality of selves towards saving. The

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[4]This specification was first introduced by Phelps and Pollak (1968) to study intergenerational time preferences.

[5]For an excellent discussion, see Diamond (2003) and Kaplow (2006).

[6]See Findley and Caliendo (2008) for a survey focusing on the behavioral justification for public pensions.

pioneering contribution using this two period specification is due to Feldstein (1985).[7] To have genuine hyperbolic preferences, one needs at least three periods as in Frogneux (2009) or Diamond and Koszegi (2000). Second, we assume that the retirement age is given. In other words we do not consider the retirement decision unlike Diamond and Koszegi (2000), Frogneux (2009) and Bassi (2008). These two limits allow us to focus on the double heterogeneity (myopia and productivity) which otherwise brings about a drastic increase in the degree of complexity.[8]

We use the same model throughout the survey: a two-period static model with work in the first period and retirement in the second.[9] The technology is linear so that both interest and wage rates are given. Individuals save part of their earnings for their consumption in retirement. They differ in productivity and in their 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. In other words, they use a discount factor which does not reflect their "true" time preferences. When they retire, they regret their earlier decisions. Consequently, they would be in favor of an imposed commitment forcing them to save a certain amount. We distinguish between two settings: a normative one and a positive one. In the normative setting, the paternalistic government helps the individuals to overcome their myopia problem. In measuring social welfare it uses the rate of time preference of the far-sighted individuals (whose myopic self never emerges). *Ex post*, myopic individuals will be grateful to the government for such forced saving. In the positive setting, individuals vote at the start of the first period. At that point, the myopics vote for an imposed commitment knowing that as soon as out of the voting booth they will relapse in their need for instant gratification. In other words, they behave as sophisticated and not as naive myopic agents. Note that this normative rule can be given a positive interpretation. Behind the veil of ignorance concerning ability and myopia, expected utility maximizing

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[7]Feldstein assumes that individual do not just use to low a discount factor assumes but that they also underestimate the level of their future pension benefits. See also Docquier (2002).

[8]We do not mention a number of studies (*e.g.,* Gustman and Steinmeier(2001) and Frogneux (2009).) showing that misperception can also arise when the information required to make plans for the future is not widely available among the population.

[9]Our assumptions and their implications are discussed in the Conclusion.

3

individuals would unanimously vote for such a rule.

The rest of the paper is organized as follows. In the next section we study a social security program with a proportional payroll tax rate and a linear benefit formula. Benefits are a weighted average of a flat and a contributive component according to a parameter which determines the degree of redistributiveness of the system. We first determine the optimal policy and then study a voting procedure. In either case, both the generosity and the degree of redistribution are chosen. Then in section 3, we consider the case of a non linear scheme. Section 4 is devoted to a number of extensions in which myopia interfere with habit formation, sinful consumption and overwork.[10]

2 Linear pension scheme

2.1 Myopic and far–sighted individuals: laissez-faire and first-best

Individuals' utility is given by

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

where c_i and d_i are first- and second-period consumption while ℓ_i is labor supplied in the first period. 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. Individuals can save part of first period income at a zero interest rate. To keep the analysis simple we often focus on the case where liquidity constraints are not binding.[11] However, the expressions for the optimal pension parameters are valid with and without liquidity constraints.

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 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

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

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[10]The backbone of this survey rests on our own work and that of coauthors. However, a number of other recent contributions are also mentioned and positioned with respect to our canonical model.

[11]When the pension system is generous poor individuals may want to borrow against future benefits and thus unsave. Introducing liquidity constraints would prevent them from doing so.

For myopic individuals we have $\beta_i = \beta_0$, while $\beta_i = \beta$ holds for the far-sighted. We adopt two alternative specifications for $V(c_i, \ell_i)$. In the linear case, both normative and positive, we use

$$V(c_i, \ell_i) = u(x_i) = u(c_i - v(\ell_i)),$$

with u being strictly concave and v strictly convex. In the non linear case, we have instead:

$$V(c_i, \ell_i) = u(c_i) - v(\ell_i).$$

The quasi linear specification allows to assume away income effects. The second specification that assumes additivity is consistent with Atkinson and Stiglitz (1976) and their proposition of zero taxation of saving.

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

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

where μ is the Lagrangian multiplier associated with the budget constraint while π_i denotes the relative number of type i's individuals. A type is here defined by a certain degree of myopia and a wage rate. Maximization of $\mathcal{L}_{FB}$ yields

$$x_i = x,$$
$$d_i = d,$$
$$\ell_j < \ell_k \ \text{ iff } \ w_j < w_k.$$

With these preferences the utilitarian solution implies that consumption levels (net of labor disutility in period one) 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 myopic individuals to save. Either way, in a full information setting, there is no conflict between paternalism and redistribution. The two objectives are addressed by separate instruments. Any redistributive impact of corrective policies can be neutralized through lump-sum transfers.

2.2   Optimal linear pension scheme

We now leave the world of first-best and introduce our linear pension scheme that is partially flat and partially earnings-related.[12] We assume that wage differences are private knowledge, as is degree of myopia. We introduce social security with two parameters, a proportional tax rate τ for youth, and a degree of redistribution $1 - \alpha$ for old age benefits. Some agents are "far-sighted", $j = F$, and some are "myopic", $j = M$. The former have intertemporal discount factor β, and the latter $\beta_0 < \beta$. In this section, we assume the myopic agents have $\beta_0 = 0$. That is to say, in youth they give no thought to their own coming old age. As to the far-sighted, we set $\beta = 1$ for simplicity. Using a continuous version of w, pension benefits of an individual with wage w is:

$$p(w) = \tau \alpha w \ell + \tau(1 - \alpha)Ew\ell,$$

where α is often called the "Bismarckian factor". Here and throughout the paper the notation Ez, where z is any function of w, is used for its average value. In particular, $Ew\ell$ denotes average earnings. We have two polar cases depending on the value of α. For $\alpha = 0$ we have a flat pension equal to $p = \tau Ew\ell$; (Beveridgean system). And for $\alpha = 1$, we have a contributive pension with benefit $p = \tau w\ell$ (Bismarckian system).

When the liquidity constraint does not bind, we have[13]

$$v'(\ell_F) = [1 - \tau(1 - \alpha)]w$$

$$v'(\ell_M) = (1 - \tau)w$$

Not surprisingly there is no distortion for the far-sighted with a fully contributory system ($\alpha = 1$). The labor choice of the myopic is distorted regardless of the value of α. These

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[12]This section follows Cremer et al. (2008b). See also Findley and Caliendo (2009).

[13]Expressions are more complicated when the liquidity constraint is binding. Consequently, labor supply depends on w, τ and α for all rational individuals, and also on $Ew\ell$ (this Beveridgean component of the pension benefits) for those rational agents who are liquidity constrained. See Cremer *et al.* (2007) for a more detailed discussion.

expression determine ℓ_F and ℓ_M as function of the wage, w, and the parameters of the pension system, τ and, in the case of ℓ_F, α.

Turning to the government's problem, we write its Lagrangian expression (where LP stands for linear pension):

$$\mathcal{L}_{LP} = \sum_{j=M,F} \pi_j \left\{ Eu[w\left(1-\tau\right)\ell_j - s_j - v\left(\ell_j\right)] \right.$$

$$\left. + Eu\left[s_j + \tau\left(\alpha w\ell_j + (1-\alpha)\sum_{k=M,F} Ew\ell_k\right)\right]\right\}$$

that is based on a utilitarian social welfare function with true (long run) preferences as arguments. Here the π_j denotes the proportion of individuals with myopia β_j ($\beta_M = 0$ and $\beta_F = 1$). Deriving the first-order conditions, simplifying and rearranging yields the following expressions

$$\tau = \frac{\sum \pi_j[(1-\alpha)\operatorname{cov}\left(w\ell_j, u'\left(d_j\right)\right)] - \sum \pi_j E\left[w\ell_j\left(u'\left(d_j\right) - u'\left(x_j\right)\right)\right]}{\sum \pi_j\left(1-\alpha\right)Eu'\left(d_j\right)E\left(w\frac{\partial \ell_j}{\partial \tau}\right) + \pi_M \alpha E\left(w\frac{\partial \ell_M}{\partial \tau}u'(d_M)\right)},$$

$$\frac{\partial \mathcal{L}_{LP}}{\partial \alpha} = \sum \pi_j \left\{ \tau \operatorname{cov}\left(w\ell_j, u'\left(d_j\right)\right) \right\} + \pi_F \tau\left(1-\alpha\right)\tau Eu'\left(d_F\right)E\left(w\frac{\partial \ell_F}{\partial \alpha}\right).$$

Recall that labor supply and savings are functions of wage and of the parameters of the pension system and that these functions are different for the myopic and the far sighted individuals. In the tax formula, the first term of both the numerator and the denominator are the standard equity and efficiency terms in optimal linear taxation. They vanish if $\alpha = 1$. The second term in the numerator reflects the cost of not being able to fully equalize marginal utilities between the two periods.[14] The second term in the denominator reflects the fact that the distortion for the myopic is independent of α, whereas for the far-sighted it vanishes when $\alpha = 1$. The second expression concerns the optimal value of α.

Two questions come to mind at this point: how does the generosity of the system and its redistributive character change with the proportion of myopics? One expects more generosity (forced saving concerns not only the poor but also the myopics) and less redistribution (part of forced saving concerns the rich myopics). Unfortunately,

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[14]This term vanished for the farsighted whose liquidity constraint is not binding.

π_F	α	τ	τ^*
0.0000	0.000	0.250	0.250
0.1000	0.066	0.247	0.247
0.2000	0.122	0.245	0.243
0.4000	0.209	0.242	0.233
0.6000	0.272	0.239	0.220
0.7000	0.298	0.238	0.211
0.9000	0.342	0.236	0.209
0.910	0.344	0.236	0.179
0.930	0.347	0.236	0.174
0.960	0.353	0.236	0.165
0.990	0.358	0.235	0.155
0.999	0.360	0.235	0.151
0.9999	0.360	0.235	0.151
1.0	-	-	0.151

Table 1: Optimal linear pension scheme as a function of the proportion of rational individuals. No liquidity constraint. We denote τ^* the optimal tax rate for $\alpha = 0$.

the above formulas are not helpful to answer these questions. Hence we resort to some numerical simulations with individual utility:

$$u = \log \left(c - \ell^2/2\right) + \log d$$

and with a positively skewed Beta $(2, 4)$ distribution for the wages with support $(1, 4)$. We continue to assume that $\beta_M = 0$ and $\beta_F = 1$. Table 1 concerns the case without liquidity constraint. It gives the optimal values of both α and τ for different proportions of myopics. The last column gives the optimal value of τ when $\alpha = 0$, that is when the pension system is purely Beveridgean. Starting with the extreme values, we see that with only myopics, the pension system is Beveridgean and the tax rate equal to .25. We observe that α increases, while τ decreases with the proportion of far-sighted individuals. Going back to the two questions raised above, we can say that both the generosity and the redistributiveness increase with the proportion of myopics. When the pension system is constrained to be purely Beveridgean, τ decreases when π_F increases. Table 2 reports the results when savings is constrained to be non negative for the far-sighted and zero for the myopics. The generosity of the system continues to decrease with π_F. However, the pattern of results pertaining to α is now more complex. We notice first that with

8

π_F	α	τ	τ^*
0.0000	0.000	0.250	0.250
0.1000	0.072	0.246	0.245
0.2000	0.131	0.243	0.240
0.4000	0.220	0.236	0.228
0.6000	0.277	0.230	0.213
0.7000	0.295	0.225	0.203
0.9000	0.290	0.209	0.191
0.9900	0.106	0.166	0.151
0.9990	-0.184	0.127	0.148
0.9999	-0.346	0.111	0.147
1.0000	-1.360	0.064	0.147

Table 2: Optimal linear pension scheme as a function of the proportion of far-sighted individuals. Liquidity constraint is imposed.

only far-sighted, α is negative, that is the pension system is means-tested, but not very generous ($\tau = 0.06$). Second, α is no longer a monotonic function of the proportion of far-sighted. As π_F increases, α increases and then decreases. The property that generosity and the redistributiveness increase with the proportion of myopics thus has to be qualified here and applies only when π_F is in the range of $[0, 0.8]$.

2.3   Voting over type and generosity of pension system

In the previous section we have dealt with myopic individuals that could have been naive or sophisticated. It was not possible to sort them out, as there were no commitment device available that could have been used by the sophisticated and not by the naive. Voting provides an opportunity for the sophisticated myopics to vote for the policy parameters, namely the tax rate and the Bismarckian factor, by using their "true", long run, preferences while anticipating that they will make some decisions in a myopic way. In other words, at the moment they vote, they try to determine the social security system that will act as a commitment device. This is an interesting feature: for a short instant, behind a kind of veil of ignorance, or rather the walls of the voting booth myopic individuals are in a state of grace.[15]

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[15] This section follows Cremer *et al.* (2007).

The term "myopic" is admittedly somewhat misleading for sophisticated myopics. The problem with these individuals is not so much their short-sightedness, but their lack of self-control when savings, labor and consumption decisions are made. At the voting stage these individuals effectively have a rather sophisticated behavior in that they anticipate their future (mis)behavior. A possible justification for this combination of sophisticated and myopic behavior is the fact that voting is a low frequency event which can serve as a commitment mechanism while savings decisions are made in a continuous (and often reversible way) which creates more opportunities to breach one's original plans. Cremer *et al.* (2007) study this problem using the above quasi linear specification for the first period utility. In their model, people vote sequentially. They first vote on whether the pension system is Bismarckian or Beveridgean. Intermediate solutions are not considered for reasons of simplicity. They then vote on the tax rate. The following conclusions are reached. First, whereas with homogeneous societies (only myopic or only rational) the majority always votes for a Beveridgean pension system, with mixed societies, a Bismarckian system can turn out to be desirable. Second, the tax rate does not always increase with the proportion of myopic individuals, which somehow contradicts the results obtained in the normative cases. Third, there are cases which result into a "ends against the middle" solution.

To illustrate these points Table 3 presents an example provided by Cremer *et al.* (2007). This example gives the voting equilibrium as a function of the proportion of myopics when the utility is logarithmic and the ability has a Beta density function. As the proportion of myopics increases the support of myopics for Beveridge increases and that of the far-sighted decreases.

Up to now we have assumed that individuals were either myopic or far-sighted and the myopics were sophisticated. Sophisticated agents are opposed to naïve ones, who do not see the problem and perceive themselves as time consistent agents. If we had naïve agents in the voting game just sketched, they would vote against any forced saving. This point is made by Bassi (2008). Bassi (2008) develops a political economy model, in which the size of the social security system and the degree of redistribution are chosen by direct majority voting. He shows that a winning coalition of hyperbolic

Prop of myopics	Support for Bev by myopics	by far-sighted	Bev/Bis	Tax
0		0.520	Bev	0.055
0.02	0.213	0.509	Bev	0.069
0.05	0.508	0.497	Bis	0.250
0.25	0.536	0.451	Bis	0.250
0.50	0.539	0.442	Bis	0.250
1.00	0.539		Bev	0.250

Table 3: Voting equilibrium as a function of the proportion of myopics

individuals is able to determine both the generosity and the degree of redistribution of the PAYGO system. In particular, his model explains why low level of redistribution are often associated with generous pension programs.

The distinction between sophisticated and naive myopic agents is particularly useful in three (or more) period-models with both saving and retirement decision. If retirement age is to be chosen in the second period its choice can be used as a commitment device to achieve the right level of saving for consumption in the third period. Frogneux (2009) builds a model in which the agents vote on the tax rate and on the generosity of the early retirement scheme. He shows that the young generation may favor setting up a PAYGO pension system even if it is a dominated saving device just because it increases the cost of early retirement and can be a way to constraint future retirement choice if these contributions are lost in case of early retirement. If the young do not perceive the self-control problem (*i.e.,* if they are naive), such a result would not emerge.

3 Nonlinear pension schemes

In the previous section, we have assumed a linear scheme that rested on gross earnings. For obvious reasons, a non linear scheme based on the same variable should be preferred particularly if it can be supplemented by some taxation of savings. We now turn to such a scheme[16]. To keep the analysis simple we consider a society consisting of four types of individuals as represented on Figure 1. Type-1 and type-3 individuals are the far-sighted with low and high ability respectively. Type-2 (low ability) and type-4 (high

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[16]This section follows Cremer *et al.* (2009). See also Tenhunen and Tuomala (2010)

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. In the analytical second-best part we provide general expressions but for their interpretation we concentrate on a three type setting. The fully-fledged four type case is then solved in numerical examples.

True preferences are given by

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

whereas savings and labor supply are chosen according to

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

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

Our non linear tax/pension system is denoted by $T(y_i, s_i)$ and $p(y_i, s_i)$ where both income $y_i = w_i \ell_i$ and savings s_i are observable. Define

$$\Theta_i = 1 - \frac{1 + p_s(y_i, s_i)}{1 + T_s(y_i, s_i)} = \frac{T_s(y_i, s_i) - p_s(y_i, s_i)}{1 + T_s(y_i, s_i)}, \tag{3}$$

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

$$\frac{u'(c_i)}{u'(d_i)} = \beta_i (1 - \Theta_i)$$

The interpretation of Θ_i depends on implementation (private savings vs pensions system). For example when d_i's are fully controlled by the pension system, $\Theta_i < 0$ means that the system implies forced saving for type i. We now characterize the optimal allocations (c_i, d_i, y_i) subject to the relevant self-selection constraints that rely on observable variables. With two dimensions we cannot avoid a complex pattern of binding IC constraints but first let us look at the first-best solutions which is given by

$$c_1 = c_2 = c_3 = c_4,$$

$$d_1 = d_2 = d_3 = d_4,$$

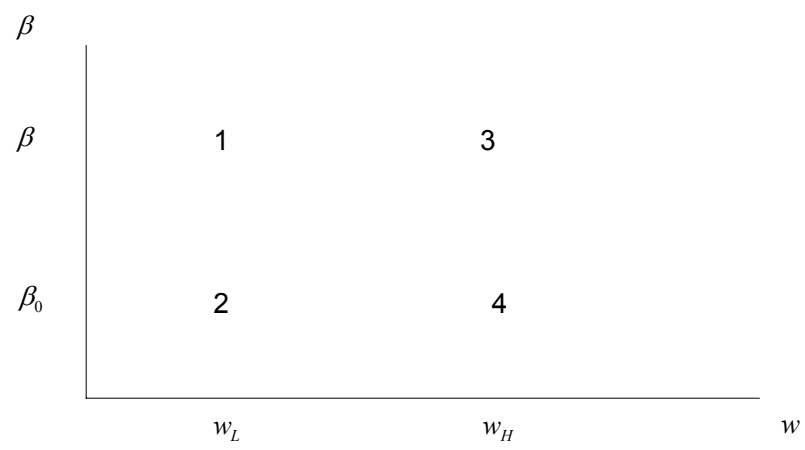$$\ell_1 = \ell_2 < \ell_3 = \ell_4.$$

12

Figure 1: Types of individuals

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This solution is of course not incentive compatible. This leads us to the second-best problem in the case where individual productivities and preferences are not publicly observable. The question we want to explore is that of a possible conflict between corrective subsidy and redistribution.

As announced, we assume $\pi_2 = 0$. In other words there are no myopic poor. In this 3-type case only "downward" constraints are binding. Namely,

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

2. $\lambda_{34} > 0$ and $\lambda_{41} > 0$, while $\lambda_{ij} = 0$ for all other constraints.[17]

When the binding incentive constraints are those associated with the Lagrange multipliers λ_{34}, λ_{41}, and λ_{31}, one can easily check (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 combining the first-order conditions with Equation 3 and simplifying yields the following expressions:

$$\Theta_3 = 0, \tag{4}$$

$$\Theta_4 = \frac{\beta - \beta_0}{\beta_0} \frac{\lambda_{34}}{\pi_4 + \lambda_{41} - \lambda_{34}} - \frac{\beta - \beta_0}{\beta_0} \frac{\pi_4}{\pi_4 + \lambda_{41} - \lambda_{34}}, \tag{5}$$

$$\Theta_1 = -\frac{\beta - \beta_0}{\beta_0} \frac{\lambda_{41}}{\pi_1 - \lambda_{31} - \lambda_{41}}. \tag{6}$$

Equation 4 means that high-ability far-sighted individuals face no distortion on their savings (they face a zero marginal tax rate). Equation 6 implies $\Theta_1 < 0$, so that savings of low-ability (far-sighted) individuals are subsidized. This is not due to paternalism but to incentive considerations (to relax an otherwise binding incentive constraint). Subsidizing saving by type-1 individuals makes their consumption bundle less attractive to type-4 individuals (who have a lower β_i). These are all rather standard results.

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, because

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[17]Recall that in a Kuhn-Tucker problem $\lambda_{ij} > 0$ means that the associated constraint is binding. See on this Cremer *et al* (2001, 2003)

the two terms in Equation 5 are of opposite sign. The optimal tax term is positive because the relevant binding incentive constraint goes from type-3 to type-4, and we have $\beta_3 = \beta > \beta_4 = \beta_0$. The paternalistic term, on the other hand, is negative (as discussed above). Which case occurs depends on the sign of $\pi_4 - \lambda_{34}$; when $\pi_4 - \lambda_{34} > (<)0$, Θ_4 is negative (positive). We thus have a conflict between paternalistic and redistributive considerations. Intuitively, correcting for myopia (through forced savings) benefits the rich myopic at the expense of the poor far-sighted.

To get more insight we now turn to some numerical results. These are obtained from an example with a utility function:

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

and myopic individuals with $\beta_0 = 0.2$ or $\beta_0 = 0.8$. Wages rates are $w_L = 4$ (proportion 0.6) and $w_H = 8$. The relative share of myopics is given by π_M.

From the figure given below it appears that social welfare decreases with π_M (except in the *first-best* where it is constant). The gap between the second-best and *laissez-faire* increases with π_M. Table 3 shows how the welfare of the far-sighted is affected by the presence of myopic individuals. It appears that the poor workers are penalized by the presence of shortsighted individuals. Myopia implies a less redistributive tax and pension system. This can be contrasted with the linear pension case in which both the generosity of the pension system and its redistributiveness increases with the number of myopics.

4 Habit formation and sin goods

In the previous sections, myopia mainly concerned retirement saving. Because of myopia individuals are not saving enough. If there exists no private or social commitment device they reach retirement without sufficient resources. We now consider two instance in which those individuals can at least in part compensate for too little saving. The first instance is when their retirement age is endogenous and they have thus the possibility to extend their career or even to unretire to meet some unexpected needs. Those needs are not always foreseen and come from habit formation. The second instance
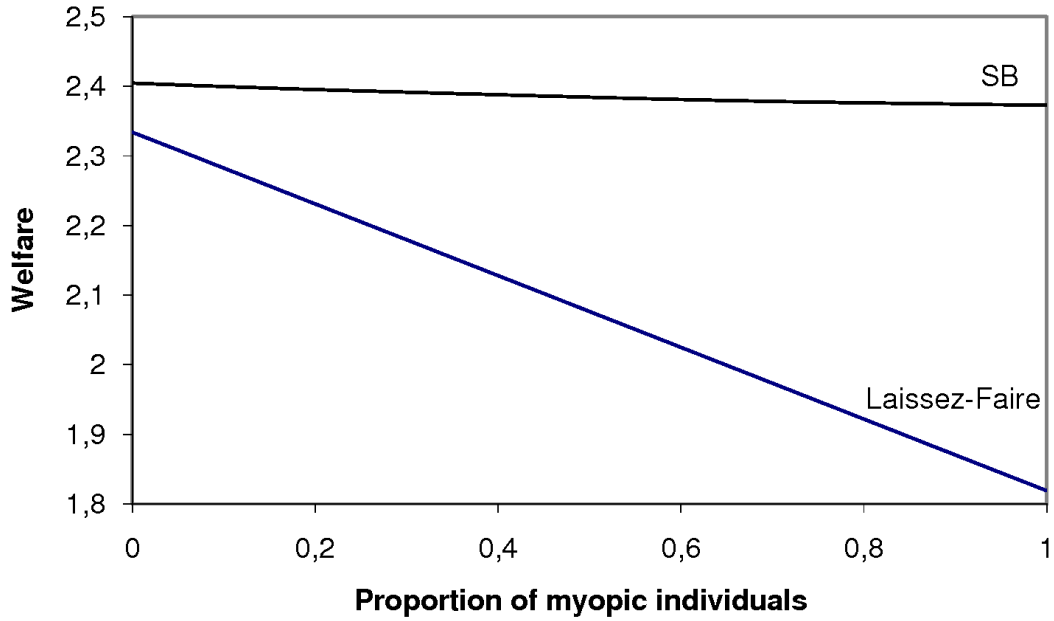
Figure 2: Welfare as a function of the proportion of myopic individuals

π_M	$\beta_0 = 0.2$		$\beta_0 = 0.8$	
	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

Table 4: Welfare and utility gap in the second-best

is when individuals consume some "sin goods" in the first period not realizing that they have detrimental effects on their health in the second period. Fortunately when they reach this second period they can alleviate some of the damage through additional non anticipated health spending. In those two instances, government policy has to be adjusted in an interesting way.

4.1 Habit formation and labor supply

Consider individuals who work the entirety of the first period and just a fraction ℓ of the second. Their consumption of first period has a stimulating effect on their consumption in second period but because of myopia they do not take that "habit formation" effect into account when saving.[18] As a consequence, when they reach the second period of their life these individuals are short of resources and to meet these unforeseen needs they have to work longer than expected. Formally, their preferences are expressed as:

$$U\left(c,d,\ell\right) = u\left(c\right) + v\left(d,c\right) - h\left(\ell\right),$$

where $v\left(d,c\right)$ is the utility for second period consumption that depends on first period consumption, and ℓ is second period labor supply (retirement age)[19] We express the idea of habit formation by positing $v_c < 0$ and $v_{dc} > 0$; namely previous period consumption generates additional needs and reduces second period's utility. As before we have myopic and far-sighted individuals. Myopic individuals use $v(d,0)$ in period 1; and we have to distinguish ℓ^P from ℓ, that is planned from actual age of retirement. As expected, in the laissez-faire ℓ is larger for myopics and this can explain the phenomenon of "unretirement". The first-best is trivial and its decentralization requires a tax on c *or* a subsidy on d. In contrast the second-best with linear taxes is complex as it implies a tricky interaction between redistribution, revenue raising and corrective (Pigouvian) considerations. Formally the model is similar to Sandmo (1975), except that it is much more intricate.[20] Unlike in Sandmo the principle of targeting does not hold. Introducing different wages along with different degrees of myopia, we show that the optimal policy

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[18]This subsection follows Cremer *et al.* (2010a).
[19]Note the difference with Diamond and Mirrlees (2000)
[20]See also Cremer *et al* (1998)

is less redistributive than it would be without myopia. Another rather surprising finding is that the consumption tax increases the welfare of both the myopic (Pigouvian effect) and far-sighted individuals (redistributive effect). There are possible extensions to this model. For example, there is the case of young workers who do overtime not realizing that this will hurt their health and force them in early retirement for reasons of disability. In the first best overtime should be regulated but in a world with double heterogeneity redistribution and myopia correction interfere.

4.2   Taxing sin goods and subsidizing health care

Sin goods are interesting when they involve the duality of self.[21] Basically when they consume the sin good individuals focus on instant gratification and neglect the delayed effects of their sinful consumption on their health. Here too they welcome the paternalistic intervention of a government that pursues two objectives: redistribution and correcting for myopia. The individual utility function is simply:

$$U_i = u\left(c_i\right) + \varphi\left(x_i\right) + u\left(d_i\right) + \beta_i h\left(x_i, e_i\right),$$

where x is consumption of sin good (period 1) and h is health status in second period; e is expenses on health care. Myopics use $\alpha_i < \beta_i$. Once again interplay between redistribution and corrective taxes (covariance and Pigouvian terms). It is interesting to distinguish not only far-sighted and myopic individuals but also myopic individuals that have a dual self (D) and "single self" individuals who happily never admit their sin (S).

We denote the tax on the sin good by θ^i where $i = D, S$. The first-best can be decentralized with

$$\theta^S \gtreqqless \theta^D \quad \text{iff} \quad h_{xe} \gtreqqless 0.$$

In other words, if x and e are complements, $h_{xe} > 0$, the sin tax is higher with persistent error than with regret; a myopic individual of type D under-estimates consumption of health care or alternatively he overestimates damage compared to an individual of type S. Note that the above inequality can also be used to compare the case with and

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[21]This subsection follows Cremer et al. (2010b).

without corrective health treatment. In case of complementarity, the sin tax is higher without such a correction being available than with it.

5   Conclusion

This paper has surveyed some of the recent work devoted to the design of a social security scheme in a setting where individuals differ in both productivity and myopia. It first looked at the normative question of a government that acts paternalistically in attributing to all individuals the same far-sighted time preferences. The main analytical result we obtain is that 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. Further in the linear case, as the number of myopics increases, the system becomes more generous but also more redistributive at least for a not too high proportion of far-sighted. The paper then turned to the choice of social security by majority voting; the main conclusion is that whereas flat rate pensions prevail in societies with only myopics or far-sighted, in mixed society, part of the benefits are earnings-related or to put it another way, the pension scheme is less redistributive.

The basic lesson that emerges from the this literature is that the interplay between redistribution and forced saving is both complex and interesting. In the absence of myopia, the problem would be "straightforward"; 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.

To keep this survey focused on the interaction between redistribution and myopia we have made several simplifying assumptions: *(i)* the wage and interest rates are given (linear technology or small open economy), *(ii)* $r = n$, so that PAYGO and fully funding are equivalent, *(iii)* individuals live just for two periods, *(iv)* the model is static, more precisely it depicts a steady-state economy and, *(v)*, the age of retirement is given.

These assumptions have lead us to neglect a number of existing contributions. For instance Frogneux (2009) considers an endogenous retirement age within a hyperbolic discounting setting *à la* Salanié and Treich (2006). He shows that the impact of a quasi-hyperbolic discount function on the retirement age is *a priori* indeterminate: a

19

self-control effect leads to early retirement while the discounting effect leads to later retirement. By restricting our model to two periods we also miss an interesting result due to Imrohoroglu *et al.* (2003) and recently generalized by Caliendo (2009) according to which in partial equilibrium, naive quasi-hyperbolic consumers who do not anticipate their own time inconsistency cannot benefit from a social security program with a negative net present value. This result is important and surprising given the conventional wisdom that social security can be rationalized as a useful commitment device for hyperbolic discounters. What is the intuition of this result? The upshot is that a PAYGO social security with $n < r$ reduces life-cycle consumption in every period across the life cycle.[22] Our model is a two-period static model. For a dynamic analysis, see Fehr *et al.* (2008) who resort to calibrated numerical simulations to show that with myopia the efficiency cost of privatization is higher than without myopia[23]. See also Fehr and Kindermann (2009) who compare the relative merits of standard social security and individual retirement accounts when individuals are more or less myopic. All this work is interesting but is not concerned by the double heterogeneity that is at the hart of this survey.

Some extensions and variations have been presented in the second part. The first one deals with situations where labor disutility or preferences for consumption are subject to "habit formation". Myopic individuals may not be aware of this relationship (or discount the future in an inappropriate way) when they make their labor supply, consumption and savings decisions. We show that the combination of habit formation (present consumption creating additional consumption needs in the future) and myopia may explain why some retirees are forced to postpone retirement. This in turn may call for government intervention. Another variation deals with the issues of "sin taxes" and the subsidization of health care for the elderly. We consider a sin good that brings pleasure but has a detrimental effect on second period health. Myopic individuals tend to underestimate this effect. In the second period, individuals can devote part of their saving to improve their health status and thus compensate for the damage caused by

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[22]See also on this Andersen and Bhattacharya (2010).
[23]See also Bucciol (2008).

their sinful consumption. We study the optimal linear taxes on sin good consumption, saving and health care expenditures for a paternalistic social planner.

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