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**Article**

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# Health, responsibility and taxation with a fresh start

Aitor Calo-Blanco<sup>1</sup>

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**Abstract** In a model where individuals differ in both their health care needs and their lifestyle preferences, we examine the fair provision of health care when those who regret their initial decisions are granted a fresh start. By considering that each agent chooses how to allocate a given amount of resources between medical and non-medical consumption, we characterise the scheme of taxes and health treatments that maximises social preferences. These preferences allow the planner to make welfare assessments when it is acceptable to compensate agents who have changed their preferences and/or who are endowed with a bad medical disposition. We show that the optimal tax scheme does not only pay additional treatments for those who are not in a good health state, but also protectively induces agents to reduce their non-medical consumption in order to limit a possible future regret.

**Keywords** Health · Lifestyle preferences · Fairness · Fresh start · Taxation

**JEL Classification** D63 · D71 · H20 · I10

## 1 Introduction

The idea of a fresh start defends compensating those who have changed their preferences and hence regret their past choices. Although the issues of health and the provision of health care have attracted a lot attention recently, they have been barely studied in relation to such an idea. In this paper we study how the interaction between

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the ethical concept of fresh starts and basic notions of fairness affects the optimal design of an incentive-compatible tax scheme which aims to provide extra health care to those who may need it.

The forgiving ethical view that advocates giving those who regret their previous choices a fresh start is a controversial one (see [Arneson 1989](#); [Dworkin 2000, 2002](#); [Fleurbaey 2002, 2005a, 2008](#)). Some authors are reluctant to endorse this view as they consider that it may entail both incentive and moral issues (e.g., [Arneson 1989](#); [Dworkin 2002](#)). Their argument is twofold. On the one hand, these authors claim that helping those who have mismanaged their resources generates incentive problems, as some individuals may fake regret in order to receive extra resources. On the other hand, such authors also consider that it is unfair to help regretful individuals for a frugality they have never practised. This would allow the spendthrift to ‘have the proverbial cake and eat it too’ (see [Dworkin 2002](#)).

All these arguments against fresh starts have been disputed by [Fleurbaey \(2005a, 2008\)](#). First of all, he argues that if providing individuals with a fresh start were completely free, basically no-one would be against this principle. Consequently, the moral criticisms seem to be only valid in cases in which fresh starts entail a cost to others. Moreover, the idea of charging costs to other individuals is not only defended by this ideal, but by any redistribution policy as well. Second, in terms of efficiency [Fleurbaey \(2005a, 2008\)](#) also shows that a properly designed incentive-compatible fresh start policy limits any possible ‘undeserved’ compensation that individuals might receive from misreporting their real preferences. Additionally, he argues that this policy would increase freedom as individuals would no longer be forced to bear the consequences of their early choices.

Together with this idea of forgiveness and fresh starts, in this paper we also consider the issue of compensating individuals who are endowed with different traits. The most relevant theories of fairness and responsibility argue that inequalities in agents’ outcomes may contain elements for which those agents are responsible, but also other elements they should not be held responsible for. The aim of such theories is to reduce only the outcome differences that originate in factors for which individuals cannot be held responsible (e.g., [Rawls 1971](#); [Dworkin 1981a, b](#); [Arneson 1989](#); [Cohen 1989](#); and [Roemer 1998](#)).

The objective of this paper is to study the optimal distribution of medical and non-medical consumption that results from the implementation of a public policy that endorses these two ethical principles, forgiveness and fair compensation. The reason to focus our analysis on the issue of health is that there is a large consensus that it is one of the most crucial dimensions of the individual well-being, and hence its allocation cannot be analysed as the distribution of other alternative goods such as consumption (e.g., [Fleurbaey and Schokkaert 2011](#)). Moreover, as regards forgiveness it is not infrequent to observe the implementation of the idea of a fresh start to real-life situations in which health is involved. An example of this kind of implementation is any public health system, which usually treats all those individuals who are in a bad health condition, regardless of their lifestyle. Interestingly enough, some countries are recently starting to defend the opposite view in order to reduce the cost of health care. Specifically, they propose limiting the right to health care of those who do not stop leading an unhealthy lifestyle.

These two ethical principles that we endorse have been separately analysed by previous works (e.g., [Fleurbaey 2005a, b](#)). In a recent paper, [Calo-Blanco \(2014\)](#) proposes a way of combining forgiveness and fair compensation in a model in which individuals differ in both their health care needs and their preferences over health and consumption. Specifically, he derives a social ordering function that gives the highest priority to that agent with the largest level of a specific measure of individual well-being loss. Such a measure is defined as the difference that exists, in terms of a hypothetical consumption, between the individual's current situation and the ideal choice she would have made with her true *ex post* preferences if she had the most favourable health disposition possible. Given the way in which this value is defined it is possible to reach a compromise between compensating individuals endowed with a poor medical disposition, and granting those who regret their initial choice a fresh start.

Nevertheless, an important question that yet remains to be addressed is the implication that the adoption of a particular social ordering function accounting for a fresh start has for the design of the optimal taxation policy. Following Mirrlees' ([1971](#)) seminal contribution, many papers have studied the issue of social welfare and optimal taxation (e.g., [Atkinson 1995](#); [Diamond 1998](#)). However, many of these papers have resorted to a specific choice of both social evaluation and individual utility functions, and hence their results are only robust to the particular specification they have assumed. By contrast, a recent branch of the literature has focused on the theory of optimal taxation from a more general viewpoint. More precisely, such a branch resorts to social value judgments that are defined by means of fairness conditions, which consider only individual non-comparable ordinal preferences. The most representative models of this last approach are due to [Fleurbaey and Maniquet \(2006, 2007\)](#). Assuming that individuals differ in both their preferences and their labour skills, the main objective of these papers is to provide criteria for the characterisation of the optimal fair tax scheme over observable income levels. They conclude that, in order to maximise social welfare, the optimal scheme should focus on a particular region of the budget set that is attainable by a specific type of agent. An extension of this framework is proposed by [Valletta \(2014\)](#), who analyses the joint taxation of income and health expenditure in a model in which agents have heterogeneous preferences over consumption, labour and health.

By assuming this recent approach to optimal taxation, in this paper we study the overall distribution of consumption and medical expenditure that results from a fresh start policy that is implemented via a particular tax scheme. This policy is designed to satisfy the social preferences that minimise the individual well-being loss as defined in [Calo-Blanco \(2014\)](#). However, such social preferences are derived in a first-best framework in which health states and medical dispositions are observable, something that is usually ruled out in taxation models (see [Valletta 2014](#)). Therefore, we adapt our analysis to a second-best scenario in which only the distribution of the total expenditure on health and consumption is observable, considering this way that the tax scheme has to be defined as monetary transfers that depend on this distribution alone. Specifically, agents are taxed as a function of their consumption, and as a consequence they may or may not receive a public subsidy that can be exclusively devoted to get additional health treatment.

Although the analysis of any policy for a population which is heterogeneous in several dimensions is a difficult task, in this paper we present a characterisation of the optimal (tax-treatment) fresh start policy and the allocation that it generates. The first conclusion we reach is that the policy defines an optimal balance between paying additional health treatments and putting protective constraints on early individual non-medical decisions (by means of a consumption tax) to limit the possibility of a future regret. This result can be used as a solution to the recent public discussion about how to deal with those who refuse to lead a healthy lifestyle. Specifically, to avoid having an ‘unfair’ society that limits the right to health care, which is a pivotal element of the individual well-being, our fresh-start policy advocates limiting instead the individuals’ ability to fully enjoy their preferences. This solution is in line with the arguments proposed by Fleurbaey (2005a) that defend the idea of a fresh start. The second outcome of our characterisation results is that the scope of the fresh start policy is limited by the informational constraints of the model. As a result of this limitation the planner cannot guarantee the goal of perfect equality in terms of individual well-being. This is so because such informational constraints allow those agents endowed with a good medical disposition to apply for low tax rates and extra health treatments that are originally intended to help those with higher health care needs. The third main conclusion we obtain is that the largest well-being loss is defined by the specific shape of the set of the indifference curves associated with each type of preferences, and not by the ‘size’ of the change between *ex ante* and *ex post* preferences. This is so because the equivalent measure that we use to compare well-being losses is specifically defined for each type. Finally, under an additional assumption about individual preferences, we show that the agent who pays the highest tax is someone who makes her choice with the preferences that show the largest concern for health, that is, someone who does not regret her choice.

The rest of the paper is organised as follows. Section 2 introduces the basic elements of the model, including the social preferences that society endorses. Section 3 develops the characterisation of the optimal tax scheme. Additionally, it displays the numerical computation for a particular parameter configuration of the model. Section 4 offers the conclusions of this study. All proofs are contained in the appendix.

## 2 The model

Let us consider a population that consists of a finite set of individuals  $N = \{1, \dots, i, \dots, n\}$ . In this economy only two goods are available, namely consumption and health. Consumption is understood as the expenditure on non-medical goods,  $c \in \mathbb{R}_+$ , while health is a variable that ranges from 0 (full ill-health) to 1 (perfect health), that is,  $h \in H = [0, 1]$ . Let  $h^* := 1$  denote the state of perfect health.

Individuals have three different traits, namely their medical disposition, their initial resources and their preferences.

Every agent  $i \in N$  is characterised by a medical disposition  $m_i \in \mathbb{R}_{++}$  which defines the amount of medical expenditure  $m_i h \in \mathbb{R}_+$  that she needs to invest to reach a given health state  $h \in H$ . For ease of exposition we consider that there are only two types of health care needs, and hence individuals have either a good or a

bad medical disposition. Therefore, let  $\mathcal{M} = \{g, b\}$  denote the set of all the possible medical dispositions, with  $g < b$ . These two values are assumed to be fixed for all possible allocations. Let  $m_N = (m_i)_{i \in N} \in \mathcal{M}^n$  be the population's profile of health dispositions.<sup>1</sup> Note that the functional form of the health disposition entails two simplifications. First, the trade-off between health and consumption, although not equal, is linear for all individuals. Second, if the monetary resources are large enough, all agents can eventually achieve the state of perfect health.

As regards the initial resources, all individuals are endowed with an equal income  $\omega \in \mathbb{R}_{++}$  that they have to allocate between consumption and medical expenditure. As we are already considering differences in health care needs, a factor for which individuals will be compensated by society, we have opted to assume a unique value for  $\omega$  in order to provide a clearer intuition of the role that fresh starts play. This monetary endowment is also assumed to be fixed for all possible allocations.

Finally, each individual has preferences over the available goods. However, as we have mentioned in the Introduction, in taxation models it is usually assumed that only income and expenditure are observable. Therefore, in order to be able to analyse the redistribution of resources that the fresh start policy yields, let us first describe an observable space that consists of consumption and total medical expenditure. Specifically, each individual  $i \in N$  has a *consumption-expenditure bundle*  $x_i = (c_i, \alpha_i) \in X = \mathbb{R}_+^2$  that designates the situation in which she has a level of consumption  $c_i$  and a total medical expenditure  $\alpha_i \in \mathbb{R}_+$ , which encompasses the sum of both private and public resources allocated to the individual's medical expenditure. Given her fixed health care needs  $m_i$ , this sum of resources determines the individual's final level of health  $h_i$ . Note that from the individual's perspective this definition of the model entails a one-to-one correspondence with respect to the space of consumption and health. An *allocation* describes all the individuals' bundles, that is,  $x_N = (x_i)_{i \in N} \in X^n$ . Let us then assume that every individual  $i \in N$  has well-defined preferences  $R^{m_i}$  over the consumption-expenditure space  $X$ , which are described by a complete preorder. Moreover, preferences must also be continuous, convex and strictly monotonic. Note that the preferences display the medical disposition since agents may transform the medical expenditure into health in a different way. For any individual  $i \in N$ ,  $(c, \alpha) R^{m_i} (c', \alpha')$  means that bundle  $(c, \alpha)$  is weakly preferred to bundle  $(c', \alpha')$ . Strict preference will be denoted by  $P^{m_i}$ , and indifference will be denoted by  $I^{m_i}$ . A profile of preferences in society is denoted by  $R_N = (R^{m_i})_{i \in N}$ .

The analysis of the design of a fresh start policy for a population endowed with unobservable heterogeneous traits is a complex task. Consequently, to keep things simple we introduce the following assumptions in the domain of admissible individual preferences.

First, preferences related to the same medical disposition are required to satisfy the *single-crossing property*. This implies that for any two individuals who differ in their preferences, but not in their health care needs, any two indifference curves cross no more than once. Let us make use of such a property to state that for any  $(c, \alpha), (c', \alpha') \in X$ ,  $j, k \in N$  and  $m_j, m_k \in \mathcal{M}$  such that  $m_j = m_k$ , individual

<sup>1</sup> A group of objects  $a_N = (a_i)_{i \in N}$  defines a list such as  $(a_1, \dots, a_i, \dots, a_n)$ .

preferences  $R^{mj}$  show a higher concern for health than the set  $R^{mk}$ , something we denote by  $R^{mj} \succ^h R^{mk}$ , if they satisfy the following relations:

$$\begin{cases} c' > c \text{ and } (c, \alpha) I^{mk}(c', \alpha') \Rightarrow (c, \alpha) P^{mj}(c', \alpha'), \\ c' < c \text{ and } (c, \alpha) I^{mj}(c', \alpha') \Rightarrow (c, \alpha) P^{mk}(c', \alpha'). \end{cases}$$

In other words, an agent  $j \in N$  is said to have a higher concern for health than any other agent  $k \in N$  if, with the same health disposition, the former devotes a higher share of the initial resources to medical expenditure than the latter. As a result of this, individuals with the same health care needs can be ordered according to their preferences over the distribution of consumption and medical expenditure. However, since agents may transform the total resources devoted to health in a different way, something that affects their assessment of consumption-expenditure bundles, the *single-crossing* property is only assured among individuals who have the same health disposition.

Second, and in accordance with the previous assumption, let us consider that for all medical dispositions there exists a fixed and finite number of concerns for health  $F \geq 2$ . Therefore, for any  $m \in \mathcal{M}$  the set of individual preferences can be ranked according to these concerns for health, with  $R_f^m \succ^h R_{f-1}^m$  for any  $f \in \{2, \dots, F\}$ . That is, among those endowed with  $m$ , an agent associated with a set of preferences  $R_1^m$  has the lowest preference for health, an agent associated with a set  $R_2^m$  the second lowest, etc. and an agent associated with a concern  $R_F^m$  has the largest preference for health. Let  $\mathcal{R} = \mathcal{M} \times F$  denote the set of individual preferences that satisfy all the properties presented above, and hence  $R_N \in \mathcal{R}^n$ .

Finally, we assume that agents make their choices according to some *ex ante* preferences  $R_N^a = ((R^{mi})^a)_{i \in N} \in \mathcal{R}^n$ , although they get their final utility from an *ex post* profile  $R_N^t = ((R^{mi})^t)_{i \in N} \in \mathcal{R}^n$  that may or may not coincide with their *ex ante* preferences. Let us consider that any individual who *ex post* changes her preferences becomes more concerned for health, that is, for all  $i \in N$  either  $(R^{mi})^t = (R^{mi})^a$  or  $(R^{mi})^t \succ^h (R^{mi})^a$ . Additionally, for any  $R_f^m, R_{f'}^m \in \mathcal{R}$ , where  $R_f^m \succ^h R_{f'}^m$ , there exist individuals  $j, k \in N$  endowed with a health disposition  $m$  such that  $j$  sticks to preferences  $R_f^m$ , and individual  $k$  changes from  $R_{f'}^m$  to  $R_f^m$ . That is, for a given medical disposition and a specific type of preferences there exist individuals who stick to this specific type of preferences, and individuals who change to it from any other type that show a lower concern for health.

In order to provide a clear intuition of the set of admissible individual preferences, let us present a particular example of the utility function that agents may have. This example, which is derived from Fleurbaey (2005b), establishes that an individual endowed with a medical disposition  $m \in \mathcal{M}$  has preferences  $R_f^m \in \mathcal{R}$  represented by the utility function:

$$u_f^m(c, \alpha) = c \left( \frac{\alpha}{m} \right)^{\delta_f},$$

where  $\delta_f > 0$  is a parameter that measures the individual concern for health. Note that since agents actually care about health, the preferences show the way in which they transform the medical expenditure into a final health state. Given that the preferences



are depicted by a Cobb–Douglas utility function, the higher the value of  $\delta_f$ , the higher the share of the initial endowment that an individual devotes to medical expenditure. Hence, for a fixed set  $\Delta = \{\delta_1, \dots, \delta_f, \dots, \delta_F\}$ , where  $\delta_f > \delta_{f-1}$ , we say that an agent who makes her choice according to  $\delta \in \Delta$  exhibits a higher concern for health than any other agent who makes her choice according to  $\delta' \in \Delta$ , if  $\delta' < \delta$ . This assertion is valid as long as both individuals are endowed with the same health care needs. Moreover, every agent with a medical disposition  $m \in \mathcal{M}$  makes her choice with  $u_f^m(c, \alpha)$ , but she derives utility from  $u_{f+t}^m(c, \alpha)$ , where  $t \geq 0$ . That is, as we have previously established, she either sticks to her choice or becomes more concerned for health. Finally, the set of all possible individual preferences in this example is  $\mathcal{R} = \{R_1^b, \dots, R_f^b, \dots, R_F^b, R_1^g, \dots, R_f^g, \dots, R_F^g\}$ .

Returning to our theoretical framework, an *economy* is described by a list  $e = (m_N, \omega, R_N^i) \in \mathcal{E}$ , where  $\mathcal{E}$  denotes the set of all the economies that satisfy the assumptions presented above. Social preferences permit us to compare allocations in terms of forgiveness and responsibility for any economy. Such preferences are denoted by  $\mathbf{R}(e)$ , and let us assume that they are described by a complete preorder.  $x_N \mathbf{R}(e) x'_N$  means that allocation  $x_N$  is at least as good as  $x'_N$ . The corresponding strict social preference and social indifference relations are denoted by  $\mathbf{P}(e)$  and by  $\mathbf{I}(e)$ , respectively. It is important to remark that the definition of an economy entails that *ex ante* preferences are the deciding factor in the determination of the allocations that are going to be evaluated by society, but such preferences are later excluded from that evaluation as it is considered that only final or *ex post* goals matter (see Fleurbaey 2005a; Calo-Blanco 2016).

After having defined the elements of the model, we now proceed to present the social ordering function that the planner adopts to assess social welfare. To do so, let us first introduce some key concepts. We start by defining the notion of *full-health equivalent consumption* (FHEC), which is the smallest level of consumption that one individual would be willing to accept, according to her *ex post* preferences, to exchange her present bundle for one in which she has perfect health (see Fleurbaey 2005b):

**Definition 1** For all  $i \in N$ ,  $m_i \in \mathcal{M}$ ,  $(R^{m_i})^t \in \mathcal{R}$  and  $x_i \in X$ , the individual  $i$ 's full-health equivalent consumption is the value  $c_{f_i}^{m_i}(x_i)$  that satisfies:

$$c_{f_i}^{m_i}(x_i) = \min\{c' \in \mathbb{R}_+ \mid (c', m_i h^*) (R^{m_i})^t (c_i, \alpha_i)\},$$

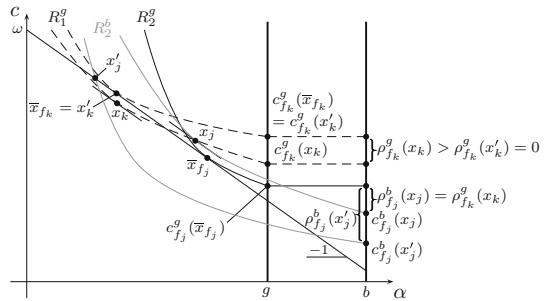
where  $f_i \in \{1, \dots, F\}$  denotes the concern for health associated with  $(R^{m_i})^t$ .

Second, we introduce a concept that we name  *$\rho$ -equivalent loss* and which will allow us to assess the well-being loss that any individual experiences as a result of not being in an 'ideal' situation which entails neither regret nor health disabilities. Such a situation, that we call the *most preferred bundle*, is defined as the choice that the individual would make, according to her *ex post* preferences and her initial resources, if she had the best medical disposition, that is, the good one. For any  $i \in N$ , let us denote this most preferred bundle by  $\bar{x}_{f_i} \in X$ . Given this ideal point, our measure of individual well-being loss is constructed as follows:

**Definition 2** For all  $e \in \mathcal{E}$ ,  $i \in N$  and  $x_i \in X$ , the individual  $i$ 's  $\rho$ -equivalent loss is:

$$\rho_{f_i}^{m_i}(x_i) = c_{f_i}^g(\bar{x}_{f_i}) - c_{f_i}^{m_i}(x_i).$$



$$\mathbf{R}_{\rho}^{\text{lex}}$$


## Social ordering function 1

$$x_N \mathbf{R}_\rho^{\text{lex}}(e)x'_N \Leftrightarrow (\rho_{f_i}^{m_i}(x'_i))_{i \in N} \succeq_L (\rho_{f_i}^{m_i}(x_i))_{i \in N}. \quad \textcolor{blue}{2}$$

Let us consider an economy in which there are only two individuals,  $j$  and  $k$ , and the initial allocation is given by  $x'_N \in X^2$ . Individual  $k$ 's choice, which she makes with the preferences that show the lowest concern for health, is characterised by both the good medical disposition and a complete absence of regret, and hence  $\rho_{fk}^g(x'_k) = 0$ . Individual  $j$  also makes her choice with the preferences that exhibit the lowest concern for health, but she is endowed with the worst medical disposition, that is, the bad one. As a consequence of this she opts for a distribution  $x'_j$  of her total resources that entails a larger level of consumption than  $x'_k$ . Moreover, she changes her preferences *ex post*

<sup>2</sup> Where  $\succeq_L$  denotes the *leximax* criterion as proposed by Bossert et al. (1994). It establishes that a group of objects  $a_N \in \mathbb{R}^n$  dominates any other group  $a'_N \in \mathbb{R}^n$  “if the highest value in  $a_N$  is higher than the highest value in  $a'_N$ . If the highest values are identical, then society eliminates that value from the two allocations and compares the highest values in the reduced allocations, and so on”.

to another set  $R_2^b$  that is related to a higher concern for health. Therefore, her measure of well-being loss,  $\rho_{f_j}^b(x'_j) > 0$ , encompasses the effects of the two factors for which society wants to compensate individuals. According to  $\mathbf{R}_\rho^{\text{lex}}$ , a redistribution policy that induces an alternative allocation such as  $x_N \in X^2$  improves social welfare, that is  $x_N \mathbf{P}_\rho^{\text{lex}}(e)x'_N$ , because the highest  $\rho$ -equivalent loss in this new allocation is smaller than the highest value in the initial one, as we can observe in Fig. 1. The task of describing how to induce this alternative allocation by means of a fresh start policy will be undertaken in the next section.

### 3 The fresh-start policy

So far we have presented a specific ranking that allows us to make welfare assessments when society wants both to compensate individuals for their health care needs and to give those who genuinely regret their choice a fresh start. After having made such a presentation, we now deal with the objective of our paper, which is the analysis of an incentive-compatible fresh start policy that satisfies this social ranking.

Let us then introduce a social planner who designs a policy that aims to minimise the highest  $\rho$ -equivalent loss across individuals, as it was established by  $\mathbf{R}_\rho^{\text{lex}}$ . This policy is defined by means of a tax scheme that characterises transfers of resources depending on the observable pieces of information (e.g., [Fleurbaey and Maniquet 2006, 2007](#); [Valletta 2014](#)). Given the available pieces of information, the planner's tax scheme is defined as a function of the individual level of consumption, that is  $\tau(c) : [0, \omega] \rightarrow \mathbb{R}$ . This scheme is used by the planner to design the optimal fresh start policy by means of distorting any individual's budget set, and hence her initial choice. Specifically, when  $\tau(c) > 0$  the individual cannot invest in health as much as she wishes because she faces an additional cost. Therefore, the tax can be used as a way of inducing individuals to limit the share of the initial endowment that they devote to non-medical consumption. On the contrary, the tax turns into a subsidy when  $\tau(c) < 0$ , and hence the individual can enjoy a level of medical expenditure which is larger than the one she could have afforded after her outlay on consumption. Let us stress that the subsidy can be solely devoted to pay additional health expenditure, and hence it cannot be used to increase the non-medical consumption. In other words, with the monetary resources collected from those who pay a strictly positive tax, the planner funds a health service to treat all those agents who are not in a good health state.

It is important to stress that any tax scheme that intervenes in the choice between medical expenditure and consumption has very different impacts on individuals depending on their preferences. On the one hand, this scheme limits those who want to expend a large share of their resources on non-medical consumption. On the other hand, agents who lead a healthy lifestyle are being forced to fund a public service that they are less likely to use. The social planner's aim is to find a *fair* balance between these two factors.

Let us now formally define the set of all the bundles that any individual can afford in the presence of a social planner:

**Definition 3** For all  $e \in \mathcal{E}$  and  $i \in N$ , the individual  $i$ 's consumption-expenditure feasible set under a tax scheme  $\tau(c) : [0, \omega] \rightarrow \mathbb{R}$  is:

$$B(c) = \{(c, \alpha) \in X \mid \alpha \leq \omega - c - \tau(c)\}.$$

That is, the agent  $i$ 's budget set in space  $X$  is characterised by how the tax scheme affects the individual's level of medical expenditure after her choice of consumption. The agent is said to be taxed (respectively subsidised) when her total expenditure, both in consumption and in health, is lower (larger) than the initial endowment. Note that  $\omega - c - \tau(c)$  defines the sum of both private and public resources allocated to medical treatment, and hence  $\alpha_i = \omega - c_i - \tau(c_i)$  for any  $i \in N$ . Such a sum determines the agent  $i$ 's final health state,  $h_i \in H$ , as a function of her health disposition. Formally:

$$h_i = \frac{\omega - c_i - \tau(c_i)}{m_i}.$$

According to the standard optimal taxation approach (e.g., [Fleurbaey and Maniquet 2006, 2011](#)), in order to have a well-defined fresh start policy the allocation induced by the tax scheme must satisfy the following two conditions. First, it has to be *feasible*, that is  $\sum_{i \in N} (c_i + \alpha_i) \leq n\omega$ . This implies that the total cost of the final allocation must not exceed the total monetary resources in the economy. Second, since individuals are free to choose their level of consumption in a budget set modified by the tax function which is identical for everybody, the allocation induced by the planner must be *incentive-compatible*. This means that any agent  $i \in N$  has to end up with a bundle that she *ex ante* prefers to the one that any other agent  $j \in N$  has. Formally, an allocation  $x_N \in X^n$  is said to be incentive-compatible if and only:<sup>3</sup>

$$\text{for all } j, k \in N; (c_j, \alpha_j) \left( R^{m_j} \right)^a (c_k, \alpha_k) \text{ or } c_{f_j}^{m_j}(x_j) \geq c_k.$$

The intuition behind the first part of the definition of this second condition is rather clear. Since what matters is the way in which the initial endowment is distributed, every individual chooses a combination of consumption and medical expenditure that, given her health disposition, provides her with the highest level of *ex ante* utility. Then, if individual  $j \in N$ , whatever her health care needs are, preferred the combination selected by any other agent  $k \in N$  to her actual choice, nothing would prevent the former from choosing the bundle picked by  $k$ . Therefore, an allocation is incentive-compatible if and only if no individual envies *ex ante* the bundle of any other agent. The second part of the incentive-compatibility constraint,  $c_{f_j}^{m_j}(x_j) \geq c_k$ , limits the use of the condition itself for bundles that entail levels of medical expenditure which are

<sup>3</sup> As [Fleurbaey and Maniquet \(2005\)](#) point out, “the theory of optimal taxation is more easily constructed in terms of maximising a social ordering over possible tax schemes (or, more precisely, over the set of incentive-compatible allocations). Therefore it is important to construct orderings over all allocations, and not only to construct allocation rules”. Alternatively, one may relate this condition to the choice of both an incentive-compatible social choice function (that is, a mechanism) and an admissible set of individual preferences that yield a particular allocation in which no individual envies *ex ante* the bundle of any other agent.

above  $g \in \mathcal{M}$ . Beyond this point individuals endowed with a good health disposition cannot get additional utility from medical consumption, and hence their indifference curves become completely flat showing, then, that additional health expenditure would not increase their utility (see Fig. 1).

Once having defined the basic elements that characterise the tax scheme, let us now present the implications of the planner's fresh start policy. Those implications can be summarised in the following theorem:

**Theorem 1** *For any economy  $e \in \mathcal{E}$ , the tax scheme  $\tau(c) : [0, \omega] \rightarrow \mathbb{R}$  which induces a feasible and incentive-compatible allocation  $x_N \in X^n$  that minimises the highest  $\rho$ -equivalent loss across individuals is such that:*

- (i) *Perfect equality in terms of the  $\rho$ -equivalent loss can never be achieved, unless the whole of the population is at the state of perfect health, and moreover the FHEC related to the most preferred bundle is the same for all types of preferences.*
- (ii) *The largest consumption is defined by an agent who selects her bundle with the preferences that show the lowest concern for health, whereas the highest medical expenditure is associated with someone who exhibits the highest concern for health.*
- (iii) *The highest  $\rho$ -equivalent loss is determined by someone endowed with a bad health disposition, and who makes her choice with the preferences that show the lowest concern for health. By contrast, the best-off in terms of the  $\rho$ -equivalent loss is someone with a good health disposition who sticks to her ex ante preferences.*
- (iv) *If the choice of consumption is independent of the medical disposition, the highest tax is paid by someone who selects her bundle with the preferences that show the largest concern for health.*

The first conclusion of the implementation of the fresh start policy is that the full egalitarian goal is unattainable, except in rather simple scenarios in which differences in preferences play virtually no role whatsoever. Such an extreme result is originated by the fact that the tax scheme must provide equal treatment to those who select the same level of consumption. Then, any individual with a good medical disposition would always mimic the behaviour of an agent who exhibits the same concern for health but who is endowed with a bad medical disposition. By selecting the same choice than the latter, the former would benefit from an extra medical treatment that was not originally designed for her. This line of argument is always valid until the point in which the scheme leads to a level of health that is equal to  $h^*$  for all agents. In such a situation the incentive-compatibility constraint would never be satisfied unless all individuals had the same value of the FHEC associated with their own respective most preferred bundle. This difficulty to achieve the full egalitarian goal was already pointed out by Fleurbaey (2005a) as a consequence of the use of the incentive-compatible condition. Nevertheless, in his model the egalitarian outcome is the optimal result when the variety of preferences is limited to only two types. In our health framework this particular egalitarian result is not possible because, besides incentive-compatibility, we have heterogeneity in health care needs as well.

The second point of the theorem deals with the extreme values of the goods in the final allocation. The largest levels of medical expenditure and consumption are

given, respectively, by individuals who present the highest and the lowest concern for health. This outcome, which is relatively expected, arises from the combined application of the incentive-compatibility constraint and the single-crossing property. The most relevant part of this result is that individuals who define these largest values can have any medical disposition, something that is owing to the fact that the single-crossing property is not satisfied among individuals endowed with different health care needs. Let us now show the intuition behind this second characterisation outcome by focusing on the largest level of consumption across the population. To do so we consider a specific case in which the bad health disposition agents who have made their initial choice with the type that exhibits the lowest concern for health, that is  $R_1^b$ , face both a high price for health and a large preference for consumption. Therefore, their indifference curves would be too flat with respect to the rest of the agents, and hence the optimal tax scheme would assign them the highest level of consumption (this example is depicted in Fig. 3 in the appendix). Specifically, since the price that they have to pay for health is too large, the planner would opt to control the well-being loss of those who stick to such a choice via increasing the utility that they derive from ordinary consumption. By contrast, if the concern for health associated with  $R_1^m$ , for any  $m \in \mathcal{M}$ , would not imply a relatively large preference for consumption the focus of the fresh start policy would turn to those who change their preferences. Hence, the planner would opt to grant the largest consumption to someone who has a good health disposition. In that case the future regret of those endowed with a bad medical disposition would be controlled by inducing them to increase their medical expenditure, limiting this way the public resources that would be required to compensate them afterwards. Consequently, depending on the interaction between the individuals' preferences and health dispositions, it is possible to obtain different characterisation results for the extreme values of the final allocation. Note that this multiplicity of outcomes implies that the highest health state, although it will be defined by someone who exhibits the highest concern for health, cannot be associated with a particular medical disposition.

The third statement of Theorem 1 characterises both the worst-off and the best-off individuals in terms of the reference comparable measure. The smallest level of well-being across the population is determined by a bad health disposition agent who has the *ex ante* preferences that show the lowest concern for health, and who may or may not regret her choice. This is so because, due to the single-crossing property, any agent who may possibly regret her choice will always outperform other agents with the same health disposition who want the same bundle *ex post*, but who have *ex ante* preferences that exhibit a smallest concern for health. Moreover, regretful good medical disposition individuals who make their choice with  $R_1^g$  cannot determine the highest  $\rho$ -equivalent loss either. The reason is that, since they have to pay the smallest price for health, the planner could always reallocate resources in such a way that these agents could be made better-off, increasing this way the social welfare. As a result, the individual who marks the largest  $\rho$ -equivalent loss in society has to be someone endowed with a bad medical disposition and who has made her choice with  $R_1^b$ . Interestingly enough, this implies that it may be the case that the worst-off agent is a steady individual (that is, someone who does not regret her choice) who is endowed with a bad health disposition. This is so because the final value of the comparable measure of utility does not depend on the 'size' of the change of preferences, but on

the shape of the indifference curves that pass through the specific most preferred bundle and through the individual's actual choice. By contrast, the intuition behind the result of who defines the highest well-being across the population is rather clear. A steady agent endowed with a good health disposition, whatever her concern for health, does not suffer any of the factors which define the  $\rho$ -equivalent loss function. Moreover, due to the incentive-compatible constraint, the tax scheme may additionally favour this individual as she may now see it profitable to impersonate those who have a bad health disposition in order to pay a smaller tax. Opposite to the framework developed by Fleurbaey (2005a), in our model it is not possible to characterise the concern for health related to the lowest  $\rho$ -equivalent loss across the population. Once again, this is due to the fact that our comparable measure is specifically defined for each type of preferences.

The principal result behind the fourth and last outcome of Theorem 1 is that it is relatively complex to identify the individual who pays the largest tax. In line with what we have previously argued, the fact that the single-crossing property is not satisfied between agents with different health care needs may lead to a multiplicity of results. After having stated this general multiplicity outcome, let us now derive a specific characterisation result for a particular family of individual preferences. More precisely, we will focus on those for which the choice of consumption does not depend on the individual's medical disposition. In this particular environment the optimal scheme induces an agent who chooses her bundle with the type that shows the highest concern for health to pay the highest tax. The reason is that such an agent has a clear advantage with respect to the rest of individuals since she will never regret her choice.

Let us conclude our analysis by presenting a numerical example of how the incentive-compatible fresh start policy may be designed in the redistribution framework that we have just analysed. To do so we assume that individual preferences over consumption and medical expenditure are described by the utility function that we have introduced in Sect. 2, that is:

$$u_f^m(c, \alpha) = c \left( \frac{\alpha}{m} \right)^{\delta_f}.$$

Let us consider that in this example there are only two concerns for health which are described by the values  $\delta_2 = 1.5 > 0.5 = \delta_1$ . Additionally, each individual is characterised by her health disposition, which can be either good,  $g = 1$ , or bad,  $b = 1.1$ . Therefore, the set of all possible individual preferences is  $\mathcal{R} = \{R_1^b, R_1^g, R_2^b, R_2^g\}$ . The initial endowment is identical for all agents, more precisely,  $\omega_i = 1$  for all  $i \in N$ .

We assume, as it was previously established, that only individuals with concern  $\delta_1$  may regret their choice. Additionally, we have that there exists one single agent per each possible case that our model considers (or that the population is equally distributed among those cases). This implies a total of 6 different individuals that we proceed to introduce. There are two agents with *ex ante* preferences with concern  $\delta_2$ , one with a good health disposition ( $s_2^g$ ) and another one with a bad health disposition ( $s_2^b$ ). As regards those with preferences associated with  $\delta_1$ , there are also good and bad health disposition individuals, but moreover some of them will change *ex post* their type to  $\delta_2$ . Hence, there exist agents with low health care needs that either stick to or regret their *ex*

**Table 1** Results of the numerical example

	$x_N^0$	$h(x_N^0)$	$\rho(x_N^0)$	$x_N^*$	$h(x_N^*)$	$\rho(x_N^*)$	$\tau(x_N^*)$
$s_2^g$	(0.400, 0.600)	0.600	0	(0.391, 0.587)	0.587	0.010	0.022
$s_2^b$	(0.400, 0.600)	0.545	0.025	(0.391, 0.587)	0.533	0.033	0.022
$s_1^g$	(0.667, 0.333)	0.333	0	(0.534, 0.477)	0.477	0.016	−0.011
$r_1^g$	(0.667, 0.333)	0.333	0.058	(0.534, 0.477)	0.477	0.010	−0.011
$s_1^b$	(0.667, 0.333)	0.303	0.018	(0.534, 0.477)	0.434	0.033	−0.011
$r_1^b$	(0.667, 0.333)	0.303	0.075	(0.534, 0.477)	0.434	0.033	−0.011

*ante* preferences. Let  $s_1^g$  and  $r_1^g$  denote such individuals respectively. The same applies for those endowed with a bad health disposition, denoted by  $s_1^b$  and  $r_1^b$  respectively. Therefore, the set of agents in this society is described by  $N = \{s_2^g, s_2^b, s_1^g, r_1^g, s_1^b, r_1^b\}$ .

Table 1 presents both the *laissez-faire* scenario and the results that emerge from the implementation of the fresh start policy. Without the planner's intervention, described by allocation  $x_N^0$ , individuals making their choice according to  $\delta_2$ ,  $s_2^g$  and  $s_2^b$ , will choose a lower level of consumption than the rest of the agents, albeit both  $s_2^g$  and  $s_2^b$  will get a higher medical expenditure, and also a higher health state, in return. Note that due to the specific utility function they choose the same distribution of the initial income. As it is only natural, the agents who suffer no well-being loss are those endowed with the best health disposition and who are properly maximising their utilities, that is,  $s_2^g$  and  $s_1^g$ . As we have characterised in the previous section, the value of the  $\rho$ -equivalent loss function is strictly positive for those who are endowed with a bad health disposition ( $s_2^b$  and  $s_1^b$ ), for those who regret their choice ( $r_1^g$ ), and for those with both issues ( $r_1^b$ ). In this *laissez-faire* scenario the worst-off agent is the one who is affected by these two factors that society wants to compensate individuals for, that is  $r_1^b$ .

The results of the optimal fresh start policy are described, in Table 1, by allocation  $x_N^*$ . In this scenario, since the actual health state is not observable, the planner designs a tax scheme that only depends on the individual level of consumption. This implies that, for instance, individual  $s_2^g$  can apply for the tax offered to any other agent as long as she selects the same consumption than the latter. Since the choice of consumption is independent of the medical disposition, agents with identical *ex ante* concern for health select the same distribution of the total expenditure, regardless of their health care needs. However, they do not end up with the same health state as they transform the medical expenditure into health in a different way.

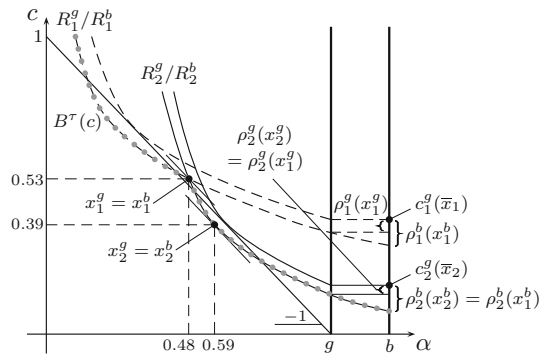
In order to reduce the maximum  $\rho$ -equivalent loss, the public authority taxes the individuals who will not regret their choice, namely, those who select their bundle with the type that defines the highest concern for health, that is,  $\delta_2$ . Since individual  $s_2^g$  is also endowed with a good health disposition, it would be optimal to extract additional resources from her. However, this cannot be done because she always mimics the choice of  $s_2^b$ , and hence the planner is constrained to reduce the tax that charges  $s_2^g$  to avoid harming  $s_2^b$ , who is eventually forced to pay a positive tax. In order to control



the individual well-being loss the planner induces specific levels of consumption and also provides those who have a bad health disposition with an additional treatment. For instance, to compensate the agents endowed with  $b \in \mathcal{M}$  and who have *ex ante* preferences associated with  $\delta_1$ , that is  $s_1^b$  and  $r_1^b$ , the planner designs an optimal scheme such that they end up with less consumption than in  $x_N^0$ , but with a higher medical expenditure as well. As one of them is going to experience a change in her preferences, by reducing the level of consumption it is possible to limit her future utility loss. Given the particular utility function that we have assumed, agents with the same *ex ante* preferences but who are endowed with different health care needs, that is  $s_1^g$  and  $s_1^b$ , will get exactly the same bundle. As a consequence, they receive a subsidy to cover the cost of an additional medical treatment. That is,  $s_1^g$  takes advantage of the existence of the group formed by the bad health disposition agents to get a more favourable deal from the planner. Therefore, and in line with what we have learnt from our theoretical results, the subsidies are funded by those agents who show the highest concern for health; namely,  $s_2^g$  and  $s_2^b$ . Finally, to compensate the individual with the good health disposition and who regrets her choice,  $r_1^g$ , the planner sets a redistribution scheme that self-induces her to limit her level of consumption. Naturally, this measure comes at the cost of reducing the utility of her steady counterpart  $s_1^g$ . As predicted by Theorem 1, perfect equality in terms of regret cannot be achieved, not even in such a simplified society. Note that these incentive constraints that we have described here clearly limit the scope of the planner's intervention. For instance, due to such constraints agent  $s_2^g$  pays a relatively low tax, whereas agent  $s_1^g$  gets a subsidy.

Finally, in Fig. 2 we graphically describe the optimal allocation  $x_N^*$ . Note that, given the specific utility function that we have assumed, the indifference curves related to  $g$  and  $b$  overlap with each other for each concern of health, although they represent different levels of utility. As we have already discussed, we can directly observe in the picture that the full egalitarian goal cannot be achieved. Individuals  $s_2^g$  and  $r_1^g$ , who enjoy the bundles  $x_2^g \in X$  and  $x_1^g \in X$  respectively, get a slightly lower well-being than in their most preferred situation. As regards  $s_2^g$ , she takes advantage of the possibility of mimicking the behaviour of  $s_2^b$ , who obtains  $x_2^b \in X$ , an agent who should be compensated for her bad health disposition. With respect to  $s_1^g$ , whose final choice is  $x_1^g \in X$ , although she is worse-off than in  $x_N^0$ , she benefits from the existence of a bad health disposition counterpart, that is  $s_1^b$ , to get a fairly favourable deal. In fact, she receives a subsidy to get additional health treatment. Therefore, the subsidy obtained by the bad health disposition agents who make their choice with the concern for health  $\delta_1$  is quite limited. Moreover, note that the bundle  $x_2^g$  is characterised by a hypothetical budget line, or a tangency, with a slope equal to 1 with respect to the indifference curve  $R_2^g$  (see Fig. 2). This implies that for those who make such a choice it is not possible to obtain the same level of utility with a lower level of income. This prevents the social planner from extracting additional resources from  $s_2^g$ , and also from  $s_2^b$ , in order to reduce the  $\rho$ -equivalent loss of those choosing  $x_1^b$ , that is,  $s_1^b$  and  $r_1^b$ . Finally, a possible budget set (net of tax) that can induce this optimal allocation

**Fig. 2** Optimal allocation with non-observable health



is the one depicted by the gray dotted line, which is defined as the envelope of the indifference curves related to that optimal allocation.<sup>4</sup>

#### 4 Concluding remarks

The idea of a fresh start is an ethical principle that advocates compensating those individuals who regret their previous choices. Standard frameworks of fairness and responsibility have barely studied this principle in relation to health. One exception is [Calo-Blanco \(2014\)](#), who derives a social ordering function that combines both approaches. Such an ordering, that is obtained by endorsing basic ethical principles, entails minimising the highest well-being loss, which is defined by means of a specific money metric. This metric is the distance, in terms of an equivalent consumption, between the individual's actual choice and a hypothetical ideal bundle which would include neither regret nor health disabilities.

In this paper we have evaluated the consequences of the implementation of an incentive-compatible fresh start policy which aims to maximise social preferences as characterised by [Calo-Blanco \(2014\)](#). By focusing on a scenario in which the planner cannot observe the agents' health state, we have defined this fresh-start policy by means of taxing consumption and subsidising extra medical expenditure. Our main result is that the optimal tax scheme advocates balancing both, raising money through taxation to treat all those agents who are not in a good health state, and providing individuals with incentives to limit the share of the initial endowment that they can devote to non-medical consumption.

Therefore, the theoretical framework that we have developed in this paper can be useful to deal with some public health problems that western societies are currently experiencing. For instance, in order to curb the soaring obesity rate, several national governments, with the support of specialised agencies such as the World Health Organization, are starting to levy taxes on likely unhealthy goods like high-sugar foods. These countries defend that the objective of this measure is twofold. On the one

<sup>4</sup> [Fleurbaey and Maniquet \(2006\)](#) designate the specific tax function which yields such a budget set as 'minimal'.

hand, it aims to dissuade people from consuming goods that have been identified as potentially harmful to their health. On the other hand, the tax can also be used to cut healthcare costs and to increase revenues which can be devoted to healthy initiatives as subsidising the price of low-sugar foods such as fresh fruits and vegetables.

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## Appendix: Proof of Theorem 1

Let us start the proof by showing that, for any economy  $e \in \mathcal{E}$ , in any *ex post* optimal incentive-compatible allocation  $x_N = (c_i, \alpha_i)_{i \in N} \in X^n$  all resources must be exhausted, that is,  $\sum_{i \in N} (c_i^x + \alpha_i^x) = n\omega$ , where  $c_i^x$  and  $\alpha_i^x$  are, respectively, the individual  $i$ 's levels of consumption and total medical expenditure in that particular allocation  $x_N$ . Note that this condition is equivalent to establishing that  $\sum_{i \in N} \tau(c_i^x) = 0$ . Opposite to the desired result, let us consider an incentive-compatible allocation  $y_N = (c_i^y, \alpha_i^y)_{i \in N} \in X^n$  in which  $\sum_{i \in N} (c_i^y + \alpha_i^y) < n\omega$ .

If  $y_j = y_k$  for all  $j, k \in N$ , it is possible to define a parameter  $\varepsilon > 0$  such that if we replace the original allocation  $y_N$  by  $y_N^\varepsilon = (c_i^y + \varepsilon, \alpha_i^y)_{i \in N}$ , we obtain a new feasible and incentive-compatible allocation in which, because of strict monotonicity, all individuals are better-off.

Let us now deal with the case in which individuals do not have the same bundle, that is, there exist  $j, k \in N$  such that  $y_j \neq y_k$ . Since the feasible space is defined in terms of consumption and total medical expenditure, due to the incentive-compatible constraint the final allocation must be distributed along the unique (net of tax) budget set. Let us then focus on that individual who presents the largest expenditure on health. Due to the monotonicity of the preferences and the incentive-compatible constraint, this individual must be associated with the smallest level of consumption. By providing this agent with an additional small amount of consumption the social welfare increases. If this extra consumption generates a problem with incentive-compatibility, it is always possible to increase the utility of, at least, one of the individuals affected by this constraint, without providing the other agents with incentives to change their choice. Due to the single-crossing property, this can be done by moving the bundle that we are considering, and that it triggers the incentive-compatibility problem, along the indifference curve of that individual who has the option to apply for it. Hence, this agent would remain indifferent between this new bundle and her actual choice.

Let us now proceed to prove the four different points of Theorem 1.

- (i) For any economy  $e \in \mathcal{E}$ , to obtain that all agents who regret their choice end up with the same well-being than those who stick to their initial preferences, it must be the case that all bundles, but those related to the preferences  $R_F^m$ , for any  $m \in \mathcal{M} = \{g, b\}$ , are equal in terms of consumption and health.

Opposite to the desired result, let us assume that the  $\rho$ -equivalent loss is identical for all agents, and that individuals endowed with a bad health disposition do not have perfect health. Let  $x_f^m \in X$  denote the choice of any agent who has a medical disposition  $m \in \mathcal{M}$  and the *ex ante* type of preferences  $R_f^m \in \mathcal{R}$ .

Then, for any  $R_f^m \neq R_F^m$  the bundle  $x_f^b \in X$  must be horizontally to the right of  $x_f^g \in X$  (as depicted in Fig. 1), given that both choices entail the same health state but  $g < b$ . However, due to incentive-compatibility, individuals with a good health disposition would also apply for the additional medical expenditure that was originally designed for those endowed with high health care needs. This is so because the health state is private information, and hence the planner cannot discriminate between agents who choose the same level of consumption.

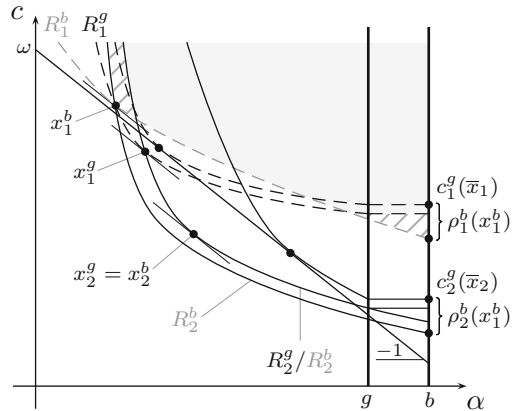
This line of reasoning is only valid as long as the bundles associated with the bad health disposition agents do not entail the state of perfect health. Otherwise, someone endowed with  $g$  would not be able to get additional utility when impersonating a bad health disposition individual. Therefore, let us now show that when this group of agents (those endowed with a bad medical disposition) have perfect health the full egalitarian goal cannot be achieved either. Let us present this result by means of a simple example with just two concerns for health, that is  $\mathcal{R} = \{R_1^b, R_2^b, R_1^g, R_2^g\}$ , in which the final well-being loss is assumed to be equal for all individuals. We additionally consider that every bad health disposition agent has perfect health, and hence her bundle must be located in the indifference curve of her good health disposition counterpart that passes through the choice of this second agent. If  $x_1^b \neq x_2^b$ , we would have that either  $x_2^b P_1^b x_1^b$  or  $x_1^b P_2^b x_2^b$ , as the individuals only care about consumption since their health state is equal to  $h^*$ , and hence incentive-compatibility would not be satisfied. In consequence, it would have to be the case that  $x_1^b = x_2^b$ , but due to the single-crossing property this would imply that  $x_2^g P_1^g x_1^g$ , and hence incentive-compatibility would not be satisfied either.

Therefore, we are left only with the case in which all individuals, but those who make their choice with the type  $R_F^m$ , for any  $m \in \mathcal{M}$ , have the same level of consumption and a perfect health state. In such a case, unless the FHEC associated with the most preferred bundle is identical for all types, the  $\rho$ -equivalent loss cannot be the same for all agents.

- (ii) The fact that in the optimal allocation the extreme values of consumption and medical expenditure are determined, respectively, by the lowest and the highest concern for health is a consequence of the combined application of the incentive-compatible constraint and the single-crossing property.

Let us now make use of a particular example to show that an individual endowed with a bad health disposition can enjoy the highest consumption across the population. Specifically, let us consider a society with just two concerns for health, that is  $\mathcal{R} = \{R_1^b, R_2^b, R_1^g, R_2^g\}$ , in which all resources are exhausted (see Fig. 3).

**Fig. 3** Proof of Theorem 1.ii



Additionally, we assume that for the type that shows the highest concern for health the choice of consumption is independent of the medical disposition, and hence all the indifference curves related to  $R_2^m$ , for any  $m \in \mathcal{M}$ , overlap with one another until the level of medical expenditure  $g$ . As we can observe in the picture, the depicted allocation is incentive-compatible. We will show that it is impossible to reallocate resources such that the maximum  $\rho$ -equivalent loss, which is defined by  $\rho_1^b(x_1^b)$  and  $\rho_2^b(x_1^b)$ , is reduced. In order to lower this maximum value the planner must increase the total expenditure related to  $x_1^b$ , since this bundle is tangent to a hypothetical line with a slope equal to 1 (see Fig. 3). Note that such a tangency means that it is impossible to raise the well-being of the individual who sticks to this bundle without increasing the total expenditure on her choice. Therefore, the social planner must extract resources from, at least, one of the other agents who belong to this particular society. However, if the bundle  $x_1^b$  is moved to the shaded region of space  $X$  (see Fig. 3), due to the incentive-compatible constraint, the rest of the agents in the economy would also apply for it, and hence the allocation would not be feasible. In consequence, there are only two regions (the lined ones) to which the bundle  $x_1^b$  may be moved in order to reduce the maximum  $\rho$ -equivalent loss. In each one of these two areas the monetary value of, at least, one of the other bundles could be decreased without violating incentive-compatibility. In the region that is closer to the vertical axis the planner may try to reduce the total expenditure on  $x_2^b$  and  $x_2^g$  in order to increase the value of  $x_1^b$ . However, because of incentive-compatibility, the agents characterised by  $R_1^g$  would also choose this new bundle  $x_1^b$ . Therefore, depending on the number of individuals who choose each option, the new allocation may not be feasible. The same line of reasoning can be applied in the other lined region of the picture. Finally, similar examples can be laid out to show that the extreme values of the optimal allocation can be characterised by individuals endowed with any possible medical disposition.

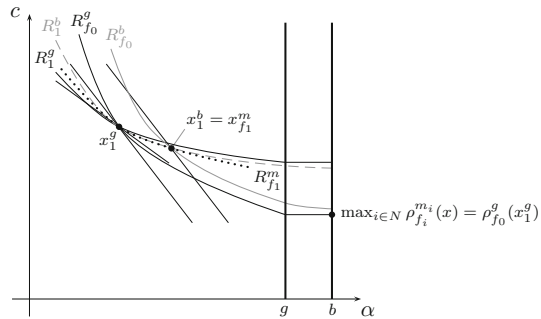
- (iii) Let us first show the characterisation of the highest  $\rho$ -equivalent loss across the population. We start this proof by considering the group of steady agents (that is, those who do not regret their initial choice) who are endowed with a good health

disposition. By incentive-compatibility, they can never be worse-off than the steady bad health disposition individuals who have the same concern for health. Let us now analyse this second group, that is, the steady agents endowed with a bad medical disposition. Because of the incentive-compatible constraint and the single-crossing property, those with preferences  $R_f^b \neq R_1^b$  must be better-off than the regretful bad health disposition agents who choose with preferences  $R_{f_1}^b$ , where  $R_f^b \succ^h R_{f_1}^b$ , and who *ex post* substitute them for  $R_f^b$ . Consequently, let us focus on the group of individuals who regret their initial choice. As regards the good health disposition individuals, for any pair  $R_f^g, R_{f_1}^g \in \mathcal{R}$ , where  $R_f^g \succ^h R_{f_1}^g$ , there exists a third type  $R_{f_2}^g \in \mathcal{R}$  with  $R_{f_2}^g \succ^h R_f^g$  such that, because of the incentive-compatible constraint and the single-crossing property, it must be the case that  $\rho_{f_2}^g(x_f^g) < \rho_{f_2}^g(x_{f_1}^g)$ . This argument is valid for all agents but those making their choice with  $R_1^g$ . Moreover, note that by definition there are no regretful agents with *ex ante* preferences  $R_f^g$ . The same line of reasoning can be applied to the bad health disposition agents who regret their initial choice.

In consequence, in order to characterise the largest  $\rho$ -equivalent loss we must focus on those individuals who choose their bundle with the type of preferences that show the lowest concern for health. Hence, we are left with only two possible cases for the determination of the highest  $\rho$ -equivalent loss in the society; namely,  $\rho_f^b(x_1^b)$  and  $\rho_{f_0}^g(x_1^g)$ , where  $R_f^b \in \mathcal{R}$  and  $R_{f_0}^g \in \mathcal{R} \setminus \{R_1^g\}$ .

Let us now show that whenever  $\max_{i \in N} \rho_{f_i}^{m_i}(x_i) = \rho_{f_0}^g(x_1^g)$ , where  $R_{f_0}^g \neq R_1^g$ , there exists a type  $R_f^b \in \mathcal{R}$ , such that  $\rho_f^b(x_1^b) = \rho_{f_0}^g(x_1^g)$ . Opposite to the desired outcome, let us assume that  $\rho_{f_0}^g(x_1^g)$  defines the strictly largest  $\rho$ -equivalent loss in the society. Since all agents must select their bundle along the unique (net of tax) consumption-expenditure budget line, the highest level of consumption must be defined by someone who has the preferences that show the lowest concern for health (see the proof of Theorem 1.ii). Moreover, since  $\rho_{f_0}^g(x_1^g) > \rho_{f_0}^b(x_1^b)$ , the level of consumption associated with bundle  $x_1^g$  must be larger than the one associated with  $x_1^b$ . Otherwise, since by incentive-compatibility  $x_1^g R_1^g x_1^b$ , the single-crossing property would imply that  $x_1^g P_f^g x_1^b$ , and hence  $\rho_f^g(x_1^g) < \rho_f^b(x_1^b)$ , for all  $R_f^g \in \mathcal{R} \setminus \{R_1^g\}$ . Let us now show that in such a scenario it is always possible to save resources, without increasing the highest  $\rho$ -equivalent loss, until we obtain that  $\rho_f^b(x_1^b) = \rho_{f_0}^g(x_1^g)$  for some  $R_f^b \in \mathcal{R}$ . If there were no incentive-compatibility problems, we could just reduce the consumption in the bundle  $x_1^b$  until we directly reached the desired result. Nevertheless, due to the incentive-compatible constraint, it may happen that when changing  $x_1^b$  those who had previously selected this bundle would opt to substitute it for  $x_{f_1}^m$ , which would be related to a set  $R_{f_1}^m \in \mathcal{R}$ , where  $m \in \mathcal{M}$ . Then, we could additionally reduce the level of consumption of all those bundles that may provide any agent with incentives to misreport their real *ex ante* preferences. However, at some point the very  $x_1^g$  might be the bundle blocking further reductions in consumption. In such a case we could move  $x_1^g$  rightwards along the indifference curve  $R_{f_0}^g$ , as long as the slope at that point were smaller than  $|-1|$ , that is, provided that the bundle

**Fig. 4** Proof of Theorem 1.iii:  
 $\max_{i \in N} \rho_{f_i}^{m_i}(x_i) = \rho_{f_0}^g(x_1^g)$



were distorted to the left with respect to that specific type of preferences (see Fig. 4).<sup>5</sup> This movement would save resources without increasing the highest  $\rho$ -equivalent loss, that is  $\rho_{f_0}^g(x_1^g)$ , and it would also make room for further reductions in the level of consumption associated with other bundles. If there existed any other bundle that, because of the incentive-compatible constraint, would prevent us from implementing such a movement, we could also reduce the value of that bundle. Note that, since the maximum  $\rho$ -equivalent loss is given by  $\rho_{f_0}^g(x_1^g)$ , there would be no other bundle below the indifference curve related to  $R_{f_0}^g$  that passes through  $x_1^g$ . Otherwise, such a bundle would determine, according to  $R_{f_0}^g$ , a higher  $\rho$ -equivalent loss. If, on the contrary, the slope in  $x_1^g$  with respect to  $R_{f_0}^g$  were equal to or higher than  $-1$  it would be possible to move  $x_1^b$ , and any other possible bundle equal to it, backwards along  $R_1^b$  and save some resources without increasing the highest  $\rho$ -equivalent loss (see Fig. 4). By implementing such a movement the bundle  $x_1^b$  would become closer to  $x_1^g$ , and hence the levels of regret would converge to the same value even before the bundles became identical. Therefore, the highest level of regret would be determined by a value  $\rho_f^b(x_1^b)$ , for some  $R_f^b \in \mathcal{R}$ , that equalled  $\rho_{f_0}^g(x_1^g)$ . Let us finish this proof of the third statement of Theorem 1 by analysing the lowest  $\rho$ -equivalent loss across the population. Due to the incentive-compatible constraint, for any steady bad health disposition individual with preferences  $R_f^b \in \mathcal{R}$  there exists another good health disposition agent with the same concern for health who, by definition, cannot be worse-off. With respect to the regretful good health disposition agents, by incentive-compatibility we know that for all  $R_f^g, R_{f_1}^g \in \mathcal{R}$  it must be the case that  $x_f^g R_f^g x_{f_1}^g$ . Therefore, when one individual with a good health disposition changes preferences from  $R_{f_1}^g$  to  $R_f^g$ , she can never end up with a higher well-being than another agent with the same medical disposition and who sticks to the type  $R_{f_1}^g$ . By combining these arguments that we have just applied, one can easily show that the regretful bad health disposition agents cannot determine the lowest well-being loss in the society either. Finally,

<sup>5</sup> For any  $m \in \mathcal{M}$ , a bundle  $x \in X$  is said to be distorted to the left (respectively to the right) with respect to the type  $R_f^m \in \mathcal{R}$  if there exists another bundle  $x' \in X$  such that  $x I_f^m x', c + \alpha > c' + \alpha'$ , and moreover  $c > c'$  (respectively  $c < c'$ ).



- the part of the statement which enunciates that the best-off individual can exhibit any type of preferences is due, once again, to the specific shape of the set of indifference curves that defines each type  $R_f^m \in \mathcal{R}$ , where  $m \in \mathcal{M}$ .
- (iv) In the present proof we focus on the set of feasible preferences for which the choice of consumption is independent of the medical disposition. In this particular scenario individuals who share the concern for health will choose the same expenditure on consumption, whatever their health care needs are. Therefore, for all  $m \in \mathcal{M}$  and  $R_f^m \in \mathcal{R}$  we have that  $x_f^g = x_f^b = x_f$ . Opposite to the desired result, let us assume that there exists a bundle  $x_f \in X$  related to the concern for health  $R_f^m \neq R_F^m$ , such that  $\max_{i \in N} \tau(c_i) = \tau(c_f) > \tau(c_F)$ , where  $c_f$  is the level of consumption associated with the choice  $x_f$ . Note that since the choice of consumption is independent of the medical disposition the single-crossing property is fully satisfied in the present scenario. Therefore, the bundle  $x_f$  has to be located in the tangency of the hypothetical line defined by  $\tau(c_f)$ , that is, it must be distorted neither to the left nor to the right with respect to the type  $R_f^m$ . If it is distorted to the left, one can move  $x_f$  to the right, along the indifference curve belonging to the type  $R_f^m$ , and save some resources without increasing the highest  $\rho$ -equivalent loss. If there existed any bundle  $x_{f+t} \in X$ , where  $t > 0$ , that due to incentive-compatibility prevented us from moving  $x_f$ , it would have to be the case that this bundle  $x_{f+t}$  were distorted to the right. Hence, the final well-being of those who would choose such a bundle could be obtained with a smaller total expenditure. In the case in which  $x_f$  were distorted to the right we could apply a similar line of reasoning, but moving the bundle leftwards. Let us only describe the case in which  $R_f^m = R_1^m$ , as by moving  $x_1 \in X$  leftwards the maximum  $\rho$ -equivalent loss might increase if its value were determined by someone who regretted this specific choice. According to the initial assumptions, the tax paid by the agent with the *ex ante* preferences  $R_{f_1}^m \succ^h R_1^m$  who would characterise the maximum  $\rho$ -equivalent loss is lower than the tax paid by those who had selected  $x_1$ . Hence, and similar to what we have done in the proof of Theorem 1.iii, we could subtract resources from  $x_{f_1}$ , and from other bundles that might prevent us from satisfying the incentive-compatible constraint, until we reached a situation in which the tax paid by  $x_1$  would no longer be the highest one.

Consequently, the bundle  $x_f$  would have to be neutral with respect to the type of preferences  $R_f^m$ , that is, it would have to be distorted neither to the right nor to the left. This would imply that the bundle would have to be located in the tangency between the indifference curve belonging to  $R_f^m$  that would pass through it, and a hypothetical line which would be defined by the tax related to  $x_f$ , that is  $\tau(c_f)$ . Then, for all  $t \geq 0$  we could reduce the value of all the bundles  $x_{f+t+1} \in X$  until we obtained that  $x_{f+t+1} I_{f+t+1}^m x_{f+t}$ . This movement would both save resources and respect incentive-compatibility, but moreover it would not increase the highest  $\rho$ -equivalent loss, which would still be defined by  $\rho_{f_1}^m(x_1)$ , for some  $R_{f_1}^m \in \mathcal{R}$ . However, because of the single-crossing property and the convexity of the preferences, the bundle  $x_F \in X$  would entail a lower total expenditure than  $x_f$ , and hence it would be associated with a higher tax.

Finally, it is important to stress that for levels of medical expenditure which are above  $g \in \mathcal{M}$  the single-crossing property might not be satisfied between agents with

different preferences if they do not have the same health care needs. However, the property is always satisfied among the bad health disposition individuals for the whole of the space  $X$ . Moreover, because of the properties of the individual preferences, an indifference curve associated with a bad health disposition agent belonging to  $R_F^b \in \mathcal{R}$  cannot cross more than once the curve of another individual with a lower concern for health, whatever her health care needs are. Therefore, the previous line of reasoning would still be valid.

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