Published in "Journal of Public Economic Theory", 2020, vol. 22, no 4, pp. 949-972, which should be cited to refer to this work.
DOI:10.1111/jpet.12428

Estate recovery and long-term care insurance[†]

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Abstract: Estate recovery is a policy under which the State recovers part of LTC subsidies from the estates of deceased beneficiaries. This paper studies the effect of estate recovery on long-term care (LTC) insurance demand. This effect strongly relies on the bequest motive since the main purpose behind purchasing LTC insurance is to protect bequests from the financial costs of LTC. We find that the impact of estate recovery on LTC insurance depends on the level of parental bequests and on whether and how the parent anticipates the child's preferences with respect to informal care. More specifically, we show that estate recovery encourages the parent to purchase LTC insurance when his child is considered selfish or to like providing care. However, this policy could provide disincentives to LTC insurance purchase by the parent if his child is considered to dislike providing informal care. Our results also show that estate recovery reduces and may even eliminate public support crowding out of private LTC insurance demand. Finally, we characterise the welfare implications of financing LTC public support by estate recovery.

JEL Classification: D1, H2, I1

Keywords: Estate recovery; long-term care; insurance; informal care; public subsidies

[†] Financial support from the Swiss National Science Foundation (grant number 100018_169662) is gratefully acknowledged.

1. Introduction

The ageing of populations and, in particular, the growing number of elderly individuals in most industrialised countries is accompanied by an increased need for long-term care[1] (LTC). Apart from their own resources, individuals can count on three main sources for supporting and financing these increasing LTC needs: the government, the family and insurance.

LTC costs are, to a large extent, financed by public expenditures (Colombo, 2012) which represented on average about 1.7% of GDP across OECD countries in 2015 (OECD, 2017). Projections suggest that this share is expected to at least double by 2060 (OECD, 2017). Family plays also a major role in LTC funding. Not only does it often contribute financially to help dependent relatives, but also a large part of LTC needs is met in the form of informal care provided by family members, in particular children (Norton, 2016). Finally, LTC insurance markets covering the financial risks linked to LTC needs have developed but with limited success. Explanations for this low development include the issue of long-term risks insurability, asymmetric information, LTC risk pricing, bias in risk perception, and crowding out effects of public support (Brown and Finkelstein, 2009).

As a way to ensure the sustainability of public LTC financing, many policy makers and scholars support the idea of linking LTC public budgets to the taxation of estates (e.g. Cremer et al., 2016). This is especially the case as the share of inherited wealth in overall capital accumulation has been rising since the 1970's and is expected to continue rising in the future (Piketty and Zucman, 2014). In this respect, some countries have implemented estate recovery policies with an aim to recover public LTC subsidies from the estates of deceased beneficiaries. These policies exist in the U.S. and France and their implementation is currently under discussion in Switzerland, England and Wales[2]. Estate recovery differs from inheritance taxation in the sense that while the later consists of a direct tax on bequests, estate recovery can be seen as a co-payment on publicly subsidized LTC, paid from the beneficiary's bequest at the end of his life.

Another rationale for estate recovery pointed out in this paper is that it could be a mean to enhance the purchase of private LTC insurance, and therefore a potential solution to incomplete LTC insurance markets (Frank, 2012). In particular, estate recovery is very likely to impact the demand for LTC insurance through a bequest motive since the main purpose behind purchasing LTC insurance is to protect bequests from the financial costs of LTC (Pauly, 1990). Estate recovery could also enhance LTC insurance purchase as it could attenuate the crowding out of LTC insurance by public support. Indeed, Pauly (1990) suggests that the demand for private LTC insurance is undermined by the availability of public support because it replaces insurance benefits. However, estate recovery, which increases following a more generous public support, together with parental altruism, might attenuate public support crowding out of private LTC insurance.

Scant literature exists on the effect of estate recovery on LTC financing. Thiébaut et al. (2012) theoretically study the impact of a hypothetical estate recovery programme financing the *Allocation Personalisée d'Autonomie*, the French main public LTC benefit, on informal care supply. They show that it depends on the level of altruism of the offspring. Kapp (2006) discusses the public policy implications of the U.S. recovery program as an alternative for the financing of LTC, also identifying some of the main ethical issues raised by this program. Dick

[1] LTC is defined as "a range of services required by individuals with a reduced degree of functional capacity, physical or cognitive, and who are consequently dependent for an extended period of time on help with basic activities of daily living" (Colombo et al., 2011).

[2] See respectively Greenhalgh-Stanley (2012) and Thiébaut et al. (2012) for an overview of the estate recovery programmes in the U.S. and France. See ATS (2018) and Cremer et al. (2016) for more details about the discussions in Switzerland, England and Wales.

(2007) addresses the effect of the estate recovery program on discouraging potential Medicaid beneficiaries from asking for public help. Yet, we are not aware of any work addressing the impact of LTC estate recovery on the purchase of LTC insurance with the bequest motive as a qualifier. Our work tries to fill this gap.

To perform our analysis, we consider a theoretical model with a parent facing the risk of being dependent, who can purchase LTC insurance and who decides about the bequest to be transferred to his child. We introduce a bequest motive by assuming the parent to be perfectly altruistic as in Becker (1974) and Andreoni (1989), i.e. the parent extracts a positive amount of utility from his offspring's inheritance. We also consider the child as a potential informal caregiver and introduce an estate recovery program partially financing the amount of subsidised public support as in Thiébaut et al. (2012).

In a first step, we assume that the parent is unable to anticipate the behaviour of his child when dependent. This allows us to focus exclusively on the bequest motive as the direct mechanism influencing the parent's decision to acquire LTC insurance in the case of estate recovery. In a second step, we consider that the parent anticipates the optimal behaviour of the child to a change in the transfer. We thus consider the possibility for the parent to influence the behaviour of the child as informal caregiver through the bequest. In that case, the parent bequeaths some of his wealth because he is altruistic but also to influence his child's behaviour.

We find that the impact of estate recovery on LTC insurance purchase depends on the level of parental bequests and on whether and how the parent anticipates the child's preferences with respect to informal care. More specifically, we show that estate recovery encourages the parent to purchase LTC insurance when he does not anticipate his child's behaviour or when he anticipates his child to be selfish or to like providing care. However, this policy could provide disincentives to LTC insurance purchase by the parent if his child is considered to dislike providing informal care. Our results also show that estate recovery reduces and may even eliminate public support crowding out of private LTC insurance demand. Hence, estate recovery can impact positively LTC insurance ownership through two channels. A direct one through the bequest motive, and an indirect one through a lower crowding out effect of public support.

Finally, we study the welfare implications of financing LTC public support by estate recovery, characterising the first best and second best solutions. We find that a more comprehensive LTC public support, financed by estate recovery, helps to overcome potential inefficiencies in LTC insurance markets and fosters informal care supply to a more efficient level from a social perspective. We also find that financing additional public LTC subsidies by estate recovery can improve social welfare.

The results obtained in this paper thus contribute to our understanding on how estate recovery influences LTC financing and might be highly beneficial to policy makers.

The paper is organised as follows. In the next section, we introduce the benchmark model and the hypotheses used. In section 3, we study the effect of estate recovery on the optimal levels of transfer and LTC insurance chosen by the parent in the case where he does not anticipate the behaviour of the child. In section 4, we address the case where the parent does anticipate the behaviour of the child. In section 5, we study the welfare implications of financing LTC public support by estate recovery. Finally, a short conclusion is provided in the last section.

2. The model

The model set-up mainly stems from Courbage and Eeckhoudt (2012), Cremer et al. (2016) and Cremer and Roeder (2017). We consider a parent characterised by a state-dependent Von Neumann-Morgenstern (VNM) utility function and a child. The parent faces a probability p of being dependent and requiring LTC at home. According to whether he is dependent or not, his utility functions are respectively $u(x,H)$ or $v(x,H)$, with $u(x,H) < v(x,H)$. The first argument x of the utility functions represents the parent's consumption of a private good and the second argument H represents the bequest to his child. The parent is perfectly altruistic in the sense of Becker (1974) and Andreoni (1989), i.e. he cares about his bequest (and not about the total welfare of his child) but does not receive any "warm glow" from the act of bequeathing. The utility functions are increasing and concave both in the consumption of the private good and the bequest. The bequest received by the child is multiplied by a constant $\theta = (1-\tau)$ with the term τ such as $0 \leq \tau \leq 1$ being equal to the inheritance tax rate. Following Cremer et al. (2016), and for simplicity, we assume that the cross-derivatives u_{xH} and v_{xH}, are negligible.

The parent is retired and has accumulated an amount of wealth w_0. In case of becoming dependent, he incurs formal LTC expenses for an amount N. The parent can receive informal care e provided by his child. Informal care has the benefit of reducing the cost of LTC at a decreasing rate. Hence, N depends on e, and $N(e)$ is such that $N'(e) < 0$ and $N''(e) > 0$. In other words, we assume informal care and formal care to be substitutes from a technical point of view[3]. The State subsidises a proportion β, with $0 \leq \beta \leq 1$, of the parent's formal LTC expenses during his life. However, a proportion ψ, with $0 \leq \psi \leq 1$, of this subsidy is recovered by the State after the parent's death from the bequest transferred to his child. Note that ψ and β are assumed to be independent of the parent's wealth.

The parent can purchase a LTC insurance policy offering a cash benefit equal to I in case of dependency. μI is the insurance premium corresponding to this contract. If $\mu = p$, the premium is actuarially fair and if $\mu > p$, the premium is loaded. The parent also decides on the amount of bequest, T and $\hat{T}$, to be transferred to his child in the states of dependency and autonomy respectively.

As for the child, we first assume that he is only interested in his wealth. He is characterised by a utility function $\bar{u}(c)$ or $\bar{v}(c)$, according to the parent being dependent or not. The utility function is increasing and concave in his wealth c, which is composed of an exogenous pre-bequest wealth z_0, his working income, with ω being his hourly wage, and the bequest received from his parent. In a second step, we assume the child is also concerned by the amount of informal care e provided to his parent through the function $b(e)$, which is added to his utility in the state of nature where the parent is dependent.

We first consider a scenario where the parent is not able to anticipate the child's behaviour. This simplification allows us to focus on the bequest motive as the direct mechanism influencing the parent's decision to acquire LTC insurance. In a second step, we consider the child in our model and his behaviour is anticipated by the parent when deciding the optimal levels of bequests and insurance.

3. The parent does not anticipate the behaviour of the child

In this basic scenario, the timing of the model is as follows: at $t = 0$, the government announces its policies, i.e. the levels of ψ and β. At $t = 1$, before knowing whether he is dependent or not, the parent chooses the optimal amount of LTC insurance I^*. At $t = 2$, the state of nature is revealed and the parent decides the optimal transfers T^* and $\hat{T}^*$ contingent on the state of health. Since the model is solved by backwards induction, we start by looking at the optimal bequest choices of the parent.

[3] Empirical evidence strongly supports the hypothesis of substitutability between informal care and formal home care (see e.g. Bolin et al., 2008; Bonsang, 2009; Bremer et al., 2017).

3.1. Optimal bequests

When the parent is dependent, his optimization problem at $t = 2$ can be written as:

$$\max_{T} u(x, H) = \max_{T} u\left(w_0 - (1-\beta)N(e) + (1-\mu)I - T, \theta\left(T - \psi\beta N(e)\right)\right) \quad (1)$$

The first order condition (FOC) with respect to T is given by:

$$u_T = \frac{\partial u}{\partial T} = -u_x(x, H) + \theta u_H(x, H) = 0 \quad (2)$$

In Appendix 1, we show that the second order condition (SOC) for a maximum is satisfied.

In the state of dependency, the parent's optimal transfer T^* is such that $\theta u_H(x, H) = u_x(x, H)$, i.e. such that the marginal benefit of the transfer, expressed by the additional utility from the transfer, equals its marginal cost, given by the decrease of utility due to lower consumption.

We can now analyse how this optimal transfer reacts to a change in insurance. By differentiating the FOC with respect to I, we have:

$$u_{TI} = \frac{\partial u^2}{\partial T\, \partial I} = -(1-\mu)u_{xx}(x, H) > 0$$

which indicates a positive relationship between the transfer and insurance. This happens as when insurance increases, the parent is richer in the bad state of nature ceteris paribus, which makes the level of the transfer rise as he values both his consumption and his bequest.

Moving to the optimization problem when the parent is autonomous, it can be written as:

$$\max_{\hat{T}} v\left(\hat{x}, \widehat{H}\right) = \max_{\hat{T}} u\left(w_0 - \mu I - \hat{T}, \theta\hat{T}\right) \quad (3)$$

The FOC with respect to $\hat{T}$ is:

$$v_{\hat{T}} = \frac{\partial v}{\partial \hat{T}} = -v_{\hat{x}}\left(\hat{x}, \widehat{H}\right) + \theta v_{\widehat{H}}\left(\hat{x}, \widehat{H}\right) = 0 \quad (4)$$

which has the same interpretation as Eq. (2). However, it can be shown that the effect of insurance on the transfer has the opposite sign than when the parent is dependent. By differentiating the FOC with respect to I we get:

$$v_{\hat{T}I} = \frac{\partial v^2}{\partial \hat{T}\, \partial I} = \mu v_{xx}(x, H) < 0$$

which indicates a negative relationship between the transfer in the state of autonomy and insurance, contrary to the case of the transfer in the case of dependency. This happens as when insurance increases, the parent is poorer in the state of autonomy as he pays a higher premium, which makes the level of the transfer decrease in this state.

3.2. Optimal insurance

At $t = 1$, before the state of nature is revealed, the optimization problem of the parent can be written as:

$$\max_I W = pu(x, H^*) + (1-p)v(\hat{x}, \hat{H}^*)$$
$$= pu\left(w_0 - (1-\beta)N(e) + (1-\mu)I - T^*(I),\ \theta\big(T^*(I) - \psi\beta N(e)\big)\right) +$$
$$(1-p)v\left(w_0 - \mu I - \hat{T}^*(I), \theta\hat{T}^*(I)\right) \quad (5)$$

The FOC with respect to I is:

$$W_I = \frac{\partial W}{\partial I} = p(1-\mu)u_x(x, H) - (1-p)\mu v_{\hat{x}}(\hat{x}, \hat{H}) = 0 \quad (6)$$

given that the FOCs with respect to T and $\hat{T}$ (i.e., Eq. (2) and (4) respectively) hold. In Appendix 1, we show that the SOC for a maximum is satisfied.

In the specific case where the premium is actuarially fair ($p = \mu$), we can provide an explicit solution for the optimal level of insurance I^*. Indeed, as the cross-derivatives u_{xH} and v_{xH} are assumed to be nil, we have two cases satisfying the FOC depending on whether the marginal utilities of consumption and inheritance are state-dependent or not.

From the FOCs with respect to T and $\hat{T}$ (Eq. (2) and (4)), we deduce that $\frac{u_x}{u_H} = \frac{v_{\hat{x}}}{v_{\hat{H}}} = \theta$. Rearranging these terms, we have that:

$$u_x = v_{\hat{x}}\, u_H / v_{\hat{H}} \quad (7)$$

From Eq. (6), in case of state-independent marginal utilities of consumption (i.e. $u_x(x, H) = v_{\hat{x}}(x, H)$ for any given value of x and H), it can easily be shown that the optimal level of insurance is such that $I^* = (1-\beta)N(e) + T^* - \hat{T}^*$ if LTC insurance is actuarially fair. In addition, the assumption of state-independency implies that $u_H(x, H) = v_{\hat{H}}(x, H)$ according to Eq. (7) and therefore $T^* = \hat{T}^* + \psi\beta N(e)$. The optimal level of insurance is then given by $I^* = (1-\beta)N(e) + \psi\beta N(e)$. It depends on the cost of formal care not covered by the public subsidy as well as on the amount recovered by the government from the bequest of the child. This is in line with Mossin's (1968) result from which full insurance is optimal under a fair premium. Indeed, from the parent's perspective, his total loss if he becomes dependent is the sum of both the out-of-pocket formal care expenses and the loss in his child's bequest from estate recovery. This explains why, in that case, the insurance indemnity purchased is higher than the out-of-pocket formal LTC expenses.

If $u_x(x, H) < v_x(x, H)$ and $u_H(x, H) < v_H(x, H)$, then $T^* < \hat{T}^* + \psi\beta N(e)$ and $I^* < (1-\beta)N(e) + \psi\beta N(e)$ if LTC insurance is actuarially fair. This corresponds to partial insurance from the parent's perspective even if the insurance indemnity could be still higher than the out-of-pocket formal LTC expenses. Note that Evans and Viscusi (1991) and Finkelstein et al. (2009) showed that the marginal utility of wealth in case of bad health is usually lower than the marginal utility of wealth in case of good health, therefore supporting the finding that optimal LTC insurance purchase is partial from the perspective of the parent.

3.3. Comparative statics

In the following section, we investigate how exogenous shocks in ψ and β affect the optimal insurance purchase by the parent. We consider these shocks as we are interested in how estate recovery and a change in the public LTC subsidy would affect the incentives of the parent to purchase LTC insurance. More specifically, we aim to unravel whether governmental intervention aiming to finance public LTC expenses by estate recovery favours or deters the demand for private LTC insurance.

If α is an exogenous parameter (i.e. ψ or β) and the optimal expected utility of the parent is given by $W\left(I^*\left(T^*(\alpha), \widehat{T}^*(\alpha), \alpha\right)\right)$, by applying the implicit function theorem, we have that $\frac{\partial I^*}{\partial \alpha} = \frac{-W_{I\alpha}}{W_{II}}$. The details of the computations are shown in Appendix 2 and the sign of the different effects below, in Table 1.

Table 1
Comparative statics for the parent (no anticipation)

	$t = 1$ I^*	$t = 2$ T^*	 $\widehat{T}^*$
ψ	$+$	$+$	0
β	$-$ iff $\psi < 1$ 0 iff $\psi = 1$	$+$	0

We first show that a higher ψ leads to an increase in LTC insurance purchase. This result is exclusively driven by altruistic reasons, i.e. the wish to leave a bequest to his child. As an increase in ψ reduces the amount of the child's bequest in the state of dependency, the parent's utility is reduced because of altruism. To compensate for that disutility, the parent increases the transfer T^* to the child, which reduces the parent's consumption in the state of dependency. Therefore, he has incentives to purchase more insurance. Estate recovery does not have any impact on $\widehat{T}^*$ as the child's bequest is not affected by this policy if the parent is not dependent.

Moving to the effect of an increase in the subvention rate β, this measure increases the parent's wealth in the state of dependency but decreases the child's bequest due to a higher amount recovered. As a consequence, the parental transfer to the child T^* rises. As before, LTC subsidies do not have any impact on the parent's transfer when healthy. As for the effect of a higher β on insurance demand, it depends on the value of ψ. If $\psi = 0$ the child's bequest is not negatively affected by the change in β. As the parent values both x and H, he increases the transfer but less than the increase in the public subsidy, which reduces LTC insurance demand. If $\psi < 1$, the increase in the amount recovered driven by a higher β leads to a rise in the transfer larger than when $\psi = 0$ but still lower than the increase in the public subsidy. LTC insurance demand is reduced, but as a consequence of the larger transfer, to a lower extent than when $\psi = 0$. If $\psi = 1$, as the increase in the public subsidy is fully recovered, the increase in the transfer T^* equals the increase in the public subsidy. Consequently, the final levels of parental consumption, x, and bequest, H, are unchanged following a change in β and thus, the demand for insurance of the parent is not affected.

Our findings have several policy implications. First, estate recovery can be a way to enhance private LTC insurance purchase according to our first result. Second, our results are important in terms of crowding out of private insurance by public LTC coverage. Indeed, for any $\psi < 1$, we observe the classical phenomenon of crowding out, i.e. LTC insurance demand is reduced due to the availability of public support (see e.g. Brown and Finkelstein, 2008; Costa-Font and Courbage, 2015). However, the presence of estate recovery attenuates the crowding out of public support on private insurance (see in Appendix 2 that the magnitude of I_β^* depends negatively on ψ) because in that case the effect of the public subsidy on the transfer is more pronounced. In the extreme case of full recovery, i.e. $\psi = 1$, public support crowding out fully disappears (see Table 1 and I_β^* in Appendix 2). Estate recovery can thus be seen as a mechanism allowing to tackle the phenomenon of private LTC insurance crowding out by public support. Our results are in line with Canta et al. (2016) and more recently Fels (2019) suggesting that public LTC provision might not necessarily discourage private LTC insurance purchase.

4. The parent anticipates the behaviour of the child

We now assume that the parent anticipates the optimal behaviour of the child to a change in the transfer. We make that assumption to consider the possibility for the parent to influence the behaviour of the child as informal caregiver through his bequest. The parent and the child interact in the guise of a non-cooperative game. The timing of the model, based on Cremer et al. (2016) and Cremer and Roeder (2017), is as follows: at $t = 0$, the government announces its policies, i.e. the levels of ψ and β. Then, the parent and the child play the following three-stage game. At $t = 1$, the parent chooses the optimal level of LTC insurance I^*. At $t = 2$, the state of nature is revealed and the parent decides the optimal transfers T^* and $\hat{T}^*$ contingent on the state of health. Finally, at $t = 3$, the child decides on the optimal quantity of informal care e^* to provide if his parent is dependent, otherwise, he does not make any decision and consumes his initial wealth, his working income and the bequest.

We consider T^* to be chosen before e^* as we assume that the parent seeks to influence the behaviour of the child through his bequest as in Pestieau and Sato (2008), Cremer et al. (2016) or Klimaviciute et al. (2017). This assumption relies on the exchange motive according to which bequests and inter-vivos transfers are means of payment for attention and care by adult children to their elderly parents (Bianchi et al., 2008). However, bequests are not strategic as in Bernheim et al. (1985) but affect informal care provision only through their impact on the child's marginal utility of consumption. As pointed out by Alessie et al. (2014), we implicitly assume credibility i.e., after receiving promise of the transfer, the child will indeed provide services to the parent later in life. This is supported by Bernheim et al. (1985) and Peters et al. (2004) pointing out that breaking a promise made to a family member, contrarily to an arbitrary third party, might be quite costly in terms of reputation and family relations. In addition, as it will be shown later, in the context of estate recovery even children who are not altruistic have strong incentives to provide care independently of the parent's transfer, which gives more freedom for parents in their timing of bequests[4].

4.1. The optimal behaviour of the child

As the model is solved by backward induction, we start by looking at the optimal caregiving choice of the child. Following Courbage and Eeckhoudt (2012) and Klimaviciute (2017), we study three different cases. First, we consider the case where the child is "selfish" and only cares about his wealth. Second, we assume the child to like providing care. Finally, we assume the child to dislike providing informal care.

4.1.1. The child only cares about his wealth

At stage two, if the parent is autonomous, the child does not have to make any decision. He just consumes his wealth, labour income and bequest. If the parent is dependent, the child faces an arbitrage between working and caring for his parent and is subject to the following optimisation problem:

$$\max_{e} V = \bar{u}(z_0 + \omega(1-e) + \theta[T - \psi\beta N(e)]) \qquad (8)$$

[4] Our model's timing is sequential. Therefore, in the state of dependency, the child does not anticipate the effect of his actions on the parent's behaviour. A possible extension would be to consider a simultaneous timing, where the child provides care also to influence the amount of the transfer received by the parent. This will not substantially change our results, but make them (mainly the comparative statics) much more difficult to interpret.

The first order condition (FOC) with respect to e is:

$$V_e = \frac{\partial V}{\partial e} = \left(-\omega - \theta\psi\beta N'(e)\right)\bar{u}_c(c) = 0 \quad (9)$$

with $c = z_0 + \omega(1-e) + \theta[T - \psi\beta N(e)]$

In Appendix 3, we show that the second order condition (SOC) for a maximum is satisfied. From the FOC, we see that the optimal level of informal care is given by:

$$\omega = -\theta\psi\beta N'(e^*)$$

Optimally, the child supplies informal care until the marginal economic benefit of providing care, i.e. the gain on inheritance due to the parent consuming less subsidised formal care, equals its opportunity cost, i.e. the salary ω. For this level of effort, the child's wealth is maximised.

The optimal level of informal care is independent of insurance I and of the amount of the parent's transfer T, since none of the two affects neither the marginal costs nor the marginal benefits of providing informal care. Hence, in this case, the transfer cannot be used by the parent to influence the amount of care provided by his child.

4.1.2. The child likes or dislikes providing care

Previously, we assumed that the child was "selfish", i.e. only concerned by his wealth and in particular the bequest he would receive from his parent. However, the child could derive some satisfaction from providing informal care (Klimaviciute, 2017). We follow Courbage and Eeckhoudt (2012) and assume that the child positively values the fact of supplying informal care to his elderly parent when he is dependent. Providing informal care entails satisfaction to the child at a decreasing rate via the function $b(e)$ which is such that $b'(e) > 0$ and $b''(e) < 0$. These preferences correspond to impure altruism as in Andreoni (1989) in the sense that the child cares only about providing informal care, and not about his parent's welfare.

Inversely, the child could also suffer some disutility when providing LTC as informal care has been shown to be detrimental for the caregiver's physical and mental health (Schulz and Beach, 1999)[5]. In this case, the child's preferences can be modelled in a similar way, the only difference being that in this scenario $b(e)$ is such that $b'(e) < 0$ and $b''(e) < 0$. As in Klimaviciute (2017), we assume that providing informal care entails dissatisfaction to the child at an increasing rate. In these two cases, the child's optimisation problem becomes:

$$\max_e \hat{V} = \bar{u}(z_0 + \omega(1-e) + \theta[T - \psi\beta N(e)]) + b(e) \quad (10)$$

The FOC with respect to e is

$$\hat{V}_e = \frac{\partial \hat{V}}{\partial e} = -\left(\omega + \theta\psi\beta N'(e^*)\right)\bar{u}_c(c) + b'(e^*) = 0 \quad (11)$$

In Appendix 3, we show that the SOC for a maximum is satisfied.

If the child likes providing care, as $b'(e) > 0$, Eq. (11) implies $\omega > -\theta\psi\beta N'(e^*)$ at the optimal level of effort if e^* is an interior solution. The child's opportunity cost of providing

[5] Klimaviciute (2017) stresses that caregiving might be associated simultaneously with both a certain degree of disutility and a certain degree of utility coming, for example, from altruistic feelings. According to her, the case "the child dislikes (likes) providing care" can be seen as a shortcut that reflects the situation when the costs (benefits) of informal care offset the utility (disutility) of caregiving.

informal care ω is now superior to the gain on inheritance due to the parent spending less on formal care. Hence, a child with such preferences provides care even if it represents a cost in terms of income.

If the child dislikes to provide care, i.e. $b'(e) < 0$, the optimality condition implies $\omega < -\theta\psi\beta N'(e^*)$ when e^* is an interior solution. At the optimal level of care, the child's opportunity cost is lower than the economic gain of providing informal care. Hence, the child provides care only up to a point where an extra unit of care implies an increase in income.

Interestingly, the possibility for the parent to influence informal care supply through his transfer depends on whether the child likes or dislikes providing care. Indeed, the optimal level of informal care depends positively (negatively) on the amount of the parent's transfer T if the child likes (dislikes) providing care. By differentiating the FOC with respect to T, we find that:

$$\hat{V}_{eT} = \frac{\partial\hat{V}}{\partial e \partial T} = -[\omega + \theta\psi\beta N'(e^*)]\theta\overline{u}_{cc}(c) \tag{12}$$

If the child likes to provide care, $b'(e) > 0$, and $\omega > -\theta\psi\beta N'(e^*)$ from Eq. (11), leading to $\hat{V}_{eT} > 0$. Intuitively, as the bequest in the state of dependency is larger after an increase in T, $\overline{u}_c$ in Eq. (11) is reduced since the child is risk averse and therefore the non-pecuniary component of e becomes relatively more attractive. To compensate, the child provides more informal care.

In the case where the child dislikes providing care, the opposite result holds. Indeed, in this case, his marginal utility of wealth decreases when T increases but here the child trades off less hours of informal care provision, which is an undesirable activity for him, against a lower bequest.

Hence, the parent can only positively influence the amount of informal care provided by his child by using the transfer when the child likes to provide care. Thus, the results obtained in Pestieau and Sato (2008) and Cremer et al. (2016) which state that bequests have a stimulating effect on informal care, strongly rely on the assumption of child's altruism.

Finally, as in the case where the child only cares about his wealth, the child's behaviour is not directly affected by insurance in our setting. However, it can be affected indirectly, through the positive effect of insurance on the optimal transfer T^* (see section 3.1).

4.1.3. Comparative statics

We investigate the impact of a change in ψ and β on the optimal supply of informal care. The details of the computations are shown in Appendix 3 and the results below, in Table 2. In the same table, we also report the effect of T on optimal informal care derived from Eq. (12).

Table 2
Comparative statics for the child

	Selfish child	Child likes providing care	Child dislikes providing care
	e^*	e^*	e^*
ψ	$+$	$+$ iff $\frac{-N'(e)}{N(e)} > -\Gamma_c \frac{\overline{u}_{cc}}{\overline{u}_c}$	$+$
β	$+$	$+$ iff $\frac{-N'(e)}{N(e)} > -\Gamma_c \frac{\overline{u}_{cc}}{\overline{u}_c}$	$+$
T	0	$+$	$-$

where $\Gamma_c = \omega + (1-\tau)\psi\beta N'(e^*)$

Starting with the case where the child is selfish, we show that a higher percentage of subsidised care ψ recovered from the bequest increases the amount of informal care supplied. This result is similar to the one of Thiébaut et al. (2012), who argue that when ψ is higher, the child has strong incentives to provide informal care in order to reduce the amount of subsidized formal care, partially recovered by the government. Second, we find that the effect of an increase in the subvention rate β also increases informal care supply for the same rationale. If the child likes to provide care, the effects of these policies on informal care are slightly different. The effect of an increase in ψ or β on informal care is ambiguous and is positive only if $-N'(e)/N(e) > -\Gamma_c \frac{\bar{u}_{cc}}{\bar{u}_c}$. As before, a rise in ψ or β increases the marginal cost of formal care which tends to increase informal care supply. However, as the child likes providing care, the marginal economic benefit of informal care is lower than hourly wages ω. Therefore, the child could have incentives to compensate the negative shock in his bequest arising from increases in ψ or β by working a larger number of hours in the labour market if $-N'(e)$ is too low. Finally, if the child dislikes providing LTC, the effect of an increase in ψ or β on e^* is positive, as when the child is selfish.

4.2. Optimal bequests

It has been previously shown that higher levels of transfers stimulate informal care if the child likes to provide care while discouraging it if the child dislikes providing LTC. Therefore, the parent's optimal transfer in the state of dependency is likely to change if he anticipates the influence of the transfer on the child's behaviour, i.e. if e becomes a function of T in the form $e(T)$. Under this framework, the parent's optimisation problem in the state of dependency becomes:

$$\max_T u(x,H) = u\Big(w_0 - (1-\beta)N\big(e^*(T)\big) + (1-\mu)I - T, \theta(T - \psi\beta N(e^*(T)))\Big) \quad (13)$$

The FOC with respect to T associated to Eq. (13) is:

$$u_T = \frac{\partial u}{\partial T} = -Bu_x(x,H) + A\theta u_H(x,H) = 0 \quad (14)$$

with $A = [1 - \psi\beta e_T' N'(e)] > 0$ and $B = [1 + (1-\beta)e_T' N'(e)] > 0$.

In Appendix 1, we show that the SOC for a maximum is satisfied if $e_{TT} < 0$.

The optimality condition implies that in the state of dependency, the parent transfers the amount T^* such that $A\theta u_H(x,H) = Bu_x(x,H)$. Since now both A and B depend on the sign of e_T', which is driven by whether the child is selfish, likes or dislikes providing care, so is the optimal transfer. This is shown by evaluating the FOC of Eq. (14) at the optimal transfer when the parent does not anticipate the reaction of the child, i.e. at $\theta u_H(x,H) = u_x(x,H)$ according to Eq. (2). This gives:

$$\left.\frac{\partial \mathrm{u}}{\partial T}\right|_{T^*} = -Bu_x(x,H) + Au_x(x,H) = -\big(1 - \beta(1-\psi)\big)\, e_T' N'(e) u_x(x,H) \quad (15)$$

If the child likes to provide care $e_T' N'(e) < 0$ as $e_T' > 0$ (see Table 2) and then, Eq. (15) is positive. Thus, the parent's transfer is relatively large compared to the case where he does not anticipate the reaction of the child. This happens as in this case the transfer encourages informal care supply. The transfer when the child dislikes providing care is relatively low for the opposite reason as $e'_T < 0$ and thus, $e'_T N'(e) > 0$. The parent's transfer without anticipation is optimal when the child is selfish as T does not affect informal care supply (i.e., $e'_T N'(e) = 0$).

The optimal transfer in the state of dependency still depends positively on insurance. Indeed,

$$u_{TI} = \frac{\partial u^2}{\partial T\, \partial I} = -B(1-\mu)u_{xx}(x,H) > 0$$

as $B > 0$ by the FOC.

Finally, the problem of the optimal level of bequest when the parent is autonomous is:

$$\max_{\hat{T}} v(\hat{x}, \hat{H}) \;=\; \max_{\hat{T}}\; u(w_0 - \mu I - \hat{T}, \hat{T})$$

which is equivalent to Eq. (3) as the child does not provide informal care in this state of nature.

4.3. Optimal insurance

Looking at optimal insurance purchase, the optimization problem of the parent is now:

$$\max_I W = pu\left(w_0 - (1-\beta)N\left(e^*(T^*(I))\right) + (1-\mu)I - T^*(I), \theta\left[T^*(I) - \psi\beta N\left(e^*(T^*(I))\right)\right]\right) + (1-p)v\left(w_0 - \mu I - \hat{T}^*(I), \hat{T}^*(I)\right)$$

The first order condition with respect to I is

$$W_I = \frac{\partial W}{\partial I} = p(1-\mu)u_x(x,H) - (1-p)\mu v_x(x,H) = 0$$

given that the FOCs with respect to T and $\hat{T}$ (Eq. (14) and (4) respectively) are holding. The SOC is also satisfied in this case (see Appendix A.1.2.).

The FOC with respect to insurance writes as Eq. (6). Therefore, if the parent's preferences are state independent and the premium is actuarially fair, $I^* = (1-\beta)N(e) + T^* - \hat{T}^*$ as in section 3.2. However, the FOCs of Eq. (14) and Eq. (4) imply $\frac{A}{B}u_H(x,H) = v_{\hat{H}}(x,H)$, with $\frac{A}{B} > 1$ (< 1) if the child is likes (dislikes) providing care. This leads to $T^* > \hat{T}^* + \psi\beta N(e)$ if the child likes providing care (the opposite if he dislikes providing care). This inequality can be rewritten as $T^* = \hat{T}^* + \psi\beta N(e) + \delta$ with $\delta > 0$ (< 0) if the child likes (dislikes) providing care. δ corresponds to the change in the optimal transfer T^* to the child when he is considered to like or dislike providing care compared to the case where the parent does not anticipate the reaction of the child. Hence, as $I^* = (1-\beta)N(e) + \psi\beta N(e) + \delta$, the optimal level of insurance is different from the case of no anticipation.

4.4. Comparative statics

We now assume that the parent anticipates the effect of the optimal transfer T^* on the child's behaviour[6]. The results of this section, especially those on insurance, differ from those of section 3.3 since the parent's reaction to the Government's decisions takes into account the

[6] To derive this subsection results, we consider that the parent only anticipates the child's reaction to changes in his own decisions (i.e. the transfer) but not to changes in the government's policies. Otherwise, the model becomes too complex to extract interpretable results.

influence of bequests on informal care. When the child is selfish results are equivalent to the ones of Table 1 as the effort of the child is not influenced by the transfer from the parent. However, results might differ when the child likes or dislikes providing care since in these cases the transfer influences informal care supply. The details of the computations are shown in Appendix 4. The results when the child likes to provide care are first presented in Table 3 below.

Table 3
Comparative statics for the parent (child who likes to provide care)

	$t=1$ I^*	$t=2$ T^*
ψ	$+$	$+$
β	$-$ when $T^*_\beta < 0$ $-$ if $-\theta^2 A(A-\psi)u_{HH} > B(B-1)u_{xx}$ (when $T^*_\beta > 0$)	$+$ if $-\xi \frac{e_T N'(e)}{N(e)} u_H < -\theta\psi BAu_{HH}$

where $\xi = 1-\psi\big(1+e_T N'(e)\big) > 0$ by assumption if $\psi < 1$.

We show that the parent LTC insurance purchase I^* increases when ψ increases if the child likes to provide care as the transfer in the state of dependency T^* rises. The transfer increases, firstly because as before, the child's bequest is reduced and the parent is altruistic. Secondly, because now an increase in T^* has a positive effect on informal care supply.

The effect of an increase in β on optimal insurance I^* is more complex than in the case of no anticipation as the effect of β on T^* is ambiguous. Indeed, when the child likes providing care, the levels of informal care and the child's bequest are already relatively high (see Eqs. (11) and (15)). The parent has therefore less incentives to encourage, with a larger transfer, his child to offer additional informal care. This explains why the optimal transfer could decrease following an increase in β. When this happens, the parent always decreases his demand for LTC insurance leading to crowding out of public support on LTC insurance. If the transfer does not incentivise much informal care (i.e. $-e_T N'(e)$ is not very large), the effect of β on T^* is positive as in the case without anticipation (see Table 3). In that case, the effect of β on LTC insurance is ambiguous even if $\psi < 1$, contrarily to section 3.3. We provide in Table 3 a sufficient condition for LTC insurance to decrease with an increase in β, i.e. crowding out.

Interestingly, our results show that crowding in, i.e. a positive effect of the public subsidy on LTC insurance, could occur if the bequest can influence positively informal care. The intuition is that when u_{xx} in absolute value is very high, the parent is very risk averse with respect to consumption. Therefore, he could have incentives to strongly increase the transfer to incentivise his child to provide more informal care and to compensate that increase by purchasing more LTC insurance. As in Canta et al. (2016) public LTC financing might incentivise private LTC insurance if family help is taken into account.

Table 4
Comparative statics for the parent (child who dislikes providing care)

	$t=1$ I^*	$t=2$ T^*
ψ	$+$ iff $-\theta A \frac{u_{HH}}{u_H} > \frac{e_T N'(e)}{N(e)}$	$+$ iff $-\theta A \frac{u_{HH}}{u_H} > \frac{e_T N'(e)}{N(e)}$
β	$-$ if $\psi\beta C - \frac{e_T N'(e)}{N(e)} \frac{\xi}{B} > 0$	$+$

where $C = e''_{TT} N'(e) + (e'_T)^2 N''(e) > 0$ assuming $e''_{TT} < 0$.

When the child dislikes to provide care, an increase in ψ can lead to either an increase or a decrease in the transfer and therefore of LTC insurance purchase. Two opposite effects need to be considered. On one hand, an increase in ψ decreases the bequest of the child and, as the parent is altruistic, he increases the transfer. On the other hand, as the transfer creates disincentives to informal care supply, the parent reduces the transfer. If the first effect dominates the second, i.e. $-\theta A \frac{u_{HH}}{u_H} > \frac{e_T N'(e)}{N(e)}$, the parent increases the transfer and consequently the level of LTC insurance. Otherwise and surprisingly, an increase in the rate of estate recovery crowds out LTC insurance demand.

The effect of β on optimal insurance is also rather complex when the child dislikes to provide care. As in the case without anticipation (section 3.3), a higher subsidy increases the transfer T^* in the state of dependency. However, since an increase in the transfer discourages informal care and increases formal care expenses, a positive change in β could lead to a higher insurance demand. We provide a sufficient condition for crowding out in Table 4. It can be seen that crowding in might occur if the transfer strongly discourages informal care supply (i.e. if $e_T N'(e) > 0$ is relatively large). In that case the parent buys more insurance to compensate for the consequential increase in formal care expenses due to the decrease in informal care induced by the higher transfer.

5. Welfare analysis

While the previous sections looked at the effect of higher rates of estate recovery and LTC public subsidies on LTC insurance purchase, we now focus on characterizing the welfare implications of these policies. To that aim, we first derive the first best allocation, i.e., the resource allocation that a social planner would implement with perfect information and full control of the economy. Then, in the second-best solution, we study the total welfare effect of an increase in the LTC subvention rate β financed by an increase in the estate recovery rate ψ.

5.1. First-best solution

Assuming that both parents and children receive equal social weights and defining the social welfare function S^{FB} as the expected utility of a representative family, the first-best problem can be written as:

$$\max_{e,x,\hat{x},c,\hat{c}} S^{FB} = p[u(x) + \bar{u}(c) + b(e)] + (1-p)[v(\hat{x}) + \bar{v}(\hat{c})]$$

$$s.t.$$

$$p\big(x + c + N(e)\big) + (1-p)(\hat{x} + \hat{c}) = w_0 + z_0 + p\omega(1-e) + (1-p)\omega \qquad (16)$$

where the decision variables are informal care e and the parent's and the child's consumption in both states of nature. We denote the latter by x, $\hat{x}$, c and $\hat{c}$ respectively. Since we assume both agents to receive equal social weights, we remove the altruistic component in the parent's utility from the social welfare function; otherwise, the child's utility would be over-weighted (Chalkley and Malcomson, 1998). Following Cremer and Roeder (2016), the child's preferences with respect to informal care $b(e)$ are included in the social planner function.

In the first best solution all variables are simultaneously set, which leads to the following optimality conditions:

$$-(\omega + N'(e))\bar{u}_c(c) + b'(e) = 0 \quad (17)$$

$$u_x(x) = v_{\hat{x}}(\hat{x}) = \bar{u}_c(c) = \bar{v}_{\hat{c}}(\hat{c}) \quad (18)$$

Eq. (17) describes the socially efficient level of informal care. As one can see from Eq. (11) informal care provision is inefficiently low without public intervention (i.e. $\psi = \beta = \tau = 0$). The comparison between Eq. (17) and Eq. (11) also shows that the socially efficient level of informal care is provided when $\theta\psi\beta = 1$. Given that tax rates are constrained to be between zero and one, this corresponds to $\tau = 0$ and $\psi = \beta = 1$.

The intuition behind this result is the following. A LTC subsidy recovered from the child's inheritance increases the child's marginal benefits of informal care provision and thus, fosters informal care to a more efficient level. When $\tau = 0$ and $\psi = \beta = 1$, public intervention makes children with dependent parents to fully internalize the social benefits of informal care. In other words, this policy makes the trade-off between the child's marginal costs and marginal benefits of informal care to be the socially efficient one. This result is similar to Cremer et al. (2016) who find that state-dependent taxes on children's income with dependent parents allow to implement the first-best level of care when informal care is suboptimal without public intervention. While they consider a state-dependent income tax, implicitly subsidizing informal care provision, we show that a similar effect can be reached in the case of estate recovery. However, when $\tau > 0$ then $\theta < 1$ and inheritance taxation is counterproductive for reaching the efficient level of informal care, as such tax reduces the child marginal benefits of informal care.

Eq. (18) states the equality of marginal utilities of consumption across states of nature and individuals. Hence, individualized lump-sum transfers, allowing for inter- and intra-generational redistribution, are required to fully decentralize the optimal allocation provided by Eq. (18). We can provide an explicit solution for the full implementation of the first best optimum when insurance is actuarially fair and marginal utilities are state-independent. If LTC insurance is fair (i.e. $p = \mu$), no public intervention is needed to decentralize the first best optimum for the parent, as Eq. (6) and Eq. (18) are equivalent. As for the child, the hypothesis of state independency and Eq. (18) imply that lump-sum transfers must be designed such that $c = \hat{c}$. Thus, the subsidy to children with dependent parents, D, and the tax imposed to children with healthy parents, $\widehat{D}$, are given by:

$$D = (1 - p)(\omega e - \delta)$$
$$\widehat{D} = p(\omega e - \delta)$$

Details of calculations are provided in Appendix 5. Children with dependent parents receive a subsidy equal to the monetary loss they incur in case of their parent becoming dependent. This loss equals the opportunity cost of providing care ωe minus δ, the change in the optimal transfer T^* driven by the parent's anticipation of his child preferences. If children are like (dislike) providing care, $\delta > 0 (< 0)$ as shown in section 4.3. Interestingly, even if ψ and β are at the highest levels possible under the first best level of informal care (Eq. 17), they do not influence D and $\widehat{D}$. This occurs as in this specific case dependent parents fully compensate estate recovery with their transfer T^* to their children (see T^* in sections 3.2 and 4.3).

Under state-dependency, the parent's transfer is reduced and does not fully compensate state recovery as shown in section 3.2. Thus, additional redistribution between children is needed to implement the first best. In addition, LTC insurance markets face multiple inefficiencies in reality leading to heavy loads in insurance premiums (Brown and Finkelstein, 2009). This entails insufficient levels of insurance coverage in practice, justifying additional redistribution mechanisms from healthy to dependent parents.

5.2. Second best solution

We now explore the second best setting. We assume the government cannot impose lump-sum taxes and its intervention is limited to financing an increase in the LTC subvention rate β by an increase in the estate recovery rate ψ. The government's budget constraint can be written as:

$$G = p\psi\beta N(e^*) + p\tau\big(T^* - \psi\beta N(e^*)\big) + (1-p)\tau\hat{T}^* - p\beta N(e^*) \tag{19}$$

The government's budget for financing LTC is the difference between the revenue received from the estate recovery program and the inheritance tax minus the expenses in subsidised formal care. The budget is in equilibrium if $G = 0$ and in deficit if $G < 0$[7].

The social welfare function in the second best setting can be written as the sum of the indirect utility functions of the parent, excluding its altruistic component, and the child, i.e.:

$$S^{SB}(e^*, T^*, I^*, \psi, \beta, \tau) = \bar{\bar{W}} + \bar{\bar{V}} \tag{20}$$

where

$$\bar{\bar{W}} = pu(w_0 - (1-\beta)N(e^*) + (1-\mu)I^* - T^*) + (1-p)v(w_0 - \mu I^* - \hat{T}^*)$$
$$\bar{\bar{V}} = p[\bar{u}(z_0 + \omega(1-e^*) + \theta[T^* - \psi\beta N(e^*)]) + b(e^*)] + (1-p)\bar{v}\big(z_0 + \omega + \theta\hat{T}^*\big)$$

with $e^*(T^*(\psi,\beta),\psi,\beta) = e^*(\psi,\beta)$, $T^*(\psi,\beta)$, $\hat{T}^*(\psi,\beta)$ and $I^*(\psi,\beta)$.

The effect on social welfare of an increase in the public LTC subsidy financed by an increase in estate recovery can be found by totally differentiating Eq. (20) with respect to β and ψ. This leads to:

$$\frac{dS^{SB}}{d\beta} = S_\beta^{SB} + S_\psi^{SB}\frac{d\psi^c}{d\beta} \tag{21}$$

The superscript c denotes the fact that any increase in β has to be compensated by an adjustment in ψ such that the total budget remains unchanged. Mathematically, this condition implies $\frac{d\psi^c}{d\beta} = -\frac{G_\beta}{G_\psi}$, where G corresponds to the budget constraint defined in Eq. (19). Assuming that an increase in the public subsidy reduces the public budget and an increase in the tax rate improves it[8], then $G_\beta < 0$ and $G_\psi > 0$ and therefore, $d\psi^c/d\beta > 0$.

[7] We assume inheritance tax τ to be a source of LTC financing as it is included in our model via the parameter θ. However, in practice, public LTC is also financed by general taxation or social contributions (Colombo, 2012). Including these instruments in our model, for example with a parameter multiplying the child's working income $\omega(1-e)$, will not substantially change our results of sections 3 and 4. It can be easily shown that the only significant difference will be that the income tax would induce more child assistance and thus, a lower likelihood of a corner solution in $e^* = 0$.

[8] This assumption is rather natural. Otherwise, the government would optimally offer unrealistic corner solutions in the form of "minimal subvention rate / maximal tax rate" or vice-versa.

An increase in β compensated by an increase in ψ is desirable as long as $dS^{SB}/d\beta > 0$. The details of the computations for S_β^{SB} and S_ψ^{SB} are provided in Appendix 6. By substituting the specific values of S_β^{SB} and S_ψ^{SB} in Eq. (21) we obtain:

$$\frac{dS^{SB}}{d\beta} = p\left[N(e^*)(u_x - \theta(\beta d + \psi)\bar{u}_c) - (1-\beta)N'(e^*)\left(e_\psi^* d + e_\beta^*\right)u_x + \left(T_\psi^* d + T_\beta^*\right)(\theta\bar{u}_c - u_x)\right] \qquad (22)$$

where $d = \frac{d\psi^c}{d\beta} > 0$.

The sign of $dS^{SB}/d\beta$ depends on the sum of three elements. The first element is the direct effect of the policy, i.e. its effect on social welfare assuming away its impact on individuals' behaviour. The second and third element of Eq. (22) correspond to the indirect effects of the policy on social welfare, due respectively to its effects on informal care and on the transfer when the parent is dependent.

In the absence of lump-sum taxes and any other public support, if LTC insurance is unfair, i.e. partial insurance coverage, a public LTC subsidy financed from estate recovery can compensate incomplete LTC insurance coverage. For such public policy to be welfare improving, the sign of Eq. (22) must be positive. We need then to consider the signs and magnitudes of the direct and indirect effects addressed previously. As for the direct effect, this policy allows for additional parental LTC coverage but at the cost of a reduction in the child's bequest. As for the indirect effects, higher ψ and β generally incentivize both informal care (see Table 2) and the transfer when the parent is dependent (see Tables 1, 3 and 4).

If ψ and β equal zero or are very low, the direct effect is positive as the cost of estate recovery to the child is relatively low. As the indirect effects are also positive, Eq. (22) is positive and an increase in the subsidy compensated by an increase in the estate recovery rate is welfare improving. However, if ψ and β equal one, the direct effect is negative, as the cost to the child in terms of bequest is at its highest level. The negative direct effect offsets the positive indirect effects as the higher transfer to the child does not not fully compensate the decrease in bequest if marginal utilities are state-dependent (see section 3.2). Eq. (22) is therefore negative and a decrease in the subsidy and the rate of estate recovery is welfare improving.

Hence, in contrast to the first best, the second best optimal policy would imply positive but lower than one rates of ψ and β if LTC insurance is unfair and marginal utilities are state-dependent.

To better identify if estate recovery is a desirable policy to finance public LTC, it might be useful to contrast it with an alternative policy such as inheritance taxation[9]. Two differences can be stressed between the two policies. First, as τ is not state-dependent, it affects the bequest of children whatever their parent's health, contrary to the case of estate recovery which affects only the bequest of children with dependent parents. Second, as seen previously, τ, contrarily to ψ, reduces the marginal benefits of informal care provision to the child. Thus, it is likely to create disincentives to informal care reducing social welfare.

Finally, the crowding out of private LTC insurance by public support does not have any implications for social welfare in our setting as the FOC of Eq. (6) is holding (see Appendix 6).

6. Conclusion

[9] Second best levels of τ and their related results are available under request.

Various countries have implemented, or will soon implement, estate recovery programmes as a way to improve public budgets allocated to finance growing LTC needs. In this article, we study how estate recovery can affect incentives to purchase private LTC insurance with the bequest motive as a qualifier. We also study the welfare implications of financing LTC public support by estate recovery.

We focus on the bequest motive as the desire to leave a bequest seems a major reason for the purchase of LTC insurance. Recovering LTC benefits impacts the level of inheritance if the beneficiary of LTC benefits were to become dependent and therefore should provide incentives to purchase LTC insurance. We show that this is generally but not always the case.

We consider two scenarios in our paper. In a first scenario, we assume that the parent is not able to anticipate the behaviour of his child when dependent. In that case, we show that, for a fair insurance premium and under state-independent marginal utilities, the presence of estate recovery pushes the parent to purchase an optimal amount of LTC insurance higher than his LTC expenses. A higher rate of estate recovery is also shown to increase LTC insurance demand. Finally, we show that estate recovery reduces and may even eliminate public support crowding out of private LTC insurance. This last result is in line with recent works such as Canta et al. (2016) and Fels (2019) suggesting that public LTC provision might not necessarily discourage private LTC insurance purchase.

In a second scenario, we consider that the parent anticipates the optimal behaviour of the child to a change in the transfer. The parent then bequeaths some of his wealth because he is altruistic but also to influence his child's behaviour to provide informal care. We show that the transfer from the parent to the child can modify the behaviour of the child as informal caregiver only when the child likes or dislikes providing informal care. The effect of estate recovery on LTC insurance demand is shown to be driven by both, altruistic reasons from the parent's side and more importantly by how the parent anticipates the reaction of the child to the transfer. In such a case, we show that estate recovery also provides incentives to purchase LTC insurance if the child is altruistic but could provide disincentives to LTC insurance purchase if the child dislikes providing care.

These results offer some interesting implications in terms of LTC financing. First they show that estate recovery programmes provide incentives to altruistic parents to purchase LTC insurance in most cases. The only situation where estate recovery could disincentive the purchase of LTC insurance is when the parent anticipates that his child does not like providing care and decides to strongly reduce the transfer, which decreases LTC insurance purchase. In this respect, estate recovery could improve LTC financing in two different ways. The first way is by decreasing the burden of LTC expenditures on public budgets with more revenues collected from the taxation of estates, which relative importance on overall capital accumulation is expected to rise in the future (Piketty and Zucman, 2014). The second way for estate recovery to improve LTC financing is through a larger share of LTC expenditures financed from LTC insurance markets, which could complement public LTC financing. A second implication behind our results is that estate recovery can be used as a mean to tackle public crowding out of LTC insurance. Pauly (1990) argued that the non-purchase of LTC insurance by the elderly might be a perfectly rational choice in the presence of public insurance schemes. Our results show that the presence of estate recovery reduces or even eliminates public support crowding out of LTC insurance. Hence, estate recovery can impact positively LTC insurance ownership through two channels. A direct one through the bequest motive, and indirect one through a lower crowding out effect of public support.

Finally, from the welfare analysis, we find that a more comprehensive LTC public support, financed by estate recovery, helps to overcome inefficiently low levels of LTC insurance coverage and fosters informal care supply to a more efficient level from a social perspective. In that sense, such a policy can improve social welfare.

There are several limitations to this study that need to be pointed out. First, we have considered that the rates of estate recovery and LTC subsidies are fixed. One can easily imagine that estate recovery and LTC subvention rates depend on the parent's wealth and possibly the offspring's wealth. Second, we have implicitly assumed that parents automatically receive public LTC subsidies if they were to become dependent. However, estate recovery policies could provide incentives not to take-up LTC public subsidies as a way to protect bequests. Finally, we have not taken into account the case of multi siblings and strategic bequests which could influence the level of transfers and informal care. Extending our results towards these perspectives would be interesting for future research in this field.

Appendix 1: Second order conditions of the parent

A.1.1. The parent does not anticipate the reaction of the child

$$u_{TT} = \frac{\partial u^2}{\partial T^2} = u_{xx} + \theta^2 u_{HH} < 0$$

$$v_{\hat{T}\hat{T}} = \frac{\partial v^2}{\partial \hat{T}^2} = v_{xx} + \theta^2 v_{HH} < 0$$

$$W_{II} = \frac{\partial W^2}{\partial I^2} = p(1-\mu)\big((1-\mu) - T_I^*\big)u_{xx} - (1-p)\mu\big(-\mu - \hat{T}_I^*\big)v_{\hat{x}\hat{x}}$$
$$= p(1-\mu)^2\left(1 - \frac{u_{xx}}{u_{TT}}\right)u_{xx} + (1-p)\mu^2\left(1 - \frac{v_{\hat{x}\hat{x}}}{v_{\hat{T}\hat{T}}}\right)v_{\hat{x}\hat{x}} < 0 \text{ as } \frac{u_{xx}}{u_{TT}}, \frac{v_{\hat{x}\hat{x}}}{v_{\hat{T}\hat{T}}} < 1$$

A.1.2. The parent anticipates the reaction of the child to a change in the transfer

$$u_{TT} = \frac{\partial u^2}{\partial T^2} = \theta^2 A^2 u_{HH} - \theta\psi\beta C u_H + B^2 u_{xx} - (1-\beta)C u_x < 0$$

Where $A = [1 - \psi\beta e_T' N'(e)] > 0$, $B = [1 + (1-\beta)e_T' N'(e)] > 0$
and $C = e_{TT}N'(e) + (e_T)^2 N''(e) > 0$ assuming $e_{TT} < 0$

$$v_{\hat{T}\hat{T}} = \frac{\partial v^2}{\partial \hat{T}^2} = v_{xx} + \theta^2 v_{HH} < 0$$

$$W_{II} = \frac{\partial W^2}{\partial I^2} = p(1-\mu)\big((1-\mu) - BT_I^*\big)u_{xx} - (1-p)\mu\big(-\mu - \hat{T}_I^*\big)v_{\hat{x}\hat{x}}$$
$$= p(1-\mu)^2\left(1 - \frac{B^2 u_{xx}}{u_{TT}}\right)u_{xx} + (1-p)\mu^2\left(1 - \frac{v_{\hat{x}\hat{x}}}{v_{\hat{T}\hat{T}}}\right)v_{\hat{x}\hat{x}} < 0 \text{ as } \frac{B^2 u_{xx}}{u_{TT}}, \frac{v_{\hat{x}\hat{x}}}{v_{\hat{T}\hat{T}}} < 1$$

Appendix 2: Comparative statics of the parent when he does not anticipate the reaction of the child

Effect of ψ

$$T_\psi^* = -\frac{u_{T\psi}}{u_{TT}} = \frac{\beta N(e)\theta^2 u_{HH}}{u_{TT}} > 0$$

$$\hat{T}_\psi^* = -\frac{u_{\hat{T}\psi}}{u_{\hat{T}\hat{T}}} = 0$$

$$I_\psi^* = -\frac{W_{I\psi}}{W_{II}} = \frac{p(1-\mu)T_\psi^* u_{xx}}{W_{II}} > 0$$

Effect of β

$$T_\beta^* = -\frac{u_{T\beta}}{u_{TT}} = \frac{N(e)(u_{xx} + \theta^2\psi u_{HH})}{u_{TT}} > 0$$

$$\hat{T}^*_\beta = -\frac{u_{\hat{T}\beta}}{u_{\hat{T}\hat{T}}} = 0$$

$$I^*_\beta = -\frac{W_{I\beta}}{W_{II}} = \frac{-p(1-\mu)\big(N(e) - T^*_\beta\big)u_{xx}}{W_{II}} = \frac{-p(1-\mu)}{W_{II}}\left(N(e) + \frac{u_{T\beta}}{u_{TT}}\right)u_{xx}$$
$$= \frac{-p(1-\mu)N(e)}{W_{II}}\left(1 - \frac{u_{xx} + \theta^2\psi u_{HH}}{u_{xx} + \theta^2 u_{HH}}\right)u_{xx} < (=)0 \quad \text{if } \psi < (=)1$$

Appendix 3: Second order condition and comparative statics of the child

SOC

$$\hat{V}_{ee} = \frac{\partial \hat{V}}{\partial e^2} = -\left((1-\tau)\psi\beta N''(e)\overline{u}_c - \big(\omega + (1-\tau)\psi\beta N'(e^*)\big)^2\overline{u}_{cc}\right) + b''(e) < 0$$

Effect of ψ

$$\hat{V}_{e\psi} = -\theta\beta\overline{u}_c N(e)\left[\frac{N'(e)}{N(e)} - \big(\omega + \theta\psi\beta N'(e)\big)\frac{\overline{u}_{cc}}{\overline{u}_c}\right]$$

Effect of β

$$\hat{V}_{e\beta} = -\theta\psi\overline{u}_c N(e)\left[\frac{N'(e)}{N(e)} - \big(\omega + \theta\psi\beta N'(e)\big)\frac{\overline{u}_{cc}}{\overline{u}_c}\right]$$

Effect of T

See Equation 12

Appendix 4: Comparative statics of the parent when he anticipates the reaction of the child to a change in the transfer

Effect of ψ

$$T^*_\psi = -\frac{u_{T\psi}}{u_{TT}} = \frac{-\beta\theta N(e)\left(\frac{e_T N'(e)}{N(e)}u_H + A\theta u_{HH}\right)}{u_{TT}}$$

$$\hat{T}^*_\psi = -\frac{u_{\hat{T}\psi}}{u_{\hat{T}\hat{T}}} = 0$$

$$I^*_\psi = -\frac{W_{I\psi}}{W_{II}} = \frac{p(1-\mu)T^*_\psi u_{xx}}{W_{II}}$$

Effect of β

$$T_\beta^* = -\frac{u_{T\beta}}{u_{TT}} = \frac{N(e)\left(Bu_{xx} + \psi\theta^2 A u_{HH} - \frac{e_T N'(e)}{N(e)}\theta\frac{\xi}{B}u_H\right)}{u_{TT}}$$

Where $\xi = 1 - \psi\big(1 + e_T N'(e)\big)$

$$\hat{T}_\beta^* = -\frac{u_{\hat{T}\beta}}{u_{\hat{T}\hat{T}}} = 0$$

$$I_\beta^* = -\frac{W_{I\beta}}{W_{II}} = \frac{-p(1-\mu)\big(N(e) - T_\beta^*\big)u_{xx}}{W_{II}} = \frac{-p(1-\mu)}{W_{II}}\left(N(e) + \frac{u_{T\beta}}{u_{TT}}\right)u_{xx}$$
$$= \frac{-p(1-\mu)N(e)}{W_{II}}\left(1 - \frac{Bu_{xx} + A\psi\theta^2 u_{HH} - \frac{e_T N'(e)}{N(e)}\theta\frac{\xi}{B}u_H}{B^2 u_{xx} + A^2\theta^2 u_{HH} - \theta\psi\beta C u_H - (1-\beta)Cu_x}\right)u_{xx}$$

Condition: $I_\beta^* < 0$ iff. $B(B-1)u_{xx} + \theta^2 A(A-\psi)u_{HH} - \theta\left(\psi\beta C - \frac{e_T N'(e)}{N(e)}\frac{\xi}{B}\right)u_H - (1-\beta)Cu_x < 0$

Appendix 5: Implementation of the first best

The child's consumption in the state of dependency and autonomy (c and $\hat{c}$ respectively) are:

$$c = z_0 + \omega(1-e) + \theta[T^* - \psi\beta N(e)]$$
$$\hat{c} = z_0 + \omega + \theta\hat{T}^*$$

Lump sum transfers in the state of dependency and autonomy (D and $\hat{D}$ respectively) must be such that the budget constraint $pD = (1-p)\hat{D}$ holds. We additionally know that the parent's bequest T^* is equal to $T^* = \hat{T}^* + \psi\beta N(e) + \delta$ under state independency of marginal utilities and fair insurance (see section 4.3). If transfers must be designed so that $c = \hat{c}$, this gives the following system of equations:

$$\begin{cases} c + D = \hat{c} - \hat{D} \\ pD = (1-p)\hat{D} \end{cases} = \begin{cases} z_0 + \omega(1-e) + \theta\big[\hat{T}^* + \delta\big] + D = z_0 + \omega + \theta\hat{T}^* - \hat{D} \\ pD = (1-p)\hat{D} \end{cases}$$

The solution to the system above is $D = p(\omega e - \theta\delta)$ and $\hat{D} = (1-p)(\omega e - \theta\delta)$. As optimal informal care in the first best implies $\theta = 1$, $D = p(\omega e - \delta)$ and $\hat{D} = (1-p)(\omega e - \delta)$.

Appendix 6: Second best

$$S_\psi^{SB} = p\big[-\theta\beta N(e^*)\bar{u}_c - (1-\beta)N'(e^*)e_\psi^* u_x + T_\psi^*(\theta\bar{u}_c - u_x)\big]$$
$$S_\beta^{SB} = p\big[N(e^*)(u_x - \theta\psi\,\bar{u}_c) - (1-\beta)N'(e^*)e_\beta^* u_x + T_\beta^*(\theta\bar{u}_c - u_x)\big]$$

given that the FOCs of Eq. (6) and (11) hold and $\hat{T}_\psi^* = \hat{T}_\beta^* = 0$.

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