# Long-term care insurance: joint contracts for mitigating relational moral hazard

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**Abstract**

Recently, joint long-term care (LTC) insurance policies covering two related individuals have become available. This contribution purports to find out whether they have the potential of mitigating relational moral hazard (RMH) effects. For decades, intra-family moral hazard has been suspected of being responsible for the sluggish development of private LTC insurance. The parent, anticipating the informal care provided by the child that has the effect of lowering expenditure on formal LTC, is tempted to buy less LTC coverage. The child (or more generally, the partner of a senior person), knowing that the bequest is protected by LTC insurance, has less incentive to provide informal care. Moreover, the amount of LTC coverage bought by the partner is found to fall in response to that of the senior person. Since a joint LTC policy makes senior and partner decide simultaneously rather than sequentially, it may lead to a partial internalization of RMH by turning the amounts of LTC coverage into strategic complements, the amount of coverage whereas the two amount of coverage purchased by the senior and opf informal care provided by the junior continue to be strategic substitutes.

**Key words:** Long-term care; long-term care insurance; intra-family moral hazard; bilateral moral hazard; relational moral hazard

**JEL classification: D19, G22, J14**

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**Highlights**

- This contribution aims to check whether a product innovation in long-term care (LTC) insurance, the possibility of a senior and his/her younger partner to sign a joint contract, has the potential to limit moral hazard effects.
- It finds that in the conventional setting, where senior and partner make their decisions sequentially, the two amounts of LTC coverage as well as the amount of informal care provided by the partner and the senior's coverage are strategic substitutes, giving rise to two moral hazard effects.
- However, when they two players are made to decide simultaneously, the amount of informal care provided by the junior and LTC coverage bought by the senior become strategic complements, which holds true also of the two amounts of coverage on the senior's side.
- Therefore, one of the two moral hazard effects may be fully and one partially suppressed by this innovation.

# 1 Introduction

Moral hazard effects have been suspected of being responsible for the sluggish development of the market for long-term care (LTC) insurance ever since the seminal contribution by Pauly (1970). He argued that by purchasing LTC coverage, parents protect their bequest against LTC expenditure, which in turn undermines children's motivation to provide informal care. A more formal treatment was provided by Zweifel and Strüwe (1996, 1998) using a principal-agent setting where the parent acting as the principal seeks to control the child as the agent. More recently, Courbage and Zweifel (2011, 2015) have argued that parent and child should be modelled as players on an equal footing because the child typically is a daughter approaching retirement age herself. The parent decides about the purchase of LTC insurance [and possibly also the rate of saving as in Zweifel and Courbage (2016)], while the child sets the amount of informal care that serves to lower the probability of admission to a nursing home or LTC expenditure more generally. The moral hazard effect on the part of the child is a reduction of effort in response to more ample LTC coverage purchased by the parent; the moral hazard effect on the part of the parent, to purchase less coverage, anticipating the child's effort designed to reduce (or even avoid) expenditure on formal LTC services.

However, viewing parent and child as being on an equal footing paves the way for analyzing not only intergenerational moral hazard but all types of relational moral hazard (RMH effects henceforth) and to place it in the more general setting of family economics. According to Becker's (1974) 'Rotten kid theorem', altruistic parents can induce altruistic behavior in their egoistic children through a conditional wealth transfer, which however needs to be a utility transfer if these children also value leisure (Bergstrom, 1989). In addition, Dijkstra (2007) has found that in the setting of a sequential game, the parent needs to move last in order to achieve his or her first best. These insights have gained importance recently because in an attempt to expand the market for LTC insurance, several U.S. insurance companies have started offering joint policies that cover a husband and a wife or indeed any two members of a family extensively defined [Kleiber Retirement Solutions (no date), LTC.com (2014)]. This contribution aims to find out whether such joint policies might indeed lead to an at least partial internalization of RMH effects by making the two players involved decide simultaneously.

In Section 2 below, the interaction of two related individuals who consider buying LTC coverage independently from each other is modelled. For simplicity, the one with the shorter remaining life expectancy will be called 'senior', while the one with the longer remaining life expectancy who might provide informal care will be dubbed 'partner'. In Section 3, senior and partner simultaneously buy a joint policy, a setting which is indeed found to mitigate and possibly suppress one of two RMH effects. Section 4 contains a conclusion and outlook.

## 2 Senior and partner purchase LTC insurance independently

Consider a senior and a partner who can lay claim to the senior's bequest, the latter having a longer remaining life expectancy. Characterized by state-dependent VNM utility functions defined over wealth, both can insure against the risk of needing LTC in future. In this section, the two players purchase LTC insurance independently from each other, typically at different points in time. Let $p$ be the probability of the senior being dependent in future and needing future LTC

at the price of 1, the present value of the associated expenditure being $N$. In case of dependency, the senior receives an insurance indemnity with present value $I$. Let $\pi(I)$ be the present value of insurance premiums paid by the senior, with $\pi_I := \partial\pi / \partial I = \kappa p$ and $\kappa = 1 + k > 1$ denoting a fixed loading factor. Thus, the older player stops short of purchasing full coverage; the case where the marginal utility of wealth when needing LTC is so high as to nevertheless induce (more than) full coverage is excluded as unrealistic in view of the high loading factors cited below eq. (9), in spite of the 'pain of risk bearing' concept introduced below eq. (3). On the other hand, the loading factor is assumed not to be so high as to choke off demand entirely. The senior also anticipates receiving $e$ units of informal care from the partner, which has the effect of lowering LTC expenditure e.g. by deferring admission to a nursing home. Thus, with subscripts denoting derivatives, $N_e < 0$ and $N_{ee} > 0$ reflecting decreasing marginal effectiveness; in return, the probability $p$ of needing LTC is taken as exogenous to avoid complications in the premium formula. By assumption the senior's final wealth becomes the bequest, given by

$D = w_0 - N(e) + I - \pi(I)$ in the case of dependency and (1)

$B = w_0 - \pi(I)$ otherwise, (2)

with $w_0$ denoting exogenous initial wealth.

Note that contrary to Zweifel and Courbage (2016), the senior's saving decision is neglected here to keep the model manageable. However, similar to their approach, the decisions are separated in time. The time line comprising four periods of unit length each is depicted in Figure 1. In the first period, the insurance company (*IC*) offers the older player LTC coverage (often as a rider to life insurance) at a marginally unfair premium such that $\pi_I = \kappa p$. The senior chooses the amount of LTC coverage, anticipating a certain amount of informal care provided by the partner. His or her expected utility is thus given by (with [*D*] and [*B*] symbolizing the wealth levels where utility is evaluated)

$$EU = (1-p)u\left[B\right] + pv\left[D\right] = \left(1-p\right)u\left[w_0 - \pi(I)\right] + p\upsilon\left[w_0 - N(e) + I - \pi(I)\right]. \qquad (3)$$

Since health is better in state *B* than in state *D* (dependency usually goes along with a deterioration in health status), $u(\cdot)$ differs from $v(\cdot)$, with $v_w > u_w$ because the 'pain of risk bearing' (i.e. $u\left[w\right] - v\left[w\right]$, the difference in utility) is maximum when both wealth and health are below expected value; it is smaller when only health is below expected value while wealth is at or above it (Eeckhoudt and Schlesinger, 2006). Therefore, $v(w)$ approaches $u(w)$ from below with increasing risky wealth, implying that $v_w$ exceeds $u_w$ [the empirical finding by Finkelstein, Luttmer, and Notowidigdo (2009) that the marginal utility is higher in the healthy than the sick state applies to certain rather than risky income].

In view of the timeline in Figure 1, it is appropriate to start at phase 3, applying backward induction. Thus for the partner, let *q* be the probability of needing LTC, assumed to be independent of *p*, and *M* the present value of LTC expenditure, of which *J* is covered at a premium $\rho(J)$ such that $\rho_J = \lambda q$, with $\lambda = 1 + \ell > 1$ again denoting a loading factor. The partner, who does not expect to receive informal care from the senior, values her effort of providing informal care with opportunity cost $\theta$ per unit of time. She stands to receive a share $s$ of the

senior's entire bequest, which does not depend on *e* for simplicity. Finally, she does not consider providing care when in need of LTC services herself. Therefore, expected utility of the partner [with $\overline{u}(\cdot)$ and $\overline{v}(\cdot)$ defined analogously to $u(\cdot)$ and $v(\cdot)$ in eq. (3) and $z_0$ denoting initial wealth] is given by

$$\begin{aligned}\overline{EU} &= (1-p)(1-q)\overline{u}\left[z_0 + sB - \theta e - \rho(J)\right] + p(1-q)\overline{u}\left[z_0 + sD - \theta e - \rho(J)\right] \\ &\quad + (1-p)q\overline{v}\left[z_0 + sB - M + J - \rho(J)\right] + pq\overline{v}\left[(z_0 + sD - M + J - \rho(J)\right] .\end{aligned} \tag{4}$$

The first term [with $(1-p(1-q)$ as the probability weight, assuming independence of the two risks] pertains to the state where neither senior nor partner need LTC; the one with $p(1-q)$ obtains when only the senior needs LTC; and the one with $(1-p)q$, when only the partner needs LTC. Finally, with probability $pq$, both will be dependent. Altruism on the part of the partner is reflected by the rankings

$$\begin{aligned}&\overline{u}_z\left[z_0 + sD - M + J - \rho(J)\right] < \overline{u}_z\left[z_0 + sB - \theta e - \rho(J)\right] \text{ and } \overline{v}_z\left[z_0 + sD - M + J - \rho(J)\right] \\ &< \overline{v}_z\left[z_0 + sB - M + J - \rho(J)\right],\end{aligned} \tag{5}$$

indicating that the partner values extra wealth less when the senior is in state *D* rather than *B* (e.g. because there is less enjoyment in joint activities) regardless of the state she is in herself. However, rankings of this type turn out to be irrelevant to the analysis below.

In determining the partner's amount of LTC coverage *J*, a simplifying assumption is that she decides on her LTC insurance in the early period no. 2 of Figure 1 while setting the amount of informal care *e* in period no. 3. In view of eq. (4), the first-order condition (FOC) for an interior solution is given by

$$\begin{aligned}\frac{d\overline{EU}}{dJ} &= (1-p)(1-q)\overline{u}_z\left[z_0 + sB - \theta e - \rho(J)\right](-\rho_J) \\ &\quad + p(1-q)\overline{u}_z\left[z_0 + sD - \theta e - \rho(J)\right](-\rho_J) \\ &\quad + (1-p)q\overline{v}_z\left[z_0 + sB - M + J - \rho(J)\right](1-\rho_J) \\ &\quad + pq\overline{v}_z\left[z_0 + sD - M + J - \rho(J)\right](1-\rho_J) \\ &= -(1-p)(1-q)\lambda q\overline{u}_z\left[z_0 + sB - \theta e - \rho(J)\right] \\ &\quad - p(1-q)\lambda q\overline{u}_z\left[z_0 + sD - \theta e - \rho(J)\right] \\ &\quad + (1-p)q(1-\lambda q)\overline{v}_z\left[z_0 + sB - M + J - \rho(J)\right] \\ &\quad + pq(1-\lambda q)\overline{v}_z\left[z_0 + sD - M + J - \rho(J)\right] = 0 .\end{aligned} \tag{6}$$

Figure 1. Timeline in the case of independent purchases of LTC insurance
(see text for symbols)

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| *IC* offers contract to Senior, who buys $I$ at $\pi_I = \kappa p$, anticip-ating $e$ by Partner (not commited) | *IC* offers contract to Partner, who buys $J$ at $\rho_J = \lambda q$, taking account of $I$ | Partner sets $e$, taking account of $I$ | Senior needs LTC with probability $p$ at cost $N(e)$ |

The older person's choice of LTC coverage in the first period acts as an exogenous shock, giving rise to the comparative-static equation

$$\frac{\partial^2 \overline{EU}}{\partial J^2} dJ + \frac{\partial^2 EU}{\partial J \partial I} dI = 0 \,, \tag{7}$$

which after division by $\partial^2 \overline{EU} / \partial J^2 < 0$ and $dI$ solves for

$$\frac{dJ}{dI} \approx \frac{\partial^2 \overline{EU}}{\partial J \partial I} \,. \tag{8}$$

Assuming that the values of $\bar{u}_{zz}$ and $\bar{\upsilon}_{zz}$ do not depend on the wealth level (thus neglecting prudence governing saving, which however is abstracted from here), one obtains from eqs. (6), (4), and (3),

$$\begin{aligned}
\frac{\partial^2 \overline{EU}}{\partial J \partial I} &= -(1-p)(1-q)\lambda q\bar{u}_{zz}s(-\kappa p) - p(1-q)\lambda q\bar{u}_{zz}s(1-\kappa p) \\
&\quad -(1-p)q(1-\lambda q)\bar{v}_{zz}s(-\kappa p) + pq(1-\lambda q)\bar{v}_{zz}s(1-\kappa p) \\
&= (1-p-q+pq)\lambda q\bar{u}_{zz}s\kappa p + (p+pq)\lambda q\bar{u}_{zz}s\kappa p - p(1-q)\lambda sq\bar{u}_{zz} \\
&\quad +(1-p-\lambda q)q\bar{v}_{zz}s\kappa p - (p+\lambda pq)q\bar{v}_{zz}s\kappa p + p(1-\lambda q)sq\bar{v}_{zz} \\
&= \left(1-q+2pq\right)\kappa\lambda pqs\bar{u}_{zz} - p(1-q)\lambda sq\bar{u}_{zz} \\
&\quad +(1-2p-\lambda q)\kappa pqs\bar{v}_{zz} + p(1-\lambda q)qs\bar{v}_{zz} \\
&= \left\{\left(1-q+2pq\right)\kappa - (1-q)\right\}\lambda pqs\bar{u}_{zz} \\
&\quad +\left\{(1-2p-\lambda q)\kappa + (1-\lambda q)\right\} pqs\bar{v}_{zz}.
\end{aligned} \tag{9}$$

This expression is negative, although the signs of the bracketed expressions appear indeterminate.

- Murtaugh and Spillman (no date) estimate the risk of needing for more than five years of LTC to be 20 percent at age 60, while Favreault and Dey (2016) arrive at 52 percent but for needing less than two years of LTC. Therefore, $p$ = 0.4 may be realistic for the senior, while for the partner, this probability is lower, $q$ = 0.2 (say) in view of the difference in age.
- As to the loading factors, Consumer Reports (2011) estimate that a 57 year old healthy male would have to pay a yearly premium of USD 2,815 to obtain coverage of USD 36,000 during four years, including an inflation adjustment 5 percent per year.
- Thus, with remaining life expectancy of 24 years for a 57 year old U.S. male (http://life-span. healthgrove.com/l/58/57) and a 2 percent rate of discount, premiums paid have a present value of USD 53,485.
- Turning to the four annual benefits, they have a present value of USD 148,200 at a net rate of discount of 3 (= 5 – 2) percent when the need for LTC sets in. Assuming this to be during the last four years of life, these USD 148,200 in turn are discounted to USD 99,700 ($i$ = 0.02, $T$ = 24 – 4). Paid with a probability of 0.4, their expected value amounts to USD 39,890.
- This results in a loading factor $\kappa = 53{,}485 / 39{,}890 = 1.316$; $\kappa = 1.3$ will be used below.
- Consumer Reports (2011) also points out that policies bought at younger age offer the same coverage at substantially lower premium, without giving details. However, this may be mainly due to the lower probability of needing LTC anytime soon (hence a lower expected value of benefits) rather than a lower loading factor covering acquisition and administrative expense. Therefore, $\lambda = \kappa = 1.3$ will be used.

For $s$=1 the multiplier pertaining to $\overline{u}_{zz} < 0$ in eq. (9) amounts to
$\left\{(1-q+2pq)\kappa-(1-q)\right\}\lambda pq =$
$\left\{(1-0.2+2\cdot 0.4\cdot 0.2)1.3-(1-0.2)\right\}1.3\cdot 0.4\cdot 0.2 = 0.448\cdot 0.104 = 0.047$, while the multiplier pertaining to $\overline{\upsilon}_{zz} < 0$, $\left\{(1-2p-\lambda q)\kappa+(1-\lambda q)\right\} pq = \left\{(1-2\cdot 0.2-1.3\cdot 0.2)1.3+(1-1.3\cdot 0.2)\right\}$ $\cdot 0.4\cdot 0.2$ amounts to $\left\{-0.078+0.74\right\}\cdot 0.08 = 0.053$. Since both multipliers are positive,

$$\frac{\partial^2 \overline{EU}}{\partial J\,\partial I} < 0 \text{ and hence } \frac{dJ}{dI} < 0, \tag{10}$$

showing that the two amounts of LTC coverage are strategic substitutes. This is a first instance of an RMH effect, cited already by Pauly (1990): Through the purchase of LTC insurance, the senior person protects the bequest, which reduces the partner's interest in buying coverage herself.

In the third period, the partner decides the level of informal care. Realistically, one can introduce the following

**Assumption:** When setting effort *e*, the partner neglects the risk of needing LTC herself, at least during the subsequent fourth period.

Thus, $q = 0$ in eq. (4) for deriving the FOC below,

$$\frac{d\overline{EU}}{de} = -(1-p)\overline{v}_z\left[(z_0 + sB - \theta e - \rho(J)\right]\theta + p\overline{v}_z\left[z_0 + sD - \theta e - \rho(J)\right](-sN_e - \theta) = 0 \ . \qquad (11)$$

For an interior solution with $e > 0$, it is necessary that $-sN_e > \theta$ ; if the share *s* in the bequest is less than $-N_e / \theta > 0$, zero effort is predicted. This is the consequence of limited altruism in that the partner does not like providing informal care *per se* [for the consequences of a child deriving utility from providing care, see Klimaviciute (2017)]. The decisive mixed derivative reads [recalling that $1-\kappa p > 0$ according to the estimates cited below eq. (9)]

$$\frac{\partial^2 \overline{EU}}{\partial e \partial I} = -(1-p)(-\kappa p)\theta \cdot \overline{v}_{zz} \ + p\overline{v}_{zz}(1-\kappa p)(-sN_e - \theta)$$

$$= p\left\{(1-\kappa p)(-sN_e - \theta) + (1-p)\kappa\theta\right\}\overline{v}_{zz} < 0 \text{ and hence } \frac{de}{dI} < 0 \ , \qquad (12)$$

indicating once again an RMH effect on the partner's side, as *I* and *e* are strategic substitutes. This was also predicted by Pauly (1990) and Zweifel and Strüwe (1996, 1998) as well as Courbage and Zweifel (2011). Preliminary empirical evidence from China reported by Xu and Zweifel (2014) supports this prediction.

Turning to the senior and noting the junior's predicted response $de / dI < 0$ according to eq. (12) , one obtains the FOC from eq. (3),

$$\frac{dEU}{dI} = (1-p)u_w[w_0 - \pi(I)](-\pi_I) + pv_w[w_0 - N_e \cdot de/dI + I - \pi(I)](1-\pi_I)$$

$$= -(1-p)\kappa p \cdot u_w[w_0 - \pi(I)] + p(1-\kappa p) \cdot v_w[w_0 - N_e \cdot de/dI + I - \pi(I)] = 0, \qquad (13)$$

which has an interior solution since $1-\kappa p > 0$. Now let there be an exogenous change $d\beta = 1$ such that $de / d\beta = de > 0$ for a given value of $de / dI < 0$, reflecting a response that is less marked than originally expected. Focusing on the crucial element of the comparative-static equation in analogy to eq. (7), one obtains (recall that $N_{ee} > 0$)

$$\frac{\partial^2 EU}{\partial I \partial e} = p(1-\kappa p)v_{ww}(N_{ee} \cdot de/dI - N_e) < 0 \text{ and hence } \frac{dI}{de} < 0. \qquad (14)$$

Therefore, the senior is predicted to scale back the amount of LTC coverage in response to an (anticipated) increase of informal care provided by the partner, confirming that the two decision variables *I* and *e* are strategic substitutes. For the same result, see e.g. Zweifel and Courbage (2016); it is supported by preliminary empirical evidence (based on stated intentions rather than actual choices) from China, a country that corresponds closely to the model due to its former one-child policy (Xu and Zweifel, 2014). Note that in this model, the senior's altruism does not go beyond bequeathing final wealth entirely, which is in line with the finding by Sloan and Norton (1997) that parental altruism is absent from decisions revolving around LTC insurance.

**Conclusion 1:** In a setting where senior and partner make their decisions surrounding long-term care (LTC) independently and sequentially, two types of relational moral hazard (RMH) are predicted. The partner, in response to a higher amount of LTC coverage purchased by the senior, may buy less LTC coverage as well as provide less informal care. In addition, the senior is predicted to buy less LTC coverage when anticipating more informal care provided by the partner. Therefore, on both sides decision variables are strategic substitutes, resulting in bilateral RMH effects.

In principle, it is conceivable that the senior's choice of LTC coverage is influenced by the partner's anticipated coverage. However, the FOC in eq. (13) is not affected by *J* (recall that the loading factor charged to the senior is constant, independent of *J*). Therefore,

$$\frac{\partial^2 EU}{\partial I \partial J} = 0 \text{ , implying } \frac{dI}{dJ} = 0 \text{ ,} \tag{15}$$

indicating that the older player's decision to purchase LTC is independent of that of the partner.

## 3 Senior and partner purchase LTC insurance jointly

This section is devoted to the innovation cited in the Introduction: Several ICs have started to write LTC contracts covering not only one individual but also a partner (usually a member of the family extensively defined). This means that the two players have to decide simultaneously. The senior now needs to take into account both insurance coverage and anticipated informal care provided by the partner. As to the partner, both her choice of LTC coverage and her commitment to future care must be made in the light of the senior's purchase of LTC coverage. This simultaneity contains an element of internalization of RMH that might limit its scope.

In Figure 2, the IC offers an LTC contract that insures both senior and partner in period 1'. Due to lower acquisition expense, the factor loaded on their combined probability *pq* of needing formal LTC services should be lower than either $\kappa$ or $\lambda$, respectively; for simplicity it is set to 0 at the margin, resulting in the joint marginal premium $\mu_{I+J} = \kappa p + \lambda q$ . On this assumption, the

IC refrains from charging the two consumers for the risk that they might need LTC at the same time. Failure to do so would render a joint policy unattractive upfront, except for the fact that it might permit each player to 'eat into' the common pool. This flexibility is neglected here because the two players would have to reach agreement over it in a separate negotiation.

Figure 2. Timeline in the case of a joint purchase of LTC insurance

| 1' | 2' |
|---|---|
| *IC* offers contract to Senior and Partner, Senior buys $I$ and Partner buys $J$ at $\mu_{I+J} = \kappa p + \lambda q$, with Partner committing to $e$ | Senior needs LTC with probability $p$ at cost $N(e)$ |

Starting with the senior this time, the pertinent FOC in period 1' is now affected by two simultaneous exogenous changes, in the partner's LTC coverage *dJ* and in effort *de*. This results in the comparative-static equation,

$$\frac{\partial^2 EU}{\partial I^2} dI + \frac{\partial^2 EU}{\partial I \partial J} dJ + \frac{\partial^2 EU}{\partial I \partial e} de = 0 \ . \qquad (16)$$

After division by $\partial^2 EU / \partial I^2 < 0$ and $de$, this solves for

$$\frac{dI}{de} \approx \underset{(0)}{\frac{\partial^2 EU}{\partial I \partial J}} \underset{(+)}{\frac{dJ}{de}} + \underset{(-)}{\frac{\partial^2 EU}{\partial I \partial e}} < 0 \ . \qquad (17)$$

The term $dJ/de$ indicates that the partner might choose her own amount of coverage in view of the amount of informal care she intends to provide. Indeed, $dJ/de > 0$, stating that these two decision variables are positively related, which by itself would have the potential of mitigating RMH. The positive sign follows from $dJ/de = (dJ/dI)/(de/dI)$, with $dJ/dI < 0$ established by eq. (10) and $de/dI < 0$, by eq. (12). However, this potential fails to be realized since the first term of eq. (17) is zero in view of eq. (15). Finally, $\partial^2 EU / \partial I \partial e < 0$ according to eq. (14). In sum, eq. (17) boils down to eq. (14), indicating that the simultaneity imposed by a joint LTC policy does not reduce the RMH effect caused by lowered effort provided by the partner.

However, this simultaneity may still have an effect by relating the two players' decisions concerning the amount of LTC to each other. Indeed, one obtains from dividing eq. (15) by *dJ* and in view of eqs. (15), (17), and (12)

$$\frac{dI}{dJ} \approx \underset{(0)}{\frac{\partial^2 EU}{\partial I \partial J}} + \underset{(-)}{\frac{\partial^2 EU}{\partial I \partial e}} \underset{(-)}{\frac{de}{dI}} > 0 \ . \tag{18}$$

The analogous prediction derived in Section 2 was $dI/dJ = 0$ due to $\partial^2 EU/\partial I \partial J = 0$ [see eq. (18)]. This is the first term of eq. (18); however, there is now a second positive term which transforms the decision variables *I* and *J* into strategic complements rather than substitutes as in Section 2 , at least on te part of the senior. The reason is the interaction of two known RMH effects. On the one hand, $\partial^2 EU/\partial I \partial e < 0$ and hence $dI/de < 0$ indicates that the senior person tends to reduce LTC coverage if the partner commits to a higher amount of informal care. On the other hand, $de/dI < 0$ [according to eq. (17)] says that such a reduction triggers less informal care provided by the partner. In view of the simultaneity of these decisions, the senior needs to take these RMH effects into account, resulting in an upward adjustment of LTC coverage.

As to the junior person, she now has to adjust two decision variables simultaneously to a change $dI > 0$ on the senior's side, giving rise to the equation system,

$$\begin{bmatrix} \frac{\partial^2 \overline{EU}}{\partial J^2} & \frac{\partial^2 \overline{EU}}{\partial J \partial e} \\ \frac{\partial^2 \overline{EU}}{\partial J \partial e} & \frac{\partial^2 \overline{EU}}{\partial e^2} \end{bmatrix} \begin{bmatrix} dJ \\ de \end{bmatrix} + \begin{bmatrix} \frac{\partial^2 \overline{EU}}{\partial J \partial I} \\ \frac{\partial^2 \overline{EU}}{\partial e \partial I} \end{bmatrix} dI = 0 \ . \tag{19}$$

With the determinant of the Hessian $H > 0$ and applying Cramer's rule, one obtains

$$\frac{dJ}{dI} = \frac{-1}{H} \begin{vmatrix} \frac{\partial^2 \overline{EU}}{\partial J \partial I} & \frac{\partial^2 \overline{EU}}{\partial J \partial e} \\ \frac{\partial^2 \overline{EU}}{\partial e \partial I} & \frac{\partial^2 \overline{EU}}{\partial e^2} \end{vmatrix} = \frac{-1}{H} \begin{vmatrix} 0 & \frac{\partial^2 \overline{EU}}{\partial J \partial e} \\ \frac{\partial^2 \overline{EU}}{\partial e \partial I} & \frac{\partial^2 \overline{EU}}{\partial e^2} \end{vmatrix} = \frac{1}{H} \left( \frac{\partial^2 \overline{EU}}{\partial J \partial e} \cdot \frac{\partial^2 \overline{EU}}{\partial e \partial I} \right) > 0 \tag{20}$$

in view of eqs. (15), (14), and from eq. (11),

$$\begin{aligned} \frac{\partial^2 \overline{EU}}{\partial e \partial J} &= -(1-p)\overline{v}_{zz}(-\lambda q)\theta^2 + p\overline{v}_{zz}(-\lambda q)(-sN_e - \theta) \\ &= -\lambda q \left\{ -(1-p)\theta^2 + p(-sN_e - \theta) \right\} \overline{v}_{zz} < 0 \end{aligned} \tag{21}$$

because the curly bracket is almost certainly negative. First, $1-p>p$ for the senior in view of the estimates cited below eq. (9); second, $-sN_e-\theta>\theta$ (the share in the increased bequest is deduced from the cost of effort in case the senior needs formal LTC). Therefore, on the part of the junior person, eq. (20) indicates that the two amounts of LTC coverage have become strategic complements, contrary to Section 2.

However, eq. (19) can also be solved for

$$\frac{de}{dI}=\frac{-1}{H}\begin{vmatrix}\frac{\partial^2\overline{EU}}{\partial J^2} & \frac{\partial^2\overline{EU}}{\partial J\partial I}\\ \frac{\partial^2\overline{EU}}{\partial J\partial e} & \frac{\partial^2\overline{EU}}{\partial e\partial I}\end{vmatrix}=\frac{-1}{H}\begin{vmatrix}\frac{\partial^2\overline{EU}}{\partial J^2} & 0\\ \frac{\partial^2\overline{EU}}{\partial e\partial I} & \frac{\partial^2\overline{EU}}{\partial J\partial e}\end{vmatrix}=\frac{-1}{H}\left(\frac{\partial^2\overline{EU}}{\partial J^2}\cdot\frac{\partial^2\overline{EU}}{\partial J\partial e}\right)<0 \qquad (22)$$

in view of $H>0$, eq. (15), , and eq. (21). Thus, informal care provided and LTC coverage purchased by the senior continue to be strategic substitutes. The reason is that according to eq. (17), the senior responds to $de<0$ on the part of the junior by increasing LTC coverage, which by eq. (20) in turn causes the junior to step up her coverage as well, which undermines her incentive to protect her bequest by exerting effort designed to reduce the cost of formal care $N(e)$.

**Conclusion 2:** The simultaneity induced by a joint LTC insurance policy has the potential of reversing one the two RMH effects present when senior and partner decide the amount of coverage independently since the two amounts of coverage become strategic complements. However, coverage purchased by the senior and informal care provided by the junior continue to be strategic substitutes.

## 4 Conclusion and outlook

This paper builds on theoretical work on intra-family moral hazard to analyze more generally the interaction between a senior person and a partner (a spouse, family member, or friend) in the context of private long-term care (LTC) insurance. First, it confirms earlier findings predicting relational moral hazard (RMH) effects in the conventional setting where the older person first purchases LTC coverage while the younger partner decides the amount of informal care provided later on: The senior may well scale back his or her purchase of LTC coverage in anticipation of higher effort provided by the partner, who in turn has less incentive to provide such effort given that LTC coverage protects the bequest against costly formal LTC services. In addition, the partner is predicted to buy less LTC coverage in response to more coverage on the part of the senior (Conclusion 1). In the broader context of Becker's (1974) 'Rotten kind theorem' and its generalizations, RMH has to be expected because the partner is last to move in a sequential game. Therefore, a contract variant recently launched by LTC insurers where senior and partner decide simultaneously about a joint amount of LTC coverage may hold promise to at least mitigate RMH. Indeed, while informal care provided by the junior and LTC coverage purchased by the senior continue to be strategic substitutes, the two amounts of coverage are now predicted to vary together, constituting strategic complements (Conclusion 2).

These results are subject to a number of limitations. First, since the insurance benefits for financing formal LTC are available jointly in these new policies, senior and partner need to reach agreement over their distribution lest the senior enjoy a decisive first-mover advantage. This side-game is neglected in the present analysis; if it fails to have a solution, the advantages of simultaneous decision-making are lost. Next, the second part of Conclusion 2 stating that RMH increases more slowly with an increasing probability of the senior needing LTC thanks to simultaneity hinges on the estimates of risks and loadings contained entered below eq. (11). While based on recent research and derived from the trade literature, these parameters strongly depend on the ages of senior and partner; moreover, they may change over time as LTC insurers have to adjust their pricing of policies. A final limitation is the paper's exclusive focus on RMH effects as a reason for undermining demand for private LTC insurance. As found theoretically by Zweifel and Courbage (2016) and empirically by Brown and Finkelstein (2008) for the case of the expansion of U.S. Medicaid to include LTC, public provision of LTC has important crowding-out effects which may easily swamp the limitation of RMH achieved by the novel LTC policies analyzed in this paper. Still, future work exploring additional aspects of these policies should be worthwhile as governments begin to realize the degree of crowding-out of private LTC insurance caused by their public provision and financing of formal LTC services.

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