

More on the optimal demand for long-term care insurance

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Abstract

In a model where individuals run the risk of becoming dependant, we analyse the demand for LTC and for long term care insurance. Our model, by taking into account intergenerational phenomena and altruism behavior, pays a special attention to the role of intra-family moral hazard and to the concern that individuals may have for their informal care givers' well-being. We first highlight the conditions under which the presence of informal care givers modifies the demand for long term care insurance. Then we investigate the effect of individuals' wealth, individuals' quality of life and informal care givers' quality of life on the demand for LTC and long-term care insurance.

1. Introduction

With the ageing of populations, the demand for long-term care¹ (LTC) is experiencing unprecedented growth (OECD, 2005). Coupled with a decline in the number of informal carers and low rates of public long-term care coverage, LTC insurance markets are expanding. LTC insurance provides a financial compensation should the policyholder suffer from loss of autonomy requiring LTC, in exchange of a premium. As LTC can be provided both formally by professional caregivers and informally by family members or other relatives, the demand for LTC insurance is known to be influenced by intergenerational phenomena.

In particular, intra-family moral hazard (IMH) has been pointed out in the LTC insurance market (Pauly, 1990). IMH refers to the disincentive for children or relatives as potential informal care givers to provide care when formal care is covered by insurance. Hence parents who prefer to receive care from children, namely informal care, may decline the offer to purchase insurance as the availability of formal care,

¹ Long-term care is a mix of social and health care provided on a daily basis, formally by professional caregivers or informally by relatives, at home or in institution, to people suffering from a loss of autonomy in their activity of daily living for an extended period of time.

paid for by insurance, may create a disincentive for children to provide care (Pauly, 1990). In other words, the presence of informal care would crowd-out LTC insurance (Costa-Font, 2010). As stressed by Mellor (2001), if having informal care available is negatively associated with the probability of owning LTC insurance, this would be consistent with intra-family moral hazard playing a role in the decision to purchase insurance.

Yet, another argument can be raised to explain that the decision to have LTC insurance is not negatively influenced by the informal care that relatives would be potentially willing to provide. This argument stems from parental altruism and relies on the fact that parents can be sensitive to the negative impact of providing care on the informal caregiver's quality of life as stressed in van den Berg *et al.* (2005). Indeed, several works show that providing informal care is painful for the caregiver's health (see e.g. Schulz and Beach, 1999). By purchasing insurance, parents would then avoid strain on the informal caregiver's health (which is an element of his/her quality of life). In other words, informal care would crowd-in LTC insurance. This argument would be consistent with LTC insurance purchase decision not being influenced by intra-family moral hazard.

The aim of this paper is to study the properties of the demand for LTC and for LTC insurance taking into account intergenerational phenomena and altruism behavior. In particular, we show that the presence of informal care modifies the classic results on the demand for insurance. Using a theoretical model based on van den Berg *et al.* (2005) with multidimensional utility functions depending on the wealth and the quality of life of the policyholder but also on the informal carer's quality of life, we first look at the demand for LTC and for LTC insurance. Second, we wonder how these two decisions interact with each other, and how exogenous shocks modify these decisions. We consider three types of exogenous shocks: on wealth, on policyholders' quality of life and on informal carers' quality of life.

The paper is organized as follows. The assumptions of the model are presented in section 2. The equilibrium levels of long-term care insurance, formal care and

informal care are defined in section 3. The effect of the existence of informal care on the demand for formal care and the demand for LTC insurance is examined in section 4. Comparative statics results are derived in section 5 and we conclude in section 6.

2. The model

The model is based on van den Berg *et al.* (2005) to which we add uncertainty and insurance, and on Eeckhoudt *et al.* (2003) and Huang and Tzeng (2006) to which we introduce informal care. Let consider an individual with an initial wealth denoted w and an initial quality of life level denoted h . The individual is subject to the risk of becoming dependent. Dependency occurs with a probability p and its negative effect on the individual's quality of life is denoted D . In case of dependency, the individual may receive both formal care (FC) and/or informal care (IC). Informal care is provided for free by children or relatives, while formal care has a cost which is set equal to α per unit of care.

The level of dependency (D) defines the needs of the dependent individual (denoted $N(D)$). The level of informal care provided by the relatives depends in our model on the level of formal care selected by the decision maker². Informal care is thus supposed to come on top of formal care, which means that the lower the level of formal care selected, the more informal care is provided³. Relatives are moreover assumed to provide the level of informal care that just complements that of formal care in order that the total level of LTC provided is constant. This assumption is consistent with the vital aspects of LTC (food supply, medicine intake,...*etc.*). It is thus assumed that relatives always supply these vital needs in case policyholders do not meet them through formal care but that the less vital aspects of LTC are not supplied by relatives. Therefore, $IC(FC) + FC = N(D)$ (implying $IC'_{FC} = -1$).

² In countries where public support or coverage for formal care is rather important, like in Europe, elderly parents in need of assistance first turn to formal care services and then informal care adapt accordingly (see Holly *et al.*, 2008).

³ This relation finds strong support empirically (see Bolin *et al.*, 2008; Bonsang, 2009).

Care, whether delivered formally or informally, is supposed to have the same impact on the decision-maker's quality of life. This impact is described through the function $b(h)$ which is increasing and concave ($b'(h) > 0$ and $b''(h) < 0$), *i.e.* care improves decision makers' quality of life at a decreasing rate. We suppose that the quality of life is necessarily lower in case of dependency whatever the level of care provided ($h > h - D + b(N(D))$). We also assume that individuals are altruist in the sense that they are sensitive to the negative impact that the provision of informal care has on the caregiver's quality of life. Higher informal care is assumed to reduce the relatives' quality of life at an increasing rate via the function $c(h)$ (with $c'(h) > 0$ and $c''(h) > 0$).

Individuals derive utility from their wealth (denoted w), their own quality of life (denoted h) and from the quality of life of their relatives (denoted h_r), hence their utility function is given by $U(w, h, h_r)$. The individual's utility is increasing and concave in all arguments, *i.e.* $U_1 > 0, U_{11} < 0, U_2 > 0, U_{22} < 0, U_3 > 0, U_{33} < 0$. In line with empirical evidence (see Viscusi and Evans (1990), Sloan *et al.* (1998), Carthy *et al.* (1999) and Finkelstein *et al.* (2009)), we assume that wealth and the quality of life are complementary ($U_{12} > 0$)⁴. We also suppose that the way people care about their relatives is independent of their wealth level and of their own quality of life ($U_{13} = U_{23} = 0$)⁵.

Finally, the individual have the opportunity to purchase an insurance policy which offers an indemnity I in case of dependency. The insurance contract is supposed to be in the form of a cash-benefit contract as this is the most common form of LTC insurance contract (Kessler, 2010). For sake of simplicity, the insurance premium is assumed to be actuarially fair (and is thus equal to pI).

⁴ The abovementioned papers actually highlight the complementarity between wealth and health. Since health is a component of the more global concept of quality of life, we assume that this complementarity relationship holds for wealth and quality of life as well. To be exhaustive on this topic, let us mention that Evans and Viscusi (1991) find that U_{12} could also be negative for minor injuries.

⁵ These assumptions are made since no empirical evidences have been provided on the sign of these derivatives.

3. The equilibrium level of insurance and formal care

The decision-maker maximization program is given by:

$$\begin{aligned} \text{Max}_{I, FC} \quad EU = & (1-p)U(w-pI, h, h_r) \\ & + pU(w+(1-p)I-\alpha FC, h-D+b(IC(FC)+FC), h_r-c(IC(FC))) \end{aligned}$$

The following notation is adopted in order to ease the reading of the expressions:

$$A = (w-pI, h, h_r)$$

$$B = (w+(1-p)I-\alpha FC, h-D+b(IC(FC)+FC), h_r-c(IC(FC)))$$

Let us first examine the optimal level of insurance (denoted I^*). The first order condition for a maximum is given by:

$$FOC_I \equiv \frac{\partial EU}{\partial I} = -p(1-p)U_1(A) + p(1-p)U_1(B) = 0 \quad (1)$$

Since $U_{12} > 0$ and $U_{13} = 0$, it follows that $I < \alpha FC$ i.e. that insurance coverage is less than complete even if the premium is fair (see Rey (2003) for a related result).

The optimal level of formal care is defined by:

$$FOC_{FC} = \frac{\partial EU}{\partial FC} = -p\alpha U_1(B) + pc'(IC(FC))U_3(B) = 0 \quad (2)$$

The optimal level of formal care (denoted FC^*) is such that the loss of utility due to the cost of formal care equals the gain of utility due to the improved quality of life of the relative who provides less informal care as the level of formal care rises.

The second-order conditions for a maximum are shown to be satisfied (appendix 1).

The reaction functions defining respectively the change in the LTC insurance demand resulting from a variation in formal care (reaction function denoted $I(FC)$ on figure 1) and the change in formal care resulting from a variation in LTC insurance (reaction function denoted $FC(I)$ on figure 1) can be drawn by differentiating Eqs. (1) and (2) with respect to I and FC :

$$\frac{\partial^2 EU}{\partial I \partial FC} = -p(1-p)\alpha U_{11}(B) > 0$$

$$\frac{\partial^2 EU}{\partial FC \partial I} = -p(1-p)U_{11}(B) > 0$$

The slopes of these reaction functions are positive and can be explained as follows. As for $I(FC)$, an increase in formal care reduces wealth and thus increases the marginal utility of wealth in case of dependency. It thus raises the demand for LTC insurance since its marginal benefit increases. Similarly for $FC(I)$, the increase in insurance indemnity in case of dependency raises wealth and thus lowers the marginal utility of wealth. This decreases the marginal cost of formal care and thus leads to an increase of the demand for this form of care.

4. Informal care and the demand for formal care and for LTC insurance

In order to provide some insights into the way the demand for LTC insurance is influenced on the one hand by the role of intra-family moral hazard and on the other hand by the concern that individuals have for their relatives' quality of life, let us determine the impact of the presence of informal care givers on the demand for LTC insurance. When there are no relatives willing to provide informal care, the level of formal care is not an endogenous variable since the needs of the dependant individual must by assumption be met ($FC = N(D)$). The demand for formal care is thus lower in the presence of informal care as long as:

$$-\alpha U_1(w+(1-p)I-\alpha FC, h-D+b(N(D)), h_r-c(0)) + c'(0)U_3(w+(1-p)I-\alpha N(D), h-D+b(N(D)), h_r-c(0)) > 0 \quad (3)$$

Eq. (3) states that the demand for formal care is lower in the presence of informal care than in its absence ($FC^* < N(D)$) in case the reduction in the level of formal care generates more benefits (due to the savings the individual do) than costs (resulting from the automatic increase in informal care that deteriorates the quality of life of the individual's informal care giver).

In case relatives cannot (or are not willing to) provide informal care, the decision-maker maximizes the following expected utility:

$$\text{Max}_I EU_1 = (1-p)U(w-pI, h, h_r) + pU(w+(1-p)I-\alpha N(D), h-D+b(N(D)), h_r)$$

The first-order condition defining the demand for LTC insurance in the absence of informal care (denoted $I_{IC=0}$) is given by:

$$\frac{\partial EU_1}{\partial I} = -p(1-p)U_1(w-pI, h, h_r) + p(1-p)U_1(w+(1-p)I-\alpha N(D), h-D+b(N(D)), h_r-c(0)) = 0 \quad (4)$$

Comparing the first-order conditions given by (1) and (4) and assuming that condition (3) is met, the presence of informal care is shown to reduce the demand for LTC insurance since under the assumptions of our model we have:

$$U_1(w+(1-p)I-\alpha FC^*, h-D+b(IC(FC^*)+FC^*), h_r-c(IC(FC^*))) < U_1(w+(1-p)I-\alpha N(D), h-D+b(N(D)), h_r-c(0))$$

If condition (3) is satisfied, the decision maker is wealthier in case of dependency in the presence of informal care. His/her marginal utility of wealth in case of dependency is lower, which gives him/her less incentive to buy LTC insurance

contracts. This situation is depicted on figure 1 using the reaction functions defined in section 3.

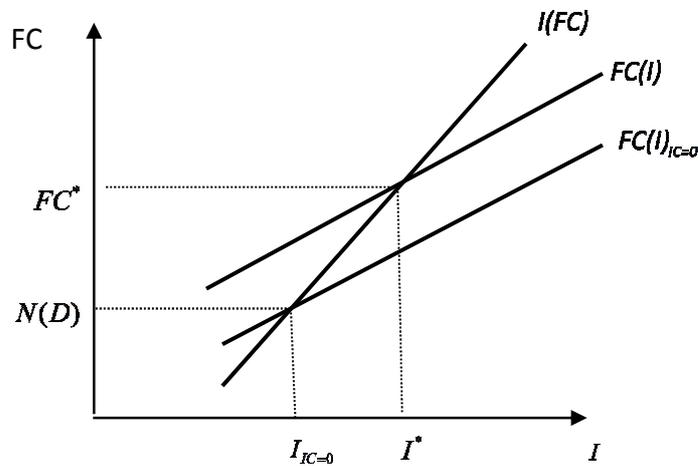


Fig. 1

We thus defined in our model a condition (Eq. (3)) such that the negative influence intra-family moral hazard could have on LTC insurance dominates the positive influence on LTC insurance due to the concern individuals have for their relatives' quality of life. The consequence of this condition is that the presence of informal care is shown to reduce the demand for formal care and for LTC insurance. Note that if condition (3) does not hold, the reverse is not true since the demand for formal care and thus the demand for LTC insurance remain unchanged.

5. Comparative statics

Let us now evaluate how the two endogenous variables change with three exogenous variables: the individuals' wealth, the individuals' quality of life and the relatives' quality of life.

5.1. Change in the individuals' wealth

To evaluate how variations in the individuals' wealth affect their demand for formal care and LTC insurance, we must use the two first-order conditions and the theorem of implicit functions and solve $Mx = d$ where:

$$M = \begin{bmatrix} pU_{11}(A) + (1-p)U_{11}(B) & -\alpha U_{11}(B) \\ -\alpha U_{11}(B) & \alpha^2 U_{11}(B) - c''(\cdot)U_3(B) + c'(\cdot)^2 U_{33}(B) \end{bmatrix}$$

$$x = \begin{bmatrix} \frac{\partial I}{\partial w} \\ \frac{\partial FC}{\partial w} \end{bmatrix} \text{ and } d = \begin{bmatrix} U_{11}(A) - U_{11}(B) \\ \alpha U_{11}(B) \end{bmatrix}$$

Using matrix inversion technique, we know that $x = M^{-1}d$ where:

$$M^{-1} = \frac{1}{|M|} \begin{bmatrix} \alpha^2 U_{11}(B) - c''(\cdot)U_3(B) + c'(\cdot)^2 U_{33}(B) & \alpha U_{11}(B) \\ \alpha U_{11}(B) & pU_{11}(A) + (1-p)U_{11}(B) \end{bmatrix}$$

where $|M|$ denotes the determinant of M , ($|M| > 0$; see appendix 1).

Since $U_{12} > 0$, we know from Rey (2003) that the insurance coverage is less than complete: $I < \alpha FC$. It follows that: $U_{11}(A) - U_{11}(B) \underset{<}{>} 0$ if $U_{111} \underset{<}{>} 0$. It can thus be shown that:

$$\frac{\partial I}{\partial w} > 0 \text{ and } \frac{\partial FC}{\partial w} > 0 \text{ if } U_{111} \leq 0$$

$$\frac{\partial I}{\partial w} \text{ and } \frac{\partial FC}{\partial w} \text{ are undetermined if } U_{111} > 0$$

The intuition of this result is the following. Any change in exogenous variables implies a direct effect (in this case, the effect of wealth on insurance and formal care) and indirect effects (the effect that LTC insurance and formal care levels play on each

other). If individuals are downside risk-lovers ($U_{111} < 0$, see Menezes, Geiss and Tressler (1980)), their fear of risks rises when they become wealthier. Consequently, they buy more insurance to get rid of this risk (direct effect of w on I ; see Eq. (1)). Moreover, the wealthier people are, the more they buy formal care since their marginal utility of wealth and thus the marginal cost of formal care falls (direct effect of w on FC ; see Eq. (2)). The indirect effects also go in the same direction (as can be seen from the reaction functions on figure 1). When individuals buy more formal care, their wealth level is reduced in the dependency state. This increases the marginal utility of wealth in that state and thus the incentives to buy LTC insurance (indirect effect of FC on I ; see Eq. (1)). Besides, in case individuals buy more LTC insurance, their wealth in the dependency state rises. This lowers the marginal utility of wealth and thus the marginal cost of formal care. Consequently, they buy more formal care (indirect effect of I on FC ; see Eq. (2)).

5.2. Change in the individuals' quality of life

Let us now evaluate how variations in the policyholders' quality of life affect their demand for formal care and for LTC insurance. Formally, the equation system we must solve is given by $Mx = g$ where M and x are defined as in section 4.1. and where g is given by:

$$g = \begin{bmatrix} U_{12}(A) - U_{12}(B) \\ \alpha U_{12}(B) \end{bmatrix}$$

It is then straightforward to show that:

$$\frac{\partial I}{\partial h} < 0 \text{ and } \frac{\partial FC}{\partial h} < 0 \text{ if } U_{12}(A) \geq U_{12}(B)$$

$$\frac{\partial I}{\partial h} \text{ and } \frac{\partial FC}{\partial h} \text{ are undetermined if } U_{12}(A) < U_{12}(B)$$

The effect of the policyholder's quality of life improvement on his/her demand for formal care and for LTC insurance depends among other things on the

complementarity between wealth and the quality of life. If this complementarity is weaker in the dependency state (compared to what it is in the non-dependency state), any given improvement in the individual's quality of life has a weaker (positive since $U_{12} > 0$) impact on the marginal utility of wealth in the dependency state. This lowers the incentives to buy LTC insurance (direct effect of h on l ; see Eq. (1)). Besides, the same improvement in the individual's quality of life results in an increase in his/her marginal utility of wealth, it therefore raises the marginal cost of formal care and thus lowers the demand for formal care (direct effect of h on FC ; see Eq. (2)). Since the indirect effects reinforce the shifts of l and FC going in the same direction (see the shape of the reaction functions on figure 1 and the interpretation of the shape of these functions page 6), a quality of life improvement reduce the demand for LTC insurance and for formal care if the complementarity between wealth and the quality of life is less strong in the dependency state. In case this complementarity is independent of the state of the world ($U_{12}(A) = U_{12}(B)$), only the direct effect of h on FC plays and the same conclusion is obtained. Results are ambiguous when $U_{12}(A) < U_{12}(B)$.

These conditions can be used to assess the effect of a deterioration of the dependency state ($\Delta^+ D$) on the demand for formal care and for LTC insurance. We have assumed (see section 2) that dependency lowers the quality of life whatever the level of care provided ($h > h - D + b(N(D))$). This assumption implies that $b'(N(D))N'(D) < 1$, i.e any deterioration in the dependency state results in a lower quality of life. It follows that $U_{12}(A) \geq U_{12}(B)$ is a sufficient condition that guarantees that a deterioration of the dependency state raises the demand for formal care and the demand for LTC insurance.

5.3. Change in relatives' quality of life

Let us now evaluate how variations in the quality of life of the relatives of the policyholders affect their demand for formal care and for LTC insurance. Formally, the

equation system we must solve is given by $Mx = k$ where M and x are defined as in section 4.1 and where k is given by:

$$k = \begin{bmatrix} 0 \\ -c'(\cdot)U_{33}(B) \end{bmatrix}$$

It can be shown that:

$$\frac{\partial I}{\partial h_r} < 0 \text{ and } \frac{\partial FC}{\partial h_r} < 0$$

Policyholders are less sensitive to their relatives' quality of life when the latter rises (since $U_{33} < 0$). An increase in the relatives' quality of life therefore reduces the demand for formal care (direct effect of h_r on FC ; see Eq. (2)). This latter effect leads to a reduction in the demand for LTC insurance (indirect effect of FC on I ; see Eq. (1)). Hence, the healthier the informal care giver, the less formal care and LTC insurance are purchased.

6. Conclusion

The objective of the present paper is to formalize the demand for long-term care and for long-term care insurance taking two elements into account: the role of intra-family moral hazard and the fact that individuals are sensitive to the quality of life of their informal care givers. In this context, we define conditions under which the presence of informal care decreases the demand for LTC insurance. We also provide the conditions under which wealthier individuals demand more formal care and more long term care insurance. We also show the conditions under which the demand for formal care and for long term care insurance falls as the policyholders' quality of life improves. Using the same technique, we show that any improvement in the quality of life of the informal care giver reduces the demand for formal care and for long-term care insurance.

Some limits of our analysis should be mentioned. The first limitation of our model comes from the assumption that the needs of the dependant individual are necessarily met, either formally or informally. The same analysis could have been provided assuming that any change in the level of formal care is not necessarily compensated by the same change (in opposite direction) in the level of informal care. This would however make necessary new assumptions about the simultaneous changes in the two different forms of long-term care. In the same way, we have supposed that the way policyholders care about their relatives' quality of life is independent of their wealth and on their own quality of life. Since neither the economic theory nor empirical evidences suggest a definitive sign for U_{13} and U_{23} , other assumptions should here again be made (on which basis?) in order to avoid the multiplication of potential results.

The sufficient conditions highlighted in the comparative static results section show that one can hardly draw clear-cut conclusions on the way the variables of our model affect the demand for long-term care and for LTC insurance. The paper at least points out the important elements to be considered when analysing the demand for long-term care and for LTC insurance, and in particular the significance of informal care in influencing these demands. Empirical evidences, for example, on the way the complementarity between health and wealth is affected by the dependency state, on the way relatives compensate (or not) the lack of informal care, on the way the sensitiveness of the policyholder to the well-being of his/her relatives changes with his/her wealth and with his/her own quality of life, would definitely be useful in order to improve these theoretical investigations.

6. References

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Appendix 1

The second order conditions are satisfied since:

$$SOC_I \equiv \frac{\partial^2 EU}{\partial I^2} = p^2(1-p)U_{11}(A) + p(1-p)^2U_{11}(B) < 0$$

$$SOC_{FC} \equiv \frac{\partial^2 EU}{\partial FC^2} = p\alpha^2U_{11}(B) - pc''(\cdot)U_3(B) + pc'(\cdot)^2U_{33}(B) < 0$$

$$\begin{aligned} \frac{\partial^2 EU}{\partial I^2} \frac{\partial^2 EU}{\partial FC^2} - \left(\frac{\partial^2 EU}{\partial I \partial FC} \right)^2 &= p^3(1-p)\alpha^2U_{11}(A)U_{11}(B) \\ &- p^3(1-p)c''(\cdot)U_{11}(A)U_3(B) - p^2(1-p)^2c''(\cdot)U_{11}(A)U_3(B) \\ &+ p^3(1-p)c'(\cdot)^2U_{11}(A)U_{33}(B) + p^2(1-p)c'(\cdot)^2U_{11}(B)U_{33}(B) > 0 \end{aligned}$$