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# Why do people buy insurance? A modern answer to an old question

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## Abstract

Three archetypical models of insurance demand based, respectively, on risk aversion, state-dependent marginal utility, and imperfectly divisible consumption are presented. These models show that the common principle underlying insurance is not always a risk transfer but meeting a conditional need. In general, insurance aligns the risk in one's financial endowment with the risk in one's financial needs. This extension of the traditional view of insurance allows simple generalizations of classic results, has implications for policy advice, and may help guiding further research.

## 1 | INTRODUCTION

Economists typically assume that the desire to insure is driven by risk aversion, a general preference of a certain amount of wealth over an uncertain one with identical expected value. Such a risk-averse person is willing to pay a positive amount of money, a risk premium, to exchange her uncertain wealth for a certain one. Buying insurance is regarded as exactly that trade.

The two topics of insurance and risk aversion are inextricably intertwined in the canon of Economics. Although above account suggests that one, risk aversion, explains the other, insurance, the economic literature is fraught with examples of insurance being regarded as evidence of risk aversion: We see a lot of people buying insurance, hence, they must be risk-averse (Arrow, 1971, p. 91; Gollier, 2001, p. 18). This line of reasoning implicitly assumes that there can be no other motive for insurance. For otherwise, we

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cannot regard insurance as evidence of risk aversion. The prevalence of insurance, and its supposed link to risk aversion, may help explain the remarkable resilience of the idea of risk aversion as a general characteristic of people's preferences in the face of empirical evidence that questions its generality.<sup>1</sup> Although deviations from risk aversion have been investigated for quite some time, a growing body of empirical research cuts to the core of the link between insurance and risk aversion. Mounting evidence shows that individual estimates of risk aversion are often, if at all, only weakly linked to insurance ownership (Charness et al., 2020; Delavande et al., 2018; Eling et al., 2021; Guiso & Paiella, 2005; Jaspersen et al., 2022). This raises the question what motivates insurance purchase beyond risk aversion.

This article seeks to take a fresh look at the question why people buy insurance. Three archetypical models of insurance demand are presented, each based on a different motive: risk aversion, state-dependent marginal utility, and imperfectly divisible consumption with state-dependent value. These stylized models allow the following conclusions: Insurance demand that is solely based on risk aversion is a special and not the general case as people can have good reason to buy insurance without being risk-averse. In addition, insurance does not always constitute a risk transfer from the insured to the insurer. Instead, insurance is a means to meet one's conditional financial needs. It does so by aligning the risk in one's financial endowment to the risk in one's financial needs. This definition subsumes the traditional understanding of insurance as a mechanism to transfer risk in the special case in which an individual's financial needs are certain. It broadens this understanding to the case in which these needs are uncertain. In the latter case, insurance constitutes taking a calculated risk that is necessary to provide for an uncertain need.

It can be shown that the novel definition of insurance helps to find simple generalizations of two classic insights of the insurance literature to the case of state-dependent marginal utility: the optimality of partial insurance and deductibles (Arrow, 1963, 1971; Mossin, 1968) and the effect of ex-ante moral hazard (Pauly, 1974; Shavell, 1979). These simple generalizations stand in contrast to the large number of case distinctions that characterize the existing literature (Dionne, 1982; Huang & Tzeng, 2006; Rey, 2003).

Finally, the novel definition allows a new perspective on existing and ongoing research in several applications of (insurance) economics. The idea of insurance being based on risk aversion, and risk aversion alone, has broad implications for this discipline. It influences the research agenda that the discipline follows, and the policy advice that it offers to the societies that we live in. A modern idea of insurance can help design a new research agenda and improve the policy advice.

<sup>1</sup>It has a long tradition to interpret the observation of risk-seeking behavior such as gambling as a failure of the expected-utility hypothesis instead of a failure of the risk-aversion hypothesis. Friedman and Savage (1948) formulated their well-known hypothesis in response to the criticism that the simultaneous observation of insurance and gambling indicate a failure of (expected) utility maximization. Similarly, the Rabin Calibration Paradox is interpreted as evidence against the expected-utility framework (Rabin and Thaler, 2000), thereby neglecting the possibility that it may equally well disqualify the idea of a universally concave utility function, and, in this way, risk aversion. Putting the blame entirely on the expected-utility hypothesis proves to be a double-edged sword, however. O'Donoghue and Somerville (2018) point out that nonexpected utility models may equally well provide alternative explanations for behavior associated with risk aversion, such as insurance. In conclusion, the flexibility of nonexpected utility models allows them to capture all kinds of risk behaviors. Whether they also have merit as normative models is a matter of an ongoing discussion, however.

## 2 | THREE SIMPLE MODELS OF INSURANCE DEMAND AND A DEFINITION

In this section, three archetypes of motives for insurance demand are presented. Starting with the classic model of insuring a wealth risk, the underlying mechanisms, that make such an insurance desirable to a risk-averse individual, are discussed. This is followed by a presentation and discussion of two different motives for insurance: state-dependent marginal utility as a motive to insure, for example, longevity risk and indivisible consumption with state-dependent value as a motive to insure, for example, health risks. These models show why risk aversion is not the common denominator in insurance demand. By analyzing the assumptions underlying each model, it is then possible to arrive at a general idea of what motivates insurance demand.

It needs to be emphasized that, although the three motives of insurance are presented in isolation to point out specific characteristics and implications, many insurance settings will be governed by more than a single motive. The different motives may reinforce or dampen each other depending on whether they motivate to insure the same or opposite states of nature. Although specific motives may be of particular relevance in certain types of insurance, state-dependent marginal utility in longevity insurance and state-dependent indivisible consumption in health or long-term care insurance, for example, that does not mean that the other motives cannot be of relevance in these settings. People's motivations for various behaviors are complex. It is unlikely that insurance is an exception. We may thus find situations where someone has more than one reason to buy insurance and situations in which opposing motives leave a person conflicted about whether to buy a particular insurance.

### 2.1 | The classic: Risk aversion

The traditional model of insurance posits that people are risk-averse and that insurance is a means to rid oneself of risk. Given that insurance is basically a transfer of wealth across states of nature, the usefulness of such transfers is linked to the assumption that the ideal distribution of wealth across states of nature is an equal distribution, that is, there is a preference for certainty over risk, or, in short, risk aversion. The desirability of insurance then requires an a priori unequal distribution of wealth that can be equalized through transfers of wealth from states with higher to states with lower wealth. Formally, consider two states of nature  $s = 1, 2$  that occur with probability  $p$  and  $1 - p$  respectively. Let the a priori wealth distribution be the lottery  $\tilde{w} = (w_1, p; w_2, 1 - p)$  with expected value  $\bar{w} = E[\tilde{w}]$ . Let  $U(\tilde{w}) = pu(w_1) + (1 - p)u(w_2)$  be the expected utility of the lottery  $\tilde{w}$ . The individual wants to insure state 1, that is, transfer wealth from state 2 to state 1 if there is an actuarially-fair transfer  $t > 0$ , such that the lottery  $\tilde{w}_t = (w_1 + t, p; w_2 - \frac{p}{1-p}t, 1 - p)$  is strictly preferred to  $\tilde{w}$ . If the person is risk-averse, then  $u(\bar{w}) \geq U(\tilde{w})$ , with strict inequality for any lottery  $\tilde{w}$  with  $w_1 \neq w_2$ . Then, if  $w_1 < w_2$ , the transfer  $t^* = \bar{w} - w_1 > 0$  is desirable as it equalizes wealth across states,  $\tilde{w}_t = (\bar{w}, p; \bar{w}, 1 - p) = (\bar{w}, 1)$ , and  $U(\tilde{w}_t) = u(\bar{w}) > U(\tilde{w})$ . Figure 1 illustrates the motive for insurance based on risk aversion familiar from many textbooks (see also Cather, 2010).

In this understanding, insurance is a means to reduce one's risk exposure. Risk aversion, that is, the desirability of an equal distribution of wealth across states, is typically justified with the plausibility of a diminishing marginal utility of wealth:  $u''(w) < 0$ . It implies that a unit of money transferred from a state with high wealth to a state with low wealth results in an increase in utility.

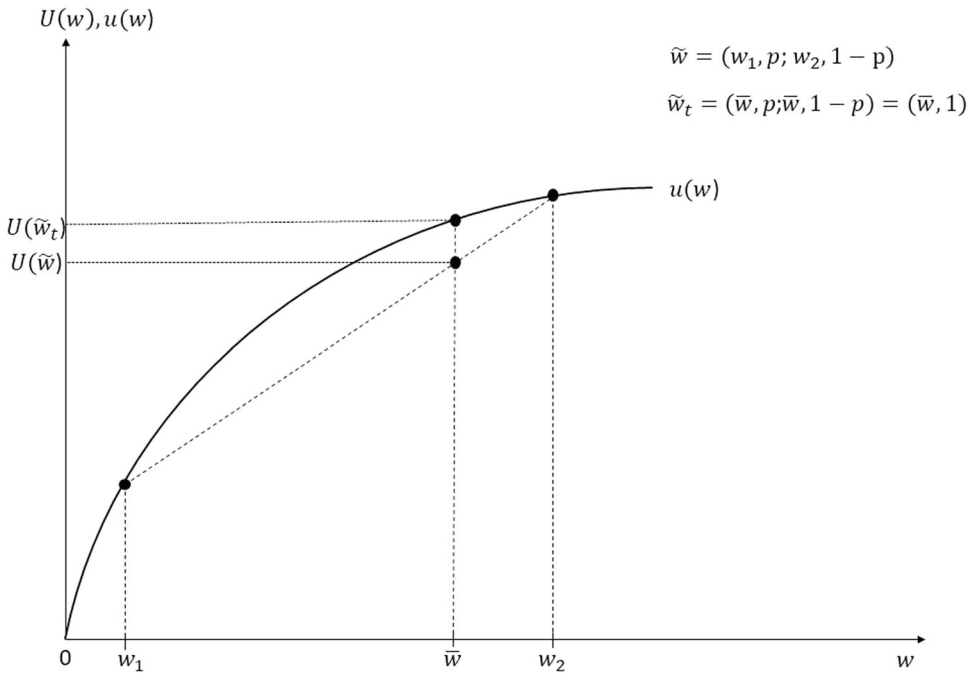


FIGURE 1 The utility from insuring a loss  $L = w_2 - w_1$  in wealth if risk-averse.

$$\begin{aligned} \left. \frac{\partial U(\tilde{w}_t)}{\partial t} \right|_{t=0} &= p[u'(w_1) - u'(w_2)] > 0 \\ &\Leftrightarrow u'(w_1) - u'(w_2) > 0 \\ &\stackrel{u'' < 0}{\Leftrightarrow} w_1 < w_2. \end{aligned}$$

It is important to recognize that it is the difference in the (marginal) value of money across state 1 and state 2,  $u'(w_1) > u'(w_2)$ , that ultimately motivates the wealth redistribution. However, utility is derived not from money itself but from the utility of the consumption goods that we can buy with it. This is the basic tenet on which the idea of diminishing marginal utility of money is built. A rational individual spends money on the most important expenses first, with additional money being spent on expenditures of less and less value. Yet, if the utility of money is derived from the utility of the consumption opportunities that we can buy with it, then the optimality of an equal distribution of wealth across states of nature requires two conditions. First, the value of the consumption opportunities that money can buy must be identical across all states of nature, that is, the function  $u(w)$  is state-independent. Second, an additional unit of money can only allow the purchase of less valuable items than any unit of money so far. These two conditions fail to hold in many settings of interest, which implies that people are not risk-averse.<sup>2</sup> Still, as the following two models will show, both failures can each form the basis of a motive to insure.

<sup>2</sup>That does not mean that an individual no longer wants to insure against possible wealth losses. After all, locally diminishing marginal utility can still contribute to insurance demand, even if marginal utility is not decreasing globally.

Thus, the very reasons that make people not risk-averse can make them want to buy insurance.

## 2.2 | State-dependent marginal utility of money

It is straightforward that the value of certain consumption possibilities is state-dependent. For example, expenditures on various activities might have more or less value depending on the state of one's health. Given that, it is natural to assume that the (marginal) value of money depends on more than just the amount of money  $w$  available, but also on the state  $s$ :  $u_s(w)$ . The expected utility of a lottery is then given by  $U(\tilde{w}) = pu_1(w_1) + (1 - p)u_2(w_2)$ . Yet, if the marginal value of money is larger in some states than in others, this presents a rationale for insuring the former states, that is, for transferring money into these states.

$$\left. \frac{\partial U(\tilde{w}_t)}{\partial t} \right|_{t=0} = p[u'_1(w_1) - u'_2(w_2)] > 0$$

$$\Leftrightarrow u'_1(w_1) - u'_2(w_2) > 0.$$

Note that for insurance to be desirable in such a setting, a loss in state 1, such that  $w_1 < w_2$ , is no longer necessary. All that is required is a marginal-utility advantage in state 1. If and only if  $u'_1(w_1) > u'_2(w_2)$ , then  $\partial U(\tilde{w}_t)/\partial t|_{t=0} > 0$  and a desirable transfer  $t > 0$  from state 2 to state 1 exists, even if  $w_1 = w_2 = \bar{w}$ . Specifically, with  $u_s(w)$  being twice continuously differentiable and  $u'_s > 0$ ,  $u''_s < 0$ , the transfer  $t^*$  that maximizes expected utility is implicitly defined by

$$\max \left\{ t \in \left[ -w_1, \frac{p}{1-p}w_2 \right] \middle| u'_1(w_1 + t^*) \geq u'_2\left(w_2 - \frac{p}{1-p}t^*\right) \right\}. \quad (1)$$

The optimal transfer  $t^*$  increases the wealth in the state that holds a marginal-utility advantage until either that advantage dissipates or there is no wealth left in state 2. In strong contrast to the previous setup, the optimal allocation of wealth across states can now be an unequal one. In conclusion, people are not risk-averse as they prefer particular unequal distributions of wealth over an equal distribution.<sup>3</sup> More importantly, insurance is exactly the means to achieve these desirable distributions, and, hence, a means to acquire particular risks. In addition, it becomes plain that the motive to insure state 1 does not require a loss. These consequences of state-dependent utility are in sharp contrast to the traditional understanding of insurance and the motives that we assume to drive its purchase.

The fact that losses have less relevance in a setting with state-dependent utility can be illustrated with the case of insurance against the risk of longevity. Given that most people deem a long life more desirable than a shorter one, annuities are a prime example of an insurance that pays benefits in a state in which a gain occurs. Yaari (1965) sets up a model in which—plausibly—an individual derives utility from money only conditional on being alive. Yet, this is a model of state-dependent utility for which the optimal solution is to annuitize all wealth, or, put differently, transfer all wealth from the state in which it has no value, death, to the state in

<sup>3</sup>Note that this does not mean that they are risk-seeking as they only prefer some, and not all, unequal distributions over the equal distribution.

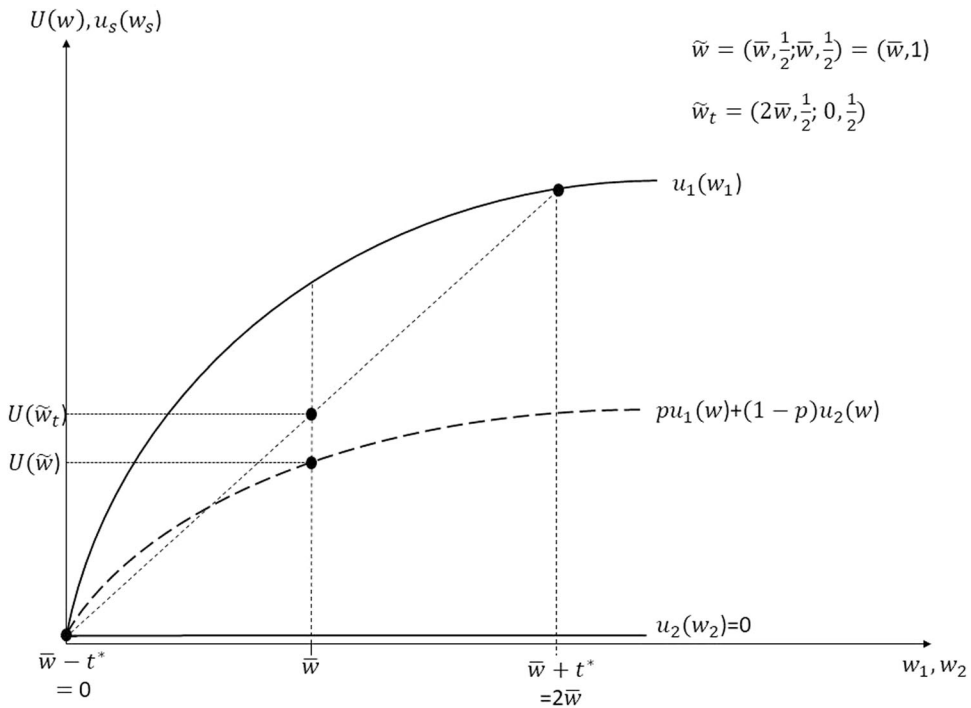


FIGURE 2 Insuring longevity.

which it has value, life. Consider Figure 2 for a simple example in which it is equally likely to survive until retirement and to die prematurely.  $w$  refers to the person's retirement wealth. Starting from a position of equal wealth in both states,  $\tilde{w} = (\bar{w}, \frac{1}{2}; \bar{w}, \frac{1}{2})$ , insurance allows to transfer all wealth from state 2, in which it has no value, to state 1, in which it has value. The optimal wealth distribution that is achieved through this transfer is  $\tilde{w}_t = (2\bar{w}, \frac{1}{2}; 0, \frac{1}{2})$ .

The optimal wealth distribution  $\tilde{w}_t = (2\bar{w}, \frac{1}{2}; 0, \frac{1}{2})$  is unequal, which means that the individual is not risk-averse. Yaari, unfortunately confusing diminishing marginal utility of wealth with risk aversion, wrongly concludes that his work shows that risk-averse individuals want to annuitize their entire retirement wealth. The appropriate conclusion is that people with state-dependent preferences, specifically those who do not put any value on money in case of a premature death, want to fully annuitize their wealth, irrespective of their risk preference. For, as Figure 3 illustrates, we can attain exactly the same result when imposing a linearity assumption on  $u_s(w)$ .

This clearly shows that it is the difference in marginal utility across states that provides the motive to insure against longevity, not the fact that marginal utility might be diminishing. In sum, marginal-utility differences constitute a reason to buy insurance independent of whether we assume diminishing marginal utility and/or losses.

The idea of state-dependent utility is not novel (Arrow, 1974; Hirshleifer, 1966), but the existing literature on insurance with state-dependent marginal utility focuses on how its findings can be fitted into the traditional framework instead of considering whether this framework is still appropriate. The traditional framework considers insurance as a means to mitigate a loss. Under state-dependence, conditions are then derived under which the rational individual underinsures, fully insures, or even overinsures a loss.

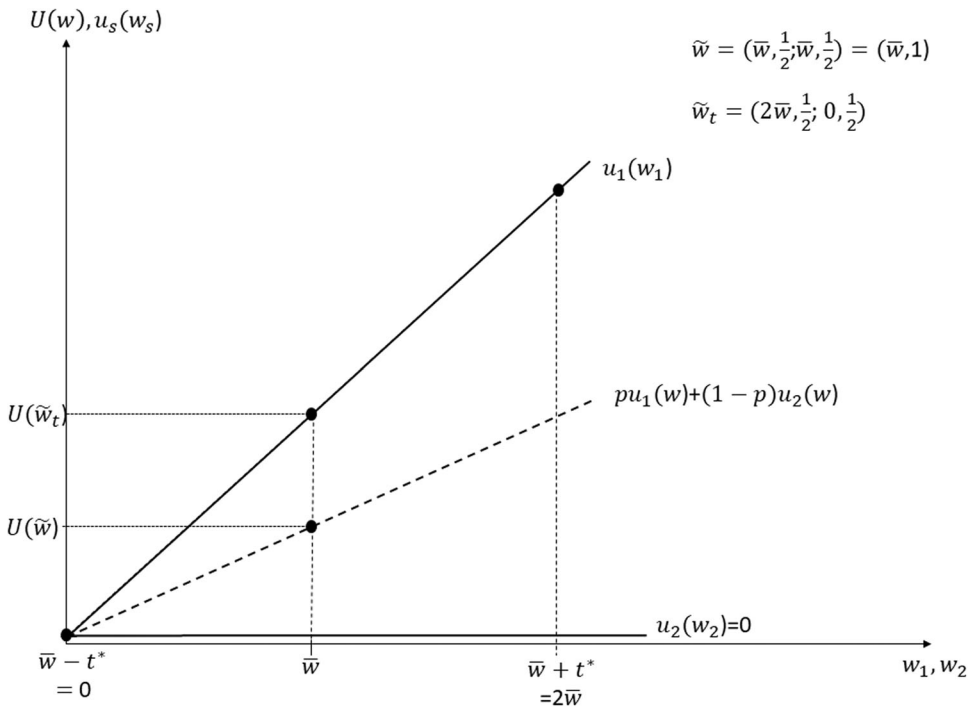


FIGURE 3 Insuring longevity, simplified.

Hence, it is well understood that differences in marginal utility change optimal insurance purchase. What is less well understood is why it does so. In the literature, marginal-utility differences are considered as a moderator of insurance demand, comparable to insurance loading, that influences *how much* insurance people seek. They are not understood as a motivator in their own right, that is, the reason *why* people seek to insure a state of the world in the first place. This is well exemplified by Viscusi and Evans (1990) who state that “Optimal insurance coverage when there is actuarially fair insurance available will equate the marginal utility of income in each health state” followed by “If ill health lowers (raises) the marginal utility of income for any given income level, less (more) than full income insurance is desirable” (Viscusi & Evans, 1990, p. 354). The first sentence indicates that Viscusi and Evans recognize the importance of marginal-utility differences for optimal coverage, that is, how much insurance is purchased. However, the second sentence from above quote shows that they do not consider such differences as a reason why people buy insurance. Their discussion of the optimal level of *income* insurance indicates that they view insurance as a means to mitigate differences in income across states, that is, losses. If, instead, marginal-utility differences are viewed as a motivator of insurance purchase, it directly follows that an individual seeks to insure the state that is characterized by a marginal-utility advantage regardless of whether this state is also characterized by a loss. In this understanding, there is no reason to compare the amount that an individual seeks to transfer across states with the wealth difference across states (the loss) and a discussion of over- or underinsurance of income is not needed. To give an example: suppose that ill health lowers marginal utility sufficiently that, ex ante, the state of ill health is characterized by a larger marginal utility than the state of good health. Equalizing marginal utility across states then requires transferring money from the sick to the healthy state



exacerbating the income difference across states. Simply subsuming this under “less than full income insurance” fails to recognize that, in this case, the individual does not seek to insure income in the first place.

Viscusi and Evans are not alone in discussing optimal insurance coverage in relation to losses. In earlier work, Cook and Graham (1977) define the “ransom” as the financial loss that is equivalent to the utility loss in case of an undesirable event such as disease, and then follow the traditional approach of insurance economists to ask to what extent a rational individual wants to mitigate this loss through insurance. An alternative suggestion by Schlesinger (1984), the one followed by Viscusi and Evans, asks us to measure the level of coverage against the size of some monetary loss that happens simultaneously with the change in the utility function. Both approaches have in common that insurance is always considered as a means to cover a loss and optimal coverage is always measured relative to the size of said loss. None of these two approaches recognizes that insurance might not always be about mitigating losses.

To see the consequences of categorizing marginal-utility differences as a moderator instead of recognizing them as a motivator, consider our example of longevity insurance from above. Suppose that we adapt the model and assume  $w_1 > w_2$ . This assumption is not unrealistic as events that prevent one from reaching retirement age will also prevent one from building up retirement wealth. We now have a situation in which state 2 is characterized by a loss in wealth (and utility), but state 1 still holds a marginal-utility advantage. As indicated above, these situations have already attracted much scrutiny in the literature, particularly in the realm of health insurance and in the literature on irreplaceable losses (Cook & Graham, 1977; Dionne, 1982; Huang & Tzeng, 2006; Kremslehner & Muermann, 2009; Rey, 2003; Schlesinger, 1984). Similar to Viscusi and Evans (1990), all these analyses conclude that the marginal-utility advantage of state 1 leads to an underinsurance of the loss in state 2. Directly applying these results to our example of longevity insurance, we would need to conclude that an individual underinsures the loss in retirement wealth that an early death entails. While this is not false, it fails to capture the most important insight. If  $u'_1(w_1) > u'_2(w_2)$  holds despite  $w_1 > w_2$ , then the individual does not want to insure the loss of retirement wealth that happens in state 2. Instead, the individual wants to insure state 1, that is characterized by the marginal-utility advantage that is associated with longevity. That the marginal-utility advantage of a state constitutes an insurance motive in its own right is so far not recognized in the analysis of insurance with state-dependent marginal utility. Instead, this stream of literature is focused on deriving how to optimally cover losses in a setting with state-dependent utility without asking whether people actually want to insure losses in such settings (see, among others, Huang & Tzeng, 2006; Rey, 2003). As will be shown in Section 3 below, regarding insurance solely as a means to mitigate losses leads to an unnecessary complication in analyzing optimal insurance decisions under state-dependent preferences.

To summarize: it is possible to retain the idea of insurance being valuable without having to assume risk aversion or diminishing marginal utility.<sup>4</sup> The possibility of a state dependence of marginal utility creates a strong incentive to reallocate wealth across states, and, hence, to

<sup>4</sup>Many scholars do not distinguish the two concepts anymore, instead equating one with the other. See for example Arrow (1974), Karni (1983), and Karni (1985). See also Epstein and Tanny (1980) and the subsequent literature on correlation attitudes. This was done by giving up, often only implicitly, the notion that risk aversion is a general desire for certainty. The only exception to the confusion of diminishing marginal utility with risk aversion seems to be Hirshleifer (1965). In a framework that allows for state-dependent utility, he recognizes that “risk aversion [...] is only a special case” (p. 534).

insure. Neither a potential loss nor risk aversion are necessary for the existence of an insurance motive.

## 2.3 | Indivisibilities in consumption

The prior two cases may leave the impression that insurance always derives its value from marginal-utility gaps across states, be they the result of losses and diminishing marginal utility or the result of exogenous events that change marginal utility directly. The following case illustrates that the exclusive look at marginal-utility differences is insufficient to fully understand the motives behind insurance.

Abstracting from state-dependence for the moment, a crucial assumption underlying diminishing marginal utility of wealth is that marginal utility of wealth is diminishing at *all* wealth levels. Starting with Friedman and Savage (1948), who suggested that local convexities in the utility function might help to explain why we observe gambling, several scholars have investigated potential sources of such convexities. Ng (1965) proposes that these result from the fact that some consumption opportunities are simply not perfectly divisible. If some consumption opportunities are indivisible, or imperfectly divisible, then the marginal utility of wealth exhibits jump discontinuities at wealth levels at which it becomes optimal to buy an indivisible (increment of a) consumption good. These jump discontinuities are again the result of an optimization behavior of the rational consumer.<sup>5</sup> With local convexities in the utility function over wealth, some lotteries over wealth are strictly preferred to their expected value. Hence, the individual is not risk-averse as some gambles are actually desirable. The literature on indivisibilities in consumption (Jones, 2008; Ng, 1965; Vasquez, 2017) correspondingly underlines that it can be rational for an individual to engage in both insurance and gambling.

By producing a rationale for gambling, indivisibilities in consumption seem to reduce the desirability of insurance at first glance. However, as Fels (2020a) shows, if some indivisible consumption opportunities are state-dependent, a new rationale for insurance arises as it is preferable to finance state-dependent indivisible consumption opportunities across instead of within state. Financing state-dependent indivisibilities across states is desirable for two reasons. First, if the marginal utility of divisible consumption is diminishing, financing an indivisible consumption opportunity across states instead of within state reduces the opportunity cost of indivisible consumption in terms of divisible consumption.<sup>6</sup> Second, if the cost of an indivisible consumption opportunity (like a medical treatment) is large, then some individuals may not be able to purchase it even if they find its value worth paying the cost. Insurance allows to overcome this affordability barrier by transferring wealth into the state in which the costly consumption opportunity arises. In this way, insurance is valuable in providing an insuree with access to an otherwise unaffordable consumption opportunity. This second advantage of financing indivisibilities

<sup>5</sup>The argument that indivisibilities in consumption lead to local convexities does not require diminishing marginal utility of divisible consumption, however. If marginal utility of divisible consumption is constant, it is the utility function over wealth itself and not only the marginal utility function that exhibits jump discontinuities (Fels, 2020a,b; Vasquez, 2017).

<sup>6</sup>Strohmenger and Wambach (2000) use a model where the individual benefits from insurance in this way. However, they incorrectly suggest that the insurance benefit stems from risk reduction (Strohmenger & Wambach, 2000, p. 203).

across states has been pointed out first by Nyman (1999b) when suggesting an access value in health insurance. Nyman's access value is thus a special case of how the existence of a state-dependent indivisible consumption opportunity gives rise to a value in insuring.

To show the access value of insurance in a simple framework, assume that utility depends linearly on perfectly divisible nonmedical consumption, the price of which is normalized to 1. State 1 signifies sickness while state 2 signifies good health. A treatment for the sickness is available at cost  $c > 0$  and confers a value  $v > c$  in state 1 and a value 0 in state 2. The treatment only confers its value if fully consumed (hence the indivisibility). As  $v > c$ , it is optimal to seek treatment in state 1 if it is affordable:  $w_1 \geq c$ . The state-dependent indirect utility functions over money are then given by:

$$\begin{aligned} u_1(w_1) &= w_1 + \mathbb{I}_{(w_1 \geq c)}(v - c), \\ u_2(w_2) &= w_2. \end{aligned}$$

Insuring state 1, that is, transferring money from state 2 into state 1, is beneficial if  $w_1 < c$  and  $w_2 \geq \frac{p}{1-p}(c - w_1)$ . In that case, the individual is unable to afford treatment without insurance, but is able to transfer enough wealth from state 2 to state 1 to gain access to treatment. Again, this is perfectly possible with  $w_1 = w_2 = \bar{w}$ , that is, a situation with a-priori certainty in wealth. Figure 4 illustrates the access value of insurance with two equiprobable states.

Starting from a position of equal wealth in both states,  $\tilde{w} = (\bar{w}, \frac{1}{2}; \bar{w}, \frac{1}{2})$ , insurance allows to transfer enough wealth from state 2 to state 1 such that the cost of treatment  $c$  becomes affordable. Nyman (1999b) calls the utility gain  $U(\tilde{w}_t) - U(\tilde{w})$  the "access value"

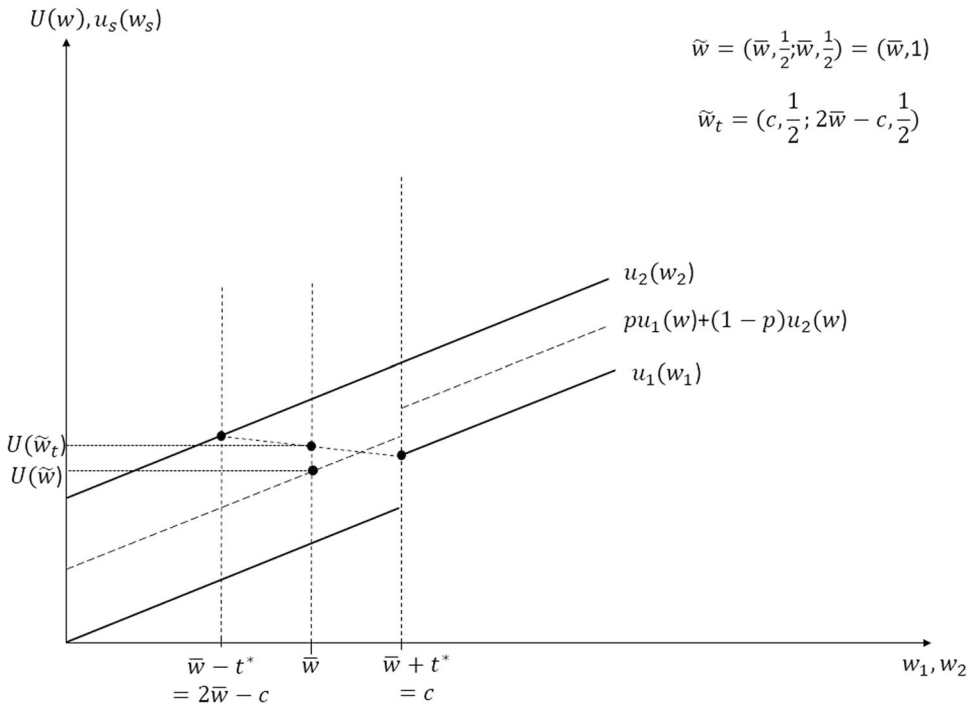


FIGURE 4 The access value of insurance.

of insurance.<sup>7</sup> The example illustrates that, again, by transferring money into the state with the indivisible consumption opportunity, one may increase the risk in one's wealth. And, again, it is insurance that is the vehicle with which the acquisition of this desirable risk is achieved.

With a desire to finance state-dependent indivisible consumption opportunities across states, it is again not risk aversion that produces a motive for insurance. In fact, individuals with such a utility function are not risk-averse as they prefer an unequal distribution of wealth—in which more wealth is allocated to the state in which the indivisible consumption opportunity occurs—to an equal distribution of wealth.

One may argue that the access motive is simply another case of state-dependent preferences creating an insurance motive. And while it is true that it requires a state-dependence in the value (or cost) of the imperfectly divisible consumption opportunities, there are important qualitative differences to the insurance motive based on a state-dependence in marginal utility. First, in contrast to the first two models, it does not require a difference in marginal utility across states for insurance to be desirable as the previous example illustrates. Hence, differences in marginal utility across states are a sufficient, but not a necessary condition for insurance to have value.<sup>8</sup> Second, the value of insurance is not a continuous function of the size of the transfer. In the first two models, the marginal increase in utility from insurance is largest at  $t = 0$  and gradually declines as  $t$  approaches  $t^*$  as long as  $u_s'' < 0$ . In contrast, there is no insurance value at all associated with small transfers if insurance is based on the access motive. Here, transfers have to be of a minimum size to create value. This has important consequences for the optimal design of insurance as we be further discussed in Section 4.

In both cases, state-dependent marginal utility and imperfectly divisible consumption, the optimal allocation of wealth across states is unequal, thereby ruling out risk aversion. Also, in both cases, the very reason that makes a person not risk-averse is not reducing but increasing the desirability of insurance. But if it is not a desire for risk reduction alone that drives insurance demand, a novel definition of insurance is needed.

## 2.4 | A definition of insurance

It was shown that risk aversion is not the common denominator in the simple models of insurance demand. Both the ideas of state-dependence of marginal utility and of indivisibilities in consumption effectively rule out risk aversion as a general preference for certainty. Moreover, in contrast to a traditional understanding of insurance, it was shown that buying insurance can mean an increase in the risk that the individual is exposed to. In consequence, these rationales for insurance require us to give up the idea that insurance is solely a means to rid oneself of undesired risks. Instead, they show that insurance can also be valuable for acquiring certain desirable risks. It was also shown that differences in marginal utility across states, as a result of losses or as a result of some exogenous preference shock, may motivate insurance. However, they do not constitute a common denominator either. As illustrated in the third case, insurance can be quite valuable even without any difference in marginal utility across states. What all cases have in common is that transferring money into a state

<sup>7</sup>In Figure 3, a utility loss of  $\epsilon = u_2(0) - u_1(0)$  is assumed. Note that the access value of insurance,  $U(\tilde{w}_l) - U(\tilde{w})$ , is independent of the existence, sign, and size of  $\epsilon$ . It is only assumed to unclutter the figure.

<sup>8</sup>This finding is robust to the (re-)introduction of diminishing marginal utility of divisible consumption (Fels, 2020b).

through insurance is desirable as money is more valuable in said state. The following definition, first proposed by Fels (2019), seeks to capture this idea.

**Definition 1.** Insurance is the directed transfer of wealth across states to meet conditional (financial) needs.<sup>9</sup>

In more technical terms, insurance is an alignment of the risk in one's financial assets to the risk in one's financial needs. This reformulation shows why the novel definition is broader than the traditional definition of insurance as a means to reduce one's risk exposure. It comprises the old idea as it does not rule out that the risk of a loss in assets can be a rationale for insurance purchase, with fire, flood, or car insurance being prominent examples. In these cases, there is no variation of financial needs across states, but a loss through fire or flood induces a variation in financial assets across states. Insurance realigns the two by compensating the financial loss, thereby aligning the variation in financial resources with the (in this case, non-) variation in financial needs. In other situations, however, there is a variation in financial needs across states. In these cases, insurance redistributes wealth into states with larger financial needs, thereby aligning the variation in financial resources to the variation in financial needs. In health insurance, for example, the primary purpose of the wealth transfer is not the compensation of a loss, but the financing of (medical) expenses satisfying the needs that are exclusive to the state (of sickness). More strikingly, the insurance of longevity cannot be directed at compensating a loss, as the insured state is associated with a gain. It is only if we stay alive long enough, that we need financial resources to finance our consumption, a need that is absent in the state in which we die early. In contrast to the old definition, the new definition does not restrict differences in wealth to be the sole source of a desirable wealth transfer. Exclusive consumption opportunities, or expenses that only have value in certain states, be they divisible or indivisible, are allowed as another source.

The definition separates insurance from gambling in that the identity of the state in which the benefit is paid matters for insurance to be desirable. Given that some financial needs are conditional, thus dependent on particular events to occur, insurance can only help to meet these needs if the wealth transfer is directed towards the states in which the needs occur. In contrast, the desirability of gambling is not related to the exact identity of the winning state. Intuitively, it seems equally desirable to win the jackpot with one's "lucky" numbers as with one's "unlucky" numbers.

### 3 | TWO APPLICATIONS AND TWO GENERALIZATIONS

In this section, it is shown how the novel definition of insurance may guide us towards simple generalizations of classic results that have been derived in the context of state-independent preferences. First, it is shown how the result of the optimality of partial insurance in case of a

<sup>9</sup>To my knowledge, Braess (1960, p. 14) is the first to argue that the purpose of insurance is to address a conditional need. Nyman (2003, p. 30), closest to the definition presented here, proposes that insurance is a directed transfer of wealth across states. In contrast to the understanding of insurance presented here, both require a loss in the state of the world that insurance targets either as the source of the conditional need (Braess, 1960, pp. 11–14) or to distinguish insurance from gambling (Nyman, 2003, p. 133). I seek to underline that it is not the presence of risk in financial wealth per se, but the misalignment between the risk in financial wealth and the risk in financial needs that is the basic requirement for insurance to be desirable.

loaded insurance premium (Arrow, 1963, 1971; Mossin, 1968) generalizes to a setting of state-dependent marginal utility. Second, it is shown how the result of incomplete coverage under ex-ante moral hazard Pauly (1974); Shavell (1979) generalizes to a setting of state-dependent marginal utility. Both questions have already been investigated in the literature.<sup>10</sup> However, lacking the framework of the general definition of insurance that is suggested in this article, the previous literature needs to resort to a large number of case distinctions and derivations for special cases. The purpose of this section is to carve out how the novel definition of insurance yields simple generalizations of the previous results, from which the classic results directly and intuitively follow, without the need to make a single case distinction.

### 3.1 | Loading and optimal insurance

Consider a model with two states  $s = 1, 2$ . State 1 occurs with probability  $p \in (0, 1)$ . The utility function over wealth  $w_s$ ,  $s = 1, 2$  is given by  $u_1(w_1)$  in state 1 and by  $u_2(w_2)$  in state 2. I assume that  $u'_1(w_1) \geq u'_2(w_2)$ , that is, state 1 is characterized by a marginal-utility advantage over state 2. A decision-maker (DM) can buy insurance that pays an indemnity  $q$  in state 1.<sup>11</sup> Insurance is available at the price of a loaded insurance premium  $\pi = (1 + l)pq$ ,  $l \geq 0$  that needs to be paid in both states. The DM chooses  $q$  to maximize the expected utility

$$U(q) = pu_1(w_1 - \pi + q) + (1 - p)u_2(w_2 - \pi).$$

The FOC, given an inner solution, yields

$$p(1 - p)[u'_1 - u'_2] - lp[(1 - p)u'_2 + pu'_1] = 0. \quad (2)$$

One can see directly that loading leads to incomplete coverage in the sense that it reduces the incentive to transfer money from state 2 into state 1. With  $l = 0$ , the DM chooses a level of coverage  $q^*$  that equalizes marginal utility across states. In contrast, if  $l$  is too large and/or the difference  $u'_1(w_1) - u'_2(w_2)$  is too small, we have a corner solution of  $\tilde{q} = 0$ .<sup>12</sup>

**Proposition 1.** *With a loaded premium, the optimal level of coverage  $0 \leq \tilde{q} < q^*$ .*

The classic result by Arrow (1963, 1971), and Mossin (1968) can thus be generalized that a proportional loading reduces the incentive to transfer wealth across states. As a result, it is not optimal to fully the close the marginal-utility gap across states and to insure only those states

<sup>10</sup>See, for example, Rey (2003) and Huang and Tzeng (2006) on the optimality of partial insurance and Dionne (1982) on ex-post moral hazard under state-dependent preferences.

<sup>11</sup>Note this major departure from the traditional model. If insurance is meant to address conditional needs, it must pay the indemnity in the state that is characterized by a larger financial need, here expressed in the marginal utility advantage. It does not matter whether state 1 is characterized by a wealth or utility loss compared to state 2.

<sup>12</sup> $q < 0$  is never an optimal solution. Effectively, this would mean that the DM wants to transfer money into state 2. Consider such a setup by simply relabeling state 1 and state 2 such that  $u'_1 \leq u'_2$  holds. Quick inspection of the first derivative of  $U(q)$  in this case reveals that it is strictly negative at  $q = 0$  for all  $l \geq 0$  showing that a premium loading, however large, never makes the DM want to insure the state with lower marginal utility.

that have a sufficiently large marginal-utility advantage. Specifically, it is optimal to refrain from insuring states of nature if their marginal-utility advantage is too small.<sup>13</sup>

We can see directly how the classic results, the optimality of partial insurance of losses and the optimality of a deductible, that is, states with wealth losses below a threshold remain uninsured, follow from this general result. In case of state-independent marginal utility, the size of the marginal-utility advantage of a state is directly tied to the size of the wealth loss that happens in this state. If and only if the loss in wealth is small, then the marginal-utility advantage of the state is small, and, hence, the state remains uninsured.

On the other hand, the generalized result underlines the limited importance of monetary or utility losses in case of state-dependent marginal utility, for state 1 could involve a heavy utility loss ( $u_1 < u_2$ ) or monetary loss ( $w_1 < w_2$ ) in comparison to state 2, yet still remain uninsured if its marginal-utility advantage is small. Similarly, state 1 could involve a small loss in wealth, no loss at all, or even a monetary gain  $w_1 > w_2$ , yet the DM still seeks to transfer a large amount of money into state 1 if  $u'_1 > u'_2$ . In short, the states that remain uninsured are characterized by small gains in marginal utility, and not necessarily by small losses in wealth compared to the uninsured state.<sup>14</sup>

Instead of a simple general result, the existing literature is characterized by numerous case distinctions. The necessity to make several case distinctions results from applying a framework that is suitable for the special case of state-independent preferences (insurance is about covering losses) to a case where this framework fails (insurance is about covering differences in needs that may or may not result from losses). The results are derived from the perspective of asking under what circumstances the classic result of the optimality of a deductible, that is, small losses are not covered, still holds in a framework with state-dependent preferences. However, such an approach does not allow us to understand the general principle that governs all cases of state-dependent preferences, and from which the optimality of a deductible follows in the special case of state-independent preferences. For that, we need to ask what, under state-dependent preferences, characterizes the states of nature that remain uninsured although there is an underlying motive to seek insurance coverage.

Apart from delivering a simple generalization of optimal coverage under state dependence, Proposition 1 suggests a novel rational for value-based insurance design (Fendrick & Chernew, 2006; Fendrick et al., 2001) that does not require any information asymmetry. State 1 is associated with a larger marginal utility compared to state 2 if some expenditures (such as health expenditures) have larger marginal utility in the former state. Proposition 1 then implies that health insurance that requires a loaded premium should only cover states in which health expenses have a large benefit-to-cost ratio as only these lead to a large increase in marginal utility in comparison to the healthy state. In contrast, health expenses with a lower benefit-to-cost ratio only slightly increase the marginal utility of a state and, thus, should not be covered according to the proposition.

<sup>13</sup>By evaluating Equation (2) at initial wealth levels ( $w_1, w_2$ ) and rearranging it, we can determine the critical marginal-utility gap below which  $\tilde{q} = 0$ .

<sup>14</sup>Huang and Tzeng (2006) claim that the optimal insurance policy involves a deductible if  $u'_2 > u'_1$ . By restricting insurance to pay a benefit in a state with a loss, coupled with the restriction of the benefit  $q$  to be nonnegative, they arrive at the result that the optimal benefit  $q^*$  is zero. However, this does not mean that the optimal policy involves a deductible, as is claimed, since the optimal benefit under a fair premium ( $q^*$ ) is actually strictly negative. This means that the individual seeks to insure the state without the loss. A similar misinterpretation can be found in Rey (2003).



### 3.2 | Ex-ante moral hazard

Consider a model with two states  $s = 1, 2$ . Again, assume that  $u'_1(w_1) \geq u'_2(w_2)$  holds. A DM can buy insurance that pays an indemnity  $q$  in state 1 at the expense of an actuarially fair premium payment  $\pi$  in both states. The probability  $p(x)$  of state 1 is a function of effort  $x$  of the DM. The DM can influence the probability  $p$  in both directions incurring cost  $C(x)$ . Both  $p(x)$  and  $C(x)$  are twice continuously differentiable. A positive value of  $x$  can be interpreted as effort to prevent state 1, a negative value of  $x$  can be interpreted as effort to promote state 1, where both efforts show diminishing returns:  $p_x < 0 \forall x$  and  $p_{xx} > 0, \forall x > 0$ ;  $p_{xx}(0) = 0$ ;  $p_{xx} < 0, \forall x < 0$ . To capture that any effort is costly and its marginal cost is increasing, assume that  $C(0) = 0$ ;  $C_x > 0, \forall x > 0$ ;  $C_x < 0, \forall x < 0$ ;  $C_{xx} > 0$ .

The DM maximizes the expected utility

$$U(x, q) = p(x)u_1(w_1 - \pi + q) + (1 - p(x))u_2(w_2 - \pi) - C(x)$$

where  $u_1(\cdot)$  is the utility function in state 1 and  $u_2(\cdot)$  is the utility function in state 2.  $w_s$  is the wealth of the individual in state  $s = 1, 2$ . The DM chooses  $x$  after an insurance contract is signed. Consider two scenarios. Under symmetric information,  $x$  is observable. Under asymmetric information,  $x$  is not observable by the insurer.

#### Scenario 1: Symmetric information

The insurer charges an actuarially fair premium  $\pi$  that depends on both effort  $x$  and coverage  $q$ :  $\pi(x, q) = p(x)q$ .

In that case,  $q$  is given at the moment of choice of  $x$ , yet  $\pi$  may vary with  $x$ . In a competitive market environment, we will have  $\pi(x, q) = p(x)q$ . Then, the DM chooses  $x$  to maximize

$$U(x, q) = p(x)u_1(w_1 - \pi(x, q) + q) + (1 - p(x))u_2(w_2 - \pi(x, q)) - C(x).$$

The FOC for a maximum is given by

$$p_x(u_1 - u_2) - \pi_x[(1 - p)u'_2 + pu'_1] = C_x, \quad (3)$$

$$\Leftrightarrow -p_x[u_2 - u_1 + q(pu'_1 + (1 - p)u'_2)] = C_x. \quad (4)$$

Given that  $p_x < 0$ , this condition is satisfied for  $u_2 > u_1$  only if  $x^* > 0$ . If the DM has a preference for state 2 (despite the wealth transfer from state 2 to state 1), effort is exerted to prevent state 1.<sup>15</sup> Note, however, that even if  $u_1 = u_2$  at  $q^*$ , that is, without any state preference after the wealth transfer, effort is exerted to prevent state 1. The intuition is as follows. As is derived below,  $q^* > 0$ , that is, it is optimal to transfer money from state 2 into state 1. If  $C'(0) = 0$ , then it is optimal to exert some effort to prevent the insured state, as it reduces the opportunity cost of this transfer.<sup>16</sup> Note that this implies that no effort,  $x^* = 0$ , is optimal only if the DM has a state preference for the insured state 1,  $u_1 > u_2$ , after insurance that exactly offsets

<sup>15</sup>Consider health insurance or long-term care insurance as possible examples.

<sup>16</sup>With actuarially fair insurance, an additional unit of wealth in state 1 costs  $p/(1 - p)$  units of wealth in state 2.



the incentive to reduce the opportunity cost of the insurance transfer. Finally, if  $u_1 > u_2$  after the wealth transfer, in the sense that the DM has a state preference for state 1 that dominates the incentive to reduce the opportunity cost of insurance, then  $x^* < 0$ . The DM has an incentive to promote the insured state 1. This does not necessarily imply deceptive activities, such as arson, but may simply reflect a natural state preference.<sup>17</sup> Anticipating the effort choice  $x^*(q)$ , the DM chooses the level of coverage  $q$  to maximize

$$U(x^*(q), q) = p(x^*(q))u_1(w_1 - \pi(x^*(q), q) + q) + (1 - p(x^*(q)))u_2(w_2 - \pi(x^*(q), q)) - C(x^*(q)).$$

The FOC yields:

$$\left\{ \underbrace{p_x(u_1 - u_2) - \pi_x[(1 - p)u'_2 + pu'_1] - C_x}_{=0} \right\} \frac{\partial x^*}{\partial q} - p(1 - p)(u'_2 - u'_1) = 0, \quad (5)$$

$$\Leftrightarrow p(1 - p)(u'_1 - u'_2) = 0, \quad (6)$$

with  $\pi_x = \partial \pi / \partial x$ . The DM chooses the level of coverage  $q^* \geq 0$  that equalizes marginal utility across states.<sup>18</sup>

#### Scenario 2: Asymmetric information

Under asymmetric information, the premium  $\pi$  and coverage  $q$  are both given at the moment of effort choice.

Hence, the DM chooses effort  $\hat{x}$  to maximize

$$U(x) = p(x)u_1(w_1 - \pi + q) + (1 - p(x))u_2(w_2 - \pi) - C(x).$$

The FOC for a maximum is given by

$$-p_x(u_2 - u_1) = C_x. \quad (7)$$

Given that,  $p_x < 0$ ,  $\hat{x} > 0$  if and only if  $u_2 > u_1$ . That is, the DM only exerts prevention effort if there remains a state preference for state 2 after the wealth transfer through insurance. The DM seeks to promote the insured state whenever there is a state preference for state 1. The reason for the lower incentive for prevention effort (higher incentive for promotion effort) is the fact that under asymmetric information the reduced opportunity cost of the wealth transfer that result from increased prevention effort cannot be passed on to the insuree as effort is not observable. The insights regarding the impact of asymmetric effort on prevention effort can thus be simply generalized as follows.

<sup>17</sup>Consider longevity insurance as an example. Annuities pay in case of survival of the recipient. The insured person's interest in promoting survival is not deceptive, and probably not much altered by purchasing insurance.

<sup>18</sup>Here, it becomes obvious that, if  $u'_1 < u'_2$ , then it must hold that  $q^* < 0$ , and, hence, the DM wants to insure state 2. Anticipating this, we chose to label state 1 and state 2 in such a way that  $u'_1 \geq u'_2$ .

**Proposition 2.** *If actions that influence the occurrence of the insured state are not observable/contractible, then this reduces incentives to prevent and increases incentives to promote the insured state.*

We see, again, that the major difference between the model with state dependence and the model with state independence, is the *identity* of the insured state. It means that it is always the state with larger marginal utility that is insured, which is not necessarily the one with lower wealth  $w_s$  or lower utility  $u_s$ . By adopting this generalized idea of insurance, the notion of insurance reducing incentives to decrease prevention effort easily generalize to a setting of state-dependent preferences without the need to make any case distinction.

An important novelty in the model with state-dependent preferences is the possibility of promotion effort. While utility losses do not determine the identity of the state that the DM wants to insure, they determine the state that the DM wants to promote or prevent.<sup>19</sup> If there is an a-priori state preference for state 2 (1), this creates an incentive to prevent (promote) the insured state. Insurance reduces (increases) this incentive, and asymmetric information strengthens this effect of insurance. The prior literature typically dismisses the possibility of promotion effort by equating it to criminal activities such as arson. Again, this is intuitive given that insurance often covers dismal events such as fire or flood. However, the model of state-dependent preferences cannot and does not rule out the possibility that an insurance covers a state of nature that is deemed preferable to the complement state. Again, longevity insurance offers an example for a case in which  $u_1 > u_2$  likely holds.

We can determine the influence of insurance on effort by defining  $g(x, q) = -p_x(u_2 - u_1) - C_x$  and using the implicit function theorem:

$$\frac{\partial \hat{x}}{\partial q} = -\frac{\partial g / \partial q}{\partial g / \partial x}. \quad (8)$$

Given that  $\frac{\partial g}{\partial x} > 0$  given our assumptions on  $p(x)$  and  $C(x)$ , and  $p_x < 0$ , the sign of  $\frac{\partial \hat{x}}{\partial q}$  is the opposite of the sign of  $\frac{\partial g}{\partial q}$ .

$$\frac{\partial g}{\partial q} = -p_x [u'_2(-\pi_q) - u'_1(1 - \pi_q)], \quad (9)$$

$$= -p_x [u'_2\pi_q + u'_1(1 - \pi_q)], \quad (10)$$

with  $\pi_q = \partial \pi / \partial q$ . At  $(\hat{x}, \hat{q})$ , it must hold that  $0 < \pi_q < 1$ . Hence, we can conclude that  $\frac{\partial g}{\partial q} > 0$ , and, thus  $\frac{\partial \hat{x}}{\partial q} < 0$ . Under asymmetric information, larger coverage unambiguously reduces the effort to prevent/increases the effort to promote the insured state.

When selecting insurance coverage  $\hat{q}$  under asymmetric information, both the actuarial premium  $\pi(q)$ , that the insurer charges, and the anticipated probability  $p(x)$  need to reflect the

<sup>19</sup>The model with state-independent preferences lacks the possibility that the state of nature, that the DM insures, and the state of nature, that the DM deems more desirable, are identical.

effort choice  $\hat{x}(q)$  that the DM anticipates to make given the choice of coverage. Hence,  $\pi(q) = p(\hat{x}(q))q$  and  $p(x) = p(\hat{x}(q))$ . Given that, the DM chooses  $\hat{q}$  to maximize

$$U(q) = p(\hat{x}(q))u_1(w_1 - \pi(q) + q) + (1 - p(\hat{x}(q)))u_2(w_2 - \pi(q)) - C(\hat{x}(q)).$$

The FOC yields

$$\left\{ \frac{p_x(u_1 - u_2) - C_x}{=0} \right\} \frac{\partial \hat{x}}{\partial q} - p_x q \left[ (1 - p)u'_2 + pu'_1 \right] \frac{\partial \hat{x}}{\partial q} - p(1 - p)(u'_2 - u'_1) = 0, \quad (11)$$

$$\Leftrightarrow p(1 - p)(u'_1 - u'_2) - p_x q \left[ (1 - p)u'_2 + pu'_1 \right] \frac{\partial \hat{x}}{\partial q} = 0. \quad (12)$$

Given that  $p_x < 0$ , the influence of asymmetric information on the level of coverage is determined by the sign of  $\frac{\partial \hat{x}}{\partial q}$ . As we have determined the sign to be negative, we can conclude that asymmetric information unambiguously reduces insurance coverage. However, it never reduces optimal coverage to zero, because  $\partial U / \partial q > 0$  at  $q = 0$ .

**Proposition 3.** *If actions that influence the occurrence of the insured state are not observable/contractible, then this reduces insurance coverage:  $0 < \hat{q} < q^*$ .*<sup>20</sup>

Asymmetric information on actions that influence the probability of the insured state reduce the level of coverage that an individual seeks. Again, this generalization is intuitive and simple compared to the extant literature. The complication and the necessity to make several case distinctions in the existing literature only arise because the authors apply the classic framework to a setting in which it no longer applies. Insisting that insurance is about covering losses, the different levels of coverage,  $\hat{q}$  and  $q^*$ , are compared to different loss measures. This can be a classic monetary loss  $L = w_2 - w_1$ , or a monetary loss-equivalent like the “ransom”  $R$  that leaves the DM indifferent between the two states  $u_2(w_2 - R) = u_1(w_1)$  (Cook & Graham, 1977).<sup>21</sup> The results from above are, however, completely independent of  $L$  and  $R$ . Indeed, the model places no restrictions on  $L$  and  $R$ : they can be positive, negative, zero, of opposite or similar sign;  $L$  can be larger, identical, or smaller than  $R$ . Depending on what assumptions are made on  $L$  and  $R$ , we can thus analyze an abundance of different cases. In some cases, as, for example, the case of  $R \geq L > 0$  that primarily motivates the literature on irreplaceable commodities (Cook & Graham, 1977; Schlesinger, 1984), this makes intuitive sense.<sup>22</sup> The limits of this approach become obvious in other cases, such as longevity insurance, where  $R < L \leq 0$  seems more plausible. It appears not appropriate to call it incomplete

<sup>20</sup>While looking similar at first glance, this result contradicts Dionne (1982) who claims that  $0 < \hat{q} < q^*$  holds with the benefit always being paid in the state with lower wealth regardless of whether this state has larger marginal utility. A quick inspection of Equations (6) and (12) reveals that, without our assumption of  $u'_1(w_1) \geq u'_2(w_2)$ , we would have  $q^* < \hat{q} < 0$ . In this case, state 2 is the insured state and  $-q$  constitutes the size of the insurance benefit in state 2.

<sup>21</sup>Schlesinger (1984), for example, proposes to talk of full insurance if  $q = R$  and to talk of complete insurance if  $q = L$ .

<sup>22</sup>This case alone allows for five sub-cases depending on the order of  $\hat{q}$ ,  $q^*$ ,  $L$ ,  $R$ .

coverage of a loss, if the DM seeks to insure the state in which a monetary/utility *gain* occurs, such that  $q/L < 0$  and/or  $q/R < 0$ .

The realization that insurance is intended to transfer money into states in which it offers a larger (marginal) utility makes these comparisons obsolete. It suggests another, quite simple, point of comparison: to compare the transfer, that an individual chooses, to the transfer that fully eliminates this underlying motive. In the model above it means that coverage  $q$  needs to be compared to the level of coverage  $q^*$  that equalizes marginal utility across states. With this point of reference, we can conclude that ex-ante moral hazard *always* results in incomplete coverage. Yet, this simplified generalization is only possible if we accept that insurance may not be about covering losses, but addressing the conditional needs that are expressed in the difference of marginal utility across states.

## 4 | WHY A NOVEL DEFINITION MATTERS

Apart from the possibility to offer a simple way to generalize classic results for state-independent utility to broader settings, the novel definition of insurance puts into perspective and offers some guidance with regard to several strands of existing and ongoing research. The novel definition differs from the previous understanding of insurance as a risk-reducing mechanism in two important regards. First, it shifts the focus of optimal insurance from the mitigation of a potential loss to the meeting of a potential need. Second, it allows risk preferences to have far more nuance than the traditional trichotomy of risk aversion, risk neutrality, and risk love and underlines the connection between risk preferences and conditional needs. Both differences offer novel perspectives on prior and possible future research in insurance economics and for the policy advice that can be derived from it.

### 4.1 | Implications for research

First, following the traditional view, the optimal design of insurance is typically analyzed as a trade-off between incentive provision and risk transfer (Pauly, 1968; Shavell, 1979). If the purpose of insurance is not to transfer risk, but to meet a conditional need, then the optimal level of incentives needs to recognize how these incentives can undermine the capability of insurance to address a conditional need. On the one hand, cost-sharing requirements may have little effect on the value of insurance if most of this value is created by the first units of coverage. That is indeed the case if insurance demand is based on risk aversion or state-dependent marginal utility. In contrast, cost-sharing can have a decisive impact on an insurance's capability to offer an access value if these requirements themselves impose access barriers (Fels, 2020c). In sum, the optimal design of insurance plans heavily depends on what purpose insurance serves.

The traditional understanding of insurance as risk transfer and gambling as risk acquisition frame these behaviors as natural opposites leading to repeated attempts to reconcile the two behaviors given evidence of their joint prevalence (Chetty & Szeidl, 2007; Conlisk, 1993; Friedman & Savage, 1948; Hartley & Farrell, 2002; Jones, 2008; Ng, 1965; Vasquez, 2017). Acknowledging that both behaviors can be different types of risk acquisition implies that there is no need for reconciliation in the first place. Instead, the relation between the two behaviors is far more complex even allowing for a complementary role (Fels, 2020a). This gives rise to the

question how these behaviors interact. Understanding under what circumstances the two behaviors reinforce or substitute each other may allow deriving testable predictions on their joint occurrence.<sup>23</sup>

There is a growing literature on the stability of risk preferences across time and context (Andersen et al., 2008; Barseghyan et al., 2011; Schildberg-Hörisch, 2018). However, if risk preferences derive from state-dependent needs, then there is no reason to expect them to be stable. Needs, both conditional and unconditional ones, change over time. Similarly, risk preferences derived in one insurance context, say health insurance, should be different from risk preferences in another insurance context, say home insurance. This is no sign of instability of preferences, but a mere consequence of these insurances addressing different conditional needs. Instead of worrying about an instability of preferences, one could investigate what the different willingness to reallocate resources across states tell us about the difference in conditional needs. Answering this question might help informing optimal insurance design and policy. In addition, it might help us to understand differences in insurance take-up across markets.

Finally, the foundation of insurance demand on conditional needs implies that one should exert great caution when making predictions on optimal insurance coverage based on risk preferences that are elicited in the laboratory. These preferences abstract from the conditional needs that need to inform considerations of optimal insurance. Laboratory evidence on decision-making under risk is crucial to understand the choice procedures that individuals apply, which are highly relevant in an insurance context. Yet, laboratory settings abstract from the conditional needs relevant in each insurance context. This means that the risk preferences elicited in a laboratory context differ from the risk preferences that govern insurance choices.<sup>24</sup> Instead of trying to recover risk preferences from laboratory data that may then end up having little relevance in actual insurance decisions, the question, what laboratory evidence can tell us about decision-making under risk, seems more important. It is exactly this question that laboratory evidence seems most valuable to answer, and the growing literature on non-expected utility models that is driven by this evidence is a testament to this value.

## 4.2 | Implications for policy

Beyond suggesting new perspectives on research, the different understanding of insurance and its purpose has implications for the policy implications that one can derive from existing theories.

One of the most influential predictions of insurance theory is that full insurance will be accompanied by ex-post moral hazard, an increased consumption of the insured service, leading to a decrease in welfare (Arrow, 1963; Pauly, 1968). The evaluation of this behavioral response of the insured as welfare-decreasing has been criticized by De Meza (1983), Nyman (1999a), and most recently Gross et al. (2022) in the context of health insurance. These works show that an increase in consumption can be the underlying purpose of insurance instead of an undesired side effect. This alternative interpretation of the behavioral response becomes more

<sup>23</sup>In a recent article, Amentier et al. (2018) find that individuals with higher wealth have both more insurance and hold more risky assets. Even after controlling for wealth, the positive correlation remains robust.

<sup>24</sup>Indeed, several studies have found risk preferences elicited in the laboratory to have little (if any) predictive power with respect to actual insurance take-up (Charness et al., 2020; Delavande et al., 2018; Jaspersen et al., 2022).

obvious if one understands the purpose of insurance (in this case health insurance) of addressing a conditional need (in this case medical need). If insurance is intended to reallocate resources into a state that is characterized by a specific need, an increase in the consumption of those services that address the need is a desired consequence of insurance. The increase of consumption by the insured is then a sign of insurance being successful in achieving its original purpose, and not an unintended side effect. Policy advice, such as Feldstein (1973), that argues for a reduction in this behavioral response could actually undermine the value of insurance instead of strengthening it (compare Nyman, 2003, pp. 145–149).

The different understanding of the purpose of insurance can also fundamentally change our evaluation of existing insurance systems. In a prominent example, the public insurance program of Medicaid is criticized for offering only a very limited insurance value (Brown & Finkelstein, 2008, 2011). This criticism is perfectly valid if insurance is seen solely as a mechanism for risk transfer. However, if insurance is intended to address a conditional need, in this case, the need of basic services of long-term care, then Medicaid is achieving its intended goal: ensuring that everyone, regardless of financial status, can meet the conditional need of long-term care at least on a basic level (Fels, 2020d). The evaluation of the public insurance scheme thus changes fundamentally depending on what we deem the purpose of insurance.

Even in cases in which adopting the new definition does not change our policy advice, maintaining the traditional understanding of insurance as a risk transfer can undermine the effectiveness of our advice. The “annuitization puzzle” refers to the observed reluctance to annuitize a major part of one’s retirement wealth despite a large insurance value in doing so. Several explanations have been put forward (Alexandrova & Gatzert, 2019). According to one of them, consumers wrongly perceive annuities as risky investment (Benartzi et al., 2011; Brown, 2007; Hu & Scott, 2007). It is important to recognize that consumers do not make a mistake if they see annuities as risky investments, for they are risky investments. Every insurance is. The idea of insurance as the “safe” option follows from the traditional characterization of insurance as a risk transfer: If the risk embodied in insurance hedges against an ex-ante risk in endowment, it allows the insuree to reduce the endowment risk. However, this traditional framework does not work in the context of annuity markets because annuities pay off in a state that is not characterized by a loss in wealth resulting in insurance increasing the variation in wealth (and consumption) across states. To my knowledge, Bommier and Le Grand (2014) are the only ones explicitly recognizing this.<sup>25</sup> Instead, most of the literature claims that annuities provide insurance against longevity risk, or the “the risk of outliving [one’s] assets” (Mitchell et al., 1999, p. 1299).<sup>26</sup>

These definitions of longevity risk and how annuities provide value are problematic for the following reasons. First, claiming that annuities eliminate longevity risk means confusing the variation in peoples’ lifespan with a possible consequence of this variation. This confusion is necessary to argue that annuities eliminate longevity risk since, obviously, annuities do not reduce the variation in a person’s lifespan. Second, when taking a closer look at the claim that annuities eliminate the risk of outliving one’s assets, it is worthwhile noting that the literature has not yet scrutinized this value of annuities.<sup>27</sup> The classic work of Yaari (1965) establishes a

<sup>25</sup>Indeed, they argue that, if individuals are risk-averse over lifetime utility, the risk-increasing nature of annuities can explain the low levels of annuitization.

<sup>26</sup>See also Brown et al. (2008), Benartzi et al. (2011), Cappelletti et al. (2013).

<sup>27</sup>This is not to say that annuities cannot provide value in this way, but that the literature has not explored this value so far.

value of annuities in a model in which the individual does not necessarily face the chance to run out of wealth. More strikingly, in the setting of Davidoff et al. (2005), the value of annuitization is established in a model in which such a risk is effectively ruled out. Indeed, this is recognized in Brown (2002, p. 20, emphasis added): “In the absence of annuities, an individual facing an unknown date of death must allocate wealth across an uncertain number of periods. Unless the individual lives to the maximum lifespan, following the optimal consumption path will result in the individual dying with *positive* financial wealth.” If the value of annuities lies in eliminating the risk of eventually running out of retirement wealth, as is often claimed, why is it possible to find a value of annuities in a model where, by assumption, no such risk exists?<sup>28</sup> The reason is that annuities provide value by optimally addressing conditional needs, or, in the words of Brown (2002, p. 20), annuities allow an individual “to make future resources contingent on survival-state”. However, it needs emphasizing that, in doing so, the individual deliberately assumes a wealth risk. The value of annuities does not lie in eliminating longevity risk, but in adapting to it. Third, and finally, another issue with the claim that annuities eliminate a risk is that it confuses the possibility of a longer life with a negative event, thereby perpetuating a misleading heuristic of “Insurance is for bad events” that, according to Brown (2007), layperson follow in their refusal to annuitize. Thus, by maintaining the traditional understanding of insurance in a context where it does not apply, economists undermine their own message regarding the value of annuities. By adopting the new definition of insurance, annuities can simply be described as provisions for a potential need, or, more technically, an alignment of the risk in endowment with the risk in needs. Increasing the salience of these potential needs is associated with larger annuitization (Brown et al., 2008). People thus seem to understand the value of insurance in providing for uncertain needs. Instead of denying the risk involved in annuitization, one could try to explain the necessity of taking a calculated risk when providing for an uncertain need.

## 5 | CONCLUSION

This article seeks to show that risk aversion is not the sole motive underlying insurance purchase. State-dependent marginal utility and indivisible consumption opportunities with state-dependent value offer additional rationales for insuring. This can explain empirical evidence that often finds only a weak link (if at all) between risk aversion and insurance ownership (Charness et al., 2020; Delavande et al., 2018; Eling et al., 2021; Guiso & Paiella, 2005; Jaspersen et al., 2022). Acknowledging these additional motives requires a departure from understanding insurance solely as a risk-transfer mechanism. More generally, insurance aligns the risk in financial means to the risk in financial needs. This understanding of insurance presents several novel research questions and has the potential to improve policy advice.

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<sup>28</sup>To actually model such a risk, one could simply assume a minimum consumption level that is necessary to survive. This, however, would culminate in a model of state-dependent indivisible consumption (see Section 2.3), a model that, to my knowledge, has not yet been applied to the problem of longevity insurance. It is easy to see that such a model could provide at least a partial explanation for some people's failure to annuitize. If the stream of income that annuitization provides does not suffice to afford the consumption minimum, but the accumulated retirement wealth itself suffices to finance such consumption at least temporarily, it is strictly better not to annuitize.



That does not mean that the traditional model of insurance, that offers a motive to insure losses in wealth, is not useful. On the contrary, it depicts well the motivation of individuals that seek to insure against such losses. However, in many settings of interest, particularly those in which states of nature are not (only) characterized by wealth losses but specific needs, other insurance motives arise. Depending on the circumstances, these motivations may be more important in driving insurance demand than the motive to insure losses. It is possible to enrich existing models simply by acknowledging the complexity of possible insurance motivations.

Despite offering a unifying framework for analyzing different motives that underlie individual insurance demand, the framework in this article is not without limitations. First, it keeps the traditional focus on individual incentives for insurance demand. While this might be an appropriate assumption in many contexts, it is far from being applicable universally. For example, Dror and Firth (2014) point out that insurance choices are not taken by the individual but by a group in many low- and middle-income countries. In addition, certain types of insurance, such as long-term care insurance, are commonly taken jointly by a couple, not by each partner individually. It thus needs to be asked how the individual motives translate to the group level if insurance theory seeks to fully understand insurance demand. Second, insurance demand reflects more than just motives and preferences. Specifically, there are two issues of particular relevance in the insurance context that might inhibit choices to perfectly reflect preferences. First, biases and mistakes may cause choices to deviate from optimal decisions. There is now a large body of literature on the impact of behavioral biases and on the lack in financial literacy in the insurance context (Pitthan & De Witte, 2021; Richter et al., 2019).<sup>29</sup> Second, insurance demand may fail to reflect the inherent value of insurance if individuals lack the financial means to express their preferences. Accordingly, Dror and Firth (2014) distinguish dormant demand, that reflects needs, from solvent demand, that combines needs and ability to pay. This distinction may be less important in insurance contexts in which the marginal value of insurance is diminishing. In these contexts, having some—even little—insurance coverage already creates a significant insurance value, while additional coverage creates less and less value. In contrast, the distinction is of major importance in contexts, in which the access value of insurance dominates. Here, insurance coverage must reach a minimum amount to create any value at all. Hence, the affordability of the premium of this minimum amount of coverage becomes a major issue.<sup>30</sup>

The discipline has made great progress on understanding how frictions and psychological barriers can influence insurance demand, thereby improving the policy advice that it can offer. However, such advice must also reflect a good understanding of what ultimately motivates insurance demand and what makes insurance valuable to an individual and to the societies that we live in. This article hopes to spark new research interest in improving this understanding,

<sup>29</sup>While human biases are a factor that needs to be taken into account, they should not be overstated either. There is a recent trend to attribute observed deviations from the theoretically optimal behavior exclusively to some form of (psychological) bias. One should not dismiss that easily the possibility that such deviations could simply mean that the theory of optimal behavior is incorrect.

<sup>30</sup>This is not just an issue in low- and middle-income countries. As Fels (2020d) argues, private long-term care insurance in the United States could not be a valid alternative to the public program of Medicaid. The reason is that private insurers are not able to offer the minimum coverage needed to address long-term care needs at premiums that are affordable to low-income households.



thereby helping businesses to offer better insurance products, and helping societies to design better risk-protection mechanisms.

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