THE DEMAND FOR INSURANCE: EXPECTED UTILITY THEORY FROM A GAIN PERSPECTIVE

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Abstract

Expected utility theory holds that the demand for insurance is a demand for certainty, because under the conventional specification of the theory, it appears as if buyers of insurance prefer certain losses to actuarially equivalent uncertain ones. Empirical studies, however, show that individuals actually prefer uncertain losses to actuarially equivalent certain ones. This paper attempts to reconcile expected utility theory with this empirical evidence by suggesting that insurance is demanded to obtain an income payoff in the "bad" state. This specification is mathematically equivalent to the conventional specification and consistent with this and other empirical evidence, but it implies that the demand for insurance has nothing to do with demand for certainty.

1. Introduction

The theory of the demand for insurance has been based on expected utility theory and an assumed preference for certain losses over uncertain ones of the same expected magnitude (e.g., Friedman and Savage, 1948; Arrow, 1963). The following is representative of this interpretation of expected utility theory:

> "The purpose of any insurance policy is to convert an uncertain, but potentially large, loss into a certain, small loss. Such a conversion benefits the consumer if greater losses cause progressively larger declines in utility (that is, if there is diminishing marginal utility of wealth)." (Newhouse, 1978, p. 19).

At a more general level but still part of the demand-for-insurance-as-demand-for-certainty theory, other studies have postulated that the demand for insurance is by "risk averse" consumers who use insurance to "avoid," "eliminate," "hedge against," "kill," "manage," "shed," "protect against," or "bear" the risk of loss (e.g., Mossin, 1968; Schlesinger and Doherty, 1985; Mayers and Smith, 1983; Cook and Graham, 1977, Arrow, 1963; Feldstein, 1973; Feldstein and Friedman, 1977; Feldman and Dowd, 1991; Manning and Marquis, 1996).

This theory, however, stands in stark contrast to a substantial body of empirical evidence suggesting that certainty is not valued when losses are at stake (Kahneman and Tversky, 1979; Tversky and Kahneman, 1981, 1986, 1990). Indeed, these studies find that uncertain losses are generally preferred to certain ones of the same expected magnitude, implying *risk-seeking* behavior when losses are concerned. That is, when risk of loss is present, people are observed to embrace, capitalize on, benefit from, or exploit this risk of loss, because according to these empirical results, it is preferred to a certain loss of the same expected size. Thus, the conventional explanation for the demand for insurance--a preference for certainty or a desire to avoid the risk of losses--flies in the face of empirical evidence.

This paper reevaluates conventional expected utility theory and its usefulness in explaining the demand for insurance and, specifically, health insurance. It suggests that the demand for insurance has been fundamentally misinterpreted as a demand for *certainty*, but in reality the demand for insurance derives from a demand for an *uncertain payoff* of income (or wealth) in a pre-specified state. Although the motivation for the purchase of insurance differs from the motivation implied by conventional theory, the utility gain is exactly the same.

It should be noted that an alternative theory--contingent claims/state dependent utility theory--has also been used to explain the demand for *health* insurance (e.g., Zweiful and Breyer, 1997; Nyman, 1999a; Mas-Colell, Whinston, Green, 1995). According to that theory, becoming ill fundamentally changes preferences. Thus, an insured consumer is able to transfer income into the ill state where the marginal utility of income is greater. Under this theory, the demand for insurance is derived from the demand for a payoff in the ill state, rather than the demand for certainty or risk avoidance. Contingent claims/state dependent utility theory, however, requires that separate utility functions be specified for each state in the model (e.g., one for the healthy state and one for the ill state). In the present theory, the same single-argument utility function describes both healthy and ill states. It is only the perspective from which the income gain is viewed that changes with health status.

The remainder of this paper is organized into four sections. In the next section, conventional expected utility theory in its simplest form is described and compared with prospect theory--the theory derived from empirical studies that show that uncertain losses are generally preferred to certain ones. In the third section, an alternative specification of expected utility theory is described, one that emphasizes the role of the insurance payoff. A discussion section follows, and then the conclusions.

2. Conventional Expected Utility Theory and Prospect Theory

2.1 Conventional expected utility theory. Under the simplest form, conventional expected utility theory assumes that a consumer's utility, U, is a function of disposable income, Y. Assuming a health insurance context, there is a probability, π, that the consumer will become ill and spend L on medical care. Alternatively, the consumer could purchase full insurance coverage for the actuarially fair premium of $P = \pi L$, for which the consumer would receive a payoff transfer, I, if ill. For simplicity, assume that $I = L$. Thus, expected utility without insurance is:

$$EU_u = (1-\pi)U(Y) + \pi u(Y-L). \quad (1)$$

With insurance, expected utility is:

$$EU_i = (1-\pi)U(Y-P) + \pi U(Y-L+I-P)$$
$$= U(Y-P). \quad (2)$$

If marginal utility of income is diminishing, the consumer is better off paying P for insurance and avoiding the risk of loss, L. Thus, the expected-utility-maximizing consumer would purchase insurance coverage for these expenditures if $EU_i > EU_u$, or if

$$U(Y-P) > (1-\pi)U(Y) + \pi U(Y-L). \quad (3)$$

This familiar result is illustrated in Figure 1. A consumer's von Neumann-Morgenstern (1947) utility function is presented as U(Y), and drawn so that $U'>0$ and $U''<0$. Y_0 represents the income endowment. The consumer can either not purchase insurance and face an expected loss of πL, or purchase insurance by paying the actuarially fair premium, $P=\pi L$. Because the fair premium is certain, the consumer's certain loss of utility with insurance, $U_0 - U_1$, is smaller than the expected loss of utility without insurance, $U_0 - U_2$.

Because of the way that the theory is specified mathematically, it appears as if the choice is between certainty and uncertainty of actuarially equivalent losses. The choice to purchase insurance is associated with certainty and a higher level of expected utility, therefore, it appears as if insurance is demanded because of the certainty it provides.

2.2. Prospect theory. The theory that consumers prefer certain losses to actuarially equivalent uncertain ones, however, is diametrically opposed to the empirical findings of studies that show that individuals tend to prefer certainty only when gains are at stake (Kahnemann and Tversky, 1979; Tversky and Kahnemann, 1981, 1986, 1990). When losses are at stake, however, individuals prefer uncertainty. That is, when given a choice between a certain loss and an uncertain loss of the same expected magnitude, individuals tend to prefer the uncertain loss.

These empirical observations have been incorporated into a theory of choice called prospect theory (Kahnemann and Tversky, 1982; Tversky and Kahnemann, 1981, 1986, 1990), which argues that from a given reference point, the value that individuals realize from gains in income increases with the size of the gain, but at a diminishing rate. Likewise, the value that individuals lose from losses of income increases with the size of the loss, but also at a diminishing rate.[1] Figure 2 shows this relationship.

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[1]It should be noted that prospect theory is richer than is described here. For example, prospect theory holds that the loss side of the function is steeper than the gain side, implying that when comparing a loss and a gain of the same magnitude, the effect of the loss on value is

Insurance is conventionally modeled under expected utility theory as a choice between a large uncertain loss, L, and a small actuarially-equivalent certain loss, P. According to prospect theory, however, the expected value of a large uncertain loss, V_0 in Figure 2, is greater than the value of an actuarially-equivalent smaller certain loss, V_1. Thus, insurance would not be purchased under this theory. Prospect theory and the empirical data supporting it imply that if people purchase insurance, it is not because of the certainty that it provides.

3. Expected Utility Theory From a Gain Perspective

The value of insurance could alternatively be represented by the one aspect of insurance that represents a gain: the payoff when ill. Under this frame, the choice to purchase insurance is made at the point when the consumer is deciding whether to spend the last P dollars of income endowment on an insurance premium or on consumption goods. Thus, inequality (3) can be transformed into this specification by first subtracting $(1-\pi)(Y-P)$ from both sides,

$$\pi U(Y-P) > (1-\pi)[U(Y) - U(Y-P)] + \pi U(Y-L), \quad (4)$$

then subtracting $\pi U(Y-L-P)$,

$$\pi[U(Y-P) - U(Y-L-P)] > (1-\pi)[U(Y) - U(Y-P)] + \pi[U(Y-L) - U(Y-L-P)] \quad (5)$$

and then adding $(1-\pi)[U(Y-P) - U(Y-P)] = 0$, so that:

$$(1-\pi)[U(Y-P) - U(Y-P)] + \pi[U(Y-P) - U(Y-L-P)] >$$

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greater. Prospect theory also holds that probabilities of events tend to be overweighted if they are small. For the purposes of this paper, however, the focus is on the empirical result that individuals prefer an uncertain loss to a certain loss because it is the starkest, most relevant challenge to conventional expected utility theory of the demand for insurance.

$$(1-\pi)[U(Y) - U(Y-P)] + \pi[U(Y-L) - U(Y-L-P)] \quad (6)$$

The right hand side of inequality (6) represents the expected utility gain without insurance. Under this specification, it is expressed as a gain from being able to spend P dollars in either the healthy state or the ill state. The right hand side can be simplified by writing Y = Y_0, (Y-P) = Y_1, (Y-L) = Y_2, and (Y-L-P) = Y_3, so that the expected change in utility from being uninsured is:

$$E\Delta U_u = (1-\pi)[U(Y_0) - U(Y_1)] + \pi[U(Y_2) - U(Y_3)]. \quad (7)$$

Y_1 is the baseline utility level if the consumer remains healthy, and Y_3 is the baseline utility level if the consumer becomes ill and has spent L = (Y_1 - Y_3) on medical care. Thus, the consumer obtains a gain in utility from spending his last P dollars on other consumption instead of on the insurance premium. If ill, this additional P dollars of disposable income is available at Y_3, increasing the income level from Y_3 to Y_2 with a probability of π, so the expected utility gain is $\pi[U(Y_2) - U(Y_3)]$ at Y_3. If healthy, the P dollars of disposable income is available at Y_1, increasing income from Y_1 to Y_0 with a probability of $(1-\pi)$, so the expected utility gain is $(1-\pi)[U(Y_0) - U(Y_1)]$ at Y_1.

The left hand side of inequality (6) represents the gain in utility if the consumer spends the marginal P dollars of his income endowment on an insurance premium and becomes insured. Using the same simplification, the expected gain in utility can be written:

$$E\Delta U_i = (1-\pi)[U(Y_1) - U(Y_1)] + \pi[U(Y_1) - U(Y_3)] \quad (8)$$

$$= \pi[U(Y_1) - U(Y_3)], \quad (9)$$

where Y_1 is the initial level of income, and if ill, the consumer would have spent L on care reducing his income level to Y_3. If ill, the payoff, I, increases income from Y_3 to Y_1 with a probability of π, so the expected utility gain if ill is $\pi[U(Y_1) - U(Y_3)]$ evaluated at Y_3.

Like prospect theory, these gains are determined from specific reference points, and the reference points vary. With insurance and if ill, the gain of disposable income I is from the reference point of just having spent L in income on medical care or Y_3. With insurance and if healthy, there is no gain in income and no change in utility because the consumer remains at the reference point, Y_1. Thus, the expected gain with insurance is equal to $\pi[U(Y_1) - U(Y_3)]$, evaluated at Y_3, or equivalently an expected gain of from U_6 to U_4 in Figure 3.

Without insurance and if healthy, the consumer would gain P dollars of income from the reference point of Y_1 with a probability of $(1-\pi)$, for which the expected gain in utility is $(1-\pi)[U(Y_0) - U(Y_1)]$ evaluated from Y_1, or an expected gain of U_2 to U_1 in Figure 3. Without insurance and if ill, the consumer would gain P dollars of income from the reference of having spent L on medical care with a probability of π, for which the expected gain in utility is $\pi[U(Y_2) - U(Y_3)]$ evaluated at Y_3, or an expected gain from U_6 to U_5 in Figure 3 .

Insurance would be purchased by the expected utility-maximizing consumer if $E\Delta U_i > E\Delta U_u$, or if

$$\pi[U(Y_1) - U(Y_3)] > (1-\pi)[U(Y_0) - U(Y_1)] + \pi[U(Y_2) - U(Y_3)], \qquad (10)$$

or in utility terms if

$$U_4 - U_6 > (U_1 - U_2) + (U_5 - U_6),$$

in Figure 3. A "risk averse" utility function would assure that the gain in utility with insurance exceeds the gain without insurance.

Equations (7), (9) and (10) are simply an alternative specification of the standard expected utility equations (1), (2) and (3). The difference is that in equations (7), (9) and (10), the loss, L, has been suppressed. The "loss" indirectly appears in the new equations by changing the reference points, but it is not directly included in the equations as reducing utility. Removing the loss from the equations converts the analysis from a choice between levels of utility to a choice between gains in utility.

These mathematical expressions mask a straightforward intuition. When the insurance choice is expressed as an expected gain in utility, the choice to purchase insurance becomes like the choice in any standard economic transaction: a commodity is purchased because the utility gained from a commodity exceeds its cost in terms the utility forgone from the other goods and services that could have been purchased. In this case, the commodity purchased is additional income in a pre-specified state (e.g., when ill), and the utility gain is an expected utility. Other than that, it is a normal *quid pro quo* transaction. When consumers purchase any commodity, they give up income that could have been used to purchase other goods and services. In this case, these other goods and services are sometimes given up in one state (illness), and sometimes in another (health). But again, this is like any other purchase made where there is uncertainty about the consumer's future (health) state. The choice to purchase insurance requires that these other goods and services be given up in order to purchase an insurance policy that has an expected utility gain associated with it. The essence of equations (7), (9) and (10) is that insurance is purchased because the expected utility gain from the payoff exceeds the expected utility loss of the premium dollars that could have been spent on other consumption.

If consumers buy insurance in order to receive an uncertain gain in income, then insurance does not present a choice between certainty and uncertainty because there is the uncertainty both with and without insurance, as equations (7) and (9) make clear. It is, however, the matching exogenous uncertainty of the reference point that makes insurance valuable. In other words, it is not the certainty or the avoidance of risk that causes the purchase of health insurance for these types of purchases, rather it is the fact that the uncertain payoff is timed to coincide with the uncertain illness and the change in the reference point that makes insurance worth purchasing.

4. Discussion

The gain specification of the insurance problem is consistent with the empirical evidence underlying prospect theory. Figure 4 shows the 4-quadrant prospect theory diagram, with the portion of the value function that lies in quadrant I indicating gains from insurance at two different reference points. Again, assume a health insurance context. With insurance, the expected gain in income from the insurance payoff if ill is πI or an expected value gain of V_0. Without insurance, the expected gain in income if ill is πP or expected value gain of V_1. If healthy, the gain without insurance is evaluated on a different value function,[2] reflecting the different reference point of the consumer who does not become ill. If healthy, the expected gain of income of $(1-\pi)P$ results in a corresponding expected value gain of V_2. So, the expected gain in value with insurance, V_0, is greater than the sum of the expected gains in value without insurance, $(V_1 + V_2)$, and insurance would be purchased.

[2]In prospect theory, "value" is a different concept than "utility," because it represents the uncertain outcome that has been multiplied by a decision weight, which is a monotonic function of the probability, but not the probability itself (Tversky and Kahneman, 1981).

Perhaps, more importantly, it is consistent with the findings of one of the only empirical studies to evaluate why insurance is purchased. Connor (1996) presented his subjects with the following five choice scenarios:

1. A: You will lose $40 on your next trip.
   B: You have a 2% chance of losing $2,000 on your next trip.

2. A: You will lose $40 on your next trip. In addition, you will have a 2% chance of losing $2,000 on your next trip AND getting an unexpected $2,000 gift the same day from a distant relative.
   B: You have a 2% chance of losing $2,000 on your next trip.

3. A: You will lose $40 on your next trip. In addition, you will have a 2% chance of losing $2,000 on your next trip AND recovering $2,000 the same day by searching.
   B: You have a 2% chance of losing $2,000 on your next trip.

4. A: You have a 2% chance of losing $2,000 on your next trip. You buy $2,000 in travel checks for $2,000 plus a $40 fee which will let you recover the $2,000 loss the same day if it occurs.
   B: You have a 2% chance of losing $2,000 on your next trip. You do not buy travel checks.

5. A: You have a 2% of losing $2,000 on your next trip. You buy travel insurance for $40 with will reimburse you for this $2,000 loss the same day if it occurs.
   B: You have a 2% chance of losing $2,000 on your next trip. You do not buy travel insurance.

When confronted with the standard gamble (choice between A and B in scenario 1), his subjects were almost equally divided between alternatives A and B, but when the same choice was placed in an insurance context (scenario 5), the purchase of insurance A was preferred with statistical significance. The results from the three intermediate choices are, perhaps, most revealing. For scenarios 2 and 3, there was no significant trend in preference (although they tended to prefer uncertain alternative B consistent with prospect theory), but for choice 4, the "certain" choice A was preferred significantly. These results suggest that it is only when the $40 payment represents a payment for an expected payoff and *when the uncertain loss is uncoupled from this payoff* (that is, choices 4 and 5), that the "certain" choice A becomes preferred. But at that point, the "certain" choice A becomes uncertain, because the payoff gain only occurs some (2 percent) of the time.

These results imply that the context in which insurance is purchased is not the standard gamble context implied by the conventional specification of expected utility theory of the demand for insurance. Instead, the theory of the demand for insurance requires that the specification of expected utility theory be consistent with the insurance context, and this in turn requires that the loss be implied--that is, be part of the environment of the insurance contract and not included as part of the insurance contract itself. With this specification, the correct interpretation becomes apparent: insurance is demanded because the uncertain payoff is timed to coincide with the occurrence of the bad state, not because of the certainty it provides.

This interpretation explains a number of seeming inconsistencies in the theory of the demand for insurance. First, as mentioned above, it is consistent with normal *quid pro quo* purchases. The demand for insurance under a theory where consumers pay a premium for an uncertain payoff in the bad state of the world is more typical of purchases in a market economy than the demand for insurance under a theory where consumers pay a premium for "certainty" in return. That is, in conventional expected utility theory, the payoff is virtually irrelevant: it is subsumed in equation (2) as a canceling of a loss. The choice is modeled as if the loss were a provision of the insurance contract itself. Indeed, if it were intended that the loss should be represented as part of the insurance contract, the consumer's choice would be specified exactly as in equation (2). Under a gain specification of expected utility theory, the loss remains exogenous to the insurance contract. The consumer purchases a contract for a payoff of income in the event that the loss occurs. The loss triggers the execution of the contract, but it is not part of the contract itself.

Second, it is consistent with recent work by Rabin (2000) and Rabin and Thaler (2001) that questions the connection between risk preferences and the shape of the consumer's utility function over defined wealth or income levels. That is, the sole source of preferences regarding risk in economic theory is the concavity (or convexity) of the consumer's utility function. Rabin (2000), however, points out that the concavity of the consumer's utility function implies intuitively impossible preferences regarding risk. Thus, there is an inkling among economic theorists that risk preferences might derive from something other than the shape of the consumer's utility function. If risk preferences are separate, then the shape of the consumer's utility function may be used to explain the demand for insurance, but at the same time the role of risk preferences on the decision to purchase insurance may be largely irrelevant.

Third, in its simplest form, conventional expected utility theory assumes implicitly that the income elasticity of demand is zero, which seems especially troubling in the context of health insurance. That is, a person who receives a payoff of income in the event of illness is assumed to purchase the same amount of health care as a person who does not receive this additional income. This awkward and empirically unsupportable (e.g., Feenberg and Skinner, 1994; Manning and Marquis, 1996) assumption is required in conventional expected utility theory in order to describe the demand for insurance as a demand for certainty. A payoff that generates additional loss (i.e., more health care spending than without insurance) would be consistent only with the new specification and interpretation.

Fourth, the gain perspective specification is consistent with diminishing marginal utility of income, as opposed to increasing marginal utility. Perhaps, one of the most difficult aspects of prospect theory for economists is the implication that the marginal utility of income is increasing at an increasing rate for losses--the loss side the value function in Figure 2. Although increasing marginal utility has long been recognized as a local possibility by economists (Friedman and Savage, 1948; Markowitz, 1952), it is mainly regarded as exceptional and inconsistent with core economic behavior and beliefs, such as downward sloping demand curves and the intuition that the rich derive less utility from an additional dollar of income than do the poor. In contrast, the present theory only requires that insurance be viewed from a gain, rather than loss, perspective. Although this different perspective is contrary to the training of economists (training that is based largely on normative assertions of why people should value insurance), it does not violate any of the fundamental theoretical concepts.

Fifth, because the gain specification is equivalent to the conventional specification mathematically, the gain specification preserves not only the ordinality of the insurance choice, but also its cardinality. That is, the gain in utility from insurance under expected utility theory from a gain perspective is exactly the same as the gain under conventional expected utility theory. For example, Table 1 shows the computations of the utility gain from insurance for two commonly used utility functions: $U = \ln Y$ and $U = Y^{1/2}$. Substituting in values for a pre-premium income level of $90,000 (corresponding to Y_1 in Figure 3) or an endowment of $100,000 (corresponding to Y_0 in Figure 1), a loss of $50,000 with a probability of 0.2, and a fair premium of $10,000, the gains under either conventional expected utility or expected utility from a gain perspective are the same. This implies that the measures used to determine the gain in

	U = ln Y: With insurance	U = ln Y: Without insurance	U = lnY: Gain in utility	U = $Y^{1/2}$: With insurance	U = $Y^{1/2}$: Without insurance	U = $Y^{1/2}$: Gain in utility
Conven-tional Expected Utility Theory	U($90K) = 11.4076	(1-π) U($100K) + πU($50K) = 11.3743	11.4076 - 11.3723 = 0.0333	U($90K) = 300	(1-π) U($100K) + πU($50K) = 297.4	300 - 297.4 = 2.6
Expected Utility Theory from a Gain Perspective	π[U($90K)-U$40K)] = 0.1622	π[U($50K)-U($40K)] +(1-π)* [U($100K) -U($90K) = 0.1289	0.1622 - 0.1289 = 0.0333	π[U($90K)-U$40K)] = 20	π[U($50K)-U($40K)] +(1-π)* [U($100K) -U($90K) = 17.4	20 - 17.4 = 2.6

Table 1

utility under the conventional expected utility approach--to the extent that they accurately measure conventional expected utility for insurance coverage of medical care that would otherwise have been purchased--may be used to measure the gain in utility under expected utility from a gain perspective.

Sixth, contingent claims/state dependent expected utility theory hypothesizes that the consumer's utility function depends on the different states of the world (Viscusi and Evans, 1990; Zweifel and Breyer, 1997; Nyman, 1999a). Because the marginal utility of income is greater in some states than in others, insurance is purchased in order to transfer income into those states where the marginal utility of income is greater. Although, the new theory is similar to state dependent utility theory, it is simpler than state dependent utility theory because it does not require the specification of a new utility function for the each state. For example, specifying separate utility functions for ill and healthy consumers is difficult at best, and because such functions are not readily available, state dependent utility theory applied to health insurance has limited predictive or evaluative capability. In the new theory, it is necessary to specify only a single utility function and simply evaluate it at different levels of income. While consistent with the spirit of state dependent utility theory, expected utility theory from a gain perspective represents a simpler, more manageable theory, that is still consistent with the findings from prospect theory and Connor's (1996) study.

5. Conclusions

Conventional expected utility theory has traditionally been specified from a loss perspective. Because of this specification, generations of economics students have been taught that consumers demand insurance because they prefer the certainty of paying the fair premium to the uncertainty of the loss itself. If the findings from the prospect theory literature are to be believed, however, nothing could be further from the truth. Repeated experiments from that literature have documented that individuals tend to prefer uncertain losses to actuarially equivalent certain losses. Therefore, if consumers buy insurance, it must be for reasons other than that they prefer certain losses.

The specification and interpretation described in this paper suggest that a consumer's demand for insurance has nothing to do with a preference for certainty. Instead, the demand for insurance derives from the demand for an income payoff that occurs only in a pre-specified state, which is purchased with income that could have been spent in either of the two uncertain states of the world. When these changes are made, uncertainty occurs both with and without insurance.

The key difference between these two interpretations lies in whether people integrate the loss into the insurance choice, or regard it as a separate characteristic, part of the environment. The intuition can be seen by describing in words the insurance choice exactly as it is represented in the conventional expected utility model as specified in equations (1) and (2) above. Thus, a translation of the conventional expected utility model into words would be a choice between:

> No contract and a 2% risk of losing $2,000 [uncertainty, equation 1]
>
> v.
>
> A contract costing $40 that has a 2% risk of simultaneously losing and gaining $2,000, [certainty, equation (2)],

Under the gain perspective model, the choice according to equations (7) and (9) is between:

> No contract and an additional $40 to spend on other goods and services, whether healthy or ill [uncertainty, equation (7)]
>
> v.
>
> A contract costing $40 where if you were ill, you would gain $2,000 [uncertainty, equation (9)].

both options being placed in the pointedly exogenous context of having a 2% chance of becoming ill and losing $2,000.

This may appear to be a subtle distinction, but it is at the crux of understanding why consumers purchase insurance. It shows how the conventional specification of the expected utility model converts insurance from a *quid pro quo* contract, which it is in reality, into what appears to be a choice between certain and uncertain losses of the same expected magnitude. This specification, however, so fundamentally alters the choices that these alternatives no longer reflect the way that consumers view insurance, leading analysts to make the wrong behavioral inferences about what motivates consumers to purchase insurance.

That is, there is nothing mathematically wrong with expressing the decision to purchase insurance as a choice between utility *levels* [that is, equations (1), (2) and (3)]. Such an analysis produces exactly the same empirical calculation of the net benefit as the analysis expressed as utility *gains* from different reference points [equations (7), (9) and (10)]. The problem with using the utility-*level* analysis, however, is that it appears as if consumers demand insurance for the certainty it provides. If it were recognized that the loss is exogenous to the insurance contract and is only included to show how the reference point changes when ill, then the true *quid pro quo* nature of the transaction would be clear. As it is, the conventional specification has led analysts erroneously to conclude--despite considerable empirical evidence to the contrary--that the demand for insurance is a demand for a certainty.

This miss-specification has been far from benign. As alluded to above, in the case of health insurance, the demand-for-certainty interpretation of expected utility theory has mislead analysts into specifying the insurance model so that a person could receive, say, a $30,000 income payoff in the event of illness, and not have this $30,000 income payment influence the level of expenditures used in treating the disease (e.g., Newhouse, 1978). That is, the expenditures (representing the "loss") were conventionally specified as being exogenous, in order for the payoff to result in certainty. For many health economists, the implication of this specification was that the increase in health care consumption that was systematically observed in the insured could only be due (by process of elimination) to a price effect, but a price effect would reduce welfare (Pauly, 1968). It was not recognized that the price reduction in health insurance was the mechanism by which an income payoff occurs and that a portion of the additional consumption by the insured was due to this income payoff (Nyman, 1999a, 1999b, 1999c, 2001; Nyman and Maude-Griffin, 2001). Thus, this specification has indirectly lead to a fundamental misunderstanding of the welfare consequences of health insurance and to the promotion of policies designed to solve problems that largely did not exist.

The paper has occasionally used a health insurance context in order to ground the theoretical discussion in an identifiable market.[3] It is clear, however, that the theory applies generally to property, life, casualty, and other forms of insurance as well. That is, all insurance represents a premium payment in exchange for an expected payoff that occurs in some uncertain but pre-specified state of the world. Thus, the decision to purchase any insurance can be modeled from a gain perspective.

Under a gain specification and interpretation, expected utility theory of the demand for insurance has nothing to do with the demand for certainty or for risk avoidance. This claim seems controversial in part because the supply side theory of insurance is about nothing other than reducing the uncertainty of payoffs (the variance) through applying the law of large numbers. It should be recognized that the demand side is much simpler and devolves into a straightforward market transaction: paying a premium for a payoff that occurs only in a pre-specified state.

It is also controversial because of the durability of loss perspective in insurance theory.

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[3]One difference between health insurance and other forms is that with health insurance, there is no real loss of resources. When a consumer becomes ill, the consumer purchases medical care rather than other goods and services. This implies that the consumer regards the medical care as being more valuable than the other goods and services that could be purchased. With other forms of insurance, the loss of income or wealth usually occurs with nothing in return. For example, with homeowner's insurance, if a house burns down it simply represents a loss of wealth; there are no compensating gains in goods or services. Whether this distinction matters, however, is not clear.

Daniel Bernoulli (1738) first postulated the concept of utility and diminishing marginal utility of income, and used an insurance example from a loss perspective to illustrate the principle that individuals prefer certainty to uncertainty. Although there was no empirical work to indicate that consumers actually view insurance from a loss perspective, or that consumers prefer certain losses to uncertain ones, this work established the demand-for-insurance-as-demand-for-certainty paradigm. The present paper is controversial because it presents the case that this 263-year-old paradigm is wrong. For insurance theory to be consistent with empirical evidence that people prefer uncertain losses, it is simply necessary to change the perspective of the insurance decision. A change of expected utility theory from a loss to a gain perspective may be all that is necessary to explain why people buy insurance.

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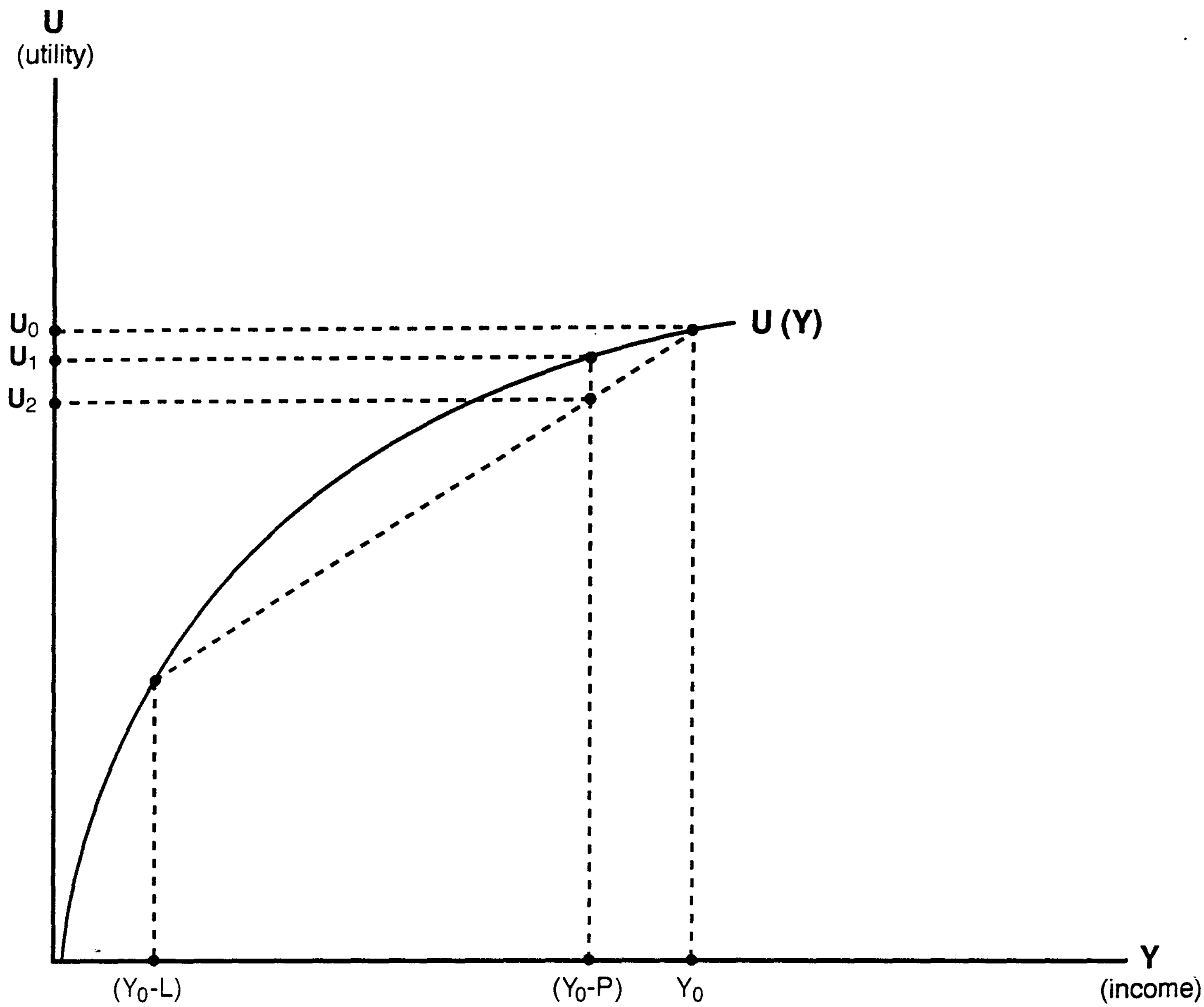

Figure 1

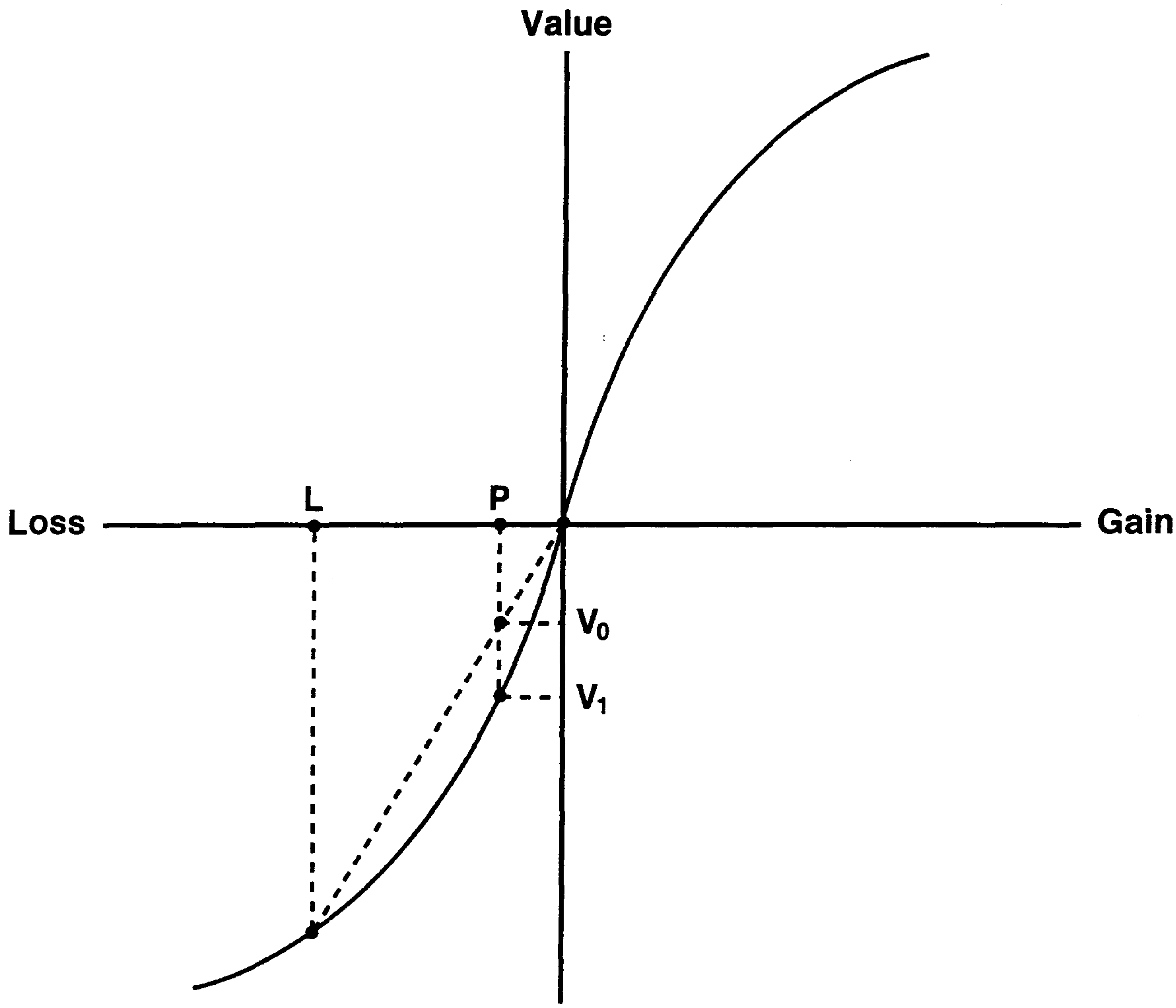

Figure 2

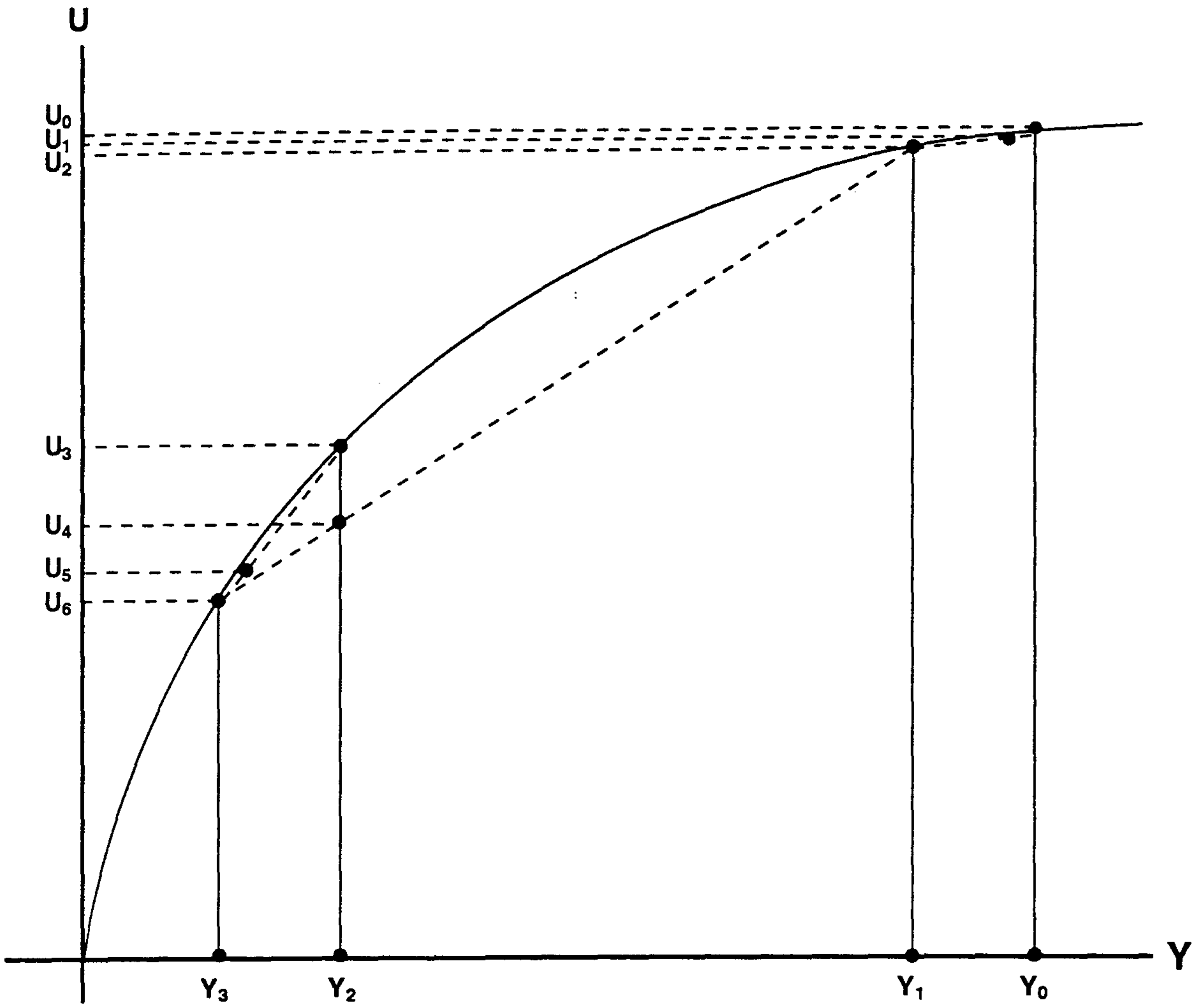

Figure 3

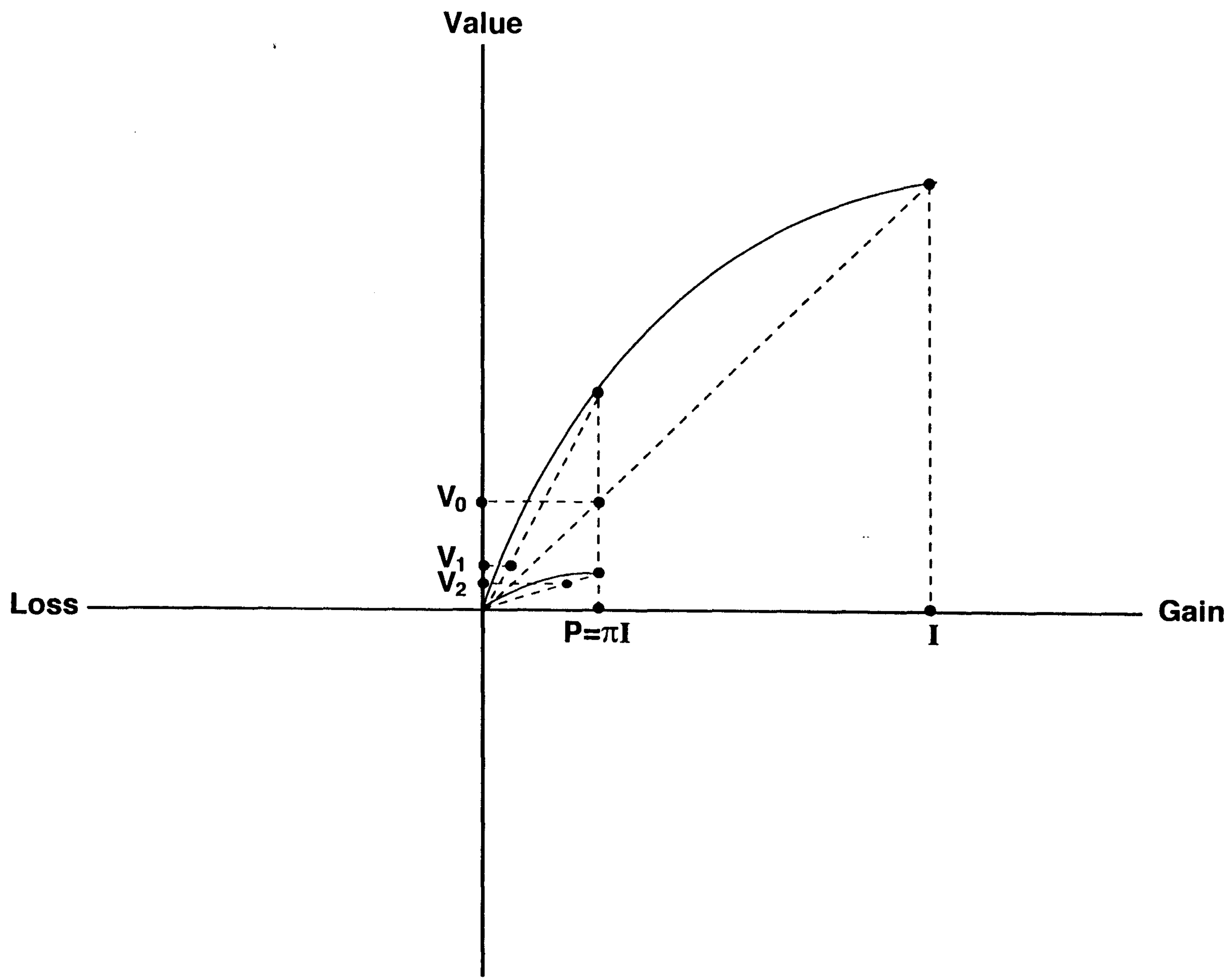

Figure 4