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Research Article

Individual Property Risk Management

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This paper reviews household property risk management and estimates normatively optimal choice under theoretical assumptions. Although risk retention limits are common in the financial planning industry, estimates of optimal risk retention that include both financial and human wealth far exceed limits commonly recommended. Households appear to frame property losses differently from other wealth losses leading to wealth-reducing, excess risk transfer. Possible theoretical explanations for excess sensitivity to loss are reviewed. Differences between observed and optimal risk management imply a large potential gain from improved choice.

1. Introduction

Property risk management, a fundamental aspect of individual financial planning, has perhaps been subject to the least amount of rigor. While investment management draws directly from a theoretical structure of modern portfolio theory, risk management often involves only the identification of risk exposures and products available to eliminate these exposures. A common method of ensuring consistency in choice among insurance products is to retain all risks beneath a risk retention limit; however the practice literature offers little insight into how much retention is appropriate. This paper uses expected utility theory to estimate optimal risk retention limits for households given reasonable assumptions about risk aversion, human and financial wealth, and cost of insurance. Estimated retention limits are generally much larger than limits chosen by individuals or recommended by professionals. This suggests that households are either overweighting losses in a manner consistent with Kahneman and Tversky's [1] prospect theory or unaware of normatively efficient insurance decision making.

Risky decision making involves consideration of the likelihood of expected outcomes and the consequences of each outcome on expected well being. While the profit motive

of firms suggests a preference for risky decisions that have a positive net expected value, households are willing to pay a greater premium to mitigate risk. More formally, consumers make decisions that maximize expected utility (U) by sacrificing expected wealth to reduce the variance of possible outcomes.

For example, a household can face m possible states of nature where the likelihood of an event is generated from a $\mathrm{Ber}(\rho_j)$ distribution where ρ_j is the likelihood of event j occurring. Along with the probabilities associated with each state is the payout or return (R) associated with each event. In this case, we can compute the expected payout associated as

$$E(\text{Payout}) = \sum_{j=1}^{m} \rho_j * R_j. \tag{1.1}$$

If a household is risk neutral, they will make insurance decisions that maximize their expected payout. Since the insurance product is costly, this assumption typically leads to no new purchases of insurance. A more realistic scenario is one where households have some aversion to risk. For example, if a household is asked whether they prefer an annual salary of \$50,000 with full certainty or either \$30,000 with a 95% likelihood or \$450,000 with a 5% likelihood, more households are likely to take the certain salary even though the expected income from the uncertain scenario is higher. This is an illustration of the Von Neumann-Morgenstern utility function, which is generally assumed to be strictly concave with respect to wealth (W). If W were a random variable and utility ($u(W)$) is strictly concave, then Jensen's inequality results in the following relationship where

$$\mathrm{EU}[W] < u(E[W]). \tag{1.2}$$

This implies that when facing large positive payouts, the utility associated with expected wealth, $u(E[W])$, is greater than the expected utility associated wealth, $\mathrm{EU}[W]$. The difference between these two points represents the welfare gain to the household as well as the profit opportunity for the insurer. In other words, a household can achieve greater utility when faced with uncertain outcomes that are less extreme and will be willing to give up expected wealth in order to forego these potential losses. The amount that a household is willing to pay to mitigate risk is dependent on their degree of risk aversion, which is known empirically as the risk aversion parameter. Risk aversion parameters are embedded into utility functions, where an individual with $U(W)'' < 0$ is risk averse, $U(W)'' > 0$ is risk seeking, and $U(W)'' = 0$ is risk neutral.

An actuarially fair premium rate is exactly equal to the expected loss or the product of the expected loss and probability of loss:

$$\text{rate} = E(\text{loss}) = \rho_{\text{loss}} E(\text{payout} \mid \text{loss}). \tag{1.3}$$

Risk-averse agents have incentive to purchase insurance in order to mitigate their risk and increase expected utility. Insurance firms are able to take on new risk due to their ability to spread risks among a diversified insurance pool while taking advantage of their risk neutrality. At the same time, consumers are willing to pay a fee for this protection. If insurance firms charged exactly the actuarial fair premium rate, they would make zero profits if they

effectively diversified their insurance pool and have no moral hazard or adverse selection. Insurance firms use load fees to pay for administrative costs and generate profits. The cost of insurance to individuals is

$$\text{cost} = (1 + \text{load}) * E(\text{loss}), \tag{1.4}$$

where *load* is some percentage greater than zero and adds to the cost. A rational, risk-averse agent might still have incentive to purchase this insurance product with a negative expected payout.

Insurance is also subject to other costs that are included in the load. Employees need to be hired to verify the claim that a negative state has occurred. Employees also need to be hired to estimate the likelihood that an uncertain state will occur in order to calculate the cost of the contingent claim (actuaries). Additional employees need to be hired to sell the contingent claims and manage the collection of fees charged for the claims. These costs, incurred to provide insurance to households, impact appropriate use of contingent claims to maximize welfare. They further increase how much wealth is sacrificed to decrease risk.

Household investment choice assumes that there is an optimal amount of portfolio risk for each investor at the point where an additional unit of risk no longer provides greater expected utility despite greater expected wealth. Insurance involves this same tradeoff of expected wealth for reduced risk. The next section focuses on calculating the point at which an additional unit of insurance no longer provides an increase in expected utility.

2. Estimating Optimal Insurance

Estimating insurance needs is similar to computing an optimal investment portfolio. In a simple model, we need only know the wealth of the household, its risk aversion, and the cost of the contingent claim.

2.1. Human Wealth

Total household wealth consists of both net worth and human wealth (discounted expected future household earnings). A formula to estimate human wealth is provided by Ibbotson et al. [2], where human capital HC is equal to the expected future earnings E from next year until retirement, discounted each year by the discount rate r and a risk premium v:

$$\text{HC}(x) = \sum_{t=x+1}^{n} \frac{E[h_t]}{(1 + r + v)^{t-x}}. \tag{2.1}$$

A good proxy for the discount rate r is the rate on taxable, low-risk corporate bonds, since income streams are similar to a bond and fully taxable. The risk premium v further discounts expected future income streams that may be more volatile. To illustrate the importance of human wealth in a household portfolio, consider that a 25-year-old with an income of \$75,000 at a 6% discount rate has an estimated present value wealth of \$1.1 million, assuming no income growth and no volatility if the individual expects to work until age 65. Alternatively, a 55-year-old with an income of \$100,000 has a human wealth of \$640,000, given the same assumptions. As we age, we transform our human wealth into income until it

is exhausted at retirement. Generally, the wealth of younger households will consist primarily of human wealth.

Risks to net worth include investment risk and negative events which will reduce the value of assets (destruction of property, a lawsuit, etc.). Risks to human wealth include uncertain events that decrease the expected value of future earnings, including disability, death, illness, or a labor market shock. Some risks are insurable through contingent claims, for example, disability and property destruction, while others must either be retained or insured through the public sector.

2.2. Cost of the Contingent Claim

Investors are often induced to accept greater risk by the opportunity to realize greater expected returns. Similarly, the decision to retain or to transfer risk is influenced by the cost of the insurance product. More expensive insurance will provide a disincentive to transfer risk and conversely a greater incentive to retain risk. Unfortunately, it is often difficult to estimate with any degree of accuracy the actual cost of the contingent claim.

In general, insurance products with heavy sales, underwriting, claims, moral, and morale hazard expenses will be more costly. These types of costs are endemic to many property and casualty policies. Loss ratios, or claims paid to policyholders, range from roughly 55% for homeowners insurance to 60% for automobile insurance to 75% for group health insurance. (Based on 2007 national insurance loss ratio statistics provided by the Missouri Department of Insurance, Financial Institutions & Professional Registration, available at http://insurance.mo.gov/reports/lossratio/.)

A loss ratio of 60% for property insurance policies implies that the expected return on the premium paid for the policies is −40%. Of every dollar paid for an insurance premium the household can expect to receive 60 cents back in claims on average. A $2,000 autopolicy will thus yield an expected annual loss in wealth of $800. This is the cost of risk transfer. However, the policy prevents a wealth loss if a negative state occurs. By choosing to buy the insurance policy the individual is revealing that the expected utility from preventing the uncertain negative state is greater than the certain loss of $800 in expected wealth, assuming full information.

It is also important to note that the ownership of any asset that may decline in value due to a negative state (peril) implies an expected annual loss in wealth that is a function of the magnitude and likelihood of this loss. It is the cost of insurance (1-loss ratio) that represents the loss in wealth above the expected loss inherent in asset ownership. For example, the ownership of a $100,000 home with a 1 in 100 chance of complete loss from a fire involves an implied cost of $1,000 per year in risk on average. A policy with a loss ratio of 50% would cost $2,000 (expected payout/loss ratio) implying an additional expected wealth loss of $1,000 per year.

2.3. Calculation of Insurance Needs

The estimate of insurance needs analysis relies on the following assumptions.

(1) Life is risky. It is possible that negative states may occur that will reduce wealth.

(2) Individuals are risk averse and are willing to reduce expected wealth in order to avoid a risk.

(3) Insurance reduces expected wealth to the extent that premiums exceed expected payouts.

(4) Risk aversion and wealth determine optimal risk retention and transfer.

Optimal risk retention will occur at the point where the expected utility from retaining an additional dollar of possible loss is equal to the expected utility of transferring risk to prevent the loss. According to Hanna [3], if we assume that this is a pure risk with two potential states (loss or no loss), the decision to insure will involve a comparison of utility over four possible outcomes. The amount of utility gained or lost is a function of wealth and risk aversion.

Suppose that individuals are assumed to exhibit constant relative risk aversion (CRRA) which can be written as

$$U = \frac{W^{1-r}}{1-r}, \tag{2.2}$$

where r is the coefficient of relative risk aversion. (While CRRA utility functions are commonly used, decreasing relative risk aversion (DRRA) can also be assumed where the relative risk coefficient decreases for higher levels of wealth. Because a DRRA utility function assumes that individuals are relatively less risk averse at higher levels of wealth, the optimal premium rate may be lower relative to CRRA as individuals are more willing to take on additional relative risk for higher levels of wealth. Other utility functions include more flexible forms as well as a class of absolute relative risk aversion functions (CARA, IARA, and DARA).) Notice that the Arrow-Pratt coefficient ($\bar{r}$) of relative risk aversion has the following relationship in this scenario:

$$\bar{r} = -\frac{U''(w)}{U'(w)}x = -\left(\frac{\partial U'}{\partial x}\right)\frac{x}{U'} = r \tag{2.3}$$

implying that the negative of the elasticity of utility with respect to wealth is constant. Also, notice that a higher r implies greater risk aversion and an r closer to 1 implies greater risk tolerance. A household with a coefficient of relative risk aversion equal to 1 is indifferent between a 50/50 chance of a 100% increase in expected lifetime income or a 50% reduction in income. A coefficient of 4 implies indifference between a gamble whose outcome is either a 100% increase in income or a 20% decline in income. Empirical estimates from Kaplow [4] suggest that most fall near a relative risk aversion coefficient of 3 to 5.

As an illustration, if we assume a wealth of W and assume one's house is worth H where ρ is the probability of fire damage destroying the house where $\rho \in [0,1]$, the choice to insure requires a premium payment of π and a deductible payment (d). The loss ratio, which is the expected loss in wealth to the agent relative to the insurance premium rate, can then be expressed as the ratio of expected losses over the premium rate:

$$lr = \frac{\pi(1-\rho) - H\rho}{\pi}. \tag{2.4}$$

For example, in the case where $W = \$250,000$ and $H = \$100,000$ where the cost of insurance was $\pi = \$2,000$ and $d = \$0$ with the likelihood of fire (ρ) equal to 1% the resulting loss ratio would be 50%.

If we compare only the expected wealth of each choice, given probabilities insurance will never be the optimal choice since by definition it will require a decline in expected wealth to be economically viable. To estimate the optimal choice of risk-averse investors dollar values must be transformed using a utility function that incorporates the degree of relative risk aversion.

In the case of insurance, two different wealth levels can be attained dependent upon two possible states (fire or no fire). In the case of fire, wealth (W_{IF}) is equal to initial wealth (W_0) minus the insurance premium (π) and deductible (d). In the case of no fire, no deductible is paid so that $W_{\mathrm{INF}} = W_0 - \pi$. In the expected utility framework, we can express expected utility as

$$\begin{aligned} \mathrm{EU}_I &= \rho * u(W_{\mathrm{IF}}) + [1-\rho] * u(W_{\mathrm{INF}}) \\ &= \rho * \frac{(W_0 - \pi - d)^{1-r}}{1-r} + [1-\rho] * \frac{(W_0 - \pi)^{1-r}}{1-r}. \end{aligned} \tag{2.5}$$

If we assume $r = 3$, then we obtain $\mathrm{EU}_I = -8.14e - 12$ units of utility. Alternatively, if the agent does not purchase insurance, $W_{\mathrm{NIF}} = W_0 - H$ and $W_{\mathrm{NINF}} = W_0$. In the case of no insurance, the expected utility ($\mathrm{EU}_{\mathrm{NI}}$) is equal to $-8.13e - 12$.

Because utility is an ordinal measure, we can conclude that even with a 50% loss ratio an individual with the specified preference function is better off purchasing insurance. The main reason is that the loss represents a very large share of wealth—in this case a loss of 40% of wealth. With this magnitude of loss an individual would only consider not buying insurance if the loss ratio fell beneath 45%. In the above example, if the initial wealth had instead been \$500,000, the maximum potential loss represents 20% of wealth. At 20% of wealth a household would be willing to buy insurance if the loss ratio is 60% or more.

The optimal retention limit is found by computing the point at which expected utility from retaining risk is exactly equal to the utility from transferring risk through insurance. At this point, π is set to the point where $\mathrm{EU}_I = \mathrm{EU}_{\mathrm{NI}}$. This can be rewritten as

$$\begin{aligned} \mathrm{EU}_I &= \rho(W - \pi - d)^{1-r} + [1-\rho](W - \pi)^{1-r} \\ &= \rho(W - H)^{1-r} + [1-\rho](W - d)^{1-r} \\ &= \mathrm{EU}_{\mathrm{NI}}. \end{aligned} \tag{2.6}$$

Even though an explicit analytical solution could not be determined for $\pi = f(W, d, r, \rho, H)$, the solution can be found numerically. With this example, the premium rate that solves the above equation is $\pi = 2,193$, which results in a loss ratio of 53.4% when the risk retention ratio is 20%. A greater loss ratio (or expected insurance claims from each premium dollar) will encourage greater transfer of risk as the cost of insurance is lower. More expensive insurance will encourage risk retention. A larger or catastrophic potential loss will lead to a greater willingness to insure. If the potential loss is small in terms of wealth, then the cost of insurance would need to be very low to induce a household to buy insurance.

Figure 1 illustrates the optimal tradeoff between risk transfer and risk retention given loss as a percentage of wealth and loss ratios. As the loss ratio declines, insurance becomes more expensive and individuals are only willing to insure if the loss represents a high percent

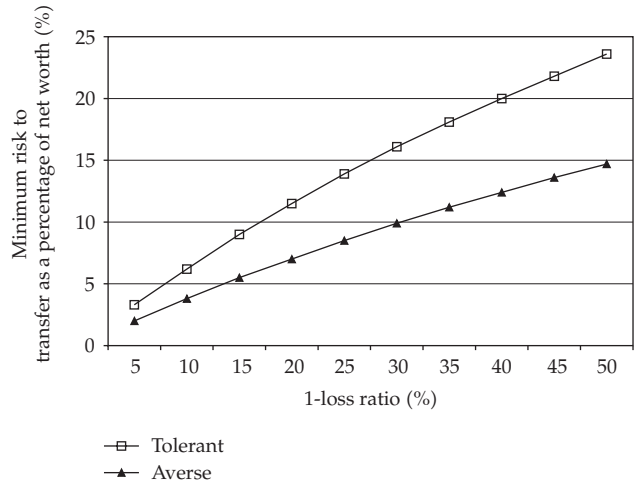

Figure 1: Optimal Risk Retention Limits.

of wealth. Risk tolerant individuals are assigned a coefficient of relative risk aversion of 3 and the risk-averse individuals are assigned a relative risk aversion of 5.

At a 40% loss ratio, characteristic of many property policies, it is only rational for individuals to insure losses that are about 1/7 of total wealth if they are risk averse. For the more risk tolerant an optimal risk retention limit is closer to 1/5 of total wealth. In practical terms these risk retention limits are enormous. A risk-averse household with a human wealth and wealth of $2 million would retain all risks below 10% of total wealth if the policy paid back 75% of premiums. With wealth this large products like comprehensive or collision insurance on a vehicle would have no appeal. It would also not make sense to carry anything other than the highest possible deductibles or to insure any assets whose value falls beneath $200,000.

While the conclusions of the model may appear extreme, they are valid in the sense that they are consistent with less intuitively extreme investment decision making. For example, retaining risk on property insurance either through very high deductibles or by not buying insurance provides an expected yield equal to the opportunity cost of insurance—which in the case of most property insurance is equivalent to a yield of at least 40%. The downside is that the household may subject themselves to a loss of, in this case, up to $200,000 to earn this return. However, expected returns on equities in the U.S. have been roughly 10%–12% and the tradeoff is exactly the same—the possibility of a large loss in wealth. In terms of wealth, there is no difference between a $100,000 loss due to property or casualty loss and a $100,000 loss in an investment portfolio. Both losses were the result of risk borne to maximize expected utility given uncertain outcomes.

Prudent risk management must also acknowledge the limitations of including human wealth when estimating risk retention limits. A wealth shock that falls beneath the estimated risk retention limit, for example, the loss of a $35,000 car to a 25-year-old, will be devastating if it wipes out liquid savings and if the ability to borrow against human capital is limited. Credit constraints in the face of a large loss can lead to a significant drop in consumption and a loss to illiquid projects that require a constant stream of cash to maintain (such as mortgages, business expenses, and student loan payments). Liquidity and access to credit are important considerations that impact optimal risk retention for those with high human wealth and few financial assets.

These results suggest that many are approaching the process of risk management by focusing on identifiable losses without recognizing the tradeoff of risk and return when choosing optimal risk management strategies. Most households are spending too much to prevent property and casualty risks while simultaneously retaining risk in their investment portfolio. This is neither wealth nor utility maximizing. However, the authors recognize that implementing this model will be difficult since many households are not prepared to retain risk they are accustomed to transferring.

3. Overweighting Losses

While the expected utility framework is rational in that it assumes disutility from wealth changes to be equal to the reduction in expected consumption, individuals appear to weigh gains and losses from risky choices differently. In fact, the persistent popularity of insurance products that protect against small losses suggests that individuals are willing to pay dearly to protect against minor losses while simultaneously paying insufficient attention to much larger risks (Kunreuther and Pauly [5]). Using results from experimental data, Kahneman and Tversky [1] point out three major limitations of expected utility theory which include the consistent overestimation of low probability events and underestimation of high probabilities. This would suggest that agents generally overinsure against rare events and underinsure against more common events, according to expected utility theory. The second finding is that utility functions (commonly referred to as value functions in the Prospect Theory literature) are generally concave concerning gains and convex for losses (Tversky and Kahneman [6]). Convexity for losses implies a large amount of disutility for relatively small losses and only a modest increase in disutility for larger losses. An individual with a prospect theory value function will place greater emphasis on avoiding small losses and a reduced emphasis on large losses than if they followed a conventional utility function.

The third problem with expected utility theory is that of absolute losses versus relative losses. As indicated by Kahneman and Tversky [1], individuals in experimental settings are shown to make decisions based on changes in their financial position rather than the impact on their final wealth. Kunreuther and Pauly [5] show that if an asset is only monetary, then it is rational to assess values based on absolute wealth changes. Instead, individuals appear to consider their current wealth a reference point and any loss from that reference point induces greater disutility than the dollar value of the loss would suggest.

Modeling a risky decision using prospect theory involves a reference point (R) from which gains and losses are assessed. The most relevant reference point is initial wealth ($R = W_0$). There is a small net loss associated with paying insurance premiums; however, there is an even larger net loss in the case of a fire under no insurance. If a fire occurs (F), there is a small net loss with and a large net loss without insurance; however, there is a no loss if insurance is not purchased and no fire occurs (NF). We define $X_i = W_i - R$, where $i = \{F, \mathrm{NF}\}$, as the net gains/losses. Because the utility function is assumed to be asymmetric around R, we then define the two parts of the value function which can be written as

$$v(X_i) = \begin{cases} 0 & \text{if } X_i \geq 0, \\ -\theta(\pi + d)^{\beta} & \text{if } X_i < 0 \text{ with probability } \rho, \\ -\theta(\pi)^{\beta} & \text{if } X_i < 0 \text{ with probability } (1-\rho), \end{cases} \tag{3.1}$$

where θ is the loss aversion parameter and is greater than 1. The value function under the purchase of insurance (V_I) becomes

$$V_I = -g(\rho) * \theta(\pi + d)^{\beta} - g(1-\rho) * \theta(\pi)^{\beta} \tag{3.2}$$

such that $g(\cdot)$ is a weighting function that accounts for overvaluing small probabilities and undervaluing large probabilities. The same reference point is used when we consider the case where no insurance is purchased. In this situation a fire results in a net loss and no fire results in a no loss. In this scenario we obtain

$$v(X_i) = \begin{cases} 0 & \text{if } X_i \geq 0, \\ -\theta(H)^{\beta} & \text{if } X_i < 0, \end{cases} \tag{3.3}$$

which then converts the value function (V_{NI}) to be

$$V_{\mathrm{NI}} = -g(\rho)\theta(H)^{\beta}. \tag{3.4}$$

To apply this function to the fire example above we assume $\beta = 0.88$ and $\theta = 2.25$ as suggested by Tversky and Kahneman [7]. To assess subjective probability biases we use the function derived by al-Nowaihi and Dhami [8] who derive their function from a more general form from Prelec [9], which is essentially

$$g(\rho) = e^{-\beta(-\ln(\rho))^{\alpha}}, \tag{3.5}$$

where we assume $\alpha = 0.80$. Using this function allows us to inflate our probability of 1% to 5% and deflate the probability of 99% to 98%. Given these adjusted probabilities and the downside risk parameter, we now look for the premium amount (π) that solves for $V_I = V_{\mathrm{NI}}$. At some point the premium will be high enough to outweigh the ability of the individual to manage the downside risk of a fire. For this scenario $\pi = 3,255$. Since both value functions are not functionally related to W, the optimal risk retention limit is unaffected by W_0. This differs from expected utility theory which assumes increasing risk tolerance with wealth from a potential loss of a given magnitude.

While prospect theory is useful as a means of understanding how individuals actually behave when faced with a decision to retain or transfer risk, it has little use as a normative tool to improve risk management practices. Estimates of optimal insurance using a prospect theory value function are high for small risks and low for more catastrophic risks. This is consistent with the current market for consumer insurance with its broad overuse of low deductibles, extended warranties, and protection of low-value tangible goods and simultaneous underuse of insurance products protecting more catastrophic risks of liability and loss of earnings. However, spending heavily to avoid small property and casualty risks while maintaining an optimal investment portfolio that requires acceptance of market risk (involving potential losses of a much greater magnitude) results in a wealth loss from framing these decisions separately. Prospect theory thus lends itself to modeling positive behavior but fails to guide practitioners or individuals in risk management.

Another possible shortcoming of Prospect Theory is that an insurance premium is itself a small-stakes loss. Payment of a premium assumes that an individual is willing to accept a small loss to avoid a possible larger loss; however, if the utility function is convex in losses (individuals are risk seeking when presented a choice that involves small and larger losses), then loss aversion becomes an even less plausible explanation unless the premium is not seen as a loss in itself. Such an individual may be induced into paying a relatively high premium to avoid a small-stakes loss since the loss from the random event creates greater disutility (per dollar) than the certain loss from the insurance premium. This appears to be the case in decisions involving the choice of homeowners' insurance deductibles. The choice between a $250 and a $500 deductible implies the payment of an added premium (say $25) to avoid an unlikely loss of the $250 difference between the two deductibles. For an individual with a total wealth of $100,000 (e.g., a destitute 80-year-old whose wealth consists of the present value of social security), choosing a $250 deductible implies a coefficient of relative risk aversion of over 500 (Sydnor [10]). Mehra and Prescott [11] describe the equity risk premium as a puzzle since it implies a coefficient of relative risk aversion of around 30. If the equity premium is a puzzle, then the risk retention premium is a mystery of inexplicable magnitude.

The only reasonable explanation for observed property insurance behavior is that the unexpected loss covered by insurance provides so much disutility that an individual is willing to give up large amounts of expected wealth to avoid it. This would be plausible if the losses caused painful regret when a peril caused a loss and if the premium itself was not viewed as a loss. Braun and Muermann [12] incorporate the unhappiness that is caused by regret into a utility function that can explain observed demand for insurance. Sydnor [10] modifies a utility function developed by Koszegi and Rabin [13] in which wealth losses are amplified by a factor that represents the relative pain felt by a random loss relative to a gain in wealth. The model suggests very strong amplification for low-stakes losses and more realistic amplification for large-scale loss, which appears consistent with observed behavior.

4. Conclusions

Proper household management of property and casualty risk requires an assessment of the dollar values of losses in various possible future states. When wealth in each state is transformed based on an individual's risk tolerance, it is possible to estimate the level of risk transfer through insurance. Using reasonable estimates of risk aversion, cost of property insurance, and initial wealth, optimal risk retention can be as high as 20% of initial household wealth. A risk retention limit of this magnitude would imply far higher deductibles in insurance policies and the abandonment of many popular policies that protect small losses. If human wealth is considered a component of total wealth, many young individuals would avoid insuring against all but catastrophic losses.

Advances in portfolio management and dissemination of normative investment science have led to broad acceptance of investment risk among households. For example, the percentage of U.S. households owning stock increased from 32% in 1989 to 52% in 2001 [14]. This increased acceptance of potential loss in investment portfolios has resulted in a significant improvement in household welfare. Holding a portfolio that is consistent with risk preferences implies an increase in expected utility relative to one that is excessively conservative. Similarly, dissemination of normative risk management science has the potential to improve welfare by illustrating the potential benefits of reducing costly

protection of small losses and increasing protection against catastrophic risks. This study provides estimates of a large potential gain from increased acceptance of certain risks that are costly to insure.

The evidence from household risk retention preference through home insurance deductibles suggests that the market for property insurance reflects strong preferences for loss aversion. Benartzi and Thaler [15] provide evidence that Prospect Theory may also explain the observed high equity premium and an unwillingness to own risky assets. However, a clear welfare loss results from simultaneous ownership of risky securities and policy protection against small-scale risks. There is also evidence that individuals place insufficient weight on the utility loss from random large losses to total wealth by failing to insure adequately for potentially large losses such as large-scale liability losses and losses to human wealth (e.g., through disability income insurance). In the case of insurance, where there is little advice available (including from financial professionals) to maintain consistency among risky financial decisions, behavior may not accurately reveal preferences. If this is the case, then the application of a standard expected utility model may provide normative value that can help guide individuals and advisors toward making better decisions (Campbell [16]).

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