WHAT DRIVES POLICYHOLDERS' RELATIVE WILLINGNESS TO PAY?

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ABSTRACT

An analysis of the empirical data acquired from an online survey reveals the key drivers for policyholders' relative willingness to pay against the background of high insured values. We apply the insurer's perspective to better understand which policyholder groups exhibit a high relative willingness to pay and which do not even cover the insurer's expected expenses. We find that the certainty effect underlies the probabilistic insurance, but not the underinsurance. This implies that insurance coverage does not have a relevant impact on the relative willingness to pay. Furthermore, the relative willingness to pay for high insured values decreases significantly with a higher default probability, older age, lower risk aversion, or lower wealth. In addition, the average relative willingness to pay for individuals with medium financial literacy is close to 1, but policyholders with the highest financial literacy pay substantially less (0.621). We also find that, for overinsurance and full coverage, policyholders significantly deviate from the results based on the Expected Utility Theory. This insight is independent of the initial wealth and the degree of risk aversion. Concerning underinsurance, the deviation is either less significant or not significant at all.

1. INTRODUCTION

Motivated by increasing digitization, the collection of information about policyholders and their behavior has become a ubiquitous part of insurance activity. In this context, a necessary, but insufficient, parameter for setting the optimal price of insurance contracts is the maximum willingness to pay.[1] Although a large number of studies have investigated policyholders' willingness to pay, a relatively small number has focused on high insured values and large potential damage events. Indeed, it is a core task of the insurer to protect policyholders against (relative to the subject's wealth) high damage events.

Our research approach is conducted from the insurance management and regulator perspectives. Firstly, an analysis of the willingness to pay for high insured values is conducted. From an insurance management perspective, it is important to recognize which policyholder groups exhibit a high willingness to pay and which do not even cover the insurer's expected payouts.[2] Secondly, from a regulatory perspective, it is important to understand for which customer segments price regulation might be necessary.

Wakker et al. (1997) investigate the willingness to pay for high insured values using a default probability and find that that willingness to pay decreases substantially for probabilistic insurance. Other studies corroborate this outcome for lower insured values [Zimmer et al. (2009, 2018)]. We extend previous research by developing and examining 8 hypotheses derived from the insights of empirical research and insurance theory. We consider different coverage levels and default

[1] The optimal price setting is affected by the maximum willingness to pay and the competition within the market. Hence, knowing the maximum willingness to pay is necessary for setting optimal prices. However, it is not sufficient, as competition results in full willingness to pay not being absorbed.
[2] This insight is especially important when the market is not fully competitive. Hence, premiums higher than the fair premium can be applied.

probabilities. We also analyze the relative willingness to pay, which we define as the ratio between the maximum willingness to pay and the expected indemnity payments. Furthermore, we conduct an online survey that focuses on a hypothetical loss domain[3] and test the hypotheses. We examine the impact of insurance coverage on the relative willingness to pay. Consequently, we investigate whether the certainty effect only exists for probabilistic insurance or underinsurance. Moreover, we investigate whether policyholders increase their relative willingness to pay for overinsurance. In this context, we aim to determine whether policyholders' financial literacy has a significant impact on their relative willingness to pay.

To measure financial literacy, the framework introduced by Lusardi and Mitchell (2011) is applied. Similar to Holt and Laury (2002), we determine the degree of risk aversion and analyze how this influences the relative willingness to pay. Economic theory suggests that an increase in willingness to pay accompanies increasing risk aversion [Mossin (1968)]. In addition, we consider whether age is a key driver for the relative willingness to pay. Hansen et al. (2016) analyze house insurance claims in the Danish market and find that the insurance claim peak is reached when the policyholders are between 30 and 40 years old. Associated with the higher claims, the policyholders also pay higher premiums. However, in our case, the considered scenario is equal among all age groups; hence from a normative perspective, it is reasonable to suggest that age does not have a significant impact.

Similar to Zimmer et al. (2018), we examine the gender effect on the relative willingness to pay. Zimmer et al. (2018) do not find a significant impact for a low insured value and Schubert et al. (1999) identify a gender-specific risk attitude depending on the decision framework. For a loss domain, men tend to be more risk-averse than women. In line with economic theory, this implies that men tend to pay more for insurance than women, as a loss domain is present according to the insurance. As Case et al. (2005) demonstrate, increasing wealth leads to higher consumption. Consequently, we analyze the wealth effect on the relative willingness to pay. We extend the insights provided in Wakker et al. (1997) and determine whether policyholders strive for expected utility results, given probabilistic insurance and no default probability with different coverage levels.

In summary, we acquire empirical data from an online survey and use the data to investigate the impact of multiple parameters on the policyholders' relative willingness to pay. Our primary aim is to develop a deeper understanding of the key drivers of the relative willingness to pay for high insured values. Furthermore, Expected Utility Theory is used as a benchmark for different coverage levels and for comparing those results with our empirical findings.

2. LITERATURE REVIEW AND POSITIONING

We initially connect our paper to the existing body of literature, including the willingness to pay a premium against the background of a default probability, as well as under- and overinsurance. Furthermore, we explain how these different streams are related to our research. First, we consider the literature on the relationship between default probability and premium. Previous studies have documented a substantial decrease in the willingness to pay when the default probability increases [Wakker et al. (1997), Zimmer et al. (2009, 2018)].[4] Moreover, under certain circumstances, policyholders might even be insensitive to a small default risk [Gatzert and Kellner (2014), Eckert and Gatzert (2018), Klein and Schmeiser (2020)], and hence, do not necessarily reduce their willingness to pay if the default probability increases.[5] More specifically, a lack of default probability transparency might be why policyholders do not adapt their willingness to pay. However, since policyholders are directly confronted with the underlying default probabilities in the empirical research [Wakker et al. (1997), Zimmer et al. (2009, 2018)], it cannot be ignored. We extend the previous research by investigating how under- and overinsurance affect policyholders' willingness to pay if a default probability and no default probability exist. Subsequently, we provide an overview of the research on under- and overinsurance.

Second, there is a large body of knowledge regarding empirical studies based on hypothetical surveys or experimental studies in the context of insurance demand. A literature overview and the pros and cons of the different model setups are provided in Jaspersen (2016). Under- and overinsurance are comprehensively discussed in the insurance literature. Mossin (1968) analyzes insurance coverage under rational behavior for a given risk. In this context, it is not optimal to purchase full coverage if a premium higher than the fair premium is

[3] We consequently focus on a loss domain, as insurance is connected with losses and the avoidance of losses. Holt and Laury (2002) investigate a gain domain. However, as Kahneman and Tversky (1979) illustrate, changing the domain might also lead to changing behavior.
[4] For a comprehensive overview of the empirical research into the default probability and willingness to pay, see, e.g., Klein and Schmeiser (2019).
[5] This insensitivity is in line with the argument by Kahneman and Tversky (1979), where very unlikely events are overweighted or ignored.

in place. Nevertheless, Mossin (1968) also mentions that if policyholders act irrationally, they face either uncertainty or the probability distribution of the potential damage being overestimated. This might explain why policyholders would prefer full coverage rather than partial coverage.

Doherty (1977) analyzes the effect of stochastic dominance models on insurance coverage and Eeckhoudt et al. (1996) consider the impact of background risk on risk-taking behavior. Moreover, Schlesinger (1997) extends Mossin (1968) and determines the optimal insurance coverage without the Expected Utility Theory. In this regard, it might be optimal to take full coverage if the premium is higher than the actuarially fair price. Cutler et al. (2008) analyze insurance markets and the preference heterogeneity and suggest that against the background of market inefficiencies (induced by private information) overinsurance should be regarded as additional to underinsurance related to adverse selection models.

In the context of natural disasters, Kunreuther (1984) investigates the reasons for underinsurance. He argues that underinsurance is induced from the demand side when low probability events with a high impact are not considered (underestimated) by individuals or the potential loss is underestimated. More concretely, this implies that the premium, which has to be paid, is overestimated. Furthermore, the premium is widely denoted as a function of the insurance coverage [Smith (1968), Viauroux (2014)].

In this paper, we analyze how insurance coverage affects policyholders' maximum willingness to pay. In this regard, we extend the previous research in the field and provide empirical insights. More precisely, we measure whether underinsurance, full insurance, or overinsurance generate the best ratio between the maximum willingness to pay and expected indemnity payments from the insurer's perspective. In practice, overinsurance is typically forbidden, due to ex-ante and ex-post moral hazard.[6] In our setting, no effects from moral hazard occur. More precisely, we assume that the policyholder cannot influence the damage probabilities or the damage amounts.

3. HYPOTHESES, EXPECTED UTILITY THEORY, AND EMPIRICAL DESIGN

3.1 HYPOTHESES

Wakker et al. (1997) and Zimmer et al. (2009, 2018) find that it is reasonable to suggest that policyholders substantially decrease their willingness to pay for low default probabilities. In contrast to the previous research, we consider a default probability that is very small and analyze high insured values. Wakker et al. (1997) also investigates high insured values; however, only for circumstances where default probability is between a 0 and 1 percent. Additionally, we focus on cases of under- and overinsurance. Derived from Kahneman and Tversky (1979), a certainty effect might exist, and hence, we derive the first hypothesis:

H1: Relative willingness to pay significantly decreases for (very) low default probabilities in relation to the non-default case

Previous research illustrates that under- or overinsurance preferences are influenced by the individual risk itself, the wrong estimation of the probability or loss functions, or missing information, which may result in uncertainty [Mossin (1968), Kunreuther (1984), Cutler et al. (2008)]. However, within our survey, such a reason does not exist. Moreover, we argue that the certainty effect, measured by Kahneman and Tversky (1979), directly refers to the default probability and not to the degree of insurance coverage. Smith (1968) and Viauroux (2014) emphasize that the premium increases with higher coverage. For a proportional relationship between coverage and the premium we would expect constant premium-coverage ratios. Consequently, we develop the second hypothesis:[7]

H2: Relative willingness to pay does not significantly deviate for varying insurance coverage values

We analyze financial literacy following the recommendations in Lusardi and Mitchell (2011). Previous research has demonstrated that individuals with high financial literacy tend to invest, to a higher degree, in stocks [Christelis et al. (2010), van Rooij et al. (2011)]. One reason for this might be a deeper understanding of risk diversification [Lusardi and Mitchell (2011)]. To the best of our knowledge, there has been no research undertaken, to date, that directly examines willingness to pay for insurance with high insured values. We argue that financial literacy affects policyholders' behavior. Individuals with higher financial literacy exhibit a higher ability to diversify their risks. Hence, it is intuitive that high financial literacy leads to a maximum willingness to pay that is closer to the expected indemnity payments (and hence lower than the willingness to pay of decisionmakers with a low financial literacy).

H3: For individuals with high financial literacy, the average relative willingness to pay is closer to 1 (fair premium) compared to individuals with lower financial literacy

Following Holt and Laury (2002; 2005), we examine risk attitudes. Based on economic theory, risk aversion affects policyholders' wealth position preference function [Gatzert and Schmeiser (2012)]. Assuming preference equality between insurance and no insurance, we conclude that the premium increases with higher risk aversion [Klein and Schmeiser (2019)]. In other words, individuals with a higher degree of risk aversion accept a higher loading than those with a lower degree of risk aversion. Focus is placed on being protected against potential damage [Mossin (1968), Braun et al. (2015)].

H4: Relative willingness to pay increases with a higher degree of risk aversion

Hansen et al. (2016) analyzes house insurance claims in the Danish market. The authors find that average insurance claims reach their peak when the insured are between 30 and 40 years old. Hence, it is reasonable to assume that willingness to pay among this age group is higher than for older or younger policyholders. However, in our empirical framework, equal damage probabilities and damage quantities are presented. Hence, age should not influence policyholders' willingness to pay.

H5: Relative willingness to pay is not affected by policyholder age

Zimmer et al. (2018) analyze whether a significant gender difference exists with respect to willingness to pay for probabilistic insurance. The authors do not find significant results based on the willingness to pay. However, the majority of studies support the gender effect on risk aversion [Charness and Gneezy (2012), Fehr-Duda et al. (2006)]. Schubert et al. (1999) identify a gender-specific risk attitude depending on the decision framework. More precisely, men tend to be more risk-averse than women if a loss domain is present and vice versa. In line with the economic theory, as a loss domain is present in insurance, men tend to pay more for insurance than women. In contrast, Halek and Eisenhauer (2001) analyze the demography of risk aversion concerning life insurance. Although they investigate a loss domain, they find that women are significantly more risk-averse than men. Previous studies do not present unique results. As explained in section 1, the Zimmer et al. (2018) study is related to our survey.

H6: Relative willingness to pay is not affected by gender

A large number of theoretical research focusses on utility and the utility of wealth [Markowitz (1952), Pratt (1964), Arrow (1965)]. To the best of our knowledge, to date, wealth effects regarding willingness to pay for probabilistic insurance have not been measured. Previous studies have documented a positive correlation between wealth and consumption [Case et al. (2005)]. More precisely, when individuals exhibit higher wealth, they tend to spend more money. We transfer this insight to the insurance industry and argue that wealth positively affects willingness to pay for insurance. In other words, wealthy policyholders are willing to pay higher loadings than less wealthy policyholders to minimize the probability that an extreme event occurs that substantially decreases their wealth.[8]

H7: Relative willingness to pay increases with policyholder wealth

Expected Utility Theory provides concave preference functions when policyholders are risk-averse, convex preference functions if risk-seeking behavior is present, and a linear function under risk neutrality [Pratt (1964), Arrow (1965)].

[6] Overinsurance typically leads to moral hazard effects, since the inpayments of policyholders are greater than the damage. However, moral hazard effects are only possible if asymmetric information can be reached between the insurer and the policyholders. For instance, under asymmetric information and ex-ante moral hazard, the actual probability that a damage event occurs might be higher than what is expected by the insurer. For further research about moral hazards, see, e.g., Kihlstrom and Pauly (1971), Pauly (1974), and Holmström (1979).

[7] Note that H2 violates the Expected Utility Theory. The second order risk aversion implies that the relative willingness to pay will decrease with the coverage level [Segal and Spizak (1990)].

[8] Note that H7 implies increasing the absolute risk aversion.

Wakker et al. (1997) show that the substantial decrease in willingness to pay for probabilistic insurance cannot be explained by risk aversion. Under Expected Utility Theory, even high risk-averse policyholders will pay substantially more than policyholders in the sample.

Concerning insurance decisions, Slovic et al. (1977) and Schoemaker and Kunreuther (1979) demonstrate that policyholders' behaviors deviate from utility theory. In our questionnaire, the policyholders communicate their maximum willingness to pay for insurance policies with and without a default probability, as well as under- and overinsurance. More precisely, under Expected Utility Theory, the policyholders would exhibit exactly the willingness to pay for insurance policies that strive to achieve expected utility results among the different contracts. However, derived from the insights of Slovic et al. (1977), Schoemaker and Kunreuther (1979), and Wakker et al. (1997), we argue that this might not hold true:

H8: Policyholders do not act in line with the Expected Utility Theory

Expected utility equilibria between probabilistic insurance and no default probability with different coverage levels cannot be reached since the premiums vary significantly from the equilibria points.

Expected Utility Theory serves as a benchmark for interpreting the different levels of willingness to pay based on the empirical findings. We consider a utility function $U(W)$ with a constant relative risk aversion; this has also been analyzed in Holt and Laury (2002). In formal terms, we have:

$$U(W) = W^{1-a}, \tag{1}$$

where W determines the wealth of the policyholders and a is the risk attitude. For $0 < a < 1$, risk aversion exists, $a = 0$ stands for risk neutrality, and $0 > a > -1$ denotes risk affinity. We consider -1 (1) as the lower (upper) bound for the risk attitude.[9]

3.1.1 SCENARIO UNDER DEFAULT AND FULL COVERAGE

Policyholders' expected utility under the default probability and the underlying utility function is described as follows:

$$\begin{aligned} E(U_{DP}) &= E(U_{DP}(p)) + E(U_{DP}(1-p)) \\ &= p \cdot (max(W_0 - \pi_{DP} - D, 0)^{1-a} \cdot DP + (W_0 - \pi_{DP})^{1-a} \\ &\cdot (1 - DP)) + (1-p) \cdot (W_0 - \pi_{DP})^{1-a}, \end{aligned} \tag{2}$$

where $W_0 \geq \pi_{DP}$, p stands for the probability that a damage event occurs, W_0 describes the initial wealth of the policyholder, D is the damage, π_{DP} is the maximum willingness to pay under the default probability, which, in our case, is equal to the premium, and DP is the default probability. If a default occurs, we assume that the insurer does not pay the policyholders' damage. Furthermore, as a policyholder's lowest wealth is 0 (in this case, the policyholder is insolvent), it results in a lower bound for the utility, which implies that for a low initial wealth, a higher default probability does not reduce the utility, as it does under high initial wealth.

3.1.2 SCENARIO UNDER NON-DEFAULT AND VARYING COVERAGE

If the insurance policy pays in each scenario, no default probability exists. In this context, we reach for the expected utility under no default:

$$\begin{aligned} E(U) &= E(U(p)) + E(U(1-p)) \\ &= p \cdot max(W_0 - \pi - D_c, 0)^{1-a} + (1-p) \cdot (W_0 - \pi)^{1-a}, \end{aligned} \tag{3}$$

where $W_0 \geq \pi$ and π denotes the premium for an insurance policy without a default risk. Moreover, D_c is the share of the damage that is not paid by the insurer. More precisely, if $D_c > 0$, underinsurance results. For $D_c < 0$, we have overinsurance, and for $D_c = 0$, we have full coverage. A result that is in line with the Expected Utility Theory can be obtained between the default and non-default case. This is the case when $E(U_{DP})$ is equal to $E(U)$.

3.2 Studydesign

Initially, we present the key elements of the questionnaire to determine the policyholders' willingness to pay under certain circumstances. Afterwards, we explain the further specifications. We consider a fire insurance contract, where the initial scenario follows Wakker et al. (1997). Furthermore, we examine a non-default scenario, 0.1, and a 1 percent default probability for the insurer. We illustrate the non-default and 0.1 percent default probability case. In addition, we investigate different coverage levels (including underinsurance ($200,000; $240,000), full coverage, and overinsurance ($260,000)). For underinsurance, we discuss a scenario with $240,000. Following Wakker et al. (1997), the different default probabilities for the given coverage are transparent for the individuals. Moreover, we randomize the order of the different coverage levels to avoid response-order effects.

[9] A risk aversion of 1 implies that the individuals are insensitive to the wealth, since the exponent $1 - a$ is equal to 0.

Table 1: 5 Lottery-choice decisions with high losses (in $)

OPTION A	OPTION B	OPTION C	EXPECTED VALUE DIFFERENCE
10% 250,000; 90% 1000	15900	Indifferent	10000
10% 250,000; 90% 1000	20900	Indifferent	5000
10% 250,000; 90% 1000	25900	Indifferent	0
10% 250,000; 90% 1000	30900	Indifferent	-5000
10% 250,000; 90% 1000	35900	Indifferent	-10000

3.2.1 QUESTIONNAIRE

Imagine you own a small house. Assume that there is a risk of 5 in 1000 per year (i.e., 0.5%) that your house will be completely destroyed by fire. The value of the house is $250,000.

- What is the most you would be willing to pay per year for an insurance policy that will cover all damages due to fire?
- Imagine that you have been offered an insurance policy that does not pay you the damage in 1 of 1000 cases (i.e., 0.1%). What is the most you would be willing to pay (per year) for this insurance policy?
- What is the most you would be willing to pay (per year) for an insurance policy that will only cover $240,000 of your damage due to fire?
- Imagine that you have been offered an insurance policy which will only cover $240,000 of your damage due to fire. However, in 1 of 1000 cases (i.e., 0.1%), the insurance policy does not pay anything. What is the most you would be willing to pay (per year) for this insurance policy?
- What is the most you would be willing to pay (per year) for an insurance policy that will pay you $260,000 (damage + reconstruction aid) when your house burns down?
- Imagine that you have been offered an insurance policy that will pay you $260,000 (damage + reconstruction aid) when your house burns down. However, in 1 of 1000 cases (i.e., 0.1%), the insurance policy does not pay anything. What is the most you would be willing to pay (per year) for this insurance policy?

In a next step, we test for financial literacy by using the three questions introduced by Lusardi and Mitchell (2011) (see Appendix A).[10] Furthermore, we measure risk attitudes in a manner similar to Holt and Laury (2002, 2005). They consider lottery-choice decisions, where the individual must choose between two options. In total, the authors consider 10 lottery choices. Moreover, Holt and Laury (2002, 2005) focus on positive payoffs. In contrast, we analyze how the risk attitude is related to the different loss scenarios. Since we are interested in risk attitudes for high potential losses, such as when the own house burns down, we analyze the choice decisions against the background of high potential losses.

Holt and Laury (2002, 2005) determine risk attitudes for relatively low values. However, we argue that individuals who are risk-averse for high loss values might be indifferent to very low losses, since their (hypothetical) utility function is only marginally affected. In addition, Holt and Laury (2002; 2005) compare real and hypothetical incentives. The authors argue that under real incentives, the degree of risk aversion is higher than under hypothetical incentives. Since we consider very high potential losses, real incentives are, in our case, only possible if the values are downscaled. However, this implies that individuals are incentivized based on low payments. We actually want to measure behaviors in relation to high loss values.

In addition, as Kahneman and Tversky (1979) emphasize, when scenarios are investigated under a potential win or loss situation they can have a significant impact on the results. From our perspective, it is misleading to analyze a loss behavior, but incentivize with positive payments. Consequently, we analyze a hypothetical scenario and introduce 5 choice decisions to measure risk attitudes. Thus, we analyze broader risk attitude classes than Holt and Laury (2002, 2005).

Table 1 illustrates the different lottery-choice decisions. Option A denotes a probabilistic loss, where a high loss or a relatively small loss can result. The probability of the relatively small loss is substantially higher. Option B shows a certain loss. Furthermore, we enable the policyholders to be indifferent

[10] Lusardi and Mitchell (2011) define the four criteria (i.e., simplicity, brevity, relevance, and capacity to differentiate), and create their three questions to measure financial literacy based on these criteria.

Table 2: Risk preference classification

ANSWER DISTRIBUTION	RISK PREFERENCE CLASSIFICATION
5 times A	Very risk-seeking (1)
More A than B	Risk-seeking (2)
Balance between A and B	Risk-neutral (3)
More B than A	Risk-averse (4)
5 times B	Very risk-averse (5)

Table 3: Descriptive survey statistics

	QUANTITY	RELATIVE VALUE (%)
GENDER		
Men	178	50.57
Women	174	49.43
AGE (IN YEARS)		
< 30	34	9.66
30 – 45	83	23.58
46 – 60	78	22.16
> 60	157	44.60
FINANCIAL LITERACY		
0 correct answers	31	8.81
1 correct answer	74	21.02
2 correct answers	91	25.85
3 correct answers	156	44.32
RISK ATTITUDE		
Very risk-seeking	68	19.32
Risk-seeking	75	21.31
Risk-neutral	135	38.35
Risk-averse	51	14.49
Very risk-averse	23	6.53
WEALTH (IN U.S.$)		
≤ 250,000	136	38.64
> 250,000 - 500,000	65	18.46
> 500,000 - 750,000	31	8.81
> 750,000 - 1,000,000	31	8.81
> 1,000,000	48	13.63
Refused to answer	41	11.65

concerning the answers (Option C). The expected loss difference illustrates the expected value of Option A minus Option B. Table 2 presents the risk preference classification in order of the choices.

Kahneman and Tversky (1979) find that individuals are risk-seeking (loss aversion) if they have a choice between a probabilistic loss underlying a high loss probability and a certain loss with comparable expected values.[11] We also recognize that such certainty avoidance may not take place if the probability of the event is sufficiently low and the impact is sufficiently high. For instance, Kahneman and Tversky (1979) demonstrate that if individuals have the option to choose between a certain loss of 5 and a loss of 5000 with 0.1 percent, 83 percent prefer the certain loss. In our survey, we tendentially expect risk-averse behavior among the policyholders as we analyze high damage events. This is the main reason why the insurance business model works in real markets. Finally, we ask personal information about the individuals to analyze the deviations among the different groups.

4. RESULTS

We distributed the survey electronically via a specialized provider in the United States. The individuals that completed the survey earned a fixed payment from the provider. In total, 500 individuals completed the study; 70.4 percent of respondents provided usable results. We eliminated all individuals who took 240 seconds to fill out the survey or less,[12] provided random results, or had extreme outliers (willingness to pay more than a factor of 50 of the fair premium). Table 3 illustrates the descriptive survey statistics. Age is cardinally scaled. In Table 3, we build the age groups to provide an overview.

Concerning the descriptive survey statistics, not in line with our expectations, the number of risk-seeking individuals is higher than the number of risk-averse participants. Hence, the policyholders prefer the probabilistic scenario with a substantially higher loss, instead of a certain loss.

Furthermore, Tables 4 and 5 show how the default probability and coverage level influence the mean willingness to pay, the ratio of the mean willingness to pay and the fair premium, and the ratio of the median willingness to pay and the fair premium. The ratio for the mean is substantially higher than for the median. Similar to the findings in Zimmer et al. (2018), the willingness to pay is skewed right. For each default probability level, the ratio of the mean and fair premium is higher, with an increased coverage starting at $240,000. Moreover, the coverage level of $200,000 leads to a higher ratio of a mean and fair premium than $240,000. Typically, insurance companies charge premiums that exceed the fair premium. However, given the results in Tables 4 and 5, a considerable number of the participants in this study are not prepared to pay above the fair premium.

Table 4: Willingness to pay for underinsurance (in $)

DEFAULT PROBABILITY (%)	0	0.1	1	0	0.1	1
COVERAGE	200,000	200,000	200,000	240,000	240,000	240,000
FAIR PREMIUM	1000	999	990	1200	1198.8	1188
MEAN	1182.04	807.83	800.09	1310.93	939.45	871.56
MEAN/FAIR PREMIUM	1.1820	0.8086	0.8082	1.0924	0.7837	0.7336
MEDIAN/FAIR PREMIUM	0.4000	0.2002	0.1843	0.4167	0.1877	0.1684
STANDARD DEVIATION	3113.74	2200.40	2338.10	3113.11	2554.74	2639.50

Table 5: Willingness to pay for full coverage and overinsurance (in $)

DEFAULT PROBABILITY (%)	0	0.1	1	0	0.1	1
COVERAGE	250,000	250,000	250,000	260,000	260,000	260,000
FAIR PREMIUM	1250	1248.75	1237.5	1300	1298.7	1287
MEAN	1690.17	1067.39	980.82	1962.91	1304.26	1061.24
MEAN/FAIR PREMIUM	1.3521	0.8548	0.7926	1.5099	1.0043	0.8245
MEDIAN/FAIR PREMIUM	0.4800	0.2002	0.1616	0.4615	0.2310	0.1904
STANDARD DEVIATION	4188.94	3200.39	3366.11	5542.25	3498.91	2973.90

Next, we run a multiple regression to measure which independent variables affect the relative willingness to pay in a significant way. The chosen independent variables do not exhibit strong correlations (see Appendix B).[13] As in Zimmer et al. (2018), we code the default probability levels as dummy variables. The different coverage levels are also coded as dummy variables. The case of full coverage and no default probability is denoted as the reference category. Financial literacy is a categorical variable. Between 0 and 3 correct answers for the financial literacy questions were obtained. Financial literacy increases with the number of correct answers. In addition, the degree of risk aversion is explained by 5 categories, where category 5 is very risk-averse and category 1 is very risk-seeking (see Table 2). As mentioned previously, age is cardinally scaled. Moreover, female is a binary variable, and wealth is subdivided into 5 categories. Wealth increases with a higher category (see Table 3). Table 6 illustrates the regression results.

The existence of a default probability substantially decreases the relative willingness to pay. Further¬more, coverage and financial literacy do not significantly influence relative willingness to pay. Based on financial literacy, we provide an additional analysis since we hypothesize that the average relative willingness to pay for high financial literacy is closer to 1 compared to individuals with a low financial literacy. Moreover, a higher degree of risk aversion positively affects the relative willingness to pay. Hence, our results are in line with economic theory. Surprisingly, age also provides strong significant results, with older individuals typically having a lower relative willingness to pay. While for the entire set of observations women pay less than men, when we exclude those who answered "refuse to answer" concerning wealth gender is found to have no relevant effect. In addition, an increase in wealth leads to a higher relative willingness to pay for the underlying insurance contracts.

[11] For further research concerning loss aversion, see., e.g., Tversky and Kahneman (1992) and Thaler et al. (1997).
[12] Each pre-test subject needed more than 240 seconds.

[13] In addition to the correlations, we also checked for the variance inflation factor. Since the variance inflation factor is less than 1.501 for all variables smaller, no multicollinearity exists (greater than 10 indicates multicollinearity).

Table 6: Regression analysis for the relative willingness to pay

	(1)	(2)	(3)
CONSTANT	1.305[a] (0.000)	3.515[a] (0.000)	2.945[a] (0.000)
CONTRACT 1 (0.1% DP)	-0.421[a] (0.000)	-0.421[a] (0.000)	-0.402[a] (0.000)
CONTRACT 2 (1% DP)	-0.494[a] (0.000)	-0.494[a] (0.000)	-0.460[a] (0.000)
CONTRACT A ($200,000 COVERAGE)	-0.067 (0.579)	-0.067 (0.564)	-0.013 (0.916)
CONTRACT B ($240,000 COVERAGE)	-0.130 (0.282)	-0.130 (0.262)	-0.083 (0.485)
CONTRACT C ($260,000 COVERAGE)	0.113 (0.349)	0.113 (0.329)	0.132 (0.266)
FINANCIAL LITERACY		-0.045 (0.316)	-0.082 (0.073)
RISK AVERSION		0.131[a] (0.000)	0.104[b] (0.005)
AGE		-0.038[a] (0.000)	-0.039[a] (0.000)
FEMALE		-0.238[b] (0.004)	-0.063 (0.459)
WEALTH			0.209[a] (0.000)
OBSERVATIONS	4224	4224	3732
R^2	0.007	0.084	0.092

Note: We consider the following significance levels c ($0.01 \le p < 0.05$), b ($0.001 \le p < 0.01$), and a ($p < 0.001$). For each table element, we insert the regression coefficient and the p-value in brackets. According to (3), we eliminate all participants who are not interested in communicating their wealth ("refuse to answer"). In general, we cannot expect high values for R2, as we have only one cardinally scaled variable (age) and most variables are binary.

Table 7: Relative willingness to pay

FINANCIAL LITERACY GROUP	MEAN	STANDARD DEVIATION
0 correct answers	0.812	1.855
1 correct answer	1.791	4.582
2 correct answers	0.989	2.658
3 correct answers	0.621	1.498

We also investigate whether a higher degree of financial literacy leads to an average relative willingness to pay that is closer to 1. As Table 7 illustrates, the average relative willingness to pay increases between 0 correct answers and 1 correct answer, but decreases with a larger number of correct answers. Surprisingly, individuals with the highest financial literacy have the lowest average relative willingness to pay, which is substantially lower than 1. Furthermore, we use the t-test to investigate whether the means are equal or whether, based on the findings of Table 7, it results in a decision for the alternative hypothesis (see Table 8). The mean for 1 correct answer is significantly higher than for 0 correct answers. Moreover, the mean for 2 correct answers is significantly lower than for 1 correct answer. The same holds for 3 and 2 correct answers.

The group with 2 correct answers is close to the fair ratio of 1.

Based on the previous findings, we conduct a one-sample t-test to determine whether the policyholders' results significantly vary from Expected Utility Theory. We set the initial wealth W0, the risk aversion parameter a, and the average willingness to pay by the reference category as input

Table 8: Relative willingness to pay equality test

FINANCIAL LITERACY GROUP	P-VALUE	ALTERNATIVE HYPOTHESIS
0 correct answers versus 1 correct answer	0.000[a]	The mean for 1 correct answer is higher than for 0 correct answers
1 correct answer versus 2 correct answers	0.000[a]	The mean for 2 correct answers is lower than for 1 correct answer
2 correct answers versus 3 correct answers	0.000[a]	The mean for 3 correct answers is lower than for 2 correct answers

Note: If the p-value is smaller than 0.05, the alternative hypothesis is supported. We consider the following significance levels c ($0.01 \le p < 0.05$), b ($0.001 \le p < 0.01$), and a ($p < 0.001$).

parameters to calculate the premium πEQ that should be paid to reach the equilibrium point. Subsequently, we measure whether or not these premiums vary from the actually paid premiums (see Tables 4 and 5).

In addition, we run for two different initial wealth W0 ($150,000 and $250,000) results for the reference category of a 0.1 percent default probability and full coverage. For a coverage of $250,000 and $260,000, and independent of the considered levels of initial wealth and degree of risk aversion, we obtain strong significant results.[14] Hence, the policyholders do not strive for results given by the Expected Utility Theory. For $240,000 coverage, a deviation from the results provided by the Expected Utility Theory is not statistically supported. Concerning coverage of $200,000, we recognize weak significance. For low initial wealth and a high degree of risk-seeking behavior the results are not significant. When the reference category changes from a 0.1 percent default probability to a 1 percent default probability, the p-value decreases for all analyzed combinations. Consequently, the policyholders' willingness to pay varies even more from the equilibrium point, as under the lower default probability.[15] In the Appendix, we summarize the results of our study in relation to the existing publication in this area.

5. IMPLICATIONS

Our survey aims to enable a deeper understanding of what an insurance contract with a high insured value (fire insurance). Similar to Wakker et al. (1997), Zimmer et al. (2009), and Zimmer et al. (2018), we find that as long as the individuals are aware of a potential default probability, a no default probability leads to the highest relative willingness to pay ratio. Furthermore, as the coverage does not significantly affect the relative willingness to pay, striving for higher coverage results in higher premiums without decreasing the relative willingness to pay ratio. However, in practice, a moral hazard problem might exist if the indemnity payments are higher than the damage.

Since potential moral hazard avoidance is connected with costs, the insurer should offer full coverage to increase its profits, as long as the costs of moral hazard and moral hazard avoidance overcome the premium surplus of overinsurance. Surprisingly, the individuals with the highest financial literacy exhibit an average relative willingness to pay of 0.621, while potential policyholders with medium financial literacy are close to the "fair premium" 1. For an insurance company, a segmentation concerning financial literacy might be beneficial to maximize profits. Consistent with economic theory [Mossin (1968)], increasing degrees of risk aversion lead to higher relative willingness to pay. This insight is also important for the insurer to price the insurance contract appropriately.

Surprisingly, we find that older people tend to pay less for an insurance contract than younger people. This implies a perceived utility shift with increasing age. Our results also indicate that gender might be a driving factor for the relative willingness to pay. Furthermore, increasing wealth substantially increases the relative willingness to pay. In summary, our findings show that multiple parameters affect the relative willingness to pay significantly. Hence, those parameters are essential to better understand for the insurer to price insurance contracts and to comprehend the behavior of the policyholders.

In addition to providing insights about the key drivers of the policyholders' willingness to pay, we extend the findings by Wakker et al. (1997) concerning the Expected Utility Theory. We reach for full coverage and overinsurance, independent of initial wealth and risk attitudes, strongly indicating significance against the findings based on the Expected Utility Theory. For underinsurance, the results are less significant or not significant at all. Consequently, coverage affects whether or not policyholders' behavior significantly deviates from the Expected Utility Theory.

Our analysis also exhibits some limitations. Consistent with Wakker et al. (1997), Zimmer et al. (2009), and Zimmer et

[14] If the p-value is smaller than 0.05, the mean of the willingness to pay significantly varies from the results derived from the Expected Utility Theory.
[15] More results on the Expected Utility Test are available on request from the authors.

al. (2018), we assume that the loss probability is known. However, in practice, theses probabilities are widely unknown for the policyholders. Moreover, although our willingness to pay analysis is important to recognize what drives policyholders' behavior, in practice, the market competition might affect the policyholders' behavior. Thus, for future research, we recommend analyzing competition-driven prices. For instance, a choice-based conjoint analysis can be used to enable a setting with different options.[16] Like many other studies in this field, we use hypothetical choices for the analysis. In such a setting, the subjects may offer erratic responses, since a baseline price is, in general, unknown to the participant. Hypothetical scenarios typically violate the Expected Utility Theory more than choices based on an experiment.[17] To account for these issues, participants should typically receive rewards depending on the outcomes of the experiment. Even though this aspect is well known, it is often hard to implement for many important research questions, like in our case of high insured values.

6. CONCLUSION

In this paper, we consider relative willingness to pay for insurance contracts with a high insured value. Our research is conducted from the insurer and regulator's perspectives. The analysis of the willingness to pay for high insured values is important for the insurer to recognize which policyholder groups exhibit a high willingness to pay and which do not cover the insurer's expected expenses. From a regulatory perspective, it is also relevant to understand which customer segment price regulations are useful to protect policyholders against potential discrimination. In this context, we develop a survey and collect empirical data. We then analyze whether or not the default probability, coverage, financial literacy, risk aversion, age, gender, and wealth are key drivers for the relative willingness to pay.

A multiple regression with dummy variables is used to determine the impact of the different independent variables. We also investigate whether higher financial literacy leads to an average relative willingness to pay which is closer to 1 compared to individuals with a low financial literacy. In addition, we examine whether policyholders strive for the expected utility results, given probabilistic insurance and no default probability with different coverage levels. We develop 8 hypotheses that we test with the collected data. Those hypotheses are derived from previous empirical findings and the economic theory. Finally, we deduce the economic implications based on our findings.

Consistent with Wakker et al. (1997), Zimmer et al. (2009), and Zimmer et al. (2018), we find that the existence of a default probability significantly decreases the relative willingness to pay. Furthermore, the coverage does not significantly affect the relative willingness to pay. Hence, increasing coverage leads to higher profits for a positive premium loading. However, in practice, some moral hazard effects induce costs. The insurer should, therefore, strive for full coverage as long as the costs of moral hazard and moral hazard avoidance are greater than the premium surplus of overinsurance. In addition, we find the surprising outcome that the average relative willingness to pay for individuals with medium financial literacy is close to 1 (fair premium), but policyholders with the highest financial literacy pay substantially less (0.621).

Consistent with economic theory, we find that the relative willingness to pay significantly increases with a higher degree of risk aversion [Mossin (1968)]. Surprisingly, older age leads to a lower relative willingness to pay. We conclude that the perceived utility of the underlying insurance contract decreases with increasing age. The results for our overall sample partly deviate from Zimmer et al. (2018), since women pay less than men for insurance contracts. However, gender does not have a significant impact when we eliminate all the individuals who do not state their current wealth status. Furthermore, we extend previous research by finding that higher wealth implies an increasing relative willingness to pay. Hence, wealth is a key driver for insurance pricing. We also find that, for overinsurance and full coverage, policyholders significantly deviate from the results based on the Expected Utility Theory. These results are independent of the initial wealth and the degree of risk aversion. Concerning underinsurance, the deviation is less significant or not significant at all.

[16] A choice-based conjoint analysis concerning term life insurance is, for instance, conducted by Braun et al. (2016).
[17] See the literature review presented in Jaspersen (2016).

APPENDIX

Appendix A: Financial literacy

The full questionnaire is available upon request.

Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

- More than $102
- Exactly $102
- Less than $102
- Do not know
- Refuse to answer

Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?

- More than today
- Exactly the same
- Less than today
- Do not know
- Refuse to answer

Please state whether or not this statement is true or false. "Buying a single company's stock usually provides a safer return than a stock mutual fund."

- True
- False
- Do not know
- Refuse to answer

Appendix B: Correlation coefficients among the independent variables

Table 9: Correlation table for the regression analysis (2)

	FINANCIAL LITERACY	RISK AVERSION	FEMALE	AGE
FINANCIAL LITERACY	1	-0.171[a] (0.000)	-0.113[a] (0.000)	0.334[a] (0.000)
RISK AVERSION	-0.171[a] (0.000)	1	-0.028 (0.066)	-0.030 (0.055)
FEMALE	-0.113[a] (0.000)	-0.028 (0.066)	1	-0.030[c] (0.048)
AGE	0.334[a] (0.000)	-0.030 (0.055)	-0.030* (0.048)	1

We consider the following significance levels c ($0.01 \le p < 0.05$), *b* ($0.001 \le p < 0.01$), and a ($p < 0.001$).

Table 10: Correlation table for the regression analysis (3)

	FINANCIAL LITERACY	RISK AVERSION	FEMALE	AGE	WEALTH
FINANCIAL LITERACY	1	-0.168[a] (0.000)	-0.100[a] (0.000)	0.341[a] (0.000)	0.182[a] (0.000)
RISK AVERSION	-0.168[a] (0.000)	1	-0.013 (0.445)	-0.014 (0.392)	0.026 (0.107)
FEMALE	-0.100[a] (0.000)	-0.013 (0.445)	1	-0.047[b] (0.004)	-0.137[a] (0.000)
AGE	0.341[a] (0.000)	-0.014 (0.392)	-0.047[b] (0.004)	1	0.227[a] (0.000)
WEALTH	0.182[a] (0.000)	0.026 (0.107)	-0.137[a] (0.000)	0.227[a] (0.000)	1

We consider the following significance levels c ($0.01 \le p < 0.05$), b ($0.001 \le p < 0.01$), and a ($p < 0.001$).

Appendix C: Summary

Table 11: Empirical results summary compared with the existing research

HYPOTHESES	MAIN RESULTS	EXISTING RESEARCH
H1: Default probability	The existence of default probabilities decreases the relative willingness to pay	Consistent with Wakker et al. (1997), Zimmer et al. (2009), and Zimmer et al. (2018)
H2: Coverage	No significant effect on the relative willingness to pay	No empirical research, to date; consistent with the theoretical research [see, e.g., Smith (1968)]
H3: Financial literacy	Medium financial literacy leads to an average relative willingness to pay that is close to 1; individuals with the highest financial literacy have a significantly lower average relative willingness to pay (0.621)	No empirical research, to date
H4: Risk Aversion	Higher relative willingness to pay with higher risk aversion	Consistent with the economic theory [see, e.g., Mossin (1968)]
H5: Age	Lower relative willingness to pay with older age	No empirical research, to date
H6: Gender	Women exhibit a lower relative willingness to pay (overall sample); no significant results (partial sample)	Charness and Gneezy (2012) and Fehr-Duda et al. (2006) did find significance; Zimmer et al. (2018) did not find significance
H7: Wealth	Higher wealth increases the relative willingness to pay	No empirical research, to date. Consistent with research about consumption [see Case et al. (2005)]
H8: Expected utility	For full coverage and overinsurance, we reach, independent of the initial wealth and risk attitudes, strong significance against the Expected Utility Theory results; for underinsurance, the results are less significant or not significant at all	Extends the findings by Wakker et al. (1997)

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