Why Use Agents? Consumer Reference Manipulation in Life Insurance Market

Abstract

We explore agents' role in life insurance on the premise that consumers are of limited rationality and their life insurance purchase decisions are reference-dependent and regret-induced. Our analysis provides a unified interpretation for both the bright and dark sides of the agency system that is still a predominant form in life insurance markets. On the one hand, consumers are passive in life insurance purchase even with complete information of mortality risk and agents can help them achieve a higher level of welfare by promoting a larger insurance amount, in the meanwhile increasing profits for the insurers. On the other hand, agents can manipulate consumers into buying a higher than optimal amount of insurance for their own benefits. We further examine the supply side of the agency system and show that insurance companies have a strong incentive to build up the system, hence justifying the enduring popularity of agency system in the information age. Moreover, we find that the agency system is often more welfare enhancing in the purchase of whole life insurance than in the purchase of term life insurance.

Keywords: Life insurance, Agency system, Limited rationality, Reference-dependent preference, Regret, Behavioral insurance

1 Introduction

As the age-old saying goes, life insurance is "sold, not bought" (e.g., Gravelee 1993, 1994; Bernheim et al. 2003). In this paper, we explore formally agents' role in life insurance market on the premise that consumers are of limited rationality and their life insurance purchase decisions are reference-dependent and regret-induced. Life insurance agents thus are essential in facilitating (and manipulating) the formation of consumer reference in purchase decisions. Anecdotal evidence and extant literature have documented that consumers are indeed passive, if not reluctant, in making life insurance purchase whereas agents have always played an indispensable role in this market. For example, Morrison (1939) argues that only a small number of people buy adequate amounts of life insurance without incentives, and agents' selling effort is helpful in improving consumers' welfare. Auerbach and Kotlikoff (1991) provide empirical evidence supporting that low life insurance purchase is prevalent. In an experimental setting, Braun et al. (2014) show that individuals' willingness to pay for term life insurance on average is low. Indirect evidence also arises from the supply side. Even as the information age has penetrated insurance businesses with abundant online resources and innovative forms of sales and marketing, life insurance agents are still the predominant distributional form widely used by world's largest insurers (see the review of insurance distribution by Regan and Tennyson 2000 and Hilliard et al. 2013).[1] With a low average 4-year retention rate of only 10-18% of new agents, insurance companies incur a substantial cost in recruiting and maintaining agents, in additional to the high commission costs (cf., Hoesly 1996; Trese 2011). This implies the benefits of an agency system must be so significant as to more than offset the associated costs. Despite its prevalence, there is overwhelming anecdotal evidence of the dark side of the agency system, some of which has also been investigated in the literature. For instance, Diacon and Ennew (1996) suggest that agents may be stimulated to oversell to consumers.

Explanations offered within the framework of standard Expected Utility Theory (EUT) are partial at best, where the role of agents in increasing consumers' life insurance demand is only considered informally and its potential to increase consumer welfare has not been examined (Inderst and Ottaviani 2009). In explaining the popularity of agency system, the EUT-based models often take as a primitive the existence of asymmetric information on insurance products and argue that agents play a positive role by offering valuable information to consumers (Mathewson 1983, Regan and Tennyson 2000, Eckardt and Räthke-Dp̈pner 2010). In this framework, agents stimulate insurance purchase by inflating the perceived

[1]According to LIMRA estimates, in 2011, independent agents, who represent several insurers, held 49 percent of the new individual life insurance sales market, followed by affiliated agents, who represent a single insurance company, with 40 percent, direct marketers with 4 percent and others accounting for the remaining 7 percent (2013 Financial Services Fact Book, P. 105).

value of the product with false information on the underlying risk. While plausible before, this explanation faces increasing challenge since information becomes abundantly available on the internet and from other less costly sources. Indeed, other insurance lines of business have successfully transformed into an online direct selling system while the life agency system maintains an enduring distributional form. The EUT-based models also do not point to any potential benefits of the agency system in increasing consumer welfare.

In the recent decades, alternative theories have been developed to better interpret the observed consumers' insurance decisions that are not consistent with the predictions of EUT-based models. The influential Prospect Theory (Kahneman and Tversky 1979, 1991) suggests that when decision making involves uncertain outcomes, individuals do not just evaluate the absolute value of the outcomes, but rather those relative to some reference points. This theory provides explanatory power for puzzles about consumers' purchase of life insurance and annuities (Hu and Scott 2007; Gottlieb 2012) and the overinsurance of moderate risk (Sydnor 2010, Barseghyan et al. 2013).[2] In particular, the theory of Regret seems to be particularly relevant for insurance decisions, where the realized outcome of an actual decision is compared with the potential outcome of a counterfactual decision. Braun and Muermann (2004) argue that consumers who make insurance purchase decisions often try to avoid the emotional regret and show that their optimal decisions exhibit behavior consistent with the predictions of Regret Theory. In this paper, building on the insights of the Prospect Theory and the Regret Theory, we assume consumers are of bounded rationality in the sense that their decisions are reference-dependent and regret-induced, and present a simple formal framework to simultaneously account for both the bright and the dark sides of agents' selling effort and justify the enduring popularity of the agency system in the life insurance market.

Section 2 describes in detail consumers' reference-dependent preference and the formulation of regret-based comparisons. To decide whether or not to buy life insurance and how much insurance to buy, a consumer often balances the pros and cons of different decision options in relation to some (sometimes implicit) reference. The trade-off exhibits a pattern of gain-loss comparison between the decision and the reference. This observation motivates us to adopt the reference-dependent utility to capture the consumer's preference. The consumer's reference-dependent utility has two important components: a reference point that the consumer's gain-loss comparison is based upon and the concept of loss aversion where losses are more painful than equal-sized gains are pleasant. In her gain-loss comparison, the consumer thus often experiences the emotional regret, or the feeling that "I should have bought more (or less) insurance" in the ex post decision assessment. As we make it clear below, this is captured by the state-by-state comparison between the outcomes of the consumer' decision

[2]Prospect theory has been widely used in various risky decision contexts, see the review by Barberis (2013) for details.

and those of her reference.

Section 3 explores agents' role in determining the consumer's life insurance purchase. We consider both term life and whole life insurance. Given any reference, consumers anticipate two possible types of regret in buying life insurance: one is the regret of paying too much premium (buying more insurance) in the case of no death during a period of interest, and the other is having too little insurance (buying less insurance) in the case of death during the period of interest. It is due to her *anticipatory regret* that the consumer prefers not to deviate her choice much from the reference and therefore her optimal choice is significantly affected by the initial reference. This dependence of optimal choices on references provides an opportunity for agents to significantly influence the consumer' decision by manipulating her initial reference, even when the consumer's decision is fully rational in our framework.

We show both the positive and negative sides of the agency system. Without the agents, a consumer naturally takes the initial state where she is without life insurance as her reference, i.e., the "status quo reference." With this reference, she ends up purchasing strictly less insurance than what maximizes her welfare.[3] Agents, through manipulating the consumer's reference, can help her choose an increased amount of coverage, making her better off. However, we also show that when the reference coverage is large enough (i.e., when agents' selling is too aggressive), the consumer prefers to purchase strictly more insurance than the one maximizing his welfare. In this case, the agent manipulates the consumer into purchasing "too much insurance", making her worse off. In summary, our analysis suggests that while agents can always stimulate life insurance demand by manipulating consumers' reference, consumer welfare is enhanced only when agents' selling effort is moderate.

In section 4, we turns to analyzing the supply side of the agency system and provides economic interpretation for the enduring popularity of the agency system in life insurance market. First, the insurance companies has a strong incentive to build up an agency system. Specifically, we compare two candidate strategies of a monopolistic insurance company "direct selling (DS) without agents" and "agent selling (AS)," and show with numerical examples under plausible parameter setting that the latter strategy generates substantially higher profits for insurers. Second, we examine the welfare implications of the agency system in a framework of competitive market and find that while it is often welfare enhancing in whole life insurance,

[3]The standard reference-independent EUT is used to measure consumers' welfare, providing a benchmark to analyze the welfare effects of agents' selling behavior. Intuitively, consumers' welfare should only be affected by their actual choice on insurance purchase and not by their reference, and thus welfare measure is reference-independent. In the context that consumers make regret-based decisions, under an appealing assumption that an experienced consumer should fully realize the effects of his anticipatory regret on the decision, we derive that consumers behave the same as a reference-independent decision maker, which also lends support to the above choice of welfare measure.

it may harm consumer welfare in term life insurance. Moreover, consumers' optimal whole life insurance coverage under the agency system increases substantially relative to that without agency system, whereas the optimal coverage of term life insurance only increases slightly. This result predicts that the agency system accounts for a higher fraction in the whole life insurance than in the term life insurance, which is consistent with the observation that more than 90% for whole life insurance policies are sold through agents while less than 70% of term life insurance is sold through agent (see Figures 25.2 and 25.3 provided by Hilliard et al. 2013).

Our comparisons between the effects of agent selling and direct selling also contribute to the study of insurance distribution system choice. In the framework of asymmetric information, previous studies present various interpretations for insurance distribution choice, including potential incentive conflicts between the insurer and consumers (Kim et al. 1996, Carr et al. 1999), transaction cost theory (Regan 1997), and costly consumer search (Posey and Tennyson 1998, Eckardt 2007). These studies focus on exploring the relative efficiency of various forms of agency systems and lack the analysis of the distribution system use in relation to consumers' shopping behavior (Hilliard et al. 2013).[4] Our paper complements the above studies by studying the relationship between agents' selling behavior and consumers' insurance decisions while eliminating the confounding effect of asymmetric information, by assuming complete information between consumers and insurers (mortality is common knowledge to both consumers and insurers). From the perspective of consumers' insurance purchase, our analysis explains why agency system is commonplace in life insurance markets and provides insights for practitioners in optimizing their distribution system design and properly justifying their choice to investors and the general public.

Our analysis of the welfare effects of the agency system also has important implications for life insurance regulation. We characterize a type of agent behavior that harms consumer welfare. In this case, consumers, equipped with complete information, are manipulated by the agents while making rational optimal insurance purchase decision. This implies that current regulation of agent behavior, such as the required extensive documentation of agents' advice and the code of conduct, is not sufficiently effective. Proper design of the agent compensation mechanism can be a promising avenue in mitigating unethical agent behavior. The heavy reliance on commission-based compensation in the current life insurance distribution systems has recently been called into question (Regan and Tennyson 2000, Hilliard et al. 2013). Our study supports the use of a fee-for-service compensation mechanism under which agents have no incentive to aggressively over sell insurance and thus can be effective in helping consumers

[4] After reviewing the insurance distribution studies, Hilliard et al. (2013) further point out "while existing academic studies of distribution system choice have focused primarily on the choice between an independent and a tied agency force, current market trends distinguish more clearly between fully integrated distribution without the use of professional agents versus the agency system of distribution itself."

achieve their optimal choice.

2 Consumers' reference-dependent Expected Utility with Regret-based comparisons

The key assumption of our model of consumers' preference is that consumers' utility is reference-dependent and the calculation of their expected utility involves the regret-based comparisons between the random outcomes determined by their decisions and the reference. To decide whether or not to buy life insurance and how much insurance to buy, a consumer often balances the advantages and disadvantages of different decision options in relation to some (maybe implicit) reference. For example, taking the case of no life insurance as a natural reference, a consumer deciding whether to buy insurance faces a gain-loss comparison: if no death occurs, he will feel loss for buying insurance (compared to not buying insurance); or if death happens, there is a gain for buying insurance since the insurance repayment provides life protection for his heirs. The consumer will average both gains and losses at different realized states of nature (death or no death in the context of life insurance) and obtain the expected utility from the decision. In the determination of his optimal choice, the consumer anticipates two possible disutilities: one is the disutility paying too much premium (due to buying more insurance) in case of no death occurring, and the other is the disutility having too little insurance (due to less purchase) in case of death happening. This type of disutility is exactly the regret defined by Zeelenberg et al. (2000), who writes "Regret is assumed to originate from comparisons between the factual decision outcome and a counterfactual outcome that might have been had one chosen differently" (p. 529). Thus we call this disutility "the regret" and consumers' comparison driving the disutility "regret-based comparison," and can reasonably believe a story of "reference-dependent and regret-avoiding choice" in the life insurance context.

2.1 Basic model

Our approach builds on prosect theory proposed by Kahneman and Tversky (1979, 1991) and developed by Kőszegi and Rabin (2006, 2007). The theory suggests that a consumer maximizes the expected value of a reference-dependent utility of the form

$$V(x, r) = u(x) + g(u(x) - u(r)). \tag{1}$$

Given the reference r, the consumers' utility is determined by the monetary wealth x. To be specific, consumers' overall utility consists of two components: intrinsic utility and gain-loss utility. Intrinsic utility derived from the wealth x determined by the consumers' decision is denoted by $u(x)$ with the properties $u'(\cdot) > 0, u'(0) = +\infty$ and $u''(\cdot) \leq 0$.[5] $g : \mathbb{R} \to \mathbb{R}$ is a value function that depends on the difference between the realized utility of the chosen alternative x and that of the reference alternative r, capturing the consumer's gain-loss comparison. This value function $g(\cdot)$ satisfies the assumptions imposed by Tversky and Kahneman (1991), consisting of four ingredients: reference point, loss aversion that losses are more painful than equal-sized gains are pleasant, a diminishing sensitivity to changes in an outcome as it moves farther from the reference point, and nonlinear probability weighting. In this paper, we focus on exploring the impact of agents' selling effort on consumers' life insurance purchase through reference manipulation, and thus preclude diminishing sensitivity and nonlinear probability weighting, and assume that $g(\cdot)$ is a piecewise linear function throughout this paper.

$$g(y) = \begin{cases} \eta y & y \geq 0 \\ \eta\lambda y & y < 0 \end{cases} \tag{2}$$

where $\eta \geq 0$ is a relative weight of gain-loss utility to the intrinsic utility, reflecting how consumers value the gain-loss comparison, and $\lambda > 1$ captures the consumers' loss aversion.

In the context of the insurance, not only the outcome of consumers' choice but also that of their reference are stochastic. For example, the reference can be no life insurance, in which consumers may or may not die, leading to random outcomes. The similar pattern also occurs for consumers' life insurance purchase decision. Given the choice $\tilde{x}$ and the reference $\tilde{r}$, consumers' expected reference-dependent utility is

$$E[V(\tilde{x}, \tilde{r})] = \int\int u(x) + g(u(x) - u(r))dH(x, r) \tag{3}$$

where $H(x, r)$ denotes the joint cumulative distribution function of $\tilde{x}$ and $\tilde{r}$. The different forms of the joint cumulative distribution reflect consumers' different economic thinking. In our context, consumers try to compare the random outcomes of their life insurance decision with the reference at the realized states of nature(death or not), i.e., they make comparisons between the realized outcome of $\tilde{x}$ and that of $\tilde{r}$ state by state. As we have discussed, this state-by-state comparison reflects consumers' regret-based thinking and we thus call it "regret-based comparison". Let $F(s)$ denote the cdf of the state variable s of nature, then this comparison makes consumers' expected reference-dependent utility become

$$E[V(\tilde{x}, \tilde{r})] = \int u(x(s)) + g(u(x(s)) - u(r(s)))dF(s) \tag{4}$$

To capture the feature that consumers try to make responsibly rational decisions, as we show below, we restrict their reference points in consumers' choice set such that any reference point $\tilde{r}$ represents one of their possible decisions.

[5]As we shall see, this set of assumptions ensure that the internal solutions exist for the optimization problem of consumers' insurance purchase.

2.2 Behavioral characteristics

We emphasize that consumers' decision in our context is "regret-based" rather than "disappointment-based". As commented by Zeelenberg et al. (2000), "disappointment is assumed to originate from a comparison between the factual decision outcome and a counterfactual outcome that might have been had another state of the world occurred" and "disappointment is typically experienced in response to unexpected negative events that were caused by uncontrolled circumstances, or by another person." In our context, these comments can be translated as that the "disappointment-based" comparison is the state-independent one and disappointment reflects the emotion that consumers wish loss never happened.[6] However, as argued by Braun and Muermann (2004), "the ex post assessment of consumers' insurance decision is 'I should have bought more (or less) insurance' and not 'I wish I hadn't incurred that loss."' Clearly, regret rather than disappointment captures the feature of consumers' insurance decisions.[7]

Moreover, for regret-based comparison, we allow consumers to compare the outcome of their actual decision with that of the reference, which can be any reasonable alternative decision. Braun and Muermann (2004) examine optimal insurance purchase decisions of individuals that exhibit behavior consistent with regret theory. In their study, regret mechanism is grasped by the comparison between the outcome of a decision and the best outcome at any state of nature, leading to a conservative decision in which consumers neither purchase too much nor too little insurance. This regret mechanism is intuitively appealing but kind of implausible since all of the best outcomes at any state in general cannot be induced by a consistent decision, as illustrated in Sugden (2003) model. Life insurance is a long-term and economically significant decision for an individual and he attempts to make a responsible and rational decision that he can commit to. In this context, comparison based on inconsistent decisions seems not appealing and thus we replace the best outcome by the outcome of the reference to avoid the potential inconsistency problem.

Our model builds on prospect theory by incorporating the reference point and loss aversion into analysis. This treatment is much motivated by experimental and empirical evidence. When decision making involves uncertain outcomes, Kahneman and Tversky (1979) demonstrate in experimental settings that people normally perceive outcomes as gains and losses relative to some reference point, rather than as final states of wealth or welfare. These obser-

[6]The disappointment theory is studied by Bell (1985), Loomes and Sugden (1986), Gul (1991), etc. Kőszegi and Rabin (2006, 2007) introduce disappointment-based comparison into the calculation of consumers' expected reference-dependent utility. Formally, assume $\tilde{x}$ and $\tilde{r}$ have marginal distribution function $F(x)$ and $G(r)$ respectively, The disappointment-based comparison implies that $\tilde{x}$ and $\tilde{r}$ are independent and consumers' expected utility writes: $E[V(\tilde{x},\tilde{r})] = \int\int u(x) + g(u(x) - u(r))dF(x)dG(r)$.

[7]A lot of experimental and empirical evidence supporting the application of Regret Theory has been documented by Braun and Muermann (2004).

vations systematically violate the predictions of expected utility theory, the standard model of choice under risk. Instead, they propose an alternative theory and call it "prospect theory." Prospect theory has been widely used in various risky decision contexts(Barberis 2013), including insurance decisions(Hu and Scott 2007, Sydnor 2010, Barseghyan et al. 2013). A notable feature of prospect theory is that consumers' choice is affected by their reference point. In the process of insurance purchase, consumers commonly collect insurance information and obtain advices from agents, friends or family, and hence their reference point can be reshaped by other people's suggestions. As we shall see, it is the updating of consumers' reference point that significantly affects their purchase of life insurance.

The introduction of reference point imposes additional problem: how consumers coincide their actual decisions and their reference choice. Kőszegi and Rabin (2006, 2007) offer a solution to the problem. They argue that the reference-dependent consumers try to make a rational decision and have some ability to predict their own behavior. To characterize the above features, they define a "personal equilibrium", where the optimal decision conditional on the consumers' reference coincides with the reference. Under this mechanism, consumers achieve their optimal choice by adjusting their choice and reference until their choice becomes consistent with the reference. This characterization is exactly what we need for capturing consumers' desire to make a rational and responsible decision in their life insurance purchase.

3 Consumers' life insurance purchase

To protect their loved ones upon death, people have a demand for life insurance.[8] We consider a life insurance market consisting of a continuum of households. A household consists of one head and at least one heir. Because household heads make insurance decisions while alive, we refer to them as "the consumers."

3.1 Term life insurance

We first consider consumers' term life insurance purchase in one-period framework. At the beginning of the period, an agent visits a consumer endowed with an initial wealth w_1 and offers him insurance policies, and the consumer decides which one to purchase (if any). During the period, the consumer dies with probability $p \in (0, 1)$ and he earns income $w > 0$ if alive.

[8] The demand of life insurance may arise from a bequest motive (Bernheim 1991, Inkmann and Michaelides 2012), or from the desire to provide a life-cycle protection for financial vulnerability caused by the death of family members (Bernheim et al. 2003, Lin and Grace 2007).

From life cycle perspective, we can treat this period as consumers' working period. Insurance company offers a term life policy (P, I) specifying that the consumer pays premium P, and his heir receives the repayment I if he dies. Note that the repayment I should be smaller than the income w, i.e. $I \in [0, w]$. We assume the policy has a premium rate α such that insurance premium $P = \alpha I$ where $\alpha \in [p, 1)$.

3.1.1 Optimal purchase under certain reference

The term life insurance coverage in the consumer's reference point is denoted by I_r. To guarantee the plausibility of the reference, we assume $I_r \in [0, w]$, reflecting that the consumer's reference point is one of his feasible insurance decisions. The stochastic outcome from the reference point is a lottery $\tilde{r}(I_r) = (w_1 + (1-\alpha)I_r, p; w_1 + w - \alpha I_r, 1-p)$, meaning that the consumer with initial wealth w_1 dies with probability p and his heirs receive the net repayment $(1-\alpha)I_r$, otherwise the consumer obtains the net wealth $w - \alpha I_r$ with probability $1-p$. In particular, consumers' status quo is to purchase no insurance, corresponding to the reference point $\tilde{r}(0) = (w_1, p; w_1 + w, 1-p)$. If the consumer purchases the contract $(\alpha I, I)$, his expected utility is characterized as follows:

$$E[V(\tilde{x}(I), \tilde{r}(I_r))] = \begin{cases} pu(w_1 + (1-\alpha)I) + (1-p)u(w_1 + w - \alpha I) \\ +p\eta[u(w_1 + (1-\alpha)I) - u(w_1 + (1-\alpha)I_r)] \\ +(1-p)\eta\lambda[u(w_1 + w - \alpha I) - u(w_1 + w - \alpha I_r)] \quad \text{if} \quad I \geq I_r \\ pu(w_1 + (1-\alpha)I) + (1-p)u(w_1 + w - \alpha I) \\ +p\eta\lambda[u(w_1 + (1-\alpha)I) - u(w_1 + (1-\alpha)I_r)] \\ +(1-p)\eta[u(w_1 + w - \alpha I) - u(w_1 + w - \alpha I_r)] \quad \text{if} \quad I < I_r \end{cases} \tag{5}$$

Equation (5) demonstrates the asymmetry of consumers' regret-based comparison between decision outcomes and reference levels. If the consumer would like to increase his coverage $(I \geq I_r)$, he treats the case as a loss that he pays higher insurance premium relative to reference level when he is alive in period 1 $(u(w_1 + w - \alpha I) - u(w_1 + w - \alpha I_r) \leq 0)$, whereas the case as a gain that death occurs since his heir obtains more insurance repayment than reference level $(u(w_1 + (1-\alpha)I) - u(w_1 + (1-\alpha)I_r \geq 0)$. Conversely, were the consumer to decrease his coverage $(I < I_r)$, a loss occurs when the death happens and his heir receives less insurance repayment than reference level $(u(w_1 + (1-\alpha)I) - u(w_1 + (1-\alpha)I_r < 0$), and the case of no death becomes a gain since the consumer pays less premium than reference level $(u(w_1 + w - \alpha I) - u(w_1 + w - \alpha I_r) > 0)$. Due to loss aversion, the consumer' regret-based gain-loss comparison is asymmetric and captures his two anticipatory regret in the decision: one is the regret paying too much premium (due to buying more insurance compared to the reference) in case of no death occurring, and the other is the regret having too little insurance (due to less purchase relative to the reference) in case of death happening. As a result, the consumer's choice is, as we shall see, not to deviate much from his reference. The first-order derivative of (5) with respect to I equals

$$\frac{d[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI} = \begin{cases} p(1-\alpha)(1+\eta)u'(w_1+(1-\alpha)I) \\ -\alpha(1-p)(1+\eta\lambda)u'(w_1+w-\alpha I) \quad \text{if} \quad I \geq I_r \\ p(1-\alpha)(1+\eta\lambda)u'(w_1+(1-\alpha)I) \\ -\alpha(1-p)(1+\eta)u'(w_1+w-\alpha I) \quad \text{if} \quad I < I_r \end{cases} \tag{6}$$

It follows that

$$\frac{d[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI} = \begin{cases} p(1-\alpha)(1+\eta)u'(w_1+w-\alpha I)\left[k(I) - \frac{\alpha(1-p)(1+\eta\lambda)}{p(1-\alpha)(1+\eta)}\right] & \text{if} \quad I \geq I_r \\ p(1-\alpha)(1+\eta\lambda)u'(w_1+w-\alpha I)\left[k(I) - \frac{\alpha(1-p)(1+\eta)}{p(1-\alpha)(1+\eta\lambda)}\right] & \text{if} \quad I < I_r \end{cases} \tag{7}$$

where $k(I) \equiv u'(w_1+(1-\alpha)I)/u'(w_1+w-\alpha I)$. Let $\underline{I}$ and $\hat{I}$ satisfy $k(\underline{I}) = \frac{\alpha(1-p)(1+\eta\lambda)}{p(1-\alpha)(1+\eta)}$ and $k(\hat{I}) = \frac{\alpha(1-p)(1+\eta)}{p(1-\alpha)(1+\eta\lambda)}$ respectively. With the assumptions $u'(\cdot) > 0, u'(0) = \infty$ and $u''(\cdot) \leq 0$, we easily derive that $0 < \underline{I} \leq \hat{I}$ and $\underline{I} < w$ (see Lemma 1 in Appendix). Note that $\hat{I}$ may excess w when the premium rate α is low.[9] However, in our context, the repayment I for the consumer should be smaller than his total wage income w. We thus define $\overline{I} = \min\{\hat{I}, w\}$ (note $\underline{I} < \overline{I}$), and obtain the following proposition.

Proposition 1. *Given the reference coverage $I_r \in [0, w]$, the optimal coverage is*

$$I^* = \begin{cases} \underline{I}, & \text{if} \quad I_r < \underline{I} \\ I_r, & \text{if} \quad \underline{I} \leq I_r \leq \overline{I} \\ \overline{I}, & \text{if} \quad \overline{I} < I_r \leq w \end{cases}$$

Proposition 1 demonstrates that consumers' reference plays a significant role in determining their optimal insurance purchase. When their reference coverage is small enough ($I_r < \underline{I}$), consumers prefer to purchase insurance coverage $\underline{I}$, whereas when their reference coverage is large enough ($\overline{I} \leq I_r \leq w$), their optimal purchase becomes $\overline{I}$. Moreover, when consumers' reference coverage is moderate ($\underline{I} \leq I_r \leq \overline{I}$), their optimal purchase turns out to be equal to their reference coverage. In contrast, when the reference coverage is not moderate, their optimal purchase is not consistent with their reference. In particular, consider a consumer taking the case of not insuring as his status quo reference. Proposition 1 says that the consumer will prefer to purchase insurance with coverage $\underline{I}$. Realizing the inconsistency between his preferred choice and his reference, a consumer trying to make a rational decision may reconsider and update his original reference.

[9]As shown in Lemma 1 of Appendix, $\hat{I} \geq w$ if $\alpha = p$.

3.1.2 Optimal purchase consistent with reference

In practice, life insurance purchase is an economically significant decision in one's life, and consumers take it serious and try to make a rational purchase. To characterize this rationality, we assume that consumers have ability to predict their own behavior and make a consistent decision. That is, consumers' optimal choice based on their reference yields the stochastic outcome that coincides with the reference. This situation is defined as "personal equilibrium" in Kőzegi and Rabin(2006). Formally, we have the following solution concept.

Definition 1. An insurance purchase I^{PE} is a personal equilibrium if for all $I \in [0, w]$, $E[V(\tilde{x}(I^{PE}), \tilde{r}(I^{PE}))] \geq E[V(\tilde{x}(I), \tilde{r}(I^{PE}))]$.

Definition 1 says that if the consumer expects to purchase the insurance coverage I^{PE} for all possible choice $I \in [0, w]$, she should indeed choose the coverage I^{PE}. From Proposition 1, with the reference coverage $I^r = 0$, the consumers' optimal choice is $\underline{I} > 0$. Therefore, $I = 0$ is not a personal equilibrium. However, the reference $I_r = 0$ can be updated to $I_r = \underline{I}$ that is a personal equilibrium. Indeed, combining Proposition 1 with Definition 1, we obtain the following corollary.

Corollary 1. *Any insurance purchase $I \in [\underline{I}, \overline{I}]$ is a personal-equilibrium choice, i.e.*

$$I^{PE} = \{I : I \in [\underline{I}, \overline{I}]\}.$$

Moreover, $\partial\underline{I}/\partial\eta < 0, \partial\underline{I}/\partial\lambda < 0$ whereas $\partial\overline{I}/\partial\eta \geq 0, \partial\overline{I}/\partial\lambda \geq 0$.

This corollary shows that on the contrary to the unique optimal choice in the framework of standard reference-independent utility theory, the reference-dependent consumer's rationally optimal choices satisfying the personal equilibrium are multiple. The multiplicity of the optimal choice comes from the asymmetry of the consumer's gain-loss comparison driven by the anticipatory regret: due to the consumer' loss aversion, he cares more about the less insurance repayment than the less premium cost if he would like to reduce his insurance purchase relative to reference, but lay more emphasis on the more premium payment than more insurance coverage if he would like to buy more insurance than reference. In other words, due to the anticipatory regret, the consumer cares more about the negative consequences of his decision than the positive ones. As a result, he prefers not to deviate his choice too much from his reference and his rational choice driven by the regret-based tradeoff turns out to be multiple and depends on the initial reference.

It is the dependence of rational choice on the reference that justifies the popularity of agents' selling behavior, which is our focus in this paper. That is, agents can influence consumers' insurance purchase through manipulating their reference even consumers try to make a rational purchase decision. The direct implication of this result is that agents' selling effort can make consumers buy the insurance coverage up to $\overline{I}$. In contrast, under the pattern of direct selling without agents, consumers's reference is to purchase no insurance ($I_r = 0$) and thus their insurance purchase is only $\underline{I}$. Compared with the case of direct selling, agents' selling effort significantly increases consumers' life insurance demand.

Moreover, as η or λ increases, $\underline{I}$ decreases while $\overline{I}$ increases, and then consumers' rational choice interval $[\underline{I}, \overline{I}]$ becomes larger. This result implies that as the consumer attaches the larger relative weight of gain-loss comparison or his loss aversion becomes higher, his regret-based trade-off imposes a more significant impact on his optimal insurance purchase in a way that his choices are more prone to reference manipulation. As a consequence, the impact of agents' selling effort on stimulating consumers' demand becomes larger.

3.1.3 Welfare analysis

Since consumers' rational choice varies with different references, an important question arises: what choice is best for consumers? In other words, what choice makes consumers achieve their highest welfare? To answer this question, we have to define what is consumers' welfare. Intuitively, consumers' welfare should only be affected by their actual choice on insurance purchase and not by their references, i.e., welfare measure is reference-independent. Thus a natural choice is to adopt the standard reference-independent utility to measure consumers' welfare. We next show that in the context consumers make regret-based decisions, it has an appealing economic justification for this choice.

Imagine that an agent herself is a consumer. Since the agent has substantial experience for life insurance purchase, she can realize the effects of her anticipatory regret on the decision. To avoid the negative role of regret, she would fully endogenize her choice and take her choice as reference. In other words, she would take her insurance purchase as a committed decision long before outcomes occur, and hence she affects her reference point by her choice. This case is defined as "choice-acclimating personal equilibrium" by Kőzegi and Rabin(2007). In the context of life insurance, we give the formal definition of this equilibrium.

Definition 2. An insurance purchase I^C is a choice-acclimating personal equilibrium if for all $I \in [0, w]$, $E[V(\tilde{x}(I^C), \tilde{r}(I^C))] \geq E[V(\tilde{x}(I), \tilde{r}(I))]$.

In this case, the gain-loss utility from regret-based comparison between the outcomes determined by the consumer's decision and the reference totally vanishes and the optimal choice thus becomes the one that maximizes the standard reference-independent utility. This definition is appealing because it grasps the intuition that an experienced consumer should not regret his decision. We thus call the consumer's optimal choice in this case achieves his highest welfare. That is, we can exactly employ the standard reference-independent utility to measure consumers' welfare. The above arguments can be formalized as the following proposition.

Proposition 2. *a welfare-maximizing insurance purchase I^C satisfies*

$$I^C = \arg \max_{I \in [0,w]} E[u(\tilde{x}(I))].$$

Moreover, for all $\eta > 0$ and $\lambda > 1$, $\underline{I} < I^C \leq \overline{I}$ and $I^C = \overline{I}$ occurs if and only if $\alpha = p$.

Proposition 2 demonstrates that for the consumer with the status-quo reference $I_r = 0$, the optimal purchase $\underline{I}$ is strictly smaller than the coverage I^C. This implies that with the status quo reference, the consumer is only willing to purchase less insurance than the one maximizing her welfare. As argued by Morrison (1939) and Gravelee (1993, 1994), consumers are passive in purchase of life insurance and hence life assurance products are "sold rather than bought". This result provides a formal explanation for the above argument and justifies the positive role of agents' selling behavior in the insurance markets, i.e., agents can help consumers choose proper insurance with more coverage, I^C, by manipulating their reference to be I^C and thus improve consumers' welfare.

However, agents' selling behavior also has the dark side. As we have analyzed, agent's selling effort can lead consumers to choose choice $\overline{I}$ (if consumers' reference is manipulated to be $I_r \geq \overline{I}$), strictly larger than I^C under the condition $\alpha > p$ which is commonplace for insurance pricing. In this situation, agents induce consumers to purchase more insurance than the one maximizing their welfare and thus harm them. Therefore, this inducing behavior is unethical. Our finding puts forward an challenge for the regulation of unethical agent behavior, for the inducing behavior can occur even in the case that consumers with complete information about life insurance products make rational decisions. As a result, it becomes difficult to identify and regulate this inducing behavior in practice. The related regulation on unethical agent behavior, such as the requirement of extensive documentation of agents' advice, and adhering to the codes of ethical conduct, seems not as powerful as we expected. Instead, compensation design for agents can play an important role in mitigating this type of unethical behavior. Under all current distribution systems in life insurance, agent compensation is largely via commissions. However, the heavy reliance on commission compensation has recently come into question (Regan and Tennyson 2000, Hilliard et al. 2013). An often-suggested alternative to commission compensation is that consumers pay fees to the agent. Our analysis supports the use of the fee-for-service compensation because with this compensation, agents have no incentive to induce consumers buy too much insurance and thus can help consumers achieve their welfare-maximizing choice.

3.2 Whole life insurance

We now consider consumer's whole life insurance purchase in a two-period framework. Period 1 is the consumer's working period and he earns income $w > 0$ in this period if alive. Period 2 represents the retirement period. The consumer is endowed with initial wealth w_1 and w_2 in Period 1 and 2 respectively. In period 1, the consumer dies with probability $p \in (0, 1)$ and then he will survive to Period 2 with probability $1 - p$. We assume that there is a risk-free rate r between period 1 and period 2 and utility discount factor δ. For a whole life policy (P, I), the consumer will pay premium P and her heir will receive the repayment I in Period 1 if he dies. Moreover, he or his heirs will be certain to receive the repayment I in Period 2. In our setting, the repayment in Period 1 captures the insuring feature of whole life insurance while the repayment in Period 2 captures the saving feature of whole life insurance.

Note that the whole-life insurance is expensive since it partly serves as a saving tool. Indeed, the actuarially fair premium rate for this policy is $p + (1 - p)/(1 + r)$, implying that the premium rate $\alpha \geq p + (1 - p)/(1 + r)$. Hence $\alpha \in [p + \delta/(1 + r), 1)$. In this framework, the consumer's expected utility with the reference I_r becomes:

$$E[V(\tilde{x}(I), \tilde{r}(I_r))] = \begin{cases} pu(w_1 + (1-\alpha)I) + (1-p)u(w_1 + w - \alpha I) + (1-p)\delta u(w_2 + I) \\ +(1-p)\eta\delta[u(w_2 + I) - u(w_2 + I_r)] \\ +p\eta[u(w_1 + (1-\alpha)I) - u(w_1 + (1-\alpha)I_r)] \\ +(1-p)\eta\lambda[u(w_1 + w - \alpha I) - u(w_1 + w - \alpha I_r)] & \text{if} \quad I \geq I_r \\ pu(w_1 + (1-\alpha)I) + (1-p)u(w_1 + w - \alpha I) + (1-p)\delta u(w_2 + I) \\ +(1-p)\eta\lambda\delta[u(w_2 + I) - u(w_2 + I_r)] \\ +p\eta\lambda[u(w_1 + (1-\alpha)I) - u(w_1 + (1-\alpha)I_r)] \\ +(1-p)\eta[u(w_1 + w - \alpha I) - u(w_1 + w - \alpha I_r)] & \text{if} \quad I < I_r \end{cases} \tag{8}$$

Compared with the case of term-life insurance as illustrated in equation (5), a new term in gain-loss comparisons refers to the difference of monetary utility in retirement period $(u(w_2 + I) - u(w_2 + I_r))$, representing the regret-based saving effect.

The first-order derivative of (8) with respect to I equals

$$\frac{d[V(\tilde{x}(I), \tilde{r}(I_r))]}{dI} = \begin{cases} (1+\eta)[(1-p)\delta u'(w_2 + I) + p(1-\alpha)u'(w_1 + (1-\alpha)I)] \\ -\alpha(1-p)(1+\eta\lambda)u'(w_1 + w - \alpha I) & \text{if} \quad I \geq I_r \\ (1+\eta\lambda)[(1-p)\delta u'(w_2 + I) + p(1-\alpha)u'(w_1 + (1-\alpha)I)] \\ -\alpha(1-p)(1+\eta)u'(w_1 + w - \alpha I) & \text{if} \quad I < I_r \end{cases}$$

We define $\underline{I}_w$, $\hat{I}_w$ and I_w^C satisfying

$$(1+\eta)[(1-p)\delta u'(w_2+\underline{I}_w)+p(1-\alpha)u'(w_1+(1-\alpha)\underline{I}_w)] \\ -\alpha(1-p)(1+\eta\lambda)u'(w_1+w-\alpha\underline{I}_w)=0 \quad (9)$$

$$(1+\eta\lambda)[(1-p)\delta u'(w_2+\hat{I}_w)+p(1-\alpha)u'(w_1+(1-\alpha)\hat{I}_w)] \\ -\alpha(1-p)(1+\eta)u'(w_1+w-\alpha\hat{I}_w)=0 \quad (10)$$

$$(1-p)u'(w_2+I_w^C)+p(1-\alpha)\delta u'(w_1+(1-\alpha)I_w^C)-\alpha(1-p)u'(w_1+w-\alpha I_w^C)=0 \quad (11)$$

where I_w^C represents the optimal purchase of whole life insurance maximizing consumers' welfare as interpreted in the case of term life insurance purchase. By defining $\overline{I}_w=\min\{\hat{I}_w,w\}$, with the analogous reasoning to the case of term-life insurance purchase, we obtain the following Proposition.

Proposition 3. *Any insurance purchase* $I\in[\underline{I}_w,\overline{I}_w]$ *is a personal-equilibrium choice, i.e.*

$$I^{PE}=\{I:I\in[\underline{I}_w,\overline{I}_w]\}.$$

Moreover,
(i) $\partial\underline{I}/\partial\eta<0,\partial\underline{I}/\partial\lambda<0$ *whereas* $\partial\overline{I}/\partial\eta\geq 0,\partial\overline{I}/\partial\lambda\geq 0$.
(ii) $\underline{I}_w<I_w^C\leq\overline{I}_w$ *for all* $\eta>0$ *and* $\lambda>1$.

This proposition says that consumers' purchase behavior for whole life insurance exhibits the same pattern as that for term life insurance and thus the similar economic implications are obtained. There exist multiple personal equilibria for their optimal choice, implying that agents have an opportunity to affect consumers' rational choice through manipulating their reference. This manipulation also has both positive and negative aspects for improving consumers' welfare. On the one hand, consumers consumer endowed with status quo as not insuring, prefer to buy less insurance than the amount making them achieve the highest welfare ($\underline{I}_w<I_w^C$), and hence agents are helpful for consumers by suggesting they should buy proper insurance with more coverage. On the other hand, as we shall see, agents may be stimulated by commission mechanism commonly used in life insurance to become substantially aggressive so that they sell more insurance than the one maximizing consumers' welfare ($\overline{I}_w\geq I_w^C$) and thus make consumers worse off.

4 The supply of agency system

As we have shown, consumers' regret-based choice provides a chance for insurers to manipulate consumers' insurance purchase via agent system. However, the question about whether and on what condition the insurer will perform this manipulation remains unclear. In other words, we need to study the supply side of the agency system. The exploration to this issue can also help to clarify why agent system is commonplace in life insurance market. In practice, distribution via professional agents is the predominant form of life insurance selling, and insurers are represented by various forms of agency system, including the career agency system and independent agents or brokers. Moreover, Under all distribution systems in life insurance, agent compensation is largely via commissions (Regan and Tennyson 2000, Hilliard et al. 2013). These features of agency system suggest that agents is in alignment with insurers on offering life insurance to consumers and we thus ignore the principal-agent problem between the insurance company and agents, and just assume that the company can hire agents to achieve its goal. In this section, we analyze the insurance companies' strategies in market equilibrium where employing agency system is one candidate strategy that insurance company may adopt.

4.1 The insurers' incentive for building agency system

Now we consider a life insurance market with a monopolistic insurance company and a continuum of consumers. In this market, the insurance company has two candidate strategies:

- *Strategy 1: direct selling.* The company sells life insurance directly to consumers and no agents are required. In this case, as we have shown, consumers' initial reference is without insurance and then will choose the optimal insurance coverage $\underline{I}$. We call this strategy "direct selling" (DS).
- *Strategy 2: agents' selling.* The company hires agents to sell life insurance to consumers by manipulating their reference coverage to be I_r. As shown in Proposition 1 and and Corollary 1, given the sufficiently large premium rate α such that $\hat{I}(\alpha) \leq w$ where $\hat{I}(\alpha)$ satisfies $k(\hat{I}(\alpha)) = \frac{\alpha(1-p)(1+\eta)}{p(1-\alpha)(1+\eta\lambda)}$, the maximal coverage consumers will purchase under reference manipulation is $\overline{I}(\alpha) = \hat{I}(\alpha)$ (recall the definition $\overline{I} = \min\{\hat{I}, w\}$), and the reference resulting in this purchase is $I_r = \overline{I}$.[10] Since the net profit of the insurance company is $\pi \equiv (\alpha - p)I$ (without considering the cost of agency system), the company, in order to maximize profit, will choose to manipulate consumers' reference coverage

[10]Note that if the premium rate is low such that $\hat{I} \geq w$, consumers would like to purchase full coverage equaling to w. In this case, the insurance company can increase the premium rate moderately and make consumers still purchase full coverage (This is easily shown by use of Lemma1 in Appendix and Proposition 1). As a result, the profit-maximizing company will set a sufficiently high premium rate such that $\hat{I} \leq w$. Moreover, as we have shown in Proposition 1, consumers' optimal purchase is $\overline{I}$ even agents manipulate consumers reference coverage $I_r \geq \overline{I}$. Since this excessive manipulation brings in no benefit but in general occurs extra cost like bad reputation, the company has no incentive to adopt it.

to be $\overline{I}(\alpha)$ for any $\alpha > p$ once the agency system is employed. We call this strategy "agents' selling" (AS).

These two strategies correspond to two optimization problems where the insurance company offers the contract (α, I) to maximize its profit. Formally, for term life insurance, we formulate both optimization problems as follows.[11]

Program 1: the company's optimization problem with DS strategy.

$$\begin{aligned}
&\max_{\alpha,I} \quad \pi_{\mathrm{DS}} \equiv (\alpha - p)I \\
&\text{s.t.} \\
&\text{(IR)} \quad p[u(w_1 + (1-\alpha)I) - u(w_1)] \geq \frac{(1+\eta\lambda)}{(1+\eta)}(1-p)[u(w_1+w) - u(w_1+w-\alpha I)] \\
&\text{(IC)} \quad k(I) = \frac{\alpha(1-p)}{p(1-\alpha)} \cdot \frac{(1+\eta\lambda)}{(1+\eta)}
\end{aligned} \tag{12}$$

where consumers' incentive constraint (IC) requires that consumers maximize their expected reference-dependent utility, which can be substituted by the first-order condition of consumer's optimization problem (as shown in Proof of Proposition 1 of Appendix). For the reference coverage $I_r = 0$ (purchase no insurance), we obtain the (IC) constraint in (12) from (7) (note $I \geq I_r$). Consumers' individual rationality constraint (IR) in (12) is derived as follows. Given consumers' reference coverage $I_r = 0$, the individual rationality constraint requires that the difference between their expected utilities for buying insurance contract (α, I) and for purchasing no insurance is larger than zero.

$$\begin{aligned}
&pu(w_1 + (1-\alpha)I) + (1-p)u(w_1 + w - \alpha I) \\
&+ \eta\lambda(1-p)[u(w_1 + w - \alpha I) - u(w_1 + w)] + \eta p[u(w_1 + (1-\alpha)I) - u(w_1)] \\
&\geq pu(w_1) + (1-p)u(w_1 + w)
\end{aligned}$$

and thus (IR) in (12) is obtained.

Program 2: the company's optimization problem with AS strategy.

$$\begin{aligned}
&\max_{\alpha,I} \quad \pi_{\mathrm{AS}} \equiv (\alpha - p)I \\
&\text{s.t.} \\
&\text{(IR)} \quad p[u(w_1 + (1-\alpha)I) - u(w_1)] \geq \frac{(1+\eta)}{(1+\eta\lambda)}(1-p)[u(w_1+w) - u(w_1+w-\alpha I)] \\
&\text{(IC)} \quad k(I) = \frac{\alpha(1-p)}{p(1-\alpha)} \cdot \frac{(1+\eta)}{(1+\eta\lambda)}
\end{aligned} \tag{13}$$

[11] The optimization problems for whole life insurance are formalized and analyzed in A.5 of Appendix.

Given the reference coverage $I_r = \overline{I}$, from (7) and Proposition 1, the (IC) in (13) follows. Given the reference coverage $I_r = \overline{I} > 0$, the consumer has the following participation constraint.

$$
\begin{aligned}
&pu(w_1 + (1-\alpha)I) + (1-p)u(w_1 + w - \alpha I) \\
&\geq pu(w_1) + (1-p)u(w_1 + w) \\
&+ \eta\lambda p[u(w_1) - u(w_1 + (1-\alpha)I)] + \eta(1-p)[u(w_1 + w) - u(w_1 + w - \alpha I)]
\end{aligned}
$$

and thus (IR) in (13) is established.

It is easy to see that compared to the feasible set defined by (IR) and (IC) in Program 1, the feasible set in Program 2 becomes larger, implying that the insurance company faces more relaxed constraint for maximizing its profit in Program 2.

Proposition 4. *Let π^*_{DS} and π^*_{AS} denote the insurance company's maximal profits in programs 1 and 2 respectively. For $\eta > 0$ and $\lambda > 1$, $\pi^*_{DS} < \pi^*_{AS}$.*

As we show in A.6 of Appendix, Proposition 4 also holds for whole life insurance. This proposition demonstrates that the insurance company can achieve higher net profit as it exerts manipulation, and hence the company has an incentive to hire agents to manipulate consumers' reference. Note that hiring agents is costly, and thus the company builds a agency system only when the increased profit through reference manipulation is larger than the cost of building agency system. We use some numerical examples to illustrate how much this incremental profit can be.

In the household finance literature, a standard assumption is that consumers' preference is characterized by a constant relative risk aversion (CRRA) function $u(x) = x^{1-\gamma}/(1-\gamma)$ with a risk aversion parameter γ (Mitchell, Poterba, Warshawsky, and Brown 1999, Cocoo 2005, Einav et al. 2010, Hong and Ríos-Rull 2012). For estimating consumers' preference from their life insurance purchase, Hong and Ríos-Rull(2012) use $\gamma = 3$ as the coefficient of relative risk aversion. Indeed, in the study on retirement plan and annuity purchase decision, a long line of simulation literature uses this value (Hubbard, Skinner, and Zeldes 1995, Engen, Gale, and Uccello (1999), Mitchell, Poterba, Warshawsky, and Brown 1999, Scholz, Seshadri, and Khitatrakun 2006, Einav et al. 2010). We thus assume that consumers have the CRRA utility function and set $\gamma = 3$.[12] The consumer's income is standardized to be $w = 100$. We examine the impacts of different initial wealth and consumers' age on their life insurance purchase. It is commonplace that consumers' age when they purchase term life insurance is smaller than that for whole life insurance, and the former's initial wealth is often lower than the latter.

[12] Although there are some literature found risk aversion level closer to 1, as in consumption studies summarized by Laibson, Repetto, and Tobacman (1998), other papers report higher levels of relative risk aversion (γ is estimated to be around 4 in Barsky, Kimball, Juster, and Shapiro (1997), and γ is set to be 5 in Cocoo(2005)).

We thus report the results with the initial wealth $w_1 = 40, 50, 60$ for term life insurance and $w_1 = 80, 100, 120$ for whole life insurance. Our mortality data is from 2009 period life table for the Social Security area population. We assume that consumers' retirement age is 60, the insurance coverage period is from the consumer's age at contracting time to 60. In particular, we report the result when the consumer's age at insurance purchase is from 25 to 35 for term life insurance, and from 35 to 45 for whole life insurance.

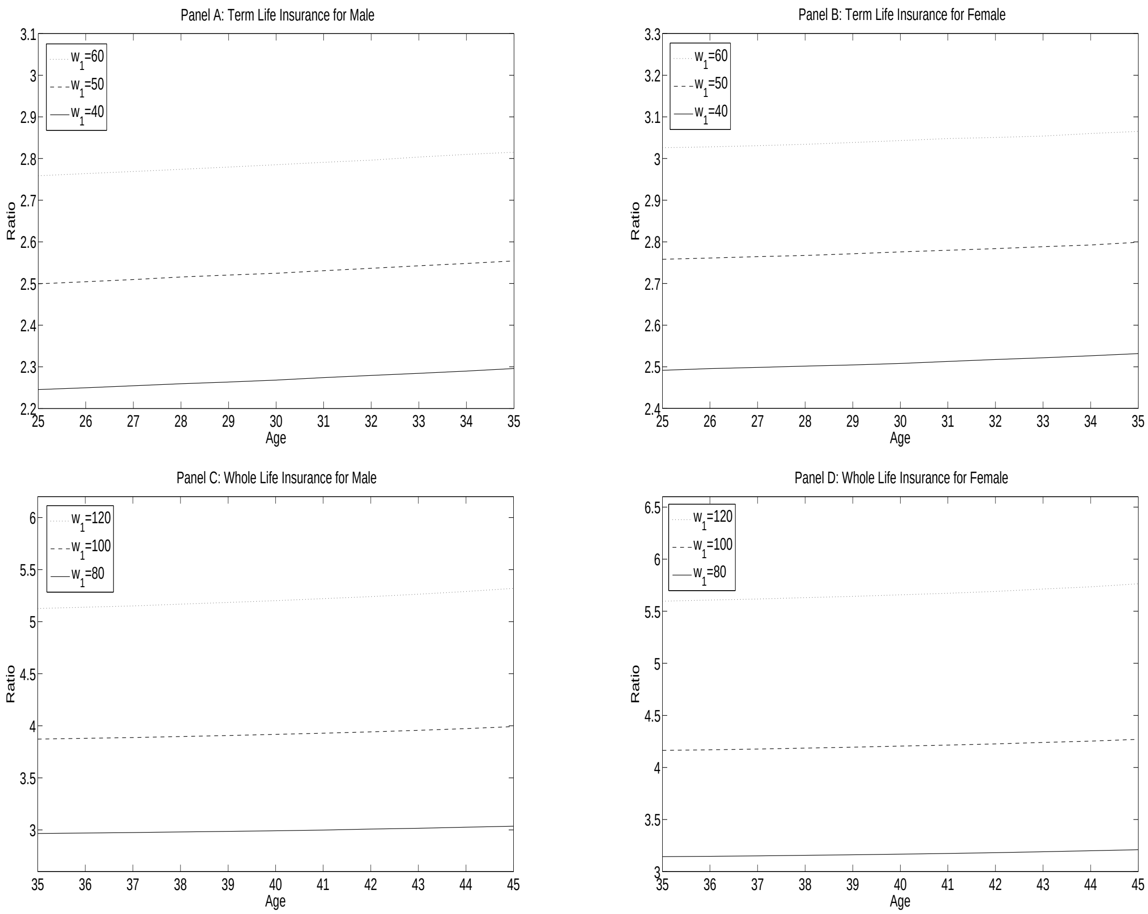
In our two-period framework for whole life insurance, The wealth w_1, the income w and the repayment I in period 1 can be treated as the present value at the beginning of this period, which we assume is less than consumers' 45 years old. Since people's life expectancy in 2009 period life table for the Social Security area population is more than 75, we can take it as the time of repayment I realized in period 2, and thus assume that time interval from buying whole life insurance to the repayment in period 2 is 40 years. We follow Cocoo(2005) by assuming that per year's utility discount factor to be 0.96 and the real risk-free rate to be 0.02, and obtain the discount factor for whole life insurance is $\delta = 0.96^{40}$ and $r = 1.02^{40} - 1$. Berkelaar et al. (2004) in the context of portfolio choice estimate $\eta = 1$ and $\lambda = 2.5$ where they use the reference-dependent model and capture the gain-loss utility with a piecewise linear function, and De Giorgi and Post (2011) use it to propose the numerical illustration for investors' portfolio choice problem.[13] We thus assume that $\eta = 1$ and $\lambda = 2.5$.

In the numerical example, we use the ratio of the insurance company's maximal profit with AS strategy relative to that with DS strategy as measure to identify the impact of agency system on the company's profit. In Figure 1, we report the ratios for different age and different initial wealth. All these ratios are much larger than 1, implying the profit margin is very high. For term life insurance, whatever the consumer's age and initial wealth, it is at least more than 2.2 and 2.4 for male and female respectively, and the higher age or the larger wealth is, the higher the ratio. The same pattern also occurs for whole life insurance, in which the ratio even becomes higher, more than 2.9 and 3.0 for male and female respectively. These results imply that the monopolistic insurance company can substantially increase profit by use of AS strategy (without considering the cost of agency system).[14] Therefore, it may have strong incentive to build up agency system, justifying the popularity of agency system in life insurance markets.

[13] Tversky and Kahneman (1992) estimated λ to be 2.25 and Benartzi and Thaler(1995) estimated λ to be 2.77 in the framework of prospect theory where there only exists gain-loss utility captured by a piecewise linear function.

[14] We also calculate the result under the alternative assumption that $\gamma = 5$, and find that the profit ratio still is larger than 1.4 for term life insurance and greater than 1.6 for whole life insurance. Compared with the case of $\gamma = 3$, the profit gain of AS strategy relative to DS strategy becomes smaller but is still very large. This result implies that our finding that insurance companies have an incentive to build up agency system becomes more conclusive as γ becomes smaller.

Figure 1: Profit ratio of AS strategy relative to DS strategy.



In this figure, the horizontal axis represents the consumer's age and vertical axis denotes the ratio of the insurance company's maximal profit with AS strategy relative to that with DS strategy. The different curves represent the ratio corresponding to the different initial wealth levels $w_1 = 40, 50, 60$ for term life insurance and $w_1 = 80, 100, 120$ for whole life insurance.

4.2 The welfare effects of agency system in a competitive market

We turn to considering the welfare effects of agency system in a framework of competitive market. That is, we would answer the question: whether the introduction of agency system increases consumers' welfare. To do this, we consider two cases where insurance companies adopt DS strategy or AS strategy, and in the latter case they will pay a cost of building an agency system. Facing two different cases, consumers make their optimal choices to maximize their expected utility under the constraint that insurance companies earn zero profit. Then we can make a comparison between consumers' welfare under their optimal choice with AS strategy and that with DS strategy. However, because we have no detailed information about the cost of agency system, we translate the above comparison into the following problem: we seek the implied cost of agent compensation satisfying the condition that consumers' welfare under their optimal choice with AS strategy is equal to that with DS strategy. The larger the cost is, the higher efficiency of agency system and the more possible agency system is employed in a competitive life insurance market.

It is commonplace that agent compensation is largely via commissions, and thus we assume the cost is proportional to the insurance coverage, and denote this loading rate as c. We formulize the optimization problems for consumers' term life insurance purchase with DS strategy and AS strategy respectively.[15]

Program 3: Consumers' optimization problem with DS strategy.

$$\max_{\alpha,I} \quad E[V(\tilde{x}(I),\tilde{r}(I_r))]|_{I_r=0} = p[u(w_1+(1-\alpha)I)-u(w_1)] - \frac{(1+\eta\lambda)}{(1+\eta)}(1-p)[u(w_1+w)-u(w_1+w-\alpha I)]$$

s.t.

$$(\alpha - p)I = 0 \tag{14}$$

where consumers' objective function is derived from Equation (5) with the reference coverage $I_r = 0$. Due to insurance companies' zero-profit constraint, the optimal premium rate is actuarially fair, i.e. $\alpha^*_{DS} = p$. From Proposition 1, it is easy to obtain that the optimal insurance coverage I^*_{DS} satisfies $k(I^*_{DS}) = (1+\eta\lambda)/(1+\eta)$.

Program 4: Consumers' optimization problem with AS strategy.

$$\max_{\alpha,I} \quad E[V(\tilde{x}(I),\tilde{r}(I_r))]|_{I_r=\overline{I}(\alpha)}$$

s.t.

$$(\alpha - p - c)I = 0 \tag{15}$$

[15] The optimization problems for whole life insurance are formalized and analyzed in A.7 of Appendix.

where consumers' objective function is given by Equation (5) with the reference coverage $I_r = \overline{I}(\alpha)$ satisfying $\overline{I}(\alpha) = \min\{\hat{I}(\alpha), w\}$ where $k(\hat{I}(\alpha)) = \frac{\alpha(1-p)(1+\eta)}{p(1-\alpha)(1+\eta\lambda)}$. From the zero-profit condition, we obtain the optimal premium rate $\alpha^*_{AS} = p + c$, and hence the the optimal insurance coverage $I^*_{AS} = \min\{\hat{I}^*_{AS}, w\}$ with $k(\hat{I}^*_{AS}) = (1+\eta)/(1+\eta\lambda)$.

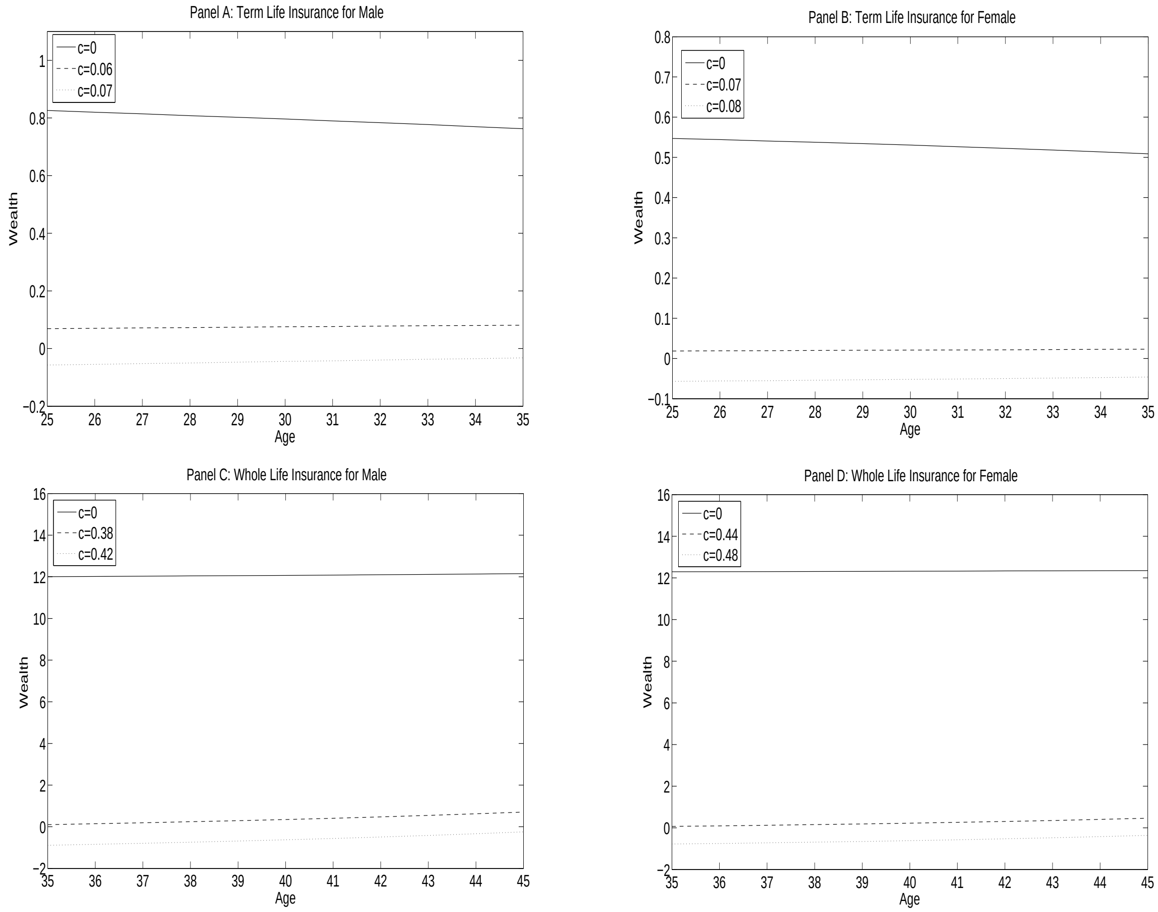
The analogous results hold for whole life insurance, see A.7 of Appendix. As we have argued, we use the reference-independent expected utility to measure consumers' welfare. It is a standard result that with the actuarially fair premium rate, the choice maximizing reference-independent expected utility is full insurance, i.e. $\alpha^* = p, I^* = w$ (or $k(I^*) = 1$). Compared with this benchmark, even facing fair premium rate, the consumer without agents' help only insures partially and thus experiences welfare loss due to the reference-dependent and regret-based comparison. In contrast, with agents' help, the consumer may purchase full insurance even the premium rate is not actuarially fair, but he also experiences welfare loss because he has to pay the cost of agency system (due to the zero-profit constraint in competitive market). The important question is whether consumers' welfare with AS strategy increases or decreases relative to DS strategy. In Figure 2, we use the dollar-denominated utility to measure the welfare gain of AS strategy compared to DS strategy. Here we set $w_1 = 50$ for term life insurance and $w_1 = 100$ for whole life insurance respectively.

It shows that for whole life insurance, the relative cost c making consumers' welfare indifferent between the case with AS strategy and the case with DS strategy lies in the interval [0.38,0.42] for male and [0.44,0.48] for female, while for term life insurance, the cost lies in the interval [0.06,0.07] for male and [0.07,0.08] for female. In practice, the commissions account for around 8-10% of the total premium.[16] Considering the actual cost of compensating agents, our quantitative result implies that agency system might be helpful to consumers for whole life insurance but may harm consumers for term life insurance. This result also predicts that term life insurance is more demanding than whole life insurance in the direct selling channels, which is quit consistent with the observation that market share through agents' selling is more than 90% for whole life while less than 70% for term life, (see Figures 25.2 and 25.3 provided by Hilliard et al. 2013).

The reason behind the above result is simple. As shown in Figure 3, with the status quo reference, consumers prefer to purchase term life insurance with large coverage (over 60% of the full coverage) but are only willing to buy whole life insurance with low coverage (less than 30% of the full coverage). As a result, agency system can increase consumers' insurance purchase largely for whole life insurance by manipulating their reference, but only increase their purchase a little for term life insurance. Note that compared to term life insurance,

[16] Based on the table "Life/Health Insurance Industry Income Statement, 2007-2011" on Page 103 of 2013 Financial Services Fact Book, we adopt the ratio of commissions over total premiums to approximate the commission ratio. The calculated ratio lies in [8%, 10%] from 2007 to 2011.

Figure 2: Wealth-equivalent Welfare gain of AS strategy relative to DS strategy.



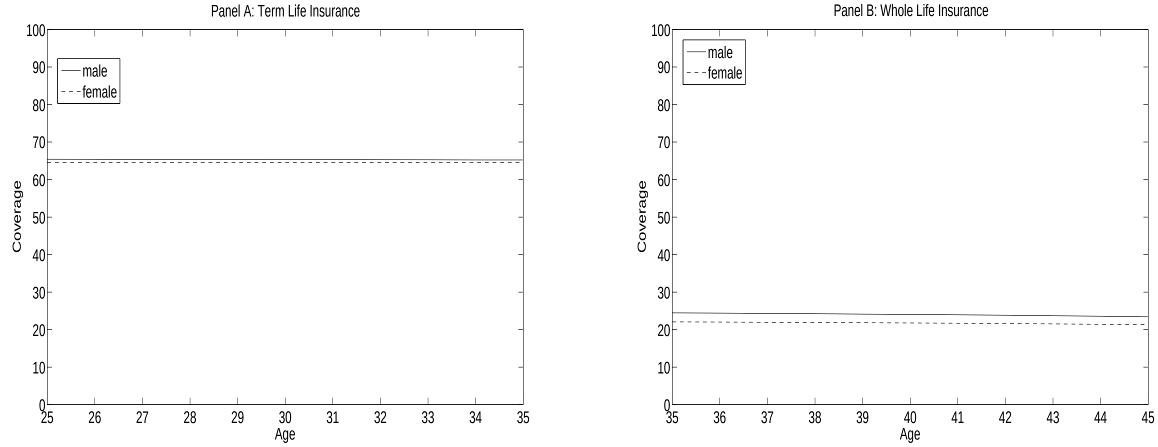
In this figure, the horizontal axis and vertical axis represent the consumer's age and wealth-equivalent welfare gain respectively. The different curves represent the wealth-equivalent welfare gain at the different cost levels.

whole life insurance is not a pure insurance product since it involves a saving part. It is the saving feature of whole life insurance decrease consumers' willingness to buy with the status quo reference and leave a large room for agents to play a crucial role.

5 Conclusion

Building on Prospect Theory and Regret Theory, we show that consumers are passive in life insurance purchase and only achieve a low level of welfare and agents can help them make a better decision by providing valuable advices and selling them more insurance, in the meanwhile increasing profits for the insurers. However, we also shed light on the dark side of the agent system that agents can succeed in inducing consumers to buy more insurance than the one maximizing their welfare, to generate more profits for insurance companies and themselves (under the popular commission-based agent compensation). This unethical behavior is diffi-

Figure 3: Consumers' optimal insurance coverage with DS strategy.



In this figure, the horizontal axis and vertical axis represent the consumer's age and life insurance coverage respectively. The different curves represent the consumers' optimal insurance purchase for male and female.

cult to identify and regulate in practice. Instead, the fee-for-service compensation should be effective to mitigate this type of unethical behavior, because with this compensation, agents have no incentive to induce consumers buy too much insurance and thus can help consumers achieve their welfare-maximizing choice.

Furthermore, we explore the supply side of agency system and justifies its presence in life insurance market. Compared to the case without it, the insurance companies with the agency system can earn much more policy profit and hence have a strong incentive to build up the system. The examination on the welfare effects of the agency system suggests that it is often helpful for consumers in the purchase of whole life insurance but may deteriorate consumers' welfare with term life insurance.

Our model proposes some testable predictions that seem popular in real-world life insurance market but lack restrict empirical evidence and thus call for further studies. The first one is that agency system on average sells more life insurance than the direct selling channels, such as by mail, telephone or through the internet. The second one is that agents sell inappropriately much insurance to consumers. The third one is that term life insurance is more demanding than whole life insurance in the direct selling channels, which is quit consistent with the observation that market share through agents' selling is more than 90% for whole life while less than 70% for term life, (see Figures 25.2 and 25.3 provided by Hilliard et al. 2013).

Despite presenting some interesting implications on agents' selling behavior in life insurance markets, our model has its limitation and cannot be readily available to the analysis of non-life insurance counterpart. First, the assumption that consumer is of limited rationality is not generally suitable for non-life insurance since commercial lines account for the large part of no-life insurance business, where consumers are commercial companies who are commonly treated as rational decision makers.

Second, our statical framework does not account for consumers' repeated purchase behavior that is commonplace in non-life insurance markets where consumers often purchase insurance annually. The evolution of consumers' reference and decision has some features distinct from the equilibrium outcome derived in the statical framework, as shown Kőszegi and Rabin (2010) in the context of consumers' consumption plan and in employment contract design. However, we believe our statical treatment is suitable for the analysis of consumers' life insurance purchase since consumers only make one or at most several times' decisions on the purchase.

Third, our model only focuses on the tradeoff between premium payment and insurance repayment and precludes the effects of other dimensional factors, and thus inherits the "narrow bracketing" feature of Kőszegi and Rabin (2007) on risky choice analysis. This narrow bracketing seems proper for the analysis of life insurance but not sufficient for non-life insurance because the latter often includes important multiple-dimensional factors, such as self-insurance, self-protection and other risk management considerations.

Last, our analysis assumes that consumers are homogeneous and abstracts from information asymmetry between consumers and insurers. This abstraction does not hurt much the effectiveness of our predictions for life insurance because of two facts. On the one hand, life insurers often keep a large amount of insured and thus the mortality distribution is stable and well known to insurers due to large number law. On the other hand, the information of the mortality distribution is readily available to consumers. However, the abstraction is critical for non-life insurance since there are commonly a high variety in non-life insured and information asymmetry is a big problem where the demand and design of some non-life insurance products (especially related to commercial line) are often substantially complicated. For all these reasons, we are hesitant about its applicability in the analysis of non-life insurance.

Appendix

A.1

Lemma 1. *For* $\eta > 0$ *and* $\lambda > 1$*, we have:*
(i) $\underline{I} < \hat{I}$ *and* $\underline{I} < w$ *.*
(ii)$\partial \underline{I}/\partial \eta < 0, \partial \underline{I}/\partial \lambda < 0$ *whereas* $\partial \hat{I}/\partial \eta > 0, \partial \hat{I}/\partial \lambda > 0$*.*
(iii) if the premium rate is actuarially fair, i.e. $\alpha = p$*, we have* $\hat{I} \geq w$*.*

Proof. (i) Given $k(I) \equiv \frac{u'(w_1+(1-\alpha)I)}{u'(w_1+w-\alpha I)}$, it is easy to see that $k(I)$ increases as I increases since $u(\cdot) > 0$ and $u''(\cdot) \leq 0$. That is, $k'(I) < 0$. Because $k(\underline{I}) = \frac{\alpha(1-p)(1+\eta\lambda)}{p(1-\alpha)(1+\eta)} > k(\hat{I}) = \frac{\alpha(1-p)(1+\eta)}{p(1-\alpha)(1+\eta\lambda)}$ for $\eta > 0$ and $\lambda > 1$, it establishes that $\underline{I} < \hat{I}$. Moreover, due to $k(\underline{I}) \equiv \frac{u'(w_1+(1-\alpha)\underline{I})}{u'(w_1+w-\alpha\underline{I})} = \frac{\alpha(1-p)(1+\eta\lambda)}{p(1-\alpha)(1+\eta)} > 1$, it follows that $\underline{I} < w$.
(ii) From $k(\underline{I}) = \frac{\alpha(1-p)(1+\eta\lambda)}{p(1-\alpha)(1+\eta)}$ and $k(\hat{I}) = \frac{\alpha(1-p)(1+\eta)}{p(1-\alpha)(1+\eta\lambda)}$, it is straightforward to obtain that $\partial\underline{I}/\partial\eta < 0, \partial\underline{I}/\partial\lambda < 0$ whereas $\partial\hat{I}/\partial\eta > 0, \partial\hat{I}/\partial\lambda > 0$ since $k'(I) < 0$.
(iii) When $\alpha = p$, $k(\hat{I}) \equiv \frac{u'(w_1+(1-\alpha)\hat{I})}{u'(w_1+w-\alpha\hat{I})} = \frac{\alpha(1-p)(1+\eta)}{p(1-\alpha)(1+\eta\lambda)} = \frac{1+\eta}{1+\eta\lambda} < 1$ for $\eta > 0$ and $\lambda > 1$, it follows that $u'(w_1 + (1-\alpha)\hat{I}) < u'(w_1 + w - \alpha\hat{I})$, or $(1-\alpha)\hat{I} \geq w - \alpha\hat{I}$ since $u''(\cdot) \leq 0$. It establishes the result of (iii). Q.E.D.

A.2 Proof of Proposition 1. Due to $u''(\cdot) \leq 0$, $\frac{d^2[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI^2} \leq 0$ and hence the first-order conditions are sufficient and necessary for the optimization of consume' life insurance purchase. We consider the following three cases to complete the proof:
(i) The case of $I_r < \underline{I}$. From equation (7), when the consumer tries to increase insurance purchase relative to the reference level ($I \geq I_r$), his optimal choice is $\underline{I}$ such that $\frac{d[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI} = 0$; When the consumer attempts to reduce insurance purchase relative to the reference level ($I < I_r$), it follows that $k(I) - \frac{\alpha(1-p)(1+\eta)}{p(1-\alpha)(1+\eta\lambda)} > 0$ since $k(I) > k(\underline{I})$ due to $I < \underline{I} < \hat{I}$, where the latter inequality holds due to (ii) of Lemma 1. Consequently $\frac{d[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI} > 0$ for all $I < I_r$, hence the consumer will not actually reduce his coverage relative to the reference level. Overall, for the case of $I_r < \underline{I}$, the consumer's optimal insurance overage $I^* = \underline{I}$.
(ii) The case of $\underline{I} \leq I_r \leq \overline{I}$. From equation (7), when the consumer attempts to purchase more insurance than the reference level ($I \geq I_r$), he finds that $\frac{d[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI} \leq 0$ due to the fact that $k(I) - \frac{\alpha(1-p)(1+\eta\lambda)}{p(1-\alpha)(1+\eta)} \leq k(\underline{I}) - \frac{\alpha(1-p)(1+\eta\lambda)}{p(1-\alpha)(1+\eta)} = 0$, and thus prefers not to do so. Alternatively, when the consumer considers purchase less insurance than the reference level ($I < I_r$), he finds that $\frac{d[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI} \geq 0$ and also prefer not to do so. In other words, for $\underline{I} \leq I_r \leq \overline{I}$, the consumer prefer to choose the optimal insurance purchase equaling to the reference level, and thus establishes $I^* = I_r$.
(iii) The case of $\overline{I} < I_r \leq w$. If $\overline{I} = w$ (i.e., $\hat{I} \geq w$), this case is ignorable. So we only need to consider the case $\overline{I} < w$ (i.e., $\overline{I} = \hat{I} < w$). When the consumer attempts to purchase more insurance than the reference level ($I \geq I_r$), he finds that $\frac{d[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI} \leq 0$ and thus prefers not to do so. However, when the consumer considers purchasing less insurance than the reference level ($I < I_r$), he optimal choice is $\overline{I}$ such that $\frac{d[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI} = 0$. Therefore, for $\overline{I} < I_r \leq w$, the consumer's optimal choice is $I^* = \overline{I}$. Q.E.D.

A.3 Proof of Corollary 1. According to the definition of personal equilibrium, the choice must be consistent with the reference, i.e. the actual insurance coverage equals the reference one $I^* = I_r$. From Proposition 1, we directly establish that any insurance purchase $I \in [\underline{I}, \overline{I}]$ is a personal-equilibrium choice. Moreover, as proved in (ii) of Lemma 1, $\partial\underline{I}/\partial\eta < 0, \partial\underline{I}/\partial\lambda < 0$. Moreover, $\partial\hat{I}/\partial\eta > 0, \partial\hat{I}/\partial\lambda > 0$, so we have $\partial\overline{I}/\partial\eta \geq 0, \partial\overline{I}/\partial\lambda \geq 0$ from the definition of

$\overline{I} = \min\{\hat{I}, w\}$. Q.E.D.

A.4 Proof of Proposition 2. For the reference-independent consumer's optimal insurance purchase problem, the first-order condition is

$$\frac{d[V(\tilde{x}(I), \tilde{r}(I_r))]}{dI} = p(1-\alpha)u'(w-\alpha I)\left[k(I) - \frac{\alpha(1-p)}{p(1-\alpha)}\right],$$

and the second-order condition $\frac{d^2[V(\tilde{x}(I),\tilde{r}(I_r))]}{dI^2} \leq 0$ due to $u''(\cdot) \leq 0$. Thus $k(I) = \frac{\alpha(1-p)}{p(1-\alpha)}$ is sufficient and necessary for this optimization problem. In other words, the choice I^C is the optimal solution to the problem. Since $k'(I) < 0$ and $k(\underline{I}) = \frac{\alpha(1-p)(1+\eta\lambda)}{p(1-\alpha)(1+\eta)} > k(I^C) = \frac{\alpha(1-p)}{p(1-\alpha)} > k(\hat{I}) = \frac{\alpha(1-p)(1+\eta)}{p(1-\alpha)(1+\eta\lambda)}$ for $\eta > 0$ and $\lambda > 1$, we obtain $\underline{I} < I^C < \hat{I}$. Note that $I^C \leq w$ and the equity occurs if and only if $\alpha = p$. From the definition $\overline{I} = \min\{\hat{I}, w\}$, we thus establish $\underline{I} < I^C \leq \overline{I}$ and $I^C = \overline{I}$ if and only if $\alpha = p$ (note when $\alpha = p$, $\hat{I} \geq w$ from (iii) of Lemma 1, and thus $\overline{I} = w$.). Q.E.D.

A.5 Formalization of the insurance company's optimization problem for whole life insurance.

Program 1′: optimization problem with DS strategy.

$$\max_{\alpha, I} \quad \pi_{W,\mathrm{DS}} \equiv \left(\alpha - p - \frac{1-p}{1+r}\right) I$$

s.t.

$$\begin{aligned}
\text{(IR)} \quad & p[u(w_1 + (1-\alpha)I) - u(w_1)] + (1-p)\delta[u(w_2 + I) - u(w_2)] \\
& \geq \frac{(1+\eta\lambda)}{(1+\eta)}(1-p)[u(w_1 + w) - u(w_1 + w - \alpha I)] \\
\text{(IC)} \quad & p(1-\alpha)u'(w_1 + (1-\alpha)I) + (1-p)\delta u'(w_2 + I) = \frac{(1+\eta\lambda)}{(1+\eta)}\alpha(1-p)u'(w_1 + w - \alpha I)
\end{aligned} \tag{16}$$

For the reference coverage $I_r = 0$ (not insuring) and then $I \geq I_r$, from (8), we obtain the (IC) constraint in (16). Consumers' individual rationality constraint (IR) in (16) is derived as follows. Given consumers' reference is not insuring, the individual rationality constraint requires that the difference of their reference-dependent utilities for buying insurance contract (α, I) and for not insuring is larger than zero.

$$\begin{aligned}
& pu(w_1 + (1-\alpha)I) + (1-p)u(w_1 + w - \alpha I) + (1-p)\delta u(w_2 + I) \\
& + \eta\lambda(1-p)[u(w_1 + w - \alpha I) - u(w)] + \eta p[u(w_1 + (1-\alpha)I) - u(0)] \\
& + \eta(1-p)\delta[u(w_2 + I) - u(w_2)] \\
& \geq pu(w_1) + (1-p)u(w_1 + w) + (1-p)u(w_2)
\end{aligned}$$

and thus (IR) in equation (16) is obtained.

Program 2′: optimization problem with AS strategy.

$$\max_{\alpha,I} \quad \pi_{\mathrm{W,AS}} \equiv \left(\alpha - p - \frac{1-p}{1+r}\right) I$$

s.t.

$$\begin{aligned}
&\text{(IR)} \quad p[u(w_1+(1-\alpha)I)-u(w_1)]+(1-p)\delta[u(w_2+I)-u(w_2)] \\
&\qquad\quad \geq \frac{(1+\eta)}{(1+\eta\lambda)}(1-p)[u(w_1+w)-u(w_1+w-\alpha I)] \\
&\text{(IC)} \quad p(1-\alpha)u'(w_1+(1-\alpha)I)+(1-p)\delta u'(w_2+I)=\frac{(1+\eta)}{(1+\eta\lambda)}\alpha(1-p)u'(w_1+w-\alpha I)
\end{aligned} \tag{17}$$

Given the reference coverage $I_r = \overline{I}$, from (8) and Proposition 3, the (IC) in (17) follows. For this problem, consumers endowed with reference coverage $I_r = I^C > 0$ have the following participation constraint.

$$\begin{aligned}
&pu(w_1+(1-\alpha)I)+(1-p)u(w_1+w-\alpha I)+(1-p)\delta u(w_2+I) \\
&\geq pu(w_1)+(1-p)u(w_1+w)+(1-p)\delta u(w_2) \\
&+\eta\lambda p[u(w_1)-u(w_1+(1-\alpha)I)]+\eta(1-p)[u(w_1+w)-u(w_1+w-\alpha I)] \\
&+\eta\lambda(1-p)\delta[u(w_2)-u(w_2+I)]
\end{aligned}$$

and thus (IR) in (17) is established.

A.6 Proof of Proposition 4.

We at first consider the case of term life insurance. We first show that (IR) is abundant in all tree programs. Because $u'(\cdot) > 0, u''(\cdot) \leq 0$, it holds

$$\frac{u(w_1+(1-\alpha)I)-u(w_1)}{w_1+(1-\alpha)I-w_1} \geq u'((1-\alpha)I), \quad \frac{u(w_1+w)-u(w_1+w-\alpha I)}{w_1+w-(w_1+w-\alpha I)} \leq u'(w_1+w-\alpha I)$$

Hence, for $\eta > 0$ and $\lambda > 1$,

$$\begin{aligned}
&\frac{u(w_1+(1-\alpha)I)-u(w_1)}{u(w_1+w)-u(w_1+w-\alpha I)} \geq \frac{u'(w_1+(1-\alpha)I)(1-\alpha)I}{u'(w_1+w-\alpha I)\alpha I} \\
&= \begin{cases} \frac{1-p}{p}\cdot\frac{1+\eta\lambda}{1+\eta}, & \text{for Program 1} \\ \frac{1-p}{p} > \frac{1-p}{p}\cdot\frac{(1+\eta)}{(1+\eta\lambda)}, & \text{for Program 2} \\ \frac{1-p}{p}\cdot\frac{(1+\eta)}{(1+\eta\lambda)}, & \text{for Program 3} \end{cases}
\end{aligned}$$

then (IR) is abundant.

Denote the optimal solutions to Program 1 and 2 by $(\alpha^*_{DS}, I^*_{DS})$ and $(\alpha^*_{AS}, I^*_{AS})$ respectively. Given $\alpha = \alpha^*_{DS}$ in Program 2, there exists $\hat{I} > I^*_{DS}$ satisfying the (IC) condition in Program 2 since $\frac{1+\eta\lambda}{1+\eta} > 1 > \frac{1+\eta}{1+\eta\lambda}$ for $\eta > 0$ and $\lambda > 1$. Moreover, the profit $\pi_{AS}(\alpha^*_{AS}, \hat{I})$ for Program 2 is strictly larger than the maximal profit π^*_{DS} for Program 1. Since the maximal profit

$\pi^*_{AS} \geq \pi_{AS}(\alpha^*_{DS}, \hat{I})$, it follows that$\pi^*_{AS} > \pi^*_{DS}$.

For the case of whole life insurance, we also first verify that (IR) is abundant in all tree programs. Because $u'(\cdot) > 0, u''(\cdot) \leq 0$, it holds

$$
\begin{aligned}
&u(w_1 + (1-\alpha)I) - u(w_1) \geq u'(w_1 + (1-\alpha)I)[w_1 + (1-\alpha)I - w_1],\\
&u(w_2 + I) - u(w_2) \geq u'(I)(w_2 + I - w_2),\\
&u(w_1 + w) - u(w_1 + w - \alpha I) \leq u'(w_1 + w - \alpha I)[w_1 + w - (w_1 + w - \alpha I)],
\end{aligned}
$$

Hence, for $\eta > 0$ and $\lambda > 1$,

For Program $1'$,

$$
\begin{aligned}
&p[u(w_1 + (1-\alpha)I) - u(w_1)] + (1-p)\delta[u(w_2 + I) - u(w_2)]\\
&\geq p(1-\alpha)Iu'(w_1 + (1-\alpha)I) + (1-p)\delta I u'(w_2 + I)\\
&= \frac{(1+\eta\lambda)}{(1+\eta)}\alpha I(1-p)u'(w_1 + w - \alpha I) \geq \frac{(1+\eta\lambda)}{(1+\eta)}(1-p)[u(w_1 + w) - u(w_1 + w - \alpha I)]
\end{aligned}
$$

For Program $2'$,

$$
\begin{aligned}
&p[u(w_1 + (1-\alpha)I) - u(w_1)] + (1-p)\delta[u(w_2 + I) - u(w_2)]\\
&\geq p(1-\alpha)Iu'(w_1 + (1-\alpha)I) + (1-p)\delta I u'(w_2 + I)\\
&= \frac{(1+\eta)}{(1+\eta\lambda)}\alpha I(1-p)u'(w_1 + w - \alpha I) \geq \frac{(1+\eta)}{(1+\eta\lambda)}(1-p)[u(w_1 + w) - u(w_1 + w - \alpha I)]
\end{aligned}
$$

then (IR) is abundant.
For the reminder of the proof, with the similar reasoning as the case of term life insurance, we can prove the inequality still holds for whole life insurance. Q.E.D.

A.7 Formalization of the consumer's optimization problem for whole life insurance.

Program $3'$: Consumers' optimization problem with DS strategy.

$$
\begin{aligned}
\max_{\alpha, I} \quad E[V(\tilde{x}(I), \tilde{r}(I_r))]|_{I_r=0} = {}& p[u(w_1 + (1-\alpha)I) - u(w_1)] + (1-p)\delta[u(w_2 + I) - u(w_2)]\\
&- \frac{(1+\eta\lambda)}{(1+\eta)}(1-p)[u(w_1 + w) - u(w_1 + w - \alpha I)]
\end{aligned}
$$

s.t.

$$
\left(\alpha - p - \frac{1-p}{1+r}\right) I = 0 \tag{18}
$$

where consumers' objective function is derived from Equation (8) with the reference coverage $I_r = 0$. It is straightforward to obtain the optimal solution $(\alpha^*_{DS,W}, I^*_{DS,W})$ satisfying $\alpha^*_{DS,W} = p + (1-p)/(1+r)$ and $pu'(w_1 + (1-p)I^*_{DS,W}) + \delta u'(I^*_{DS,W}) = \frac{(1+\eta\lambda)}{(1+\eta)} pu'(w_1 + w - pI^*_{DS,W})$.

Program 4′: Consumers' optimization problem with AS strategy.

$$\max_{\alpha,I} \quad E[V(\tilde{x}(I),\tilde{r}(I_r))]|_{I_r=\overline{I}(\alpha)}$$

s.t.

$$\left(\alpha - p - \frac{1-p}{1+r} - c\right) I = 0 \tag{19}$$

where consumers' objective function is given by Equation (8) with the reference coverage $I_r = \overline{I}(\alpha)$ satisfying $p(1-\alpha)u'(w_1+(1-\alpha)\overline{I})+(1-p)\delta u'(\overline{I}) = \frac{(1+\eta)}{(1+\eta\lambda)}\alpha(1-p)u'(w_1+w-\alpha\overline{I})$.

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