

A study into the rationale behind remaining uninsured

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Topic Statement:

An analysis of the choice to remain uninsured using Behavioural Economics and Game Theory.

Abstract: Life insurance is a huge industry in many developed countries and ownership of a life insurance policy is considered to be a basic necessity for secure life. However in spite of the extensive boost given to the insurance sector and the numerous incentives being offered to prospective customers of insurance, there still exist people who choose to remain out of the insurance net, voluntarily. These outliers have impeded the universalisation of life insurance and thus there is a pressing need to study their justification for avoiding the purchase of life insurance so as to take appropriate policy measures to integrate them into the insurance net. This paper is an attempt to study the rationale of these insurance outliers through a game theoretical analysis of their decisions and further to study the biases that may lead to their stand-out behaviour through behavioural economics.

Introduction:

An insurance is a risk transfer mechanism which guarantees the insured protection against potential but uncertain losses or compensations for the same. An insurance company hedges the risk of an individual by spreading it over a large body of insured thus successfully lowering the risk burden of each of the insured in return of pre-determined, regular payments called premiums. Life insurance is a huge industry in developed countries and insurance coverage is considered to be an indicator of socio-economic development and standard of living. Ownership

of a life insurance policy guarantees to the household a sustained capacity of survival even after the death of the income earner. Thus, it is not so much a compensation for death as it is an instrument for the survival of those left behind.

Though the insurance sector has been studied extensively from the point of view of the insurance companies, there is hardly any research done on the rationale of those choosing to be (or not to be) insured. The insurance net in most developed countries is widely laid and insurance penetration is considerably high. Owning a life insurance is considered to be a basic necessity for any household along with clothing and shelter as it ensures sustainability of the household's stability even after contingency. However, in spite of this, there are people who choose to remain out of the insurance net voluntarily. Whether these insurance outliers are simply 'irrational' individuals who fail to apprehend the advantages of having an insurance or whether they are perfectly rational persons who have an uncustomary justification for this decision is not known. Nor has it been studied in any systematic way. The aim of this paper is to fill in this gap in research.

Theme Connect:

Insurance penetration is considered to be an indicator of socio-economic development and standard of living. In developed countries, insurance penetration is significantly high ("OECD Statistics", 2016). However, there are still some people who voluntarily chose to remain uninsured and thus emulate the behaviour of an outlier. This research will try to theoretically understand why people opt to stay out of the insurance net and investigate if something can be done to change their

behavioural notions and perceived trade-offs so as to bring them within the insurance coverage.

Hypotheses:

1. People who voluntarily chose to remain uninsured do so out of 'rationally' perceived trade-offs. These outliers (the uninsured) can be integrated into the insurance net through policy measures targeted towards changing their risk perceptions and trade-offs.

Objectives:

1. To study why some people voluntarily choose to remain uninsured despite the obvious advantages associated with having an insurance
2. To explain through game theory, how individuals make the choice of whether or not to buy a life insurance by estimating the relative payoffs and the expected utility from either choice.
3. To understand how behavioural notions influence an individual's perception of risk about his/her health prospects and thus influence their decisions on whether or not to buy an insurance.

Methodology:

The author will use game theory to systematically understand the relative pay-offs involved in the decision of buying an insurance. The various factors that affect the utility derived from individual decisions will also be studied in detail. Finally, the psychological factors that cannot be incorporated in the mathematical model will be analysed through behavioural economics.

Literature Review:

Game theory is an efficient tool for the scientific analysis of decision making. Game theory suggests how individuals—when faced by choices based on uncertain outcomes and involving relative payoffs—should behave, so as to get the optimum benefit out of their decision. A Gaming matrix enables us to systematically lay down all the possible choice permutations before a player and then proceed to analyse which choice will give him/her an

equilibrium outcome. Thus, it is the most suitable way for studying decisions in a scientific and impartial manner.

The decision to purchase an insurance can also be analysed methodically through game theory. Richard Zeckhauser has done extensive research on the subject of risk sharing in the insurance sector in his paper, 'Medical insurance: A Case Study of the Tradeoff between Risk Spreading and Appropriate incentives' (Zeckhauser, 1970). Here, he talks about how insurance premiums are set and how an insurance company secures its payoffs through game theoretical decision making. However, game theory alone cannot be used to holistically understand decision-making as there is also the impact of certain psychological and sociological influences which need to be factored in. These factors can be analysed through behavioural economics. Authors C. Arthur Williams Jr. and O. D. Dickerson have tried to systematically analyse insurance decisions of 'rational' customers in their paper 'Game Theory and Insurance Consumption: The Worry Factor Revisited', wherein they have also incorporated psychological traits that may impact rational decision-making (Williams, Dickerson, 1966). Besides papers such as 'Behavioral game theory: Experiments in strategic interaction by Colin Camerer' (Cramer, 2011) and 'Behavioural Game theory' (Durlauf, Lawrence E, 2008) provide valuable insights into the linkage between game theory and behavioural economics in understanding strategic decision making while also accounting for psychological factors. 'Health Insurance Coverage and Take-Up: Lessons from Behavioral Economics' (Baicker, William, and Sendhil, 2012) and 'Insurance and behavioral economics: Improving decisions in the most misunderstood industry' (Kunreuther, Pauly, McMorro, 2013) are some other papers that have made instrumental contributions towards behavioural understanding of the Insurance sector by providing intelligent insights into the rationale of the decision maker.

Analysis:

Hereunder, we have tried to analyse insurance decisions using a 2x2 gaming matrix. Following is a two-player finite game, modelled to compare the tradeoffs for a person making a decision about whether or not to purchase a life insurance policy (Table 1). The game is the most stripped down version of the choice theory and is based on multiple assumptions. Game theory proceeds with the a priori assumptions of rationality¹ and perfect knowledge, both of which are difficult to

actualise in empirical situations. However, for the sake of simplicity and in-telligible results from the model, we go ahead with the aforementioned assumptions. To make the analysis more practicable and suited to real life situations, the author will dedicate the latter part of her research to explaining the behavioural characteristics that may impact the choices of individuals. Thus the empirical limitations of the model will be removed further down in the research

	DEATH	NO DEATH
INSURED	(A) PROFITABLE OUTCOME (Ability of the household to survive after death of breadwinner)	(C) LOSS OF UTILITY THROUGH PREMIUMS (Utility as determined by purchasing power)
UNINSURED	(D) INABILITY TO PROVIDE FOR FUTURE (Death of bread earner leading to loss of income)	(B) PROFITABLE OUTCOME (No loss of purchasing power due to payment of premium s)

Table. 1

As we can see in this gaming matrix, the two profitable outcomes are:

a) Choosing to get insured and dying within the coverage period, in which case the insurer gets the full reim-bursement for the premium payments as well as an additional lump sum amount of the insurance money; and
Choosing not to get insured and not dying, in which case there is no outgo of money in the form of premiums and thus more utility enjoyed through a higher purchasing power which did not come at the cost of insufficiency after death. The choice of the individual must lie between these two outcomes depending on the trade-off between forfei-ture of purchasing

power through premiums (w.r.t choice A) and taking on the risk of dying without adequate indemnity in the form of insurance (w.r.t choice B). The two remaining options (C and D) quantify the opportunity costs involved in each of the two pure strategies. Since death is a one-time phenomenon and irreversible, we assume that there can be no mixed strategy equilibriums i.e. picking different options in different repeated to achieve a minimax solution.²

¹ Rationality, by itself, need not be an absolute but may be relative to the player making the choice. Any reasonable objective is rationale. In fact, Game theorists believe that a person is acting rationally if he chooses that decision-making rule which is most likely to enable him/her to achieve his/her objective. (Arthur Williams, Jr, 1960)

The above is a basic model that gives us an overview into the most fundamental trade-offs in the insurance decision, one between risk and money. However, this is just the tip of the iceberg and a comprehensive game-theoretical analysis needs to incorporate many more factors. For instance, here we move ahead with the assumption that premium payments constitute a loss of utility as they lead to fall in funds for consumption expenditure. However, this might not be the case if the player under consideration earns a surplus and ends up saving the same. We also do not consider any emotions on part of the insurer—such as worry of dying for an uninsured or irritation from having to pay premiums for an insured—which do have an impact over the overall utility of the person. Furthermore, it is assumed that the benefits of insurance are transferable i.e. the profit that the kin of the deceased will get from the insurance can be transferred to the deceased. This is because even though a life insurance is taken by person A who also pays the premiums for the same, the benefit of the insurance accrues to a third party B. So unless we assume that the profit/loss of the third party is equal to the profit/loss of the deceased, this game cannot be applied to our case. Although these assumptions may seem contrived at face value, they are requisite for a clean model. The subjective factors that this model fails to address will be explained later.

The above game is a modified version of a 'two player game' wherein neither player knows what the other is going to do and so the most rational choice is one that maximises gains or minimises losses of the player in question regardless of what the second player does. Such a utility maximising move is called a dominating strategy. Here the second player is

nature or fate or any such abstraction that you may attribute the possibility of death to. If we were to find the minimax Nash equilibrium³ for this game, the rational thing to do would be to assume that the other player (nature) will be at her worst and so act in a way that would minimise your maximum losses. So the Nash Equilibrium output is Death-Insured (Row 1, Cell 1). This is rationality in absolute terms whereby we assume that the loss/gain of utilities other than those accruing from living / dying account for nothing (i.e. we ignore the influence of worry, irritation and other behavioural factors on utility). So the Nash equilibrium simply says that given the worst that nature can do to you i.e. cause your death, your most optimal move would be to get insured. However, if every individual acted in accordance to Nash equilibrium, the insurance rate would be much higher. The fact that it is not is proof that the relative pay-offs and utilities ignored in the equilibrium have a role to play in the real decisions. This makes it important to inspect the second profitable outcome i.e. No Death - Not Insured (Row 2, Cell 2) which will offer us an explanation for the insurance outliers. People choose not to get insured when they perceive the risk of dying as not very high. This can be attributed to either of the following two factors or even a combination of both;

A) They assume the probability of them dying in near future to be very low (thus the perceived benefits from insurance are low) or
 B) They assume the premiums to be too high (thus the loss of utility through payment of premiums is too high) These two perceptions differ with change in age and income level and will be analysed hereunder.

²The idea of quantifying and comparing utilities has been directly borrowed from several existing researches of this kind and the author will simply move ahead with the assumption that such a quantification is possible. Any further explanation on the ordinality of utilities will only complicate the practical application of this game and will serve as a digression from the main topic. But for the sake of clarity, utilities here are measured ordinarily i.e. in orders of preference since it is assumed that the individual has the capability to rate one outcome over the other depending on

A) Impact of Age on Risk Perceptions:

An assumption that we make while drawing out the Nash equilibrium in the above game is that the second player (nature) is completely independent and thus its move in the game is random and cannot be predicted. In simpler words, we assume that death is random and can happen to any person at any time without any con-straining factors. However, there are certain factors that influence the probability of death such as health of the person, his lifestyle, family's medical history etc. If we take health as a factor impacting probability of dying, then we can make this variable less random and this can help us make a more calculated choice. The most ob-vious and uniformly applicable factor influencing health is age. Ceteris paribus,

health deteriorates as age pro-gresses (after a certain age level). For the following analysis, we consider households within the USA surveyed for their ownership of life insurance. It has been observed in repeated surveys that most life insurance owners in the USA are concentrated along the upper age margins i.e. above the age of 35. The youngest households are the least likely to own life insurance and furthermore the percentage of households with the bread earner below the age of 35 covered by life insurance have been declining over the years. The following table by the Life Insurance Management Research Association (LIMRA) survey clearly illustrates the same. ("LIMRA", 2015)

Table 9
Ownership by Age of Household Head

	Percent Owning									Number of Households		
	Individual			Group			Any					
	1998	2004	2010	1998	2004	2010	1998	2004	2010	1998	2004	2010
Under age 35	33%	33%	29%	45%	50%	46%	62%	70%	60%	481	401	1,122
35–44	52	46	45	66	65	54	82	82	75	433	374	758
45–54	60	59	48	70	62	52	87	84	73	370	497	747
55–64	63	57	51	49	53	51	80	80	75	172	480	757
65 or older	52	60	52	27	29	40	74	77	70	187	345	382
All households	50%	50%	44%	52%	52%	49%	76%	78%	70%	1,644	2,143	3,766

Table. 2 Source: Household Trends in U.S. Life Insurance Ownership, LIMRA Report. These results have seen being replicated in a number of such surveys.

Thus it is seen that younger households are less likely to buy a life insurance policy and thus constitute the largest section of the outliers. It is important to understand this find against the backdrop of the policy rates and their relation with age. For any life insurance policy, the premium rates increase with increase in age, typically by about 8 per cent to 10 per cent for every year of age. This means that a 55 year old will have to pay an ap-proximately 80 per cent higher premium than a 45 year old to purchase the same life insurance with the same coverage and same—if any—term period. The reason for this is that every successive year inches you one year closer to your life expectancy or in grimmer terms, to your death. The higher your age, the higher is the probability of you dying within the coverage period and this consideration is most important when determining in-surance premiums. This can be better illustrated through the mortality or morbidity table which shows the prob-ability of death or the likelihood of a person of a certain age dying before his/her next birthday. The mortality rate quantifies the probability of death and is naturally a figure between 0 and 1, 0 being the least probable and 1 being the most. As is seen in the table, the mortality rate rises with rise in age and so naturally the premium amount also increases. This is because at a higher probability of death, the insurer takes up a much higher risk of the person dying and so the probability that the insuring company will have to pay the indemnities is also very high. So higher the age, pricier it is to procure an insurance coverage. This implies that it would cost an individual much more to get an insurance coverage at a later age than it would to get the same coverage earlier. Superimposing these results on the previously obtained information, one is faced by an irony. There is a higher tendency among individuals to purchase life insurance at a higher age in spite of the fact that it would cost them a lot less to purchase the same insurance at a lower age. Inferentially, individuals attribute a higher

weightage to mortality rates than to the rates of premium while calculating their trade-offs for buying a life insurance. Since the probability of dying at a younger age is low, individuals are willing to take on the mortality risk and defer availing an insurance so as to not forgo the loss of purchasing power through premiums. However, the same individual at a higher age, is much more likely to avail the life insurance as the probability of death is higher thus making the insurance more beneficial in terms of likelihood of returns. This clearly shows the competing priorities at different ages wherein at a lower age individuals prioritise purchasing power while at a higher age they prioritise security.⁴

In order to understand the impact of the probability of death on an individual's perception of risk, let us specify the trade-offs in more concrete terms. Let L be the loss of utility due to premium payments, P the probability of death which is directly proportional to age of the person and W the worry factor which quantifies the worry caused due to risk of not having an insurance cover.

Intuitively, $Worry \propto Probability (Death)$ as higher the mortality higher is the risk taken on by the individual and therefore higher is the worry. Therefore, the Worry factor will be compounded with every rise in age.

An individual will be willing to buy an insurance cover as long as the following equation holds; $L \leq$

That is, insurance will be purchased as long as the disutility arising through risk of death outweighs the disutility due to loss of purchasing power. So, if the real income of an individual remains more or less constant, the Worry factor will intensify with rise in age and so the individual will be more likely to get an insurance cover.

B) Impact of Rate of Premium on Relative Pay-Offs:

The other factor that impacts purchase of insurance is the rate of premiums contrasted against the individual's purchasing power. At what rate of premium will an individual buy an insurance considering he/she has a certain level of income? The obvious answer is - when the premium is less than or equal to the risk perception. According to the LIMRA survey, life insurance ownership increases with household income. The following table indicates this trend and also shows that the purchase of insurance has fallen for people across all income groups.

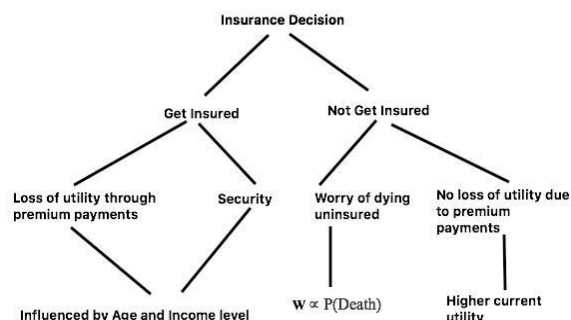
Ownership by Household Income*									
	Percent Owning						Number of Households		
	Individual		Group		Any				
	2004	2010	2004	2010	2004	2010	2004	2010	
Under \$35,000	34%	31%	22%	18%	53%	42%	239	816	
\$35,000-\$49,999	53	40	53	44	82	66	439	765	
\$50,000-\$99,999	52	46	68	62	89	81	467	1,490	
\$100,000-\$124,999	58	53	70	67	88	85	339	358	
\$125,000 and over	65	59	66	65	93	86	457	336	
All households	50%	44%	52%	49%	78%	70%	2,143	3,766	

Table. 4 Source: Household Trends in U.S. Life Insurance Ownership, LIMRA Report.

Usually players in a game try to find a minimax solution i.e. to maximise the minimum gains or minimise the maximum losses. In this case, the individual aims at minimising his losses if death does not occur. This is different from the Nash equilibrium as it goes ahead with the assumption that the most favourable outcome will happen. In our context, it refers to a player who will assume that he is not going to die in the near future and will thus abstain from getting an insurance cover to avoid the opportunity cost of having to forfeit the purchasing power lost through premium payments.

Given the objective of avoiding this cost, the rational thing to do is to refuse to buy insurance until $P > L$ i.e. the probability of death is greater than disutility due to premium payments. Now, assuming that L is larger for low income households (as premium outflows will hurt their incomes to a greater extent than they would to high-income

households), it naturally follows that these households would be less likely to get covered.



C) The Market for Lemons and its Impact on Insurance Purchase:

Insurance decision is also influenced by the other individuals in the insurance net. Potential insurance buyers may be deterred due to adverse selection. The problem of adverse selection, also known as the lemons problem, explains how low quality goods drive out high quality goods from the market. The same also applies to insurance markets. Insurance companies cannot sufficiently distinguish high-risk individuals from low-risk ones. If it anticipates adverse selection, it raises its premium which breeds further adverse selection. As a result, people with lower risk no longer find it viable to buy the insurance policy knowing that they will be paying for someone else's risk. Thus high-risk people drive low-risk people out of the market.

Furthermore, there is also the illusion of moral hazard. Individuals with lower risk perceive themselves to be on the receiving end of an unjust risk burden. The insurance company, by pooling the risk of all the insured, reduces its overall risk by laying it over a wider space. But at an individual insurer level, the risk may be elevated. The high risk individuals benefit at the cost of low risk one due to the levelling effect. A low risk individual seeking to buy an insurance might find it more viable not to do so if he is able to make this calculation and weigh his pay-offs accordingly.

D) Behavioral Factors Influencing Insurance Decision:

The risk perceptions of individuals depend upon their estimation of the probability of death and utility that they expect to derive from various choices. Usually these estimates are a mixture of objective and subjective elements. The objective elements include past experience, empirical data and an analysis of present situation. The subjective elements are impacted by the psychological makeup of the individuals. These psychological elements involved in the decision making introduces an additional layer of complexity in the decision

1. **Confirmation Bias:** Confirmation Bias is the tendency of interpreting data in a way that confirms one's pre-existing beliefs. It is based on inductive reasoning based on the limited information available to individuals and may thus not be completely correct. Individuals may defer the purchase of an insurance policy if they perceive their personal loss from the information asymmetry in the insurance market to be very high. In particular, a person who understands the insurance sector would be able to justify his not buying an insurance through the idea of market of lemons.
2. **Short-termism:** It refers to an excessive focus on short-term results at the expense of long-term interests. Individuals tend to give a higher weightage to the current utility at the cost of future stability. Thus they may desist from buying a life insurance as it adversely impacts the current purchasing power

Illusion of Control Bias: The illusion of control is the tendency for people to overestimate their ability to control events. This is a very important factor that influences investment decisions and may be responsible

for a large number of outliers. To many people, buying an insurance is akin to letting go of the reins to one's life. People tend to believe that they can control the circumstances and time of their deaths to a great extent. They do not ascribe a high

2) Probability to untimely death and thus abstain from taking insurance.

3) **Availability heuristic:** People who cannot recall to mind recent deaths in their families tend to be affected by this bias. A person who has experienced a recent death is more likely to get himself insured. On the other hand, people who observe the insured around them getting no returns from their coverage may have less inclination to get coverage themselves. Thus behavioral traits also play a great role in impacting insurance decisions and in many cases may be the reason of the insurance outliers.

Conclusion:

The theoretical analysis of insurance decision-making produced some rather interesting results. It demonstrated how individuals weigh their relative utilities based on their perceptions of the probability of death and premium rates. It also revealed the competing priorities at different ages wherein at a lower age individuals prioritise purchasing power while at a higher age they prioritise security. Furthermore, through the use of ideas based in behavioural economics, the author was able to rationalise the decisions of the insurance outliers thus going beyond theoretical modelling and making space for the formulation of a practicable solution to the problem of insurance eluders. The inferences drawn through this research may perhaps be utilized in designing an appropriate nudge architecture to integrate the insurance outliers into the mainstream. However, that is beyond the scope of this research and will thus be left open to further studies.

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