Essay Question 1

Lay out a model of screening in an insurance market. Explain why, if the proportion of the 'safe' type in the population is sufficiently high, the model may not permit any equilibrium. Provide examples of real-life insurance markets and discuss the relevance of the model.

Word Count: 1495

Note: All graphs used in this essay were created using R.

Introduction

Adverse selection, a situation of asymmetric information, may emerge in a competitive insurance market when customers possess private information about their risk, and use this to their advantage when buying insurance. Insurance companies recognize that separate risk types represent different profitability and thus employ a screening strategy, first developed by Rothschild & Stiglitz (1976), which attempts to distinguish risk types, with the intuition that 'risky' customers will buy more insurance than 'safe' customers. This screening process, where individuals self-select into separate risk groups, succeeds and results in an equilibrium, whereby 'safe' types choose to purchase only partial insurance coverage, and 'risky' types choose full insurance. However, when the proportion of 'safe' types in the market is sufficiently high, all risk types favor an identical so-called 'pooling' contract. Such a contract cannot be an equilibrium because insurers can always offer an alternative contract which is preferred by the 'safe' types. It follows that under these conditions no equilibrium exists. Following the discussion of the model, I review an empirical study of the auto-insurance market in Singapore, which finds evidence of adverse selection and a positive coverage-risk relationship among policyholders.

Model Overview

First, I present a brief overview of the model. The competitive insurance market can be simplified into a two-player game such that there are competing insurance companies who sell insurance and a population of individuals who buy insurance. Individuals can be classed as S ('safe') or R ('risky') types, where the probability θ, of incurring a loss is greater for R types than for S types and lies between 0 and 1:

$$0 < \theta^S < \theta^R < 1$$

Both types have initial wealth W. For simplicity, assume the proportion of safe and risky individuals in the population is equal and assume that when a loss occurs they lose all their wealth. Each insurance company offers a single insurance contract $C \equiv (K, L)$, where K is the insurance premium and L is the pay-out if the loss occurs. Upon purchasing insurance, individuals have $W_1 = (W - W) - K + L$ if a loss occurs, or $W_0 = W - K$ if no loss occurs. Individuals all have the same concave utility function $U(\cdot)$ and are risk averse. The contract C gives an individual of type i in (S, R) expected utility $V^i(C)$ which simply takes a weighted average of the utility derived from each state multiplied by the probability of that state occurring. This is captured in equation (1).

$$V^i(C) = (1 - \theta^i)U(W_0) + (\theta^i)U(W_1) \tag{1}$$

Insurers get expected profits $\pi^i(C)$ and are risk neutral, meaning equilibrium contracts must make zero profits as in equation (2).

$$\pi^i(C) = K - \theta^i(L) = 0 \tag{2}$$

Perfect Information

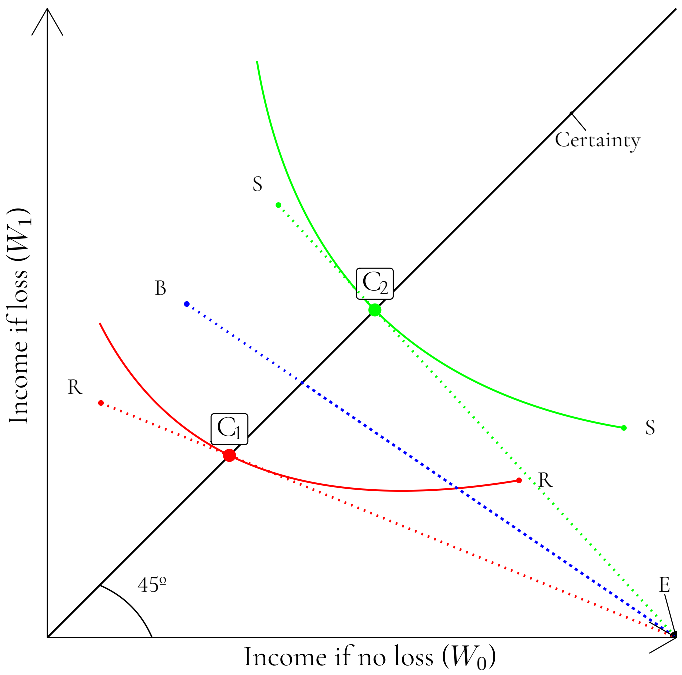


Figure 1: Equilibrium under perfect information

To begin, it is helpful to examine the equilibrium outcome under perfect information which exists when insurance companies are able to observe individuals' types. Figure 1 shows this result graphically. The 45° certainty line represents full insurance, i.e. equal income in the states 'loss' and 'no loss'. The curves S and R are indifference curves for each type and indicate preferences towards each state and utility increases when moving away from the origin. Line segments ES, EB and ER are the firms' zero-profit lines. EB represents the zero-profit line when both types choose the same contract. All agents, without insurance, start off at the endowment point E, where they possess wealth W. The perfect information equilibrium consists of full insurance contracts: C1 for the R type and C2 for the S type. C1 and C2 maximise the expected utility, $V^i(C)$ from equation (1) for both types. From Figure 1, it becomes apparent that C2 allows a higher overall income in both states than C1 due to the fact that R types pay a higher premium than S types, owing to their increased risk.

Asymmetric information

In reality, insurers are unable to observe individuals' types. There exist two possible equilibrium outcomes: pooling, where both groups choose the same contract or separating, where each group chooses a separate contract.

Pooling Equilibrium

First, consider the proposed pooling contract, C3 on Figure 2. For a pooling equilibrium to hold, it must be that a contract makes zero-profits, lies on the EB zero-profit line, and no profitable deviation exists. The single-crossing property states that indifference curves may only cross once (Belli 2001). From this property, it follows that a contract such as C4 may be offered, which the S type prefers to C3. In fact, any contract that lies below the ES zero-profit line and between the two indifference curves, would be preferred by the safe type and therefore a pooling equilibrium is impossible.

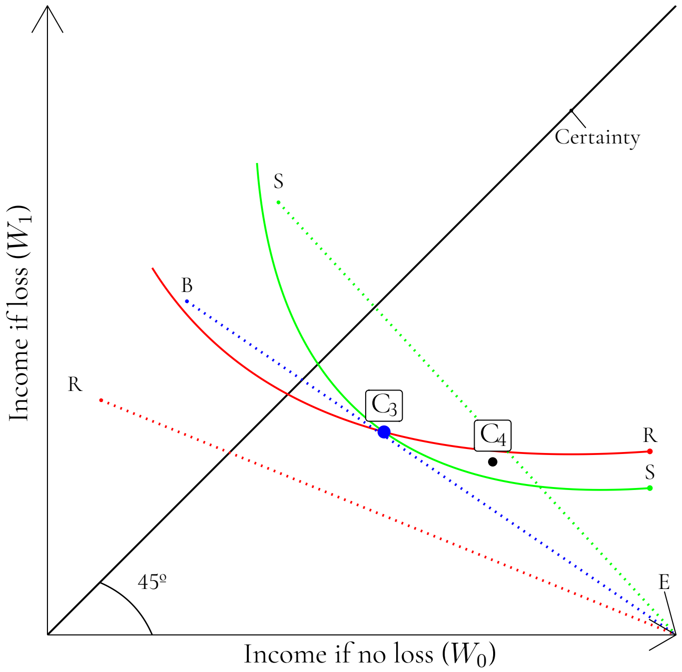
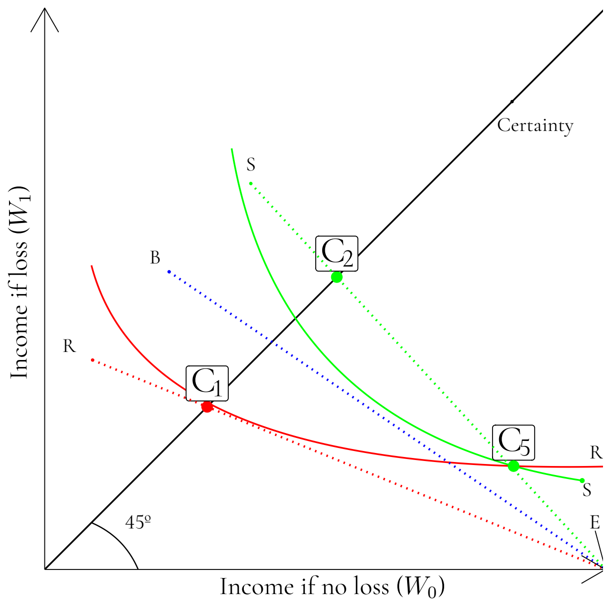


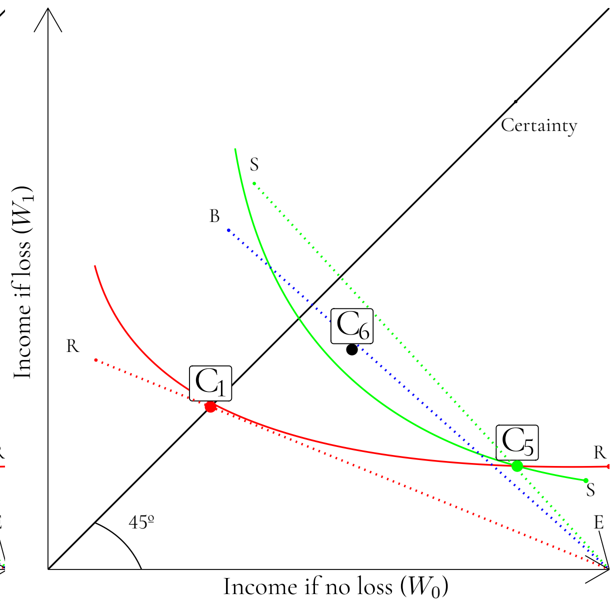
Figure 2: Pooling equilibrium under asymmetric information

Separating Equilibrium

Next, consider a separating equilibrium, where individuals choose different contracts. Figure 3(a) shows the result when a separating equilibrium exists. Recall C1 and C2 as the equilibrium contracts under perfect information. Under asymmetric information, however, two incentive constraints must be introduced. These constraints stipulate that each risk type must prefer to purchase the contract which is intended for them, as opposed to the contract designed for the other risk group (Crocker & Snow 2011). C2 violates this constraint since, if offered, both types would prefer this contract to any other. The result would be a pooling equilibrium which was previously shown to be impossible. Therefore, the only possible separating equilibrium is given by contracts C1 and C5. R types purchase full insurance at C1 while S types purchase only partial insurance at C5. Finally, I address the case of non-existence, shown in Figure 3(b). If the proportion of safe types in the population is sufficiently high, the EB average zero-profit line shifts closer to the ES zero-profit line. Furthermore, now any contract which lies between the EB zero-profit line and the S indifference curve can be offered as an alternative pooling contract to C1 and C5. A contract such as C6, would be preferred by both types and so they deviate to this contract. However, once again, this would result in an unsustainable pooling equilibrium. Therefore, when the proportion of safe types in the market is too high, an equilibrium fails to exist.



(a) Existence



(b) Non-existence

Figure 3: Separating Equilibrium under asymmetric information

Examples of real-life insurance markets

Following the discussion of the screening model, it now stands to ask whether the model has any merit in real insurance markets. Most studies in the literature test for a coverage-risk correlation, which if positive suggests the presence of adverse selection. Shi et al. (2012) investigated the auto-insurance market in Singapore to test for this.

In Singapore, car owners and drivers are required to purchase a mandatory insurance policy which constitutes a minimum level of 'third party' insurance which covers incidences of death and injury to third-parties and some form of liability against damage to the third-parties vehicle. If individuals want coverage beyond this, they must purchase an additional comprehensive policy which covers losses such as theft, fire, damage to the policyholders vehicle and medical expenses, which may be incurred due to an accident.

Using a large cross-sectional dataset, Shi et al. (2012) were able to identify the accident probabilities of individuals who only purchased the third-party insurance and those who purchased the additional comprehensive insurance policy. They found that those who purchased the comprehensive policy had, on average, a higher accident probability (13.72%) than those who opted to only choose the third party insurance (5.67%). This suggests there is a positive relationship between

risk and coverage choice. They proposed that a driver's experience level serves as a valid indicator for ones knowledge of the risk of driving. Therefore, individuals were classed into beginning drivers (<3 years experience) and experienced drivers (more than 3 years experience). Testing for a risk-coverage relationship they found a significant relationship for experienced drivers but not for beginning drivers. This result agrees with the model presented. Those individuals who possess hidden information about their risk (the experienced drivers) self-select into different risk groups, where the riskier individuals purchase the comprehensive policy and individuals who feel they have low accident risk maintain only the third party insurance, resulting in a separating equilibrium.
However, in contrast to this, other studies such as Cardon & Hendel (2001) investigated the U.S. health insurance market with a sample of over 13,000 households and concluded that any coverage-risk correlation could be explained by observable information and thus found no evidence of adverse selection.

Conclusion

In conclusion, adverse selection distorts the market outcome such that safe type individuals are forced to purchase partial insurance to signal their type, while risky types receive full and fair insurance. Furthermore, when too many safe types are in the market, no set of contracts can be offered which sustain an equilibrium. The empirical evidence from the auto-insurance and health insurance markets show that the model may be accurate for some real-life insurance markets but seems to lie within its limits as a theoretical model which overall does not always accurately explain the real-world.

References

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