CHAPTER 3

THEORETICAL BACKGROUND

3.1 Economics of Information: Asymmetry

A market with asymmetric information or imperfect information is defined as a situation where one party has more information than the other party in the same market. The problem of asymmetric information prevents the market from achieving economic efficiency. For instance, in a market for used cars, the seller has more information than buyer regarding the quality of the car and he also has incentive to keep that information from the buyer. This will cause the buyer does not purchase the car because they are uncertain about the quality of the car. In other words, the buyer does not want to engage in the transaction, although the seller emphasis the car is of high quality. Therefore, there is inefficiency for used cars market.

The insurance market is also one of the markets with imperfect information. The insured typically has more information than insurer about his risk types. Thus, the insurer tends to get information from insured in order to determine the insured's risk type and then prepares a set of fair market premium according to the risk. For those high-risk insured, he will be charged higher premium if compare to the low-risk insured.

On the other hand, the insured has an incentive to understate his probability of loss if we assume that the insurer is unable to discriminate the risk type of insured. As a result, the problem of adverse selection occurs in the insurance market where the high-risk insured is misapprehending his probability of loss and paying the premium for the low-risk insured.

The presence of high-risk insured in the market will increase the number of claims since the insurer cannot distinguish between the high- and low-risk insured. Thus, the insurer increases the insurance premium due to the increment of claim amount. The low-risk insured will not purchase an insurance policy because he is unwilling to pay for a higher premium. The low-risk insured leaves the insurance market will cause the premium increase continuously. Finally, only the high-risk insured purchases an insurance policy with high premium, whereas the low-risk insured will drop out from the market. Therefore, the problem of adverse selection precludes the insurance market from efficient performance.

3.1.1 Theory of adverse selection[17]

Rothschild and Stiglitz (1976) studied the problem of adverse selection, in non-life insurance market. In their model, there is a group of insurers who try to attract the customers to purchase insurance. Low-risk customers have a low

[17] Refer to Macho-Stadler, Inés and Pérez-Castrillo, J. David. (1997), "An Introduction To The Economics of Information", p.142

probability of accident, π^G, while high-risk customers have a high probability of accident, π^B where $\pi^G < \pi^B$. The customers have initial wealth, W, if no accident happens. However, they only have net wealth of $W - L$, where L is a loss of accident, if they are involved in an accident.

All customers are risk-averse and $U(.)$ represents their utility function, whereas the insurers are risk-neutral. Initially, we assumed that an insurer offers coverage at a price p per unit and each customer chooses his optimal coverage amount. Therefore, low-risk customer has to solve his maximizing problem as follows,

$$\text{Max } \{ \pi^G U(W - L - pz + z) + (1 - \pi^G) U(W - pz) \} \tag{1}$$

Where z is the amount of compensation paid by insurer to customer who incurs an accident.

Then, the low- and high-risk customers will choose their optimal coverage which is determined by the conditions (2) and (3) as below respectively.

$$\frac{U'(W - L - pz^G + z^G)}{U'(W - pz^G)} = \frac{(1 - \pi^G)p}{\pi^G(1 - p)} \tag{2}$$

$$\frac{U'(W-L-pz^B+z^B)}{U'(W-pz^B)}=\frac{(1-\pi^B)p}{\pi^B(1-p)} \tag{3}$$

Now, we assume that the insurers offer contracts in specific price/coverage packages. The customers choose a price and coverage amount at the same time.

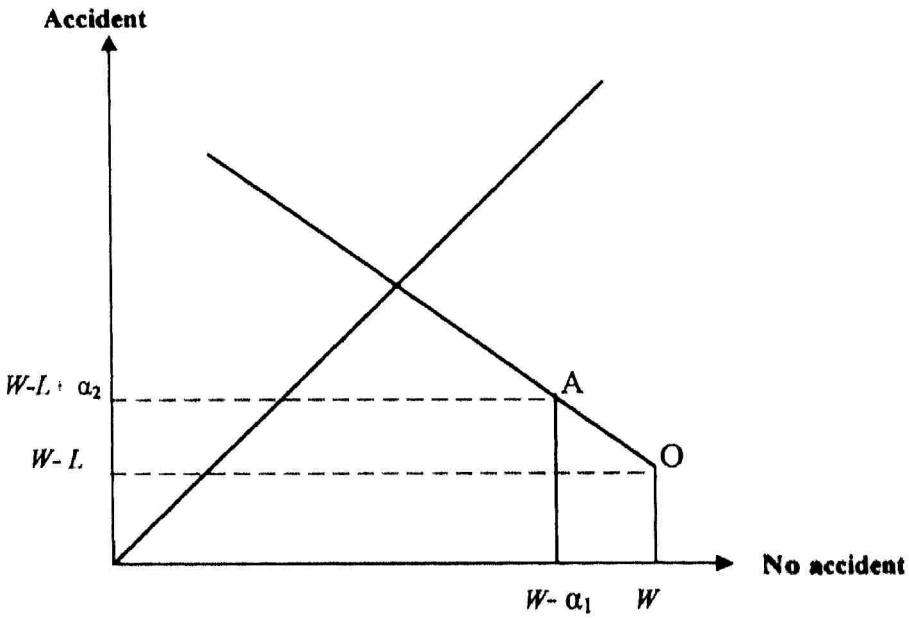

FIGURE 3a Outcome of Occurrence of Accident Versus No Accident

From FIGURE 3a, insurers offer contract A and O, α_1 is the premium and α_2 is the net compensation if accident occurs. In other words, the insurers are offering a price of $\alpha_1 / (\alpha_1 + \alpha_2)$ for a coverage of $z = \alpha_1 + \alpha_2$.

There are two possibilities of equilibrium contracts, namely pooling contracts (α_1 , α_2), for all customers and separating contracts (α_1^B , α_2^B), (α_1^G , α_2^G) that lead to self-selection. Firstly, the pooling contract is said to be not robust to the competition because the insurer still gains positive expected profits. Otherwise, it must be on the line which corresponding to the price, $\rho = q\,\pi^G + (1 - q)\,\pi^B$ where q is the proportion of low-risk customers.

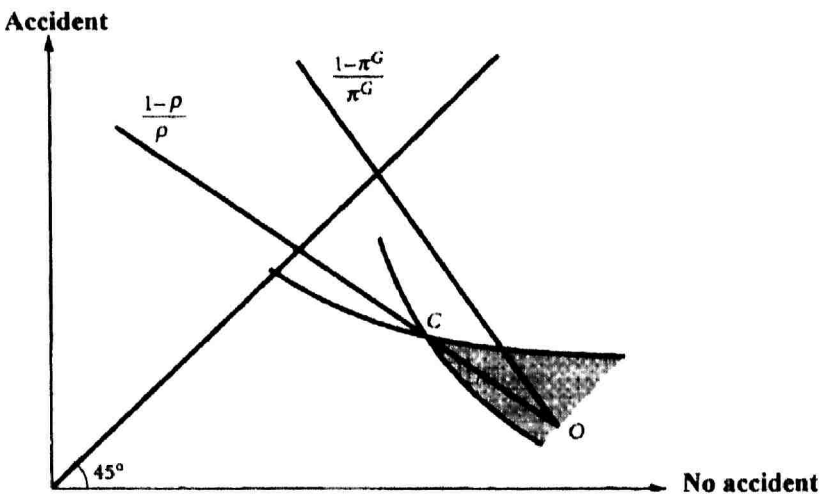

FIGURE 3b Pooling Equilibrium: Pooling Contract Is Not Robust To Competition

The FIGURE 3b indicates that pooling contracts, C is not robust to competition. Low-risk customers prefer the new contract in the darkened area if compared to contract C which is preferred by high-risk customers. Hence, the insurers would offer the new contract to low-risk customers in order to obtain positive expected profit and not offer contract C.

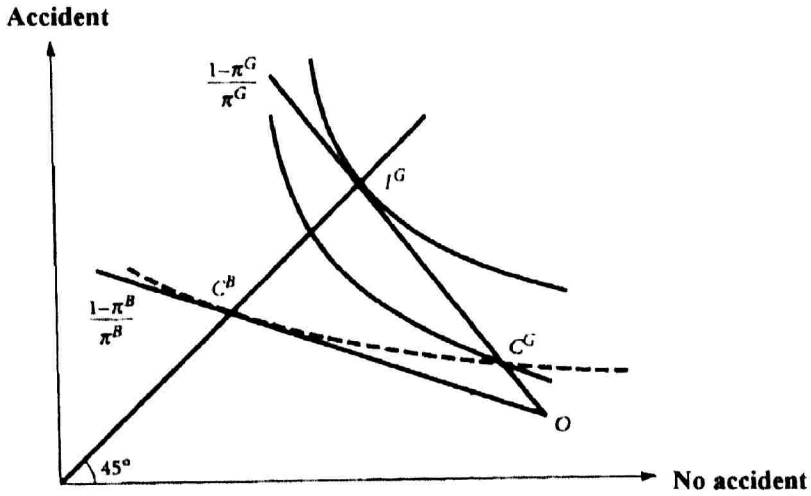

FIGURE 3c Separating Equilibrium

However, FIGURE 3c implies that in the separating equilibrium, the high-risk customers purchase full insurance coverage, C^B, whereas the low- risk customers only purchase partial insurance coverage, which is C^G. Nevertheless, we have to consider the value of q, the proportion of low-risk customers because it is an important element in market equilibrium. For instance, there is non-existence equilibrium in the market if the proportion is relatively high. Inversely, if the value of q is relatively low, then the market will be in separating equilibrium where the two contracts lead to self-selection.

3.1.2 Theory of signaling

Basically, markets with asymmetric information can generate market inefficiencies. However, there are also some market corrections in order to mitigate

the degree of market inefficiencies. Warranties, guarantees, good reputation and name brand are solutions to the market with asymmetric information.

Essentially, signaling generates information about attributes of individuals (Phlips, 1988). Signaling is some activity or decision that proves the concerned party has certain ability or characteristics (Macho-Stadler and Pérez-Castrillo, 1997).

In the labor market, education is a useful signal for employers to screen the capabilities of job applicants. Spence states this as manipulation or activities, which convey information in this context, defined as the signal. However, in credit markets, the low-risk borrowers would like to accept a high collateral requirement but are reluctant to pay high interest rates in order to signal their quality to the creditors.

Likewise, the low-risk insured tends to choose a higher deductible[18] compare with high-risk insured in the automobile insurance market. It is because they want to signal their low probability of accident to the insurers. The high-risk insured parties will not accept high deductibles due to the higher the probability of loss, the higher is the marginal loss in utility associated with accepting less than full coverage. In other words, the high-risk insured parties have higher marginal cost if they accept a large deductible.

[18] Riley, John G. (2002), "Weak And Strong Signals", Scandinavian Journal of Economics 104(2), p. 213-236, deductible is a "weak" sorting device.

To illustrate the signaling equilibrium in insurance market,[19] we consider a competitive market with different types of customers. We assume that the insurers cannot observe the probabilities of accident of customers. Besides that, there are only two types of customers, the high- and low-risk customers with accident probabilities p^H and p^L respectively. In market equilibrium, the different types of customers will purchase different insurance coverage.

As seen in FIGURE 3d, W_1 is income if no accident happens, while W_2 is net income if customers are involved in an accident. The EH and EL are two showing fair odds. The high-risk customers prefer α_H on EH, while low-risk customers prefer β on EL. However, the high-risk customers will switch to β since it can generate more income than α_H. Thus, β cannot be a part of the equilibrium. In other words, the insurance contracts (α_H , β) are not equilibrium. The insurers will offer new contract to low-risk customer, which is α_L.

[19] Refer to Phlips, Louis. (1988), "The Economics of Imperfect Information", Cambridge University Press. p.136

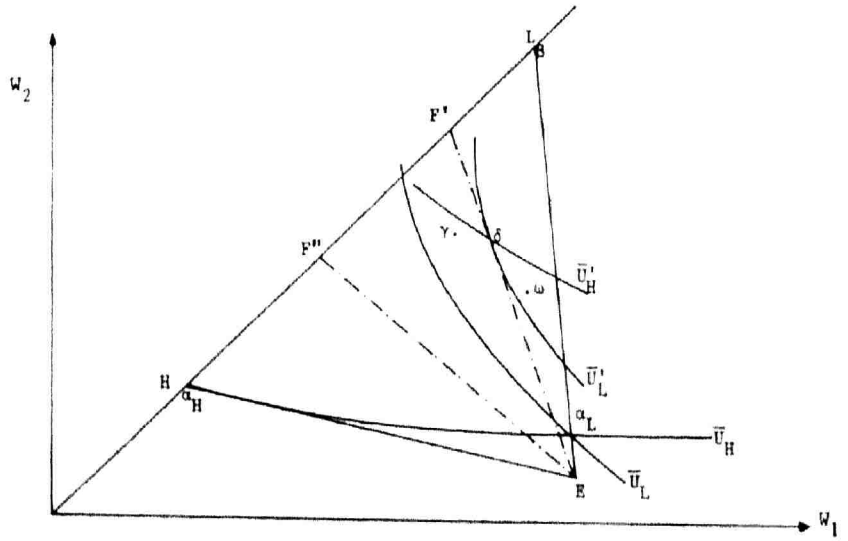

FIGURE 3d Equilibrium Contracts for High-risk And Low-risk Customers

Anyway, in order to analyze whether the insurance contract (α_H , α_L) is in equilibrium for market with low- and high-risk customers, it depends on the proportion of high-risk customer in the pool of customers. In the case where the proportion of high-risk customers is low, the market odds is EF'. All customers will purchase insurance coverage, γ if insurers offer it. Thus, the insurance contracts (α_H , α_L) do not exist in the market. We conclude that there is no signaling equilibrium.

However, in the case where the proportion of high-risk customers is high, the market odds line is EF". Since there is no other contract, which is better or more attractive for all customers, thus, (α_H , α_L) is a competitive equilibrium. In other words, the market has signaling equilibrium where high- risk customers are fully

insured and they do not choose deductible because this saving is unable to compensate their risk in retaining a part of the probable loss (Phlips, 1988). Whereas the low-risk customers will be only partially insured since they are willing to accept a deductible with lower premium.

3.2 Alternative Theory of Adverse Selection[20]

Puelz and Snow (1994) established a simple model for the automobile insurance market. In their model, the premium for an insurance policy, P_τ when insurer obtains zero expected profit as,

$$P_\tau = (1 + k_0)\,[k_1 + \Pi_\tau(X + k_2 + D_\tau) + k_{3\tau}] \qquad (1)$$

Where Π_τ is the probability of loss for a customer X. D_τ is a deductible in an insurance policy. The cost proportional to the net premium is represented by k_0. k_1 and k_2 are the fixed cost of booking and cost of processing a claim, respectively. The charge for cross subsidization is shown by $k_{3\tau}$.

[20] Refer to Puelz, Robert; and Snow, Arthur. (1994), "Evidence On Adverse Selection: Equilibrium Signaling and Cross-subsidization In The Insurance Market", *Journal of Political Economy* 102, p. 236-257

The insurer sets a premium-deductible schedule as below that leads the customer self-select themselves in order to reveal their own probability of loss, due to the insurer cannot distinguish the risk types of customers.

$$P = g(D, z) \tag{2}$$

z is a vector of observable characteristics of customers such as gender. We assume that a customer who has wealth, W and von Neumman-Morgenstern utility function $U(.)$ is risk-averse. Thus, he maximizes his expected utility by choosing the particular level of deductible,

$$(1-\Pi_\tau)U[W - g(D, z)] + \Pi_\tau U[W - g(D, z) - D] \tag{3}$$

When the customer is choosing the deductible $D = D_\tau$, it satisfies the first order condition as follow,

$$\frac{(1-\Pi_\tau)U'[W - g(D,z)]}{\Pi_\tau U'[W - g(D,z) - D]} = \frac{1 + g_D(D,z)}{-g_D(D,z)} \tag{4}$$

We must satisfy these four conditions in order to achieve market equilibrium.

However, we can express the insurance demand function in equation (4) in other form, that is the demand for a deductible,

$$D = f[\tau, \rho, g_D(D, z)] \tag{5}$$

Equation (5) shows that there are three factors will affect the choice of deductible for a customer, namely risk type (τ), the degree of risk aversion (ρ) and marginal price of coverage ($-g_D$).

Then, we use the premium-deductible schedule (2) and the demand function (5) to analyze equilibrium in insurance market. Empirically, the insurance market is in a separating equilibrium if the riskiness shows the significant influence on deductible choice ($f_\tau<0$). Moreover, there is equilibrium with market signaling if the estimated premium-deductible schedule is nonlinear ($g_{DD} \neq 0$), given the influence of risk-aversion and marginal price of coverage on deductible choice.

However, there is a pooling equilibrium in insurance market if the riskiness is insignificant influence on deductible choice ($f_\tau=0$) and estimated premium-deductible schedule is linear ($g_{DD}=0$).

Alternatively, in achieving linear pricing equilibrium with pure competition, the estimated premium-deductible schedule must be linear ($g_{DD}=0$) and the riskiness is statistically significant influence on deductible choice ($f_{\tau}<0$).

3.3 Conclusion

In this chapter, we reviewed the theory of adverse selection as outlined in Rothschild and Stiglitz (1976). The theory of signaling and an alternative theory of adverse selection as established by Puelz and Snow (1994) was also discussed.