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EXPLORING INFORMATION ASYMMETRY IN THE MALAYSIAN AUTOMOBILE INSURANCE MARKET

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Abstract

The study empirically investigates the existence of adverse selection and market signaling in the Malaysian automobile insurance market using data on 345 insured parties under the comprehensive insurance scheme for the year 2001. While adverse selection and market signaling are widely regarded as the outcome of information asymmetry, there have been comparatively few empirical studies testing for their presence in the market. The study attempts to address this need particularly with reference to the Malaysian insurance market. Our findings point to a separating equilibrium with adverse selection. The empirical model derived also provides evidence of the presence of signaling by low risk potential customers within a non-linear pricing equilibrium.

1.0 Introduction

The term insurance may be defined as a system under which the insurer,[1] for a consideration usually agreed upon in advance, promises to reimburse the insured[2] or to render services to the insured, in the event that certain accidental occurrences result in losing during a given period.[3]

In the Malaysian insurance industry, automobile insurance and life insurance comprise two dominant insurance categories. The growth of the automobile insurance industry is extremely important because of its compulsory nature, at least in part, of every motorist's insurance policy.[4] Moreover, the Malaysian automobile insurance industry is evidence of a tremendous socioeconomic transformation that accompanied is high-speed growth since the 1990s.

The study aims to analyze the characteristics of the automobile insurance under competitive markets with asymmetric information or imperfect information, rather than in an environment of perfect information as traditionally assumed. Recently, the outcome of information asymmetry on economic incentives have

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[1] Refer to Willman,George. (1973) "The Penguin Guide To Insurance", Penguin Books, p.233, insurer is the insurance company who agrees to provide the insurance required and accepts the risk
[2] Refer to Willman,George. (1973) "The Penguin Guide To Insurance", Penguin Books, p.233, insured is the person covered or protected by a policy of insurance.
[3] The New Encyclopedia Britannica. (1998), Volume 21, USA: Encyclopedia Britannica Inc. p.741, cited in Kamaruzaman, (2001), p.9
[4] Refer to Willman,George. (1973) "The Penguin Guide To Insurance", Penguin Books, p.233, insurance policy is the document providing evidence and stating the terms of an insurance contract

become important to microeconomic theory. Research has proven that the presence of information asymmetry results in inefficiency as demonstrated in "the market for lemons" detailed in Akerlof (1970) for used car markets.

When knowledge is asymmetrically distributed (Stadler and Castrillo, 1997) between two parties in the same marketplace, it generates problems of adverse selection, moral hazard and signaling. Theoretically, the problem of adverse selection exists in the insurance market. Within a Nash equilibrium,[5] high-risk customers purchase full insurance coverage, whereas low-risk customers purchase partial insurance coverage.

According to the literature, low-risk customers are prone to signal their quality by choosing an insurance policy with higher deductibles.[6] On the other hand, high-risk customers prefer lower deductibles. Market signaling theories predict that a higher price per unit for insurance will be charged for high risk customers as the amount of coverage increases. In contrast, for those who choose high deductibles, they will be compensated by having to pay lower average prices for insurance coverage.

[5] Refer to Black, John. (1997) "Dictionary of Economics", it is a situation in which two or more agents are taking decisions on their strategies, where no agent can gain by any change in their strategy given the strategies currently being pursued by the others. Such a non-cooperative equilibrium is usually not Pareto-optimal, and could be improved on by some form of co-operation.

[6] Refer to Black, John. (1997) "Dictionary of Economics", it is the part of any insured loss which has to be borne by the insured party. The U.K term for this is an excess. The point of making the insured bear the first part of any loss is partly to reduce moral hazard by making them more careful, and partly to avoid the administrative cost of processing numerous small claims.

In this paper, we investigate the market equilibrium in order to ascertain whether the problems of adverse selection and market signaling occur in the Malaysian automobile insurance market. In attempting to analyze the two problems, individual data from a representative insurer in Malaysia is employed to estimate the premium-deductible schedule and the demand function for a deductible. We present evidence on adverse selection in the automobile insurance market with separating equilibrium and market signaling (Puelz and Snow, 1994). These results are consistent with the market signaling theories developed by Rothschild and Stiglitz (1976), Riley (1979,1985), and Cho and Kreps (1987). They proposed that equilibrium in markets with adverse selection entails separating and occurrence of signaling is possible through the choice of deductible. Our results also support the alternative theory of adverse selection as described in Puelz and Snow (1994) that the automobile insurance market entails a separating equilibrium with adverse selection and market signaling. Evidence is derived from the premium-deductible schedule and the demand function for deductibles. Signaling with the possibility of cross-subsidization is consistent with Miyazaki (1977). However, our findings are inconsistent with theories of a pooling equilibrium predicted by Wilson (1977), Grossman (1979) and Hellwig (1987).

Formal analysis of information asymmetry in microeconomic theory commenced about three decades ago (Akerlof,1970; Pauly,1974; Wilson,1977).

Information asymmetry results from the presence of private information where market agents (insured parties or the person covered or protected by a policy of insurance) have information not available to the other party (insurer or the insurance company who agrees to provide the insurance required and accepts the risk).

The existence of information asymmetry in contractual relationships causes the insurance market to under-perform. This is because it destroys the desirable state of contract between the economic agents by raising the possibility of opportunistic behavior such as lying and cheating (Molho, 1997).

Asymmetric information may be categorized under adverse selection, moral hazard and signaling. An adverse selection problem happens when the insured has relevant private information before the contract is signed, whereas the moral hazard problem arises after the contract has been signed (Macho-Stadler and Pérez-Castrillo, 1997).

In fact, the specific terms of adverse selection and moral hazard are believed to have originated from the insurance industry. Both problems can be present in one situation. In the insurance industry, there is a pool of customers or potential insured parties seeking insurance. Some customers are classified as high-risk and the others are deemed low-risk . However, the type of risk is unobservable to the insurer and it has to offer the same premium to every potential insured. Consequently, the market will end up primarily with those from the high-risk group. From the insurers' point of view, they get an adverse selection of customers in the sense that the high-risk group tends to buy insurance or to buy larger amounts of insurance than those in the low-risk group (Cummins, Smith, Vance and VanDerhei, 1983).

The problem of moral hazard could arise in the insurance industry after the customer buys an insurance policy. In such a circumstance, the insured has less initiative in his preventive action in order to avoid an accident from happening. Thus, moral hazard occurs in the industry since the insurer is unable to observe this hidden action of the insured parties.

Lastly, signaling occurs when the insured is able to reveal private information via individual behavior prior to the formalization of a contract (Macho-Stadler and Pérez-Castrillo, 1997).

The paper embodies two main objectives. Firstly, we test for the presence of adverse selection in the Malaysian automobile insurance market. According to the theory of adverse selection, the high-risk group will purchase full insurance coverage, whereas the low-risk group will purchase partial insurance coverage in the market equilibrium with presence of private information or hidden knowledge. Therefore the study analyzes whether our automobile insurance market is consistent with this theory.

Secondly, we are interested in testing whether signaling arises in our automobile insurance market. We would like to know whether the market's characteristics parallel the predictions of market signaling theory, where the high-risk group tends to choose insurance policies with lower deductibles associated with higher average price of coverage, while the low-risk group signal themselves as "high quality" insured by choosing higher deductibles with lower average price of coverage.

Our findings indicate a separating equilibrium with adverse selection. The empirical model also yields evidence of the presence of signaling by low risk potential customers. Moreover, results suggest the possibility of cross-subsidization of high risk customers by low risk ones.

2.0 Literature Review

Recent years have seen the emergence of a number of analytical and empirical studies on various information models describing the nature of equilibrium in markets. Akerlof's (1970)'s work on asymmetric information in "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," explains adverse selection. In particular, he employed examples in the used car market as evidence of private information leading to the malfunctioning of markets. Similarly, asymmetric information in the insurance market leads to a pre-dominance of high-risk types. Akerlof's study has since become the most important contribution to the literature on economics of information.

Rothschild and Stiglitz (1976) developed a model to analyze the equilibrium in competitive insurance markets assuming that customers in the market are identical, although not in term of probability of loss. In addition, the insurers are unable to discriminate the risk types of the customers. Thus, the insurers screened their customers through self-selection mechanism. It was shown that the pooling equilibrium where all customers bought the same insurance did not exist in the market. On the other hand, it was demonstrated that a unique separating equilibrium where the high-risk group purchased full insurance contracts while the low-risk group purchased partial insurance coverage within an environment of asymmetric information.

Wilson (1977) researched the allocation of insurance contracts in competitive insurance markets. In another paper, Wilson (1980) analyzed market equilibrium under three different methods of setting price, where an auctioneer sets the price between buyers and sellers. He provided evidence of equilibrium characterized by a single price only if the price was determined by an auctioneer. Excess demand resulted when sellers or buyers set the price. In other words, the market with adverse selection was sensitive to the system of price-setting.

Riley (1979) discovered non-cooperative equilibrium with incomplete transmission of information via markets. In contrast, there is a unique "reactive" informational equilibrium if the information transfer is complete.

Following Riley's study, Engers and Fernandez (1987) explored the existence of the Pareto-dominant separating and zero profit equilibrium investigated by Cho and Kreps (1987) and Riley (1985) in markets with hidden knowledge and self-selection. They provided the evidence of its existence. Under assumption that the seller had more information than the buyer, they showed that equilibrium was the unique reactive equilibrium by applying Riley (1979)'s reactive equilibrium concept to a market.

Crocker and Snow (1985), pointed out that resource allocations in the market faced additional constraints in the presence of asymmetric information in their study on the relationship between competitive equilibrium and efficient allocations They employed the definition of second best efficiency introduced by Harris and Townsend (1981) to the insurance model by Rothschild and Stiglitz (1976).

Hoy (1982) investigated the impact of imperfect categorizing risk on the welfare criterion in the presence of asymmetric information in the insurance market while Crocker and Snow (1986) examined the efficiency effects of categorical discrimination based on age, sex and race in insurance market.

Empirical analyses of automobile insurance markets have provided evidence that adverse selection exists in almost all insurance markets. For instance, Dahlby (1983) revealed that the Canadian automobile insurance market faced the problem of adverse selection, using data on drivers over the age of 20 for the years 1975-1978.

Puelz and Snow (1994) have also shown that adverse selection arises in the market for automobile collision insurance by utilizing the data for year 1986 based in Georgia. They estimated the premium-deductible schedule and demand function for a deductible in order to test the theories of adverse selection and market signaling. They found that there was separation by risk type in the insurance market: the high-risk group purchased full insurance coverage, while the low-risk group purchased partial insurance coverage. They also showed evidence that the market was consistent with the market signaling theory, where the high-risk group has the incentive to choose low deductibles with relatively high

Richaudeau (1997) also demonstrated the presence of adverse selection in the French automobile insurance market.

In order to address the effects of adverse selection, useful signals have been suggested in the literature. For example, Spence (1973) indicated that the education level is an important signal in the labor market since the employer is otherwise unable to discriminate between high productivity and low productivity employees. Riley (1979), and Lang and Kropp (1986) further developed Spence's signaling model

Overall, interest has gravitated towards evaluating markets under conditions of information asymmetry, as opposed to the traditional assumption of symmetrical knowledge.

3.0 Theoretical Background

Imperfect information typically arises in the insurance market as the insured holds more information than the insurer concerning his risk type. Moreover, 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 the insured. Consequently, the problem of adverse selection emerges in the insurance market where the high-risk insured misrepresents his probability of loss and pays the premium for the low-risk insured.

The presence of high-risk insured in the market tends to increase the number of claims since the insurer cannot distinguish between risk categories. As a result, the insurer increases the insurance premium in response to the increment in total claims. The low-risk insured tends not to purchase an insurance policy because he is unwilling to pay for a higher premium. The low-risk insured leave the insurance market and this causes the premium to increase continuously. Finally, the high-risk insured dominate the market paying high premiums, whereas the low-risk insured, if given a choice, will drop out from the market. Therefore, the problem of adverse selection precludes the insurance market from efficient performance.

3.1 Theory of adverse selection[7]

In Macho-Stadler and Castrillo (1997), the problem of adverse selection according to Rothschild and Stiglitz (1976) is explained in the context of the insurance market. Their model, illustrates competition amongst insurers vying for clients who wish to insure themselves against risk. Low-risk customers are assigned a low probability of accident, given by 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 occurs. However, they only have a net wealth of $W - L$, 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, it is assumed that an insurer offers coverage at a price *p* per unit and each customer chooses his optimal coverage amount. Therefore, the low-risk customer has to solve his maximizing problem given as follows,

$$\text{Max } \{ \pi^G U(W - L - p\,z + z) + (1 - \pi^G)\, U(W - p\,z) \} \qquad (3.1)$$

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

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

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

$$\frac{U'(W-L-pz^G+z^G)}{U'(W-pz^G)}=\frac{(1-\pi^G)p}{\pi^G(1-p)} \qquad (3.2)$$

$$\frac{U'(W-L-pz^B+z^B)}{U'(W-pz^B)}=\frac{(1-\pi^B)p}{\pi^B(1-p)} \qquad (3.3)$$

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.

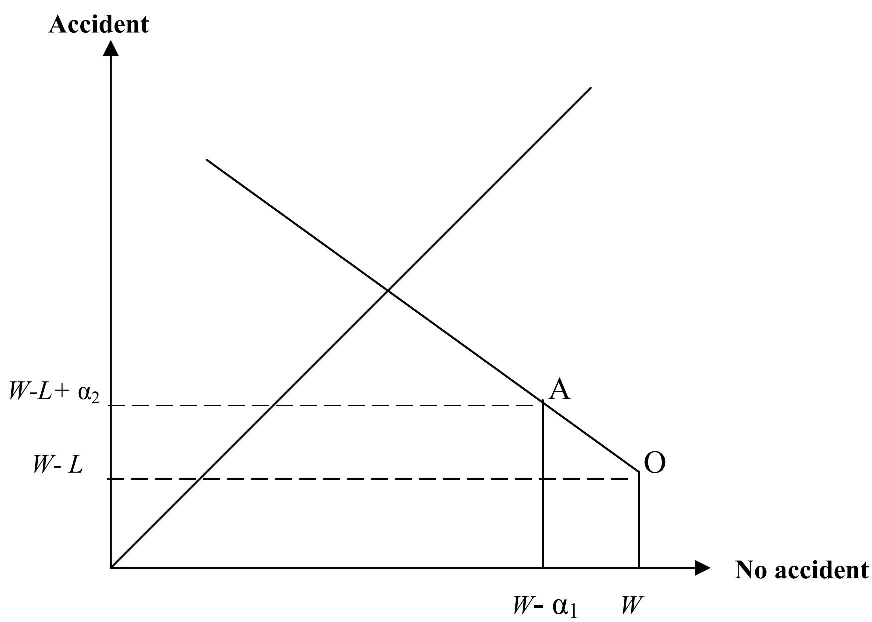

FIGURE 3.1 Outcome of Occurrence of Accident Versus No Accident

In FIGURE 3.1, 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 possible 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 as illustrated in Figure 3.2. Choose any contract C along the price line, $\rho = q\,\pi^G + (1 - q)\,\pi^B$ where q is the proportion of low-risk customers.Assume that a rebel firm offers a contract in the shaded area.

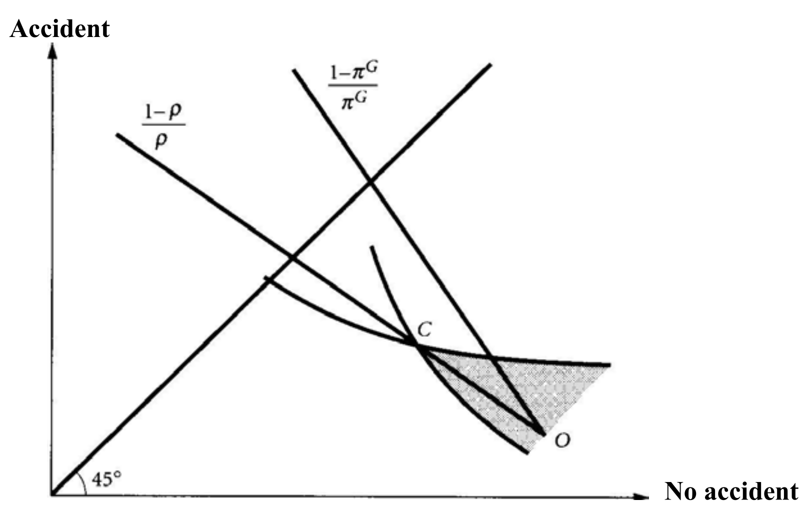

FIGURE 3.2 Pooling Equilibrium: Pooling Contract Is Not Robust To Competition

Low-risk customers prefer the new contract in the darkened area, 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.

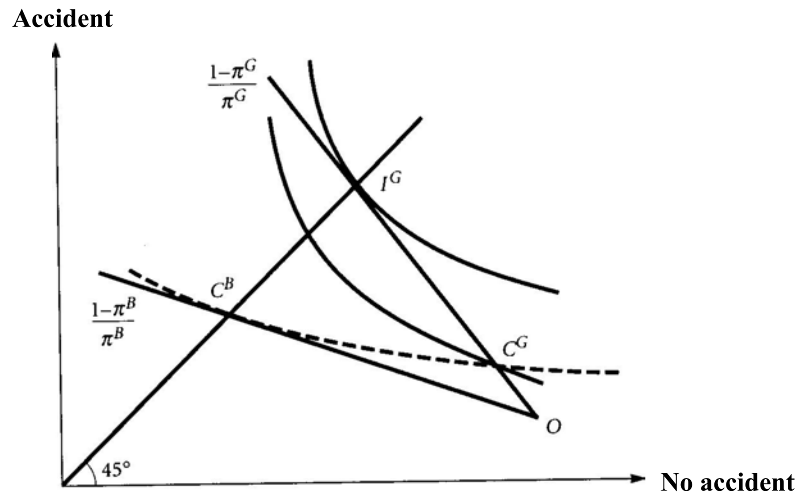

FIGURE 3.3 Separating Equilibrium

On the other hand, FIGURE 3.3 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. High risk agents receive the same allocation under conditions of both symmetric and asymmetric information. In comparison, low risk agents receive I^G under conditions of information symmetry and C^G under conditions of information asymmetry. Low risk agents must pay the consequences of informational asymmetry, as they are not permitted to fully cover their risk. These are the agents likely to signal their low risk attributes by accepting partial coverage contract (Macho-Stadler and Castrillo, 1997).

3.2 Alternative Theory of Adverse Selection[8]

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 the insurer obtains zero expected profit is given by,

$$P_\tau = (1 + k_0)\,[k_1 + \Pi_\tau (X + k_2 + D_\tau) + k_{3\tau}] \qquad (3.4)$$

Where Π_τ is the probability of loss X for a customer and D_τ represents te deductible in an insurance policy. A cost proportional to the net premium (in particular commission payments to agents) is represented by k_0. k_1 and k_2 are the fixed costs of bookkeeping and the cost of processing a claim, respectively. The charge for cross subsidization is shown by $k_{3\tau}$.

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

$$P = g(D\,,\, z) \qquad (3.5)$$

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8 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

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

$$(1 - \Pi_\tau) U[W - g(D, z)] + \Pi_\tau U[W - g(D, z) - D] \qquad (3..6)$$

The level of deductible chosen, $D = D_\tau$, satisfies the first order condition as follows,

$$\frac{(1 - \Pi_\tau)U'[W - g(D,z)]}{\Pi_\tau U'[W - g(D,z) - D]} = \frac{1 + g_D(D,z)}{-g_D(D,z)} \qquad (3.7)$$

The above four conditions must be fulfilled in order to achieve market equilibrium.

The insurance demand function in equation (4) may be restated as an expression showing the demand for a deductible,

$$D = f[\tau, \rho, g_D(D, z)] \qquad (3.8)$$

Equation (5) shows that there are three factors affecting 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) are employed in the equilibrium analysis for the market. Empirically, the insurance market is in a separating equilibrium if riskiness exerts a 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 the insurance market if riskiness lacks statistical significance in terms of its influence on deductible choice ($f_\tau=0$) while a linear estimated premium-deductible schedule ($g_{DD} =0$) suggests pure price competiton linked to a linear-pricing equilibrium.

4.0 Methodology

Cross sectional data set is used, drawn from a representative insurer domiciled in Malaysia for 2001. The sample contains data on 345 insured parties under the comprehensive insurance scheme. For each data point, we have information not only regarding the gender and age for an individual insured, but also his claim history. We also know the characteristics of the corresponding automobile such as its age, cubic capacity and so on.

In this section, we employ the empirical model in order to test for separation and nonlinearity of the pricing system in the Malaysian automobile insurance market. The premium-deductible and the demand function for a deductible follows the interpretation of Puelz and Snow (1994) as that of the standard hedonic system described in Rosen (1974). We estimate the empirical counterpart to the theoretical models using a procedure first discussed in Bartik (1987) and Epple (1987).

4.1 Testing for non-linearity of the premium-deductible schedule

In attempting to test for pricing system nonlinearity, we estimate the premium-deductible schedule as a reduced form equation as postulated in model 4.1. The variables are described in TABLE 4.1

We assume that the schedule is determined by the market interaction of insurer and customers. Following the model estimation we determine the reliability of results in order to establish if the parameters obtained are theoretically sensible and statistically satisfactory (Kew, 1996).

$$P = \alpha_0 + \alpha_1 Perage + \alpha_2 Male + \alpha_3 Age + \alpha_4 Cubic + \alpha_5 D_1 + \alpha_6 D_2 + \alpha_7 CD_1 + \alpha_8 CD_2 + \mu \quad (4.1)$$

P	Gross premium of insurance coverage
Perage	Age of the insured
Male	=1 for a male =0 for otherwise
Age	Age of the automobile
Cubic	Cubic capacity of automobile
D_1	= 1 for RM 251- 500 deductible = 0 for otherwise
D_2	= 1 for more than RM 500 deductible = 0 for otherwise
CD_1	Interaction variables between cubic capacity and D_1 dummy variable
CD_2	Interaction variables between cubic capacity and D_2 dummy variable
μ	Error term

TABLE 4.1 Variables Description for Model 4.1

A priori, we expect a positive relationship between gross premium and male insured (Male = 1). However, the control variables of perage and age are related negatively to the gross premium. The equation incorporates a set of interaction terms of deductible choice with cubic capacity of the automobile that reflects our suspicions that the marginal premium of insurance coverage varies with the automobile's characteristics.

In model 1, the dummy variables, D_1 and D_2 represent deductibles categories as described in TABLE 4a. D_1 and D_2 are equal to zero when representing the benchmark, that is the RM100-250 deductible category. Hence, we can test for the nonlinearity of the premium-deductible schedule using this benchmark and the fact that the deductible variables interact with other explanatory variables.

The estimates from model 4.1 are very important for us to estimate the marginal effects on the premium of moving from the RM100-250 deductible group to the RM251-500 deductible group and to the group with more than RM500 in deductibles respectively,

$$B1 = \alpha_5 + \alpha_7 C \qquad (4.2)$$

and

$$B2 = \alpha_6 + \alpha_8 C \qquad (4.3)$$

Over the range of deductibles in our sample, nonlinearity is present when the marginal premium between the RM100-250 and RM251-500 deductible differs from the marginal premium between the RM251-500 and more than RM500 deductible.

Therefore, we estimate

$$B3 = \frac{1135.8643B2 - 169.9411B1}{965.9232} \tag{4.4}$$

Since the three deductible categories in the data are: RM100-250, RM251-500 and more than RM500, we use the mean values for each level of deductibles in order to obtain a more representative result. Then, we compare the value of *B3* with the value of *B1*. There is a nonlinear premium-deductible schedule in the automobile insurance market if the value of the calculated *B3* is different from the calculated *B1* (Puelz and Snow, 1994). However, a calculated value for *B3* that equals the calculated *B1* is evidence of a linear pricing system in the market.

We attempt to establish whether the insurance market is characterized by a separating or pooling equilibrium by estimating the demand function for a deductible in the model below via ordered logit.

$$\overline{D} = \beta_0 RT + \beta_1 Male + \varepsilon \qquad (4.5)$$

$\overline{D}$	is 0 for D = RM 100- 250 deductible is 1 for D = RM 251- 500 deductible is 2 for D = more than RM 500 deductible
RT	= 1 for those who filed a claim or more than one claim during year 2001 = 0 for otherwise
Male	= 1 for a male = 0 for otherwise
ε	Error term

TABLE 4.2 Variable Description for Model 4.5

In ordered dependant variable models, the observed outcomes representing ordered or ranked categories. The ordered logit is implemented using the E-views software version 3.1 whereby our ordered dependant variable that is deductible variable $\overline{D}$, must be integer valued.

The choice of deductible, $\overline{D}$ is regressed against two explanatory variables namely, risk type, RT and the gender dummy variable, Male. We use the claim history as proxy for risk types because the latter is unobservable. This identification supported by Boyer and Dionne (1989) is drawn on the argument that the past accident record is a good predictor of an individual's loss probability. The variable, Male serves as a control for variation in risk preferences.

We are interested in demonstrating whether or not the coefficient for risk type RT, statistically significant different from zero in model 4.5. If the sign for RT variable is negative, and if the riskiness has a statistically significant influence on deductible choice, we may conclude that the insurance market is in a separating equilibrium in the presence of asymmetric information. Customers of different risk types are separated by deductible choices: the high-risk type chooses a lower deductible, while a higher deductible is more likely to be chosen by te low-risk customer.

Conversely, we have a pooling equilibrium or equilibrium with perfect categorization in the insurance market if the RT variable shows an insignificant influence on deductible choice. In other words, there is no separation by risk type when the market is in equilibrium.

5.0 Results and Analysis

The results of the analysis from the tests outlined in the previous section are presented here.

5.1 Data Description

The variables which are used in the regression analysis are first described in this Table 5.1. We report the mean values of the variables with the standard deviations in parentheses.

The mean statistics for the variables across deductible levels suggest support for the hypothesized relationships in the model of the insurance market. For instance, the table indicates that the loss frequency increases as the deductibles decline. The loss frequency is calculated as the number of losses divided by the number of exposures. Besides that, it also exhibits the hypothesized trend for the age of individual insured, whereby the older insured are more likely to choose a higher deductible compared to the younger insured.

Deductible Category	D = RM 100 – 250	D_1 = RM 251- 500	D_2 = >RM 500
Number of exposures	103	150	92
Number incurring a loss or claim	20	25	14
Loss frequency	0.1942	0.1667	0.1522
Mean age of automobile	5.41 (3.66)	4.67 (2.98)	5.41 (3.20)
Mean age of individual insured	33.35 (8.62)	36.09 (10.61)	43.51 (9.85)
Mean of cubic capacity	1258.91 (509.76)	1656.57 (410.86)	2492.04 (521.66)

TABLE 5.1 Summary Statistics for Variables Used In The Model

5.2 Testing For Separation

In this section, we test the hypothesis that equilibrium in the insurance market entails low-risk customers choosing insurance policies with higher deductibles. We would like to first consider the result of the estimation for the demand function for deductibles, particularly with regard to the effect of risk type on the choice of deductible. TABLE 5.2 presents the results corresponding to model 4.5. The model provides necessary input for model 4.1 which is why it is discussed first.

Our results show that the RT variable is statistically significant at the five percent level as reported in the TABLE 5.2. It underlines the strong relationship between risk type and deductible choice. We infer that the Malaysian automobile insurance market is in an equilibrium with separation where high-risk customers or those who filed a claim have an incentive to select the insurance policy with a lower deductible. However, low-risk customers or those who have never incurred a loss are more likely to select a higher deductible insurance policy.

These findings are consistent with the market signaling theories developed by Rothschild and Stiglitz (1976), Riley (1979,1985), and Cho and Kreps (1987). They proposed that equilibrium in markets with adverse selection entail separation and occurrence of signaling is possible through the choice of deductible. It also supports the alternative theories of adverse selection, suggested by Puelz and Snow (1994), that automobile insurance market entails a separating, adverse selection equilibrium and market signaling. However, our findings are inconsistent with theories of a pooling equilibrium as predicted by Wilson (1977), Grossman (1979), and Hellwig (1987).

A separating equilibrium is important in the insurance market with asymmetric information. This is because the separation of the two risk types of customers matched with appropriate insurance contracts will enable the insurer to obtain greater expected profits than if only one insurance contract was offered.

Therefore, in the Malaysian automobile insurance market, a menu of several possible insurance contracts provides a better alternative and every customer freely chooses the one most preferred under given conditions. To quote, "I have these schedules, one for each of the possible types you can be. So, tell me which is your type, and I will give you your corresponding contract" (Macho-Stadler and Pérez-Castrillo, 1997) .However, these possible contracts must be correctly designed and each type of customers must select the contract designed for him. Moreover, it is must be such that each customer obtains greater utility by truthfully revealing his type than by deceiving the insurer. Undoubtedly, the insurance market will perform well if all these conditions are satisfied where the customers choose their most preferred insurance contracts tailored to their behavioural types and the insurer also acquires higher profits.

In conclusion, we find evidence that the Malaysian automobile insurance market entails separation by risk types in an equilibrium with adverse selection.

Dependant Variable: $\overline{D}$		
Variable	**Coefficient**	**z- statistic**
RT	-0.1269	-2.71*
Male	0.7283	3.26*

Limit Points			
LIMIT_ 1: C(3)	-0.3819	0.1951	-1.95
LIMIT_ 2: C(4)	1.5319	7.1989	7.19

Akaike info criterion	2.142	Probability(LR stat)	0.004
Log likelihood	-365.529	Schwarz criterion	2.187
Restr. log likelihood	-371.046	Hannan-Quinn criter.	2.159
LR statistic (2 df)	11.034	Avg. log likelihood	-1.059
LR index (Pseudo-R2)	0.015		

* Significant at 5% level

TABLE 5.2 Results based on Model 4.5

5.3 Testing For Nonlinearity of The Premium-Deductible Schedule

The hypothesis which needs to be tested in this section is that of nonlinear pricing of insurance coverage in the market. Firstly, we would like to analyze the regression results for model 4.1. Then we calculate the marginal effect on the premium with respect to the deductible choice by applying the information from the model.

Our analysis commenced with the testing of the overall ability of the explanatory variables, to explain the dependant variable in the model. This was done by referring to the statistical tests, such as the test of goodness of fit (R^2), and test of the overall significance of regression (F-statistics). The empirical finding for the premium-deductible schedule in model 4.1 shows goodness of fit of 0.5551 as reported in the TABLE 5.3. In other words, 55.51% of the variation of gross premium is determined by the explanatory variables in the model. This value is considered high for cross-sectional data. Based on empirical observation, in cross-sectional data involving several observations, one generally obtains low R^2 because of the diversity of the cross-sectional units.[9]

The F value in the table is 52.40, which is a measure of the overall significance of the estimated regression and also a test of the significance of R^2 . At the five percent level, clearly this F value is statistically significant. Therefore, the explanatory variables determine the dependant variable that is the gross premium.

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9 Gujarati, Damador N.(2003), "Basic Econometrics", Fourth Edition, The McGraw-Hill Companies Inc. p.260

A priori, the gross premium is expected to be negatively related to the age of the insured and automobile and positively related to the gender dummy. Based on TABLE 5.3, it shows that these variables have the expected signs as postulated in the model.

Although the per-age variable exhibits the correct sign as expected, it is not statistically significant at the five percent level. The negative value indicates that on average, the premium of insurance decreases as the age of the insured and automobile increase, holding all other variables constant. If the age of insured increases, the premium charges decreases as the older driver acquires more experience. Moreover, it is possible that the older driver exerts more care in driving compared to the younger driver.

The positive sign for the gender dummy parallels expectations. However, it is insignificant at the five percent level. The coefficient for the Male factor is quite high which suggests that holding all the other variables constant, the premium charged on the male insured is higher on average than for the female counterpart by about RM70.60. The probability of accident for a male driver is higher than for a female driver perhaps as a result of inherent differences in driving attitudes.

Although the age of automobile variable is not statistically significant at the five percent level, it has the correct sign as expected. Likewise, the negative coefficient of -128.30 indicates that, if the age of automobile increases one year, the premium charged will decrease by RM128.30 on the average while holding other variables constant. It is postulated that when the automobile gets older, its engine function weakens thus inhibiting driving speeds, and that this indirectly reduces the probability of accidents.

The explanatory variable, cubic, is highly significant at the five percent level in affecting the gross premium. The positive sign implies that an increase in the cubic capacity of the automobile, raises the premium, holding all the variables constant. It serves to capture the engine-size factor in its relation to premium levels. The positive relationship is consistent with expectations, in that a larger vehicle is associated with a higher premium.

Theoretically, there is a negative relationship between the premium and its corresponding deductible. Both D_1 and D_2 have appropriate signs. On average, choosing a higher deductible, namely D_1 or D_2, results in a lower premium. For instance, for those who choose the RM251- 500 deductible, the premium is lower by about RM293.66 compared with the benchmark category, the RM100-250 deductible. Likewise, the premium is lower by about RM121.09 for those who select more than RM500 deductible. However, it is important to note that this is only true if the interactive terms are assumed constant. The marginal effect of deductibles on the premium allowing for adjustment in both D_1 or D_2 as well as CD_1 or CD_2 respectively, has different connotations as discussed in a subsequent section.

Dependant Variable: P			
Variable	**Coefficient**	**Standard Error**	**t- statistic**
Constant	569.71	421.17	1.35
Perage	-0.70	7.72	-0.09
Male	70.60	163.29	0.43
Age	-128.30	26.06	-4.92
Cubic	0.77	0.28	2.72*
D_1	-293.66	586.55	-0.50
D_2	-121.09	775.56	-0.16
CD_1	0.31	0.38	0.83
CD_2	1.02	0.38	2.68*
R-squared	0.5551	Akaike Info Criterion	17.2580
Adjusted R-squared	0.5445	Schwarz Criterion	17.3583
F-statistic	52.4033	Prob(F-statistic)	0.0000*

* Significant at the 5% level

TABLE 5.3 Regression Results of Model 4.1

Our data supports the theory that embodies separation by risk type in an equilibrium with adverse selection in section 5.2, whereby low-risk customers have an incentive to choose higher deductibles. However, this finding is not enough to show the presence of signals to insurers. Therefore, we proceed to test for nonlinear pricing of insurance coverage with respect to deductible choice in order to demonstrate that that low-risk customers can effectively signal their risk types to insurers.

The regression results of the model 4.1 enable us to calculate the values for *B1*, *B2* and *B3* in order to demonstrate that the insurers offer nonlinear pricing for insurance coverage. *B1* represents the marginal effect on the premium of moving from the benchmark deductible category of RM 100-250 to that of deductible category RM 251-500. Likewise , *B2* provides the marginal effects on the premium of moving from the benchmark deductible category to that of the category above Rm 500 in deductibles. The estimated values for *B1* and *B2* at sample mean are 258.6511 and 1676.8797 respectively while the value for *B3* is 1926.3978.

In conclusion, the insurers offer a nonlinear pricing system since the value for *B3* differs from *B1* suggesting a nonlinear premium-deductible schedule. In other words, the average premium for insurance coverage charged by insurers varies with the selected deductible and there is market signaling in the Malaysian automobile insurance market. This result is consistent with the study carried out by Puelz and

Snow (1994), as they found evidence of a nonlinear premium-deductible schedule in automobile collision insurance market in Georgia. Besides that, our results also support the market signaling theories developed by Rothschild and Stiglitz (1976), Riley (1979,1985) and Cho and Kreps (1987 However, our results are inconsistent with the work of Pauly (1974) and Schmalensee (1984), with regard to linear pricing equilibrium in which insurers engage in pure price competition.

The results also show a positive link between the changes in the premium of insurance coverage with respect to deductible choice. This reflects that low-risk customers have to pay a higher-than-expected premium when choosing insurance contracts with a higher deductible. Hence, the low-risk customers are not compensated by insurers as predicted by market signaling theory through the payment of lower premiums for insurance at lower levels of coverage when they purchase the higher deductible insurance policies. Clearly, the insurers in the Malaysian automobile insurance market engage in the nonlinear pricing equilibrium and there is market signaling with cross-subsidization of high-risk customers by low-risk customers. This result supports theory of signaling with cross-subsidization as proposed by Miyazaki (1977).

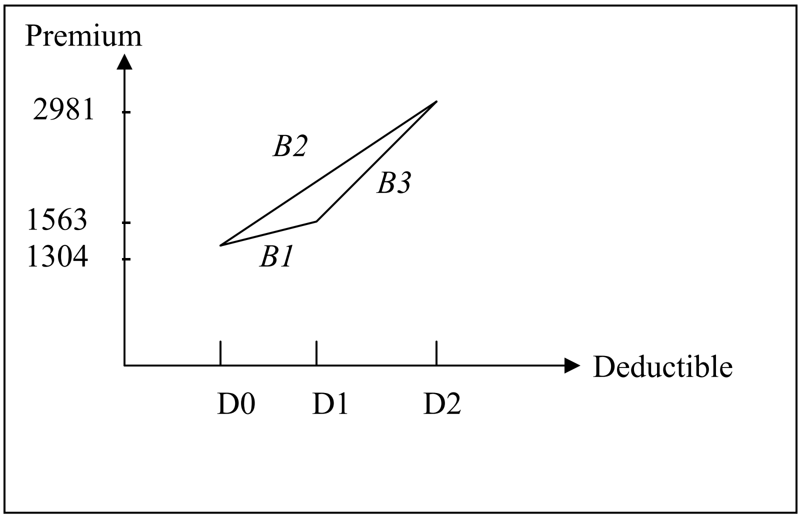

FIGURE 5.1 Nonlinear Premium-Deductible Schedule

(Not drawn to scale)

5.4 Summary of Main Findings

The main findings are illustrated in the form of flow chart in FIGURE 5.2.

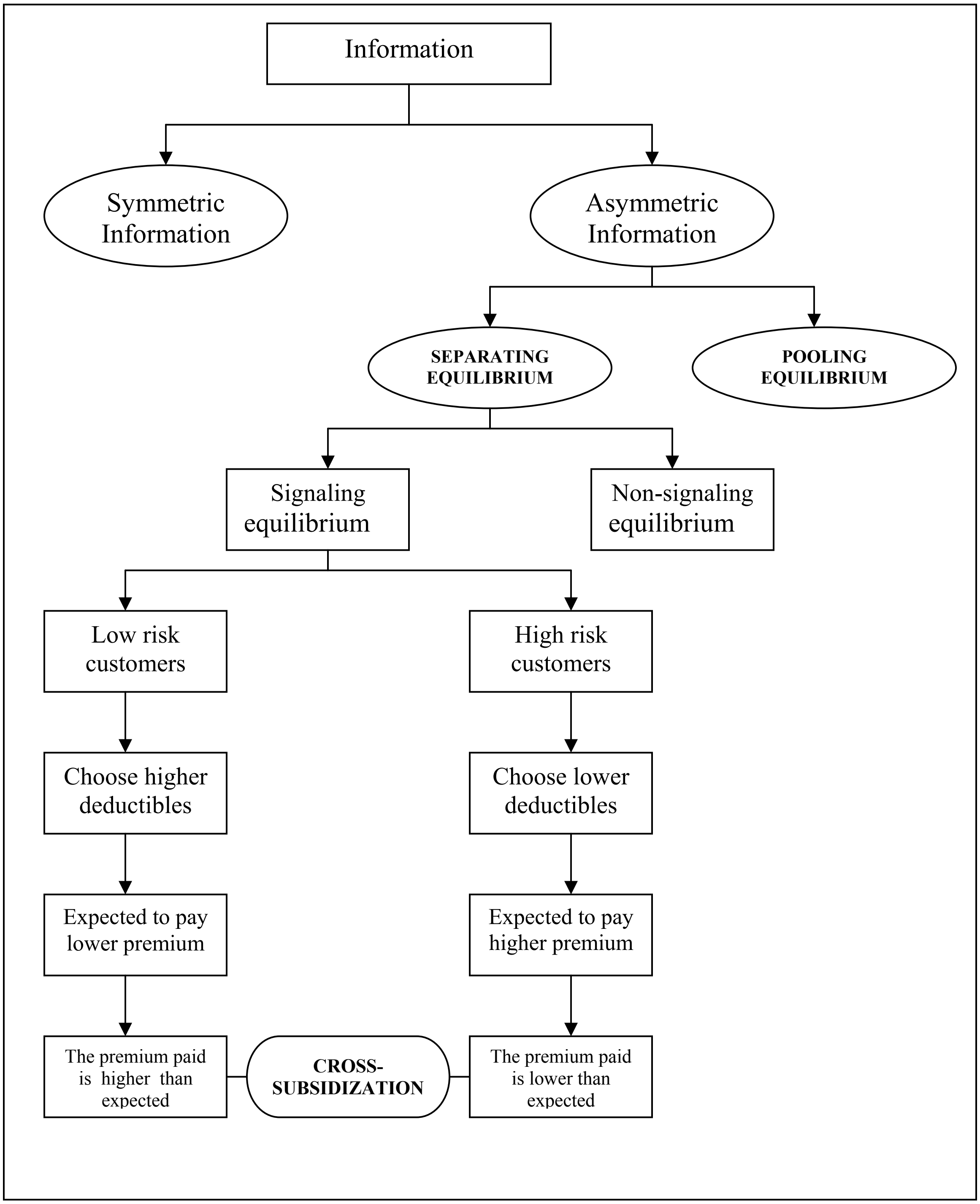

FIGURE 5.2 Flow Chart: Summary of Main Findings

Since there is asymmetric information in the insurance market, the insurer is unable to distinguish between the low-risk and high-risk customers. Therefore, it offers the premium-deductible schedule to encourage customers to select themselves and to reveal their own risk types. Our data indicates that the low-risk customers are willing to choose larger deductibles to convey information with regard to their low probability of serious accidents. They desire to signal that they are good drivers to the insurer. However, high-risk customers prefer lower deductibles. They have no incentive to signal their status to the insurer. In this sense, the information is generated endogenously by the self-selection mechanism.

Therefore, we maintain that the Malaysian automobile insurance market entails a separating equilibrium. This equilibrium implies that different types purchase different insurance policies and that the customers' choices of deductibles are significantly affected by their risk types: low-risk customers purchase large deductible insurance policies while high-risk customers purchase low deductible insurance policies.

According to the prediction of market signaling theories, the low-risk customers who choose higher deductibles are expected to pay the lower premium, whereas the high-risk customers are expected to pay the higher premium because they choose lower deductibles. However, in the Malaysian automobile insurance market, the equilibrium with adverse selection does not satisfy this monotonic signaling property. In reality, the actual premiums paid by low-risk customers are higher than the expected premium, whereas the actual premium paid by high-risk customers are lower than the expected premium.

Why has this been observed in the Malaysian automobile insurance market?

It is interesting that the study postulates cross-subsidization of high-risk by low-risk customers in the Malaysian automobile insurance market. This is due to the fact that all general insurance companies in Malaysia which are the members of PIAM need to follow a standard rating structure known as tariff, which is devised by PIAM and approved by the Central Bank of Malaysia in order to price their insurance policies. According to Section 144 of the Insurance Act 1996, no licensed general insurer or association of licensed general insurers shall adopt a tariff or premium rates, except with the prior written approval of the Central Bank of Malaysia (Kamaruzaman, 2001). Therefore, the insurer has no right to set its own price of insurance coverage under the restriction of regulation.

From the regulators' perspective, in price regulated markets, insurance policies tend to be standardized; it is often as much for the convenience of regulators as it is to assist customer choice. Besides that, with the Malaysian automobile insurance in particular, it is very easy to obtain premium quotations over the telephone for a set of standardized policies differing primarily by the limits on damages chosen, and this low search cost doubtless contributes to the observed outcome.

Although cross-subsidization is unfair in the regulatory context, nonetheless, some cross-subsidy among customers is inevitable especially under competition with imperfect information (Schamalensee, 1984). Moreover, according to Henriet and Rochet (1987), some degree of cross-subsidization between risks could improve market efficiency when adverse selection exists.

6.0 Conclusion

Our investigations appear to verify that the phenomena of adverse selection is consistent with a model of equilibrium in the automobile insurance market. It also exhibits market signaling and findings imply cross-subsidization of high-risk customers by low-risk customers. For analytical purposes, we consider two large groups of otherwise identical individuals who differ only in the probability that they will have accidents. As a result, we find that the customers of different risk types self-select their most preferred insurance coverage at given premium rates. The low- risk types purchase partial insurance coverage while high-risk types prefer full insurance coverage. However, the equilibrium with adverse selection does not satisfy a monotonic signaling property in that the low-risk customers are not being compensated for selecting higher deductibles by paying a lower average premium for their insurance coverage.

The problem of adverse selection originates from the insurance market and it seems inevitable in a market with asymmetric information. Therefore, the insurers try to infer as much as possible about individual accident possibilities from observable characteristics of customers that are correlated with accident experience, as the best way to mitigate such a problem (Grossman, 1979). However, to what extent this results in efficiency remains unconfirmed. Hence, there are avenues for future research.

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