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Advantageous Selection versus Adverse Selection in Life Insurance Market

By Ghadir Mahdavi*

Abstract: The conventional theory of adverse selection ignores the effect of precautionary efforts on the probability of death and also doesn't consider the correlation between the attitude towards risk and risk exposure. The implication of such ignorance will be the insurers end up with high-risk individuals and the market faces the insufficient provision of the policies. However, this theory is not supported by most of the empirical works. The alternative advantageous selection theory assumes a negative correlation between risk aversion and risk exposure and considers the effect of precautionary activity on the death rate. Under these assumptions, insurers end up with relatively low-risk individuals, the market offers sufficient of policies and, the selection effect will be propitious to insurers as more risk-averse low-risk individuals are not only willing to pay more for precautionary efforts but also are more inclined to insure.

We show that under certain circumstances when the individuals are sufficiently risk averse, the probability of death is smaller than its critical value, and the processing cost is sufficiently large the selection effect will be advantageous to the market. We also show that when individuals are not sufficiently risk averse and consequently their probability of death is not sufficiently small, the necessary condition for having advantageous selection regime is the processing cost to be smaller than its critical value.

Keywords: Adverse Selection, Advantageous Selection, Life Insurance, precautionary effort.

Gel Classification: G22, D82, D41

1. Introduction

Adverse selection is originally defined in insurance theory (Rothschild and Stiglitz, 1976) to describe a situation where the information asymmetry between policyholders and insurers leads the market to a situation that the policyholders claim losses that are higher than the average rate of loss of population used by the insurers to set their premiums. According to the conventional theory of demand for life insurance under asymmetric information (See Dionne, Doherty and Fombaron, 2000), life insurers consider the perceived mortality rates of population to set the premium, while the individuals can be divided into two groups of risk level, let's say, low- and high-mortality groups, and the insurance companies can't distinguish between them but the individuals know what group they belong to. Low-risk individuals realize that their mortality rate is low and they are subsidizing high-risk individuals so will be reluctant to insure, while high-risk individuals will have motivation for purchasing more insurance as they are paying less than their real rate and are actually receiving subsidy from low-risk individuals. Consequently, the average mortality rates of purchasers of life insurance is higher than the perceived mortality rates by insurance companies and thus the companies end up with policyholders who are of higher than average risk rates.

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The extent of adverse selection is affected by the reason the individual purchases the product. If the policy is compulsory or is offered by the employer, the effect of adverse selection will likely be less severe than the voluntary policy. The extent of adverse selection is also affected by age, sex, income, wealth, occupation, current health status and the size of policy applied for. It seems that the extent of adverse selection declines over time as people can better guess their health situation for the next year than for many years later. So, the type of policy will also have significant effect on the extent of adverse selection. For example, we expect higher level of adverse selection in short-term life insurance policy than whole-life insurance.

The conventional theory of adverse selection contains the following assumptions: (1) The difference in exposure to risk: People differ in the level of exogenously determined risk exposures. For simplicity, we consider that people are divided into two groups of risk levels, high- and low-risk groups. (2) Positive correlation between self-perceived risk level and real risk level: Adverse selection occurs when the individuals' beliefs about their mortality and their true rates are positively correlated. If not, there will not be a systematic difference between policyholders' and population's mortality rates and hence no adverse selection occurs. (3) No relationship between the level of risk aversion and riskiness: In other words, there's no way to claim whether high-risk individuals are less risk averse than low-risk individuals and vice versa. (4) Customers know more about their riskiness than the insurers and efficiently use their information against the insurers.

The implication of such assumptions will be that insurers facing adverse selection set the premium higher to be able to afford the claims which, results the exit of good risks from the market and insufficient provision of the product.

Despite this straightforward understanding from the conventional theory of insurance demand under asymmetric information, this theory is not supported by most of the empirical works. There are many empirical evidences that appear to conflict with the standard theory of adverse selection in insurance market. Hemenway (1990) finds that at a hospital in Texas, the percentage of insured individuals amongst helmeted and unhelmeted motorcyclists is 73% and 59%, respectively. He also found that amongst drivers, 40 percent of those who wore their seat belt bought insurance while only 33 percent of those not wearing the belt purchased the coverage. Both examples show that high-risk individuals (unhelmeted and not wearing the belts) purchase less coverage.

Cawley and Philipson (1999) using U.S. Teachers Insurance and Annuity Data conclude that asymmetric information is not actually a barrier to trade in the life insurance market as they couldn't find enough evidence on existence of adverse selection in this market. They couldn't find any significant correlation between indicator variables for self-perceived risk and the quantity of term insurance. They also couldn't find any significant effect between actual risk and the demand for life insurance. Surprisingly, they could show negative covariance between risk exposure and the demand of life insurance. They also found evidence of bulk discounts and negative relationship between price and quantity that indicates the fact that low-risk individuals purchase more life insurance. Otherwise, the insurance company will not be able to afford the liabilities of high-risk individuals with lower premiums. They concluded that this can be due to effective underwriting policy and the fact that insurers may know their costs of production better than policyholders and, the insurers' perceived risk rates are more accurate than the rate perceived by customers.

McCarthy and Mitchell (2003) found that the mortality rate of UK and US males and females purchasing term- and whole-life insurance is below that of the uninsureds. For example, they found that mortality rates for male and female purchasers of whole-life insurance are only 77.5 and 68.5 percent of the total population mortality rate for the UK, and 78.6 and 90.9, for the US, respectively.

Siegelman (2004) claims that the informational asymmetries are in the favor of insurers not insureds as insurers utilize various strategies of underwriting and risk classification that compensate for or even overcome informational advantage of policyholders. Moreover, the behavioral or psychological factors help to offset insureds' informational advantages. For example, when there is negative correlation between risk aversion and risk exposure, the additional demand of the higher-risk individuals will cancel out.

Meza and Webb (2001) state that in addition to precautionary effort that explains the negative correlation between insurance demand and risk level, heterogeneous optimism also supports this negative correlation: High risks are more optimistic about the events to be improbable, so they purchase less insurance.

Dachraoui, Dionne, Eeckhoudt and Godfroid (2004) show that more risk-averse agents whose behavior follow the mixed risk aversion utility function may spend more on self-protection activities when the loss probabilities are below 1/2. Jullien, Salanie and Salanie (1999) give the sufficient conditions under which more risk-averse agents exert more efforts to decrease the probability of loss. They show that self protection increases with risk aversion if and only if the initial probability of loss is low enough. These results reinforce the idea of advantageous selection in life insurance market, as the customers' mortality rate is usually very small.

These empirical evidences that contradict the conventional theory of demand for insurance under asymmetric information and adverse selection theory lead us to view the problem from a new perspective.

To describe the contradiction between the conventional theory and the empirical results, we focus on the precautionary effort for avoiding losses. Instead of the assumption that people differ in the level of exogenously determined risk exposures that determines the insurance demand, we concentrate on the assumption that highly risk-avoiding individuals are more likely both to try to reduce hazard by purchasing insurance and taking physical precautionary efforts. In other words, people who buy more insurance tend to be more safety conscious and thus are more inclined to undertake precautionary efforts. Inversely, less risk-averse individuals are less likely to buy insurance voluntarily, and they are the ones most likely to place themselves deliberately in dangerous situations. Consequently, in this setting, the selection effect will be advantageous to the market as insurers end up with a lot of cautious low-risk individuals who are likely to pay for precautionary efforts.

In the next section we develop a model to discuss the effect of precautionary activity on the life insurance demand and to find the conditions under which advantageous selection occurs. In section 3 we find the demands for two groups of different risk levels and the optimal pooling price. Section 4 presents a numerical example to show why low-risk individuals prefer to continue purchasing at the market even though they are subsidizing the high risks. Section 5 discusses the Direction of the effect of parameters on changing the regime to advantageous selection by graphical manipulation. Section 6 concludes.

2. The Model

Suppose all individuals have the same opportunity to lower the probability of death by preventive efforts. Each individual i faces the probability of death $p(e_i)$ where e_i indicates the precautionary efforts and is assumed to affect the probability of death in the same way for all the individuals. We assume $p' < 0$ which emphasizes that precautionary activity improves the survival rate and has negative effect on the probability of death. Letting the function $U(.)$ represent utility in the life state and $V(.)$ utility for surviving members of the household in the death state, the expected utility of a policyholder i is

$$EU_i(e_i, q, W_i, Y_i) = (1 - p(e_i))[U_i(W_i + Y_i - e_i - qx_i(e_i)] + p(e_i)V_i(W_i + (1-q)x_i(e_i)) \quad . \tag{1}$$

The variable q is the insurance unit premium, W_i is the individual's wealth, Y_i is the income and, $x_i(e_i)$ refers to the demand for life insurance which is defined as the total coverage in the event of death. This model suggests that the agents invest in both of precautionary effort for reducing the probability of death and, life insurance for handling the remaining risk. Obviously, the amount of insurance demand should be nonnegative, $x_i(e_i) \geq 0$.

We plan to examine the direction of the effect of death rate upon the demand for life insurance to find the conditions under which the market selection is advantageous for insurers. In other words, we want to show whether advantageous selection can occur in this setting. While the conventional theory is based on policyholder's exogenous risk exposure, our theoretical setup is based on the assumption that precautionary efforts of policyholders and negative correlation between risk exposure and risk aversion determine the level of life insurance demand.

The problem can be stated as

$$\underset{e_i}{Max}\ EU_i(e_i, q, W_i, Y_i) = (1 - p(e_i))[U_i(W_i + Y_i - e_i - qx_i(e_i)] + p(e_i)V_i(W_i + (1-q)x_i(e_i)). \tag{2}$$

The first order condition for maximization is

$$-p'(e_i)U_i(.) + (1 - p(e_i))U_i'(.)(-1 - q\frac{dx_i}{dp}p'(e_i)) + p'(e_i)V_i(.) + p(e_i)(1-q)\frac{dx_i}{dp}p'(e_i)V_i'(.) = 0, \tag{3}$$

where U_i' is the marginal utility with respect to total asset. The terms of V_i' and dx_i/dp are the marginal utility of bequest with respect to asset and the derivative of life insurance demand with respect to the mortality rate, respectively.

The second order condition is

$$\begin{aligned}&\frac{\partial^2 EU_i(.)}{\partial e_i^2} \leq 0\\ &-p''(e_i)U_i(.) - p'(e_i)U_i'(.)q - p'(e_i)U_i'(.)q + (1 - p(e_i))[U_{ii}''(.)q^2 + U_i'(.)q']\\ &+ p''(e_i)V_i(.) + p'(e_i)V_i'(.)f + p'(e_i)V_i'(.)f + p(e_i)[V_{ii}''(.)f^2 + V_i'(.)f'] \leq 0\end{aligned} \tag{4}$$

Where $q = (-1 - q\frac{dx_i}{dp}p'(e_i))$, $f = (1-q)\frac{dx_i}{dp}p'(e_i)$.

Obviously, risk aversion conditions ($U' > 0, V' > 0, U'' < 0, V'' < 0$) are not sufficient to ensure the second order conditions, but we assume the second order condition is met letting the solution be global maximum.

From (3) the derivative of life insurance demand with respect to the mortality rate will be found as

$$\frac{dx_i}{dp} = \frac{p'(e_i)[V(.) - U(.)] - (1 - p_i(e_i))U_i'(.)}{p'(e_i)\{q(1 - p(e_i))U_i'(.) - (1-q)p(e_i)V_i'(.)\}} \tag{5}$$

Our purpose is to find the conditions, once satisfied, the adverse selection regime changes to advantageous selection. The necessary condition for advantageous selection to occur is the less risky individuals purchase more than high risks. Therefore, we should find the conditions that shift the sign of (5) to negative.

Insurers do not permit the customers to purchase more than their expected loss. In other words, the customers are permitted to purchase either full-insurance amount of coverage or partial one. In a full-insurance condition where total loss is completely covered by life insurance compensation or in a partial coverage condition where the coverage is less than the expected loss, the utility from bequest will not exceed that of the consumption [$V(.) - U(.) \leq 0$]. Since $p'(e_i) < 0$ and $0 < p(e_i) < 1$, the following sufficient conditions together result in advantageous selection regime $(dx_i / dp < 0)$.

a) $$|p'(e_i)| > (1 - p(e_i)) \frac{U_i'(.)}{U_i(.) - V_i(.)} \tag{6}$$

b) $$q(1 - p_i(e_i))U_i'(.) - (1 - q)\, p(e_i)V_i'(.) > 0 \tag{7}$$

Condition (6) states that precautionary activities should have considerable effect on pushing the probability of death down. This condition is satisfied when the individuals value the effort so highly that the effect of precautionary efforts on the probability of loss exceeds its critical value. In other words, the individuals should be sufficiently sensitive to precautionary effort. If the individuals are sufficiently risk averse that value the efforts highly, the effect of precautionary efforts on decreasing the mortality rate be considerable.

Condition (7) is satisfied when the probability of loss is sufficiently small and the loading factor is sufficiently large. The insurers can perceive the overall probability of loss and determine the premiums according to this perceived risk rate and a loading factor. The equation $q = (1 + l)\bar{p}$ indicates the relation between price q and the perceived risk level by insurers $\bar{p}$, where l indicates the loading factor. The loading factor is added to the premium to cover the processing cost, contingencies, and to guarantee profit for insurers. Therefore, when processing cost is sufficiently large, the price q will become considerably larger than *p*. This condition together with the condition of having very small *p* guarantees the left hand side of (7) to be positive.

Consequently, when individuals are sufficiently sensitive to precautionary efforts and their probability of loss is sufficiently small while the loading factor is sufficiently large, advantageous selection will be the existing regime for the demand under asymmetric information $(dx_i / dp < 0)$.

This result is logical as more risk-averse low-risk individuals can tolerate higher increase in prices and deductibles incurred because of any increase in processing cost. Shortly speaking, when people are sufficiently risk averse and their corresponding mortality rates are sufficiently small, the necessary condition for having advantageous selection regime is the processing cost to be larger than its critical value.

If individuals are sufficiently sensitive to precautionary efforts and loading factors are sufficiently large, the implicit critical value for probability of loss “p” that guarantees the advantageous selection regime will be found from (7) as

$$p_{im}{}^{C} = \frac{qU_i'(.)}{qU_i'(.) + (1-q)V_i'(.)} \tag{8}$$

For values less than the critical value ($p < p_{im}{}^{C}$), the term (7) will become positive and hence the condition for advantageous selection will be ensured . In an advantageous selection condition, the individual’s efforts for avoiding loss, which decreases the probability of death, has positive correlation with the demand for life insurance.

To find the critical processing cost, we assume there’s no contingencies and profit. So, loading factor will be equal to the processing cost. Under such assumption the implicit critical value for processing cost will be

$$C^{C}{}_{im} = \frac{(1-p_i)(V_i'(.) - U_i'(.))}{(1-p_i)U_i'(.) + p_iV_i'(.)} \quad . \tag{9}$$

If the individuals are sufficiently sensitive to precautionary efforts that inequality (6) satisfies, then the processing cost should be greater than its critical value to result in advantageous selection regime.

Referring to (5), we can find another set of conditions that lead to the advantageous selection:

c) $$|p'(e_i)| < (1-p(e_i))\frac{U_i'(.)}{U_i(.) - V_i(.)} \tag{10}$$

d) $$q(1-p_i(e_i))U_i'(.) - (1-q)p_i(e_i)V_i'(.) < 0 \tag{11}$$

When precautionary activity is not sufficiently effective on decreasing the probability of loss, and the probability of death is larger than its critical value, the necessary condition for having advantageous selection regime is the loading factor and the processing cost to be smaller than their critical values. As a result, for less risk-averse individuals, the market is advantageous to the insurer if probability of loss is relatively large while the processing cost is relatively small.

3. The Demand Level

In this section we determine the demand level for two groups of more risk-averse low-risk individuals and less risk-averse high-risk individuals to check if advantageous selection occurs in this setting (See also Mahdavi and Rinaz, 2005). We assume the utility and bequest functions are of a class of CRRA. The problem will be to maximize the expected utility function

$$\underset{x_i}{Max}\;\; EU_i(e_i,q,W_i,Y_i) = (1-p(e_i))\frac{1}{1-a_i}(W_i+Y_i-e_i-qx(e_i))^{1-a_i} + p(e_i)\frac{1}{1-a_i}(W_i+(1-q)x_i(e_i))^{1-a_i}, \qquad (12)$$

subject to the constraints that nonnegative amount of insurance is purchased and, over-insurance is not permitted in the market indicating the insurer doesn't permit the customers to purchase more than their expected loss.

The first order condition will be as

$$-(1-p(e_i))(W_i+Y_i-e_i-qx(e_i))^{-a_i}q + p(e_i)(W_i+(1-q)x(e_i))^{-a_i}(1-q) = 0\,, \qquad (13)$$

that yields the optimal demand for life insurance as

$$x^*_i(q) = \frac{(W_i+Y_i-e_i)K_i(q)-W_i}{qK_i(q)+1-q}\,, \qquad (14)$$

where

$$K_i(q) = \left(\frac{p_i(1-q)}{q(1-p_i)}\right)^{1/a_i}.$$

At the supply side, the insurer faces with the processing cost of *"C"* for each unit of coverage to offer the contracts to customers. Actually, the insurer cannot distinguish the risk levels of his customers but can perceive the overall condition of the whole population. Under perfect competition

$$\sum_{i=H,L}[(1-p_i)q - p_i(C+1)]x_i = 0 \qquad (15)$$

After inserting the obtained optimal demand (13) for both groups of low-risk individuals *L* and high-risk individuals *H*, the insurer's problem in a perfect competition condition will be stated as

$$\begin{aligned}&[(1-p_L)q-p_L(C+1)][(Y_L+W_L-e_L)K_L-W_L](qK_H+1-q)+\\&[(1-p_H)q-p_H(C+1)][(Y_H+W_H-e_H)K_H-W_H](qK_L+1-q)=0\end{aligned} \tag{16}$$

4. Numerical Example

The key modification to the conventional adverse selection model is the negative correlation between individual's attitude towards risk and his risk exposure. Moreover, more risk averse individuals are not only more likely to reduce risks on their own by taking good care of their health, but also they are more averse to financial risks and hence more willing to pay to eliminate such risks through insurance. As a result, they seem to be low-risk (longer-lived) individuals who would like to purchase more insurance.

In the conventional model, the low-risk individuals do not want to pool themselves with the high-risk group since even though the premium is actuarially fair for all the insureds as a whole; it is too high for them. So, there will be a motivation for them to lapse. But if low risks are assumed to be more risk averse than the high risks, they value insurance contracts more than their high-risk neighbors and will have motivation to pool with them even though the rates are higher than their actuarially fair rates(see also Siegelman,2004). Now assume the parameters for both groups of the equal size are as follows:

$W_H = W_L = 0,\quad Y_H = Y_L = 100,\quad p_H = 0.0015,\quad a_H = 0.5,\quad e_H = 1,\quad and$

$p_L = 0.001,\quad a_L = 0.9,\quad e_L = 2\quad and\quad C = 0.2\cdot$

The pooling equilibrium price for this numerical example and the optimal demand for both groups are obtained as

$q^* = 0.0016,\quad x^*_H = 87.29,\quad x^*_L = 58.24\cdot$

The answers satisfy the constraints and logical consideration, as the demand levels are less than the full-insurance demand.

To examine whether advantageous selection may occur in the setting, we should check in terms of utility whether low-risk individuals prefer to purchase the pooling insurance or would like to go uninsured.

The individuals' expected utility in no insurance, full insurance at fair price, pooling equilibrium with obtained optimal demand cases and, the gains from insurance purchase for the expected utility (12) are shown in the table.

Table 1-Utility comparison

	Low-Risk Individuals	*High-Risk Individuals*
Probability of death	0.001	0.0015
Income	100	100
Cost of Effort	2	1
Actuarially fair premium for each unit	0.001	0.0015
Coefficient of relative risk aversion	0.9	0.5
EU in no insurance case	15.80	19.87
EU in full insurance case at fair separate prices (q =0.001,0.0015)	15.82	19.884
Gain from insurance (%)	0.13	0.07
EU in Pooling equilibrium (q=0.0016, X*L=58.24, X*H=87.29)*	15.81	19.883

Low-risk individuals are more risk averse and have higher coefficient of relative risk aversion while the condition for high risks is the opposite. After introducing insurance at fair premium, low-risk insureds obtain a greater percentage gain in utility since they pay lower premium while they are more risk averse, valuing insurance higher and hence, obtain more satisfaction from any unit of insurance coverage.

It is shown that low risks are more satisfied with pooling equilibrium rather than leaving uninsured. Even though the price is not fair to them and they are subsidizing the high-risk policyholders, still they prefer to purchase life insurance policy. That is because they are sufficiently risk averse to pool with their high-risk neighbors. In other words, they do not drop out of the market as they are sufficiently risk averse that can tolerate higher than fair prices. Needless to say, the high risks prefer pooling equilibrium to no-insurance case. High risks would also prefer the pooling equilibrium to full insurance at fair separate prices if there weren't large processing cost that makes pooling price greater than their fair separate price. But since the pooling price is greater than their fair rates due to high processing cost, they prefer the full insurance at fair separate prices the best.

Shortly speaking, the negative correlation between risk aversion and risk exposure makes the market plausible that low-risk individuals do not exit from the market and consequently the insurer will not face the problem of adverse selection. When the low-risk group is sufficiently risk averse, there is a tendency for them to remain at the market while some parts of high risks drop out of it, leaving the good risks to continue purchasing the policy. Moreover, the sufficiently risk-averse low-risk individuals also undertake preventive efforts that decrease the mortality rate further and make the situation more plausible for insurers.

5. The Effect of Parameters

In this section we use graphical manipulations of the numerical example to find the parameters that are crucial to determine the regime. The figure 1 shows the optimal demand for high- and low-risk groups (x_H, x_L) and the corresponding price q for 10,000 units of insurance when processing cost changes from 0 to 1.5 while other parameters are kept given as the numerical example. It is shown that the gap between x_H and x_L is getting smaller when the processing cost is increasing. At around $C = 1$ they intersect and the adverse selection regime changes to the advantageous one as the optimal demand of low-risk individuals exceeds that of high risks.

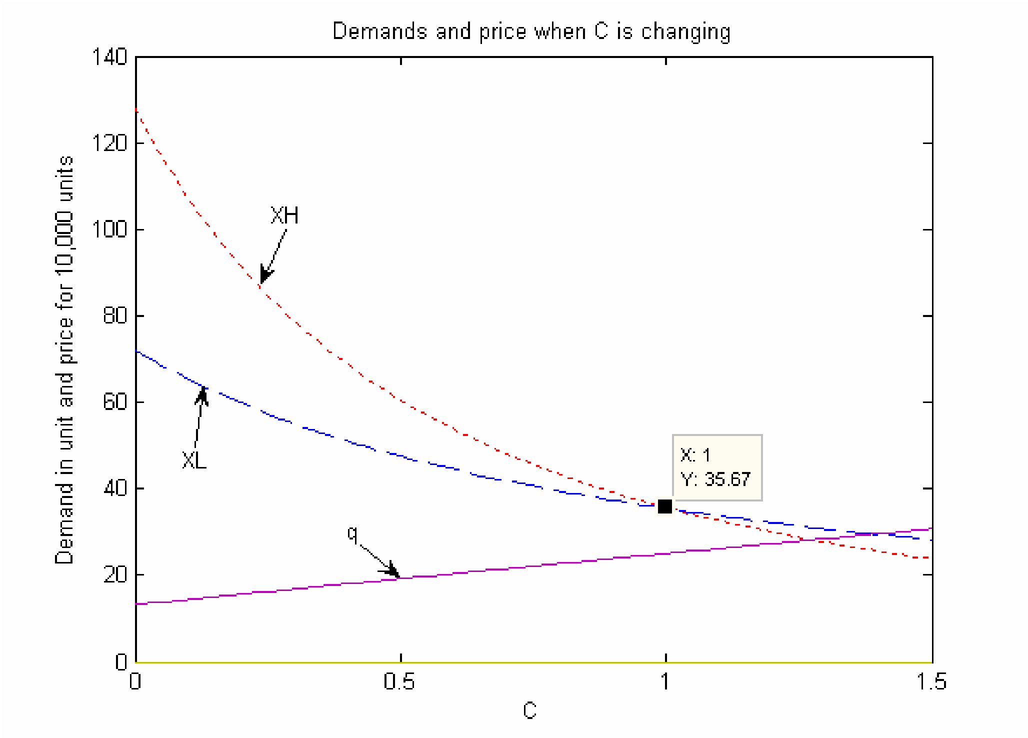

Figure 1- *Demands and price when* C *is endogenous, for the following parameters:* $p_L = 0.001$, $a_L = 0.9$, $e_L = 2$, $W_H = W_L = 0$, $Y_H = Y_L = 100$, $p_H = 0.0015$, $a_H = 0.5$, $e_H = 1$. *The regime changes to advantageous selection at the critical value of* $C = 1$.

In figure 2 we just decreased the risk aversion of high-risk individuals from 0.5 to 0.1 in order to increase the relative risk aversion of low-risk individuals. In doing so, the regime changes to advantageous selection for smaller processing cost (*C = 0.2626*) .

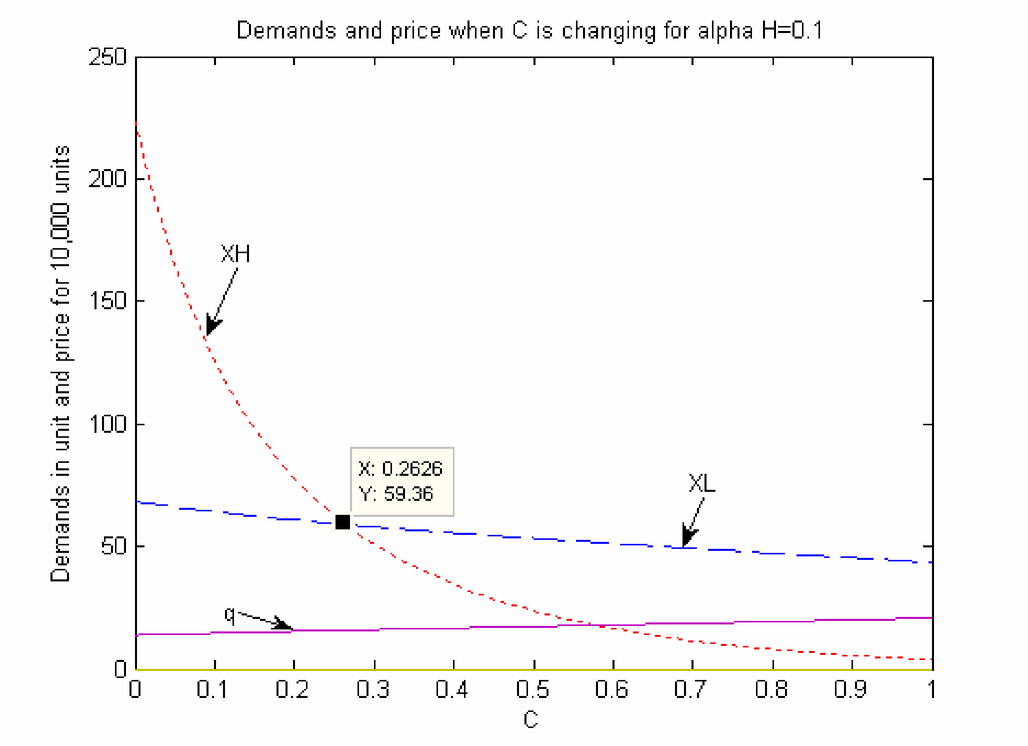

***Figure 2**- Demands and price when C is endogenous and a_H is declined, for parameters: $p_L = 0.001$, $a_L = 0.9$, $e_L = 2$, $W_H = W_L = 0$, $Y_H = Y_L = 100$, $p_H = 0.0015$, $a_H = 0.1$, $e_H = 1$. The regime changes to advantageous selection for a smaller critical value of $C = 0.2626$.*

These two figures obviously show that increasing processing cost leads to advantageous regime especially when low risks are sufficiently risk averse compared to high-risk individuals.

The effect of risk aversion is shown in figure 3. We plotted the demands and price when the low-risk individuals' risk aversion is changing from 0 to 1 endogenously while all other factors are fixed as the original numerical example. Even though the optimal demand of high-risk individuals exceeds that of low risks for all the range, its gap is getting smaller when low-risk individuals become more risk averse, indicating that risk aversion has positive effect on switching the regime to advantageous selection.

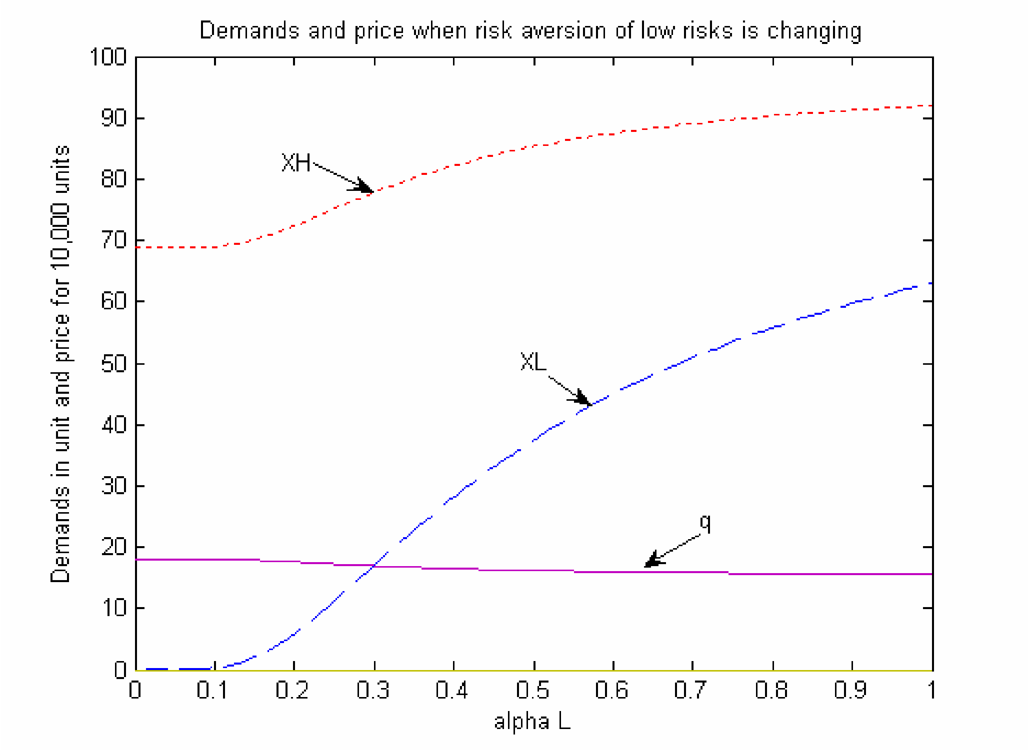

Figure 3- *Demands and price when* a_L *is endogenous for Parameters:* $p_L = 0.001$, $e_L = 2$, $C = 0.2$, $W_H = W_L = 0$, $Y_H = Y_L = 100$, $p_H = 0.0015$, $a_H = 0.5$, $e_H = 1$. *When low risks become relatively more risk averse, the regime tends to change to advantageous selection.*

To examine the effect of risk aversion under a higher level of processing cost, we plotted the demands and corresponding price when the processing cost is 0.9. We observe that for the low-risk individuals, when risk aversion is larger than 0.9495, the regime changes to advantageous selection as the optimal demand for low risks exceeds that of high-risk individuals. These conditions are in correspondence with the derived conditions of the theoretical part (6) and (7) that suggested under high level of risk aversion and low level of mortality rate, a higher level of processing cost is required to result in advantageous selection .

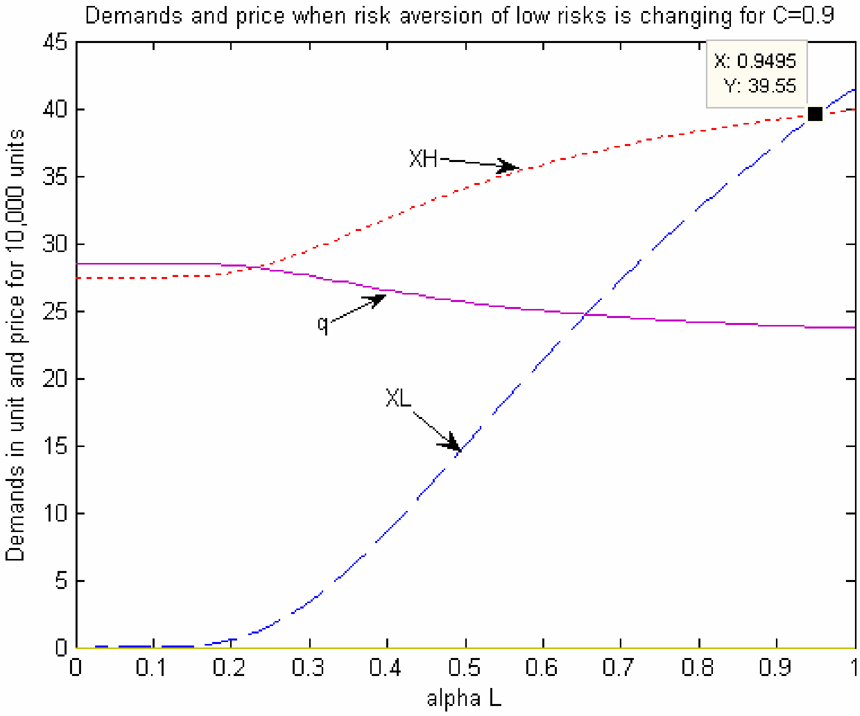

Figure 4*- Demands and price when* a_L *is endogenous and* C *is increased, for parameters:* $p_L = 0.001$, $e_L = 2$, $C = 0.9$, $W_H = W_L = 0$, $Y_H = Y_L = 100$, $p_H = 0.0015$, $a_H = 0.5$, $e_H = 1$. *The regime Changes to advantageous selection for critical value of* $a_L = 0.9495$.

In figure 5, the probability of death *pL* is assumed to be a decreasing affine function of risk aversion a_L passing through the points (a_L, p_L) = (0.9, 0.001) and (a_L, p_L) = (0.5, 0.0015). Obviously, two demand curves cross at a_L = 0.5 as two groups' risk aversion and probability of death are identical at this point. The other intersection is at a_L =0.0496. At these two points two groups purchase equally and the insurers perceived mortality rate will be equal to the real rate of the insureds and, there will be no information asymmetry.

We can discuss the selection problem in three partitions: for the part $0.5 < a_L < 1$, the high-risk group of *'H'* demands more and therefore the so-called adverse selection regime prevails in the market. For the part $0.0496 < a_L < 0.5$, even though x_L exceeds x_H, still adverse-selection regime prevails as previously called low risks with the demand level of x_L are more risky at this section as their risk aversion is smaller than the risk aversion for the group which was previously called high risks with the demand level of x_H. The only section where advantageous selection can be observed is the extreme left where $0 < a_L < 0.0496$ as the currently less risky group whose demand is shown by x_H purchases more than the currently more risky group with the demand level of x_L. This graph supports the conditions (10) and (11) which suggested when the risk aversion level is relatively low and therefore the probability of loss is relatively large and the processing cost is relatively small the selection effect will be advantageous as observed in the extreme left where $0 < a_L < 0.0496$.

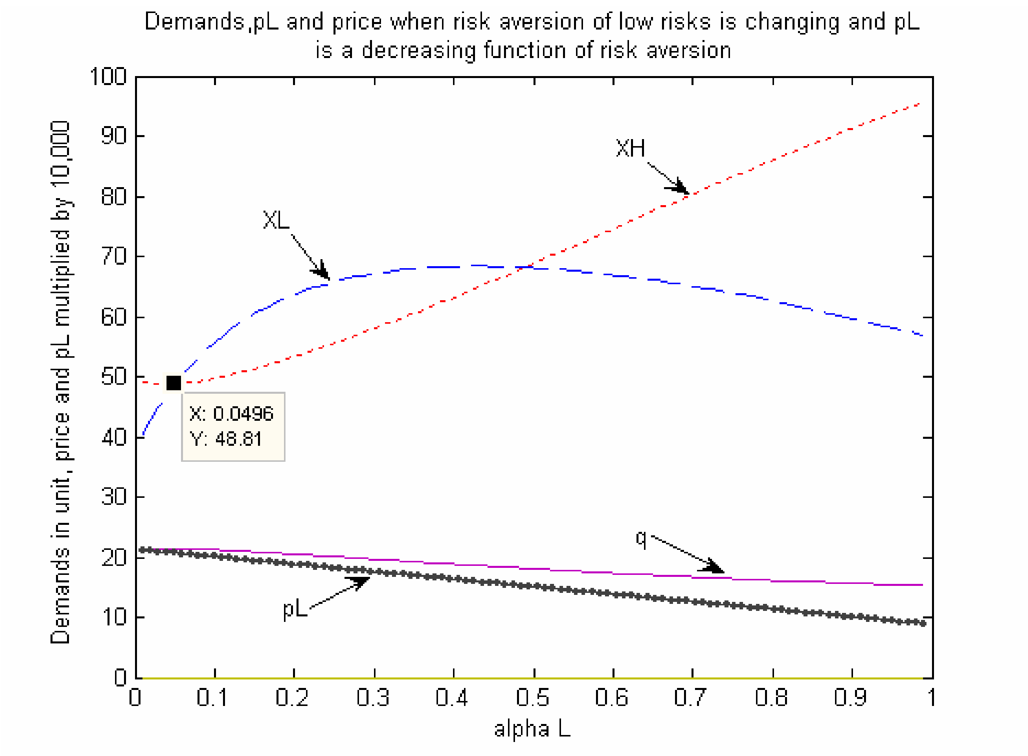

***Figure 5**- Demands, p_L and price when a_L is endogenous and p_L is a decreasing function of a_L passing through the points (0.9,0.001) and (0.5,0.0015) for parameters:* $e_L = 2$, $C = 0.2$, $W_H = W_L = 0$, $Y_H = Y_L = 100$, $p_H = 0.0015$, $a_H = 0.5$, $e_H = 1$. *We observe the advantageous selection regime only in extreme left where risk aversion is low, p_L is relatively large and C is relatively small.*

In figure 6, the processing cost C is increased from 0.2 to 0.9, the mortality rate of high-risk individuals is increased from 0.0015 to 0.002 to make low risks safer comparatively, and the relative risk aversion level of high risks is decreased from 0.5 to 0.1 to increase the relative risk aversion of low risk individuals. The result of such changes is satisfactory: the market faces with advantageous selection for the range $0.1 < a_L < 1$.

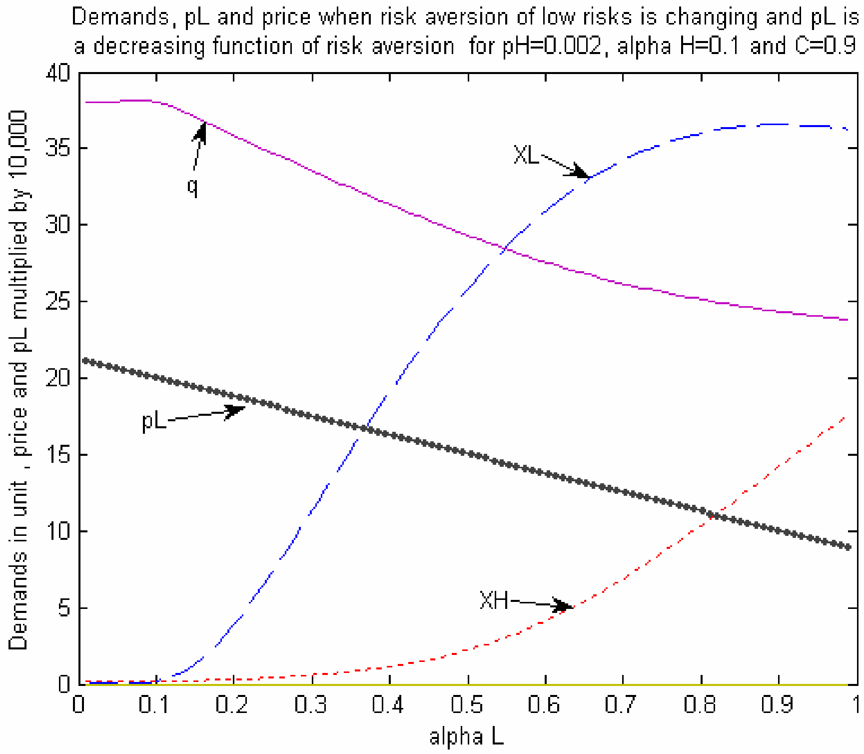

Figure 6- *Demands, p_L and price when a_L is endogenous and p_L is a decreasing function of a_L passing through the points (0.9,0.001) and (0.1,0.002) for parameters:*

$e_L = 2,\ \ C = 0.9,\ \ W_H = W_L = 0,\ \ Y_H = Y_L = 100,\ \ p_H = 0.002,\ a_H = 0.1,\ \ e_H = 1$

We observe the advantageous selection regime for a wide range of $0.1 < a_L < 1$. *The result corresponds with the theory as the relative risk aversion of low risks and the processing costs are increased while the relative riskiness of low risks is decreased.*

The result corresponds with the conditions (6) and (7) which state that, when individuals are sufficiently risk averse and their probability of loss is sufficiently small and the processing cost is sufficiently large, advantageous selection will be the existing regime for the demand under asymmetric information.

6. Conclusions

The classical theory of demand for insurance under asymmetric information results in insufficient provision of policies and adverse selection. These conclusions seem to contradict most of the empirical works in the field. We try to resolve this contradiction by introducing the effect of precautionary activities which improves the survival rates, and assuming a negative correlation between risk aversion and risk exposure. Under these two assumptions, the so-called adverse selection regime can be substituted with a favorable situation which is called advantageous selection.

In a numerical setting, we have shown the case where low-risk individuals preferred to continue purchasing the policy even though they were paying more than their fair price.

We could also show that under certain circumstances when the probability of loss is smaller than its critical value, the policy holders are sufficiently risk averse and the processing cost is sufficiently large, the selection effect will be advantageous to the market and the so-called adverse selection regime prevails no longer. We could also show graphically the cases that good risks are better off with pooling equilibrium rather than drop out of the insurance pool. As a result of negative correlation between risk aversion and risk exposure, the low-risk individuals prefer to purchase life insurance policy even though the price is not fair to them and they are actually subsidizing the high-risk policyholders.

If the individuals are not sufficiently risk averse and have higher probability of death, then the necessary condition for having advantageous selection regime will be facing a low level of processing cost smaller than its critical value.

Examining the effect of income and wealth can extend this research. To eliminate the income and wealth effect, we need to discuss how the differentials of these factors change the regime from adverse selection to advantageous selection.

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