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AN EXPERIMENTAL STUDY ON ADVERSE SELECTION AND MORAL HAZARD*

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Abstract

This paper examines adverse selection and moral hazard in the life insurance market. Using actual company data in Japan, we find evidence that life insurance companies use medical examination techniques to control problems of adverse selection in the lines of new whole life and term life insurance. After an elapse of a few years, however, the mortality index is clearly changing for the worse in our observation. Although it may depend upon disappearance of the effect of medical selection, it would be noteworthy that the mortality index in some case becomes even worse than that of people without medical examination. We conclude by saying that moral hazard, in some case, adverse selection could exert an influence on an aggravation of the mortality index.

Keywords: adverse selection, moral hazard, life insurance, suicide

I. *Introduction*

In 2009, the Japanese life insurance market accounted for 17% of the world market in premium income, making it the second largest following the U.S. market (Swiss Re, 2009). For a long period following WWII, sales were mainly concentrated in large domestic life insurance companies and were skewed towards death security. Currently, however, products have become increasingly diverse because of the changing market environment and customer needs. Competition is also increasing as the market is no longer limited to the large domestic life insurance companies, with foreign and online companies in the market.

Table 1 demonstrates new policy statistics by type while Table 2 demonstrates existing policy statistics by type. The whole life and term life insurance products addressed in this analysis are primary death security products.

In recent years, the number of term life insurance policies has been increasing with new policies accounting for 35.3% (Table 1) of the total on a monetary basis. Average benefits in this category are the highest amongst all products at 17.89 million yen per policy. This can

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TABLE 1. STATISTICS FOR NEW INDIVIDUAL INSURANCE POLICIES BY TYPE (total of all 46 companies in Japan) (April 2009-March 2010)

Insurance Type		Number of Policies (million)	Ratio(%)	Total Amount (JPY trillion)	Ratio (%)	Average Benefits (JPY million)
Individual Insurance Total		12	100.0	63	100.0	5.17
1. Life Insurance	Subtotal	9	73.9	50	80.2	5.60
	Whole Life	2	19.4	10	15.2	404
	Whole with Term	0	3.3	6	10.0	15.6
	Floating Rate Accumulating on Whole Life	1	4.2	7	10.6	12.93
	Term	1	10.2	22	35.3	17.89
	Variable	0	0.4	0	0.4	4.25
	Other	4	36.3	6	8.8	1.25
2. Mixed Insurance	Subtotal	3	20.8	12	19.0	4.72
	Endowment	2	14.2	5	8.6	3.15
	Endowment with Term	0	0.2	0	0.4	10.27
	Other	1	6.3	6	9.4	7.75
3. Pure Endowment Insurance		1	5.2	1	0.8	0.81
Individual Pension Total		2	100.0	8	100.0	5.12
	Fixed Pension	1	73.9	6	71.0	4.93
	Floating Pension	0	26.1	2	29.0	5.68

Note: Excerpt from Life Insurance Association of Japan website. Amounts shown per insurance type are as follows:
Individual insurance primary security amount
Individual pension insurance pre-pension payout: pension assets at the time pensionpayout begins
after pension payout begins: actuarialliability at each point

partially be attributed to the heavy selling of term life insurance by foreign and online life insurance companies, whose market shares have been growing in recent years. Moreover, as the Japanese national income continues to stagnate, many consumers are showing a preference for cheaper term life insurance benefits.

The most prominent characteristic of Japanese term life insurance is that the majority of companies automatically renew policies at the end of the term with no medical selection. Optional renewal is limited to a few products such as Daido Life's Health Discount Term Life Insurance and AXA Life's Non-Renewal Term Life Insurance.

Automatic renewal is advantageous for insured individuals, as the policy can be renewed regardless of one's health condition and at the same premium paid by a healthy person. However, insurance companies are faced with the problem of increasing mortality rates since insured individuals with deteriorating health conditions can renew their policies at a price identical to that for healthy people. Certainly, the more one's health declines, the higher the rate of renewal and continuance is likely to be. On the other hand, healthy people are likely to switch to companies that offer cheaper term life insurance in the Japanese market, where companies have started to compete on price. In insurance economics, this phenomenon is called adverse selection.

Among 'incentive issues due to asymmetric information,' adverse selection is an equally

TABLE 2. STATISTICS FOR EXISTING INDIVIDUAL INSURANCE POLICIES BY TYPE (total of all 46 companies in Japan) (as of end of March, 2010)

Insurance Type		Number of Policies (million)	Ratio(%)	Total Amount (JPY trillion)	Ratio (%)	Average Benefits (JPY million)
Individual Insurance		117	100.0	903	100.0	7.71
1. Life Insurance	Subtotal	93	79.8	746	82.6	7.98
	Whole Life	18	15.7	101	11.2	5.52
	Whole with Term	13	11.0	234	25.9	18.17
	Floating Rate Accumulating on Whole Life	8	6.9	145	16.0	17.95
	Term	13	10.7	176	19.4	14.03
	Variable	1	1.1	8	0.9	6.68
	Other	40	34.4	81	9.0	2.01
2. Mixed Insurance	Subtotal	20	16.8	152	16.9	7.72
	Endowment	9	7.8	31	3.4	3.39
	Endowment with Term	1	1.1	11	1.2	7.86
	Other	9	7.9	110	12.2	12.04
3. Pure Endowment Insurance		4	3.4	5	0.6	1.3
Individual Pensions		18	100.0	94	100.0	5.13
1. Fixed Pension	Subtotal	15	81.2	75	79.1	5.00
	Pre-pension payout	13	68.5	67	70.8	5.30
	After pension payout begins	2	12.7	8	8.4	3.38
2. Floating Pension	Subtotal	3	18.8	20	20.9	5.71
	Pre-pension payout	3	17.8	18	19.6	5.64
	After pension payout begins	0	0.9	1	1.3	7.11

Note: Excerpt from Life Insurance Association of Japan website. Amounts shown per insurance type are as follows:
Individual insurance primary security amount
Individual pension insurance pre-pension payout: pension assets at the time pension payout begins after pension payout begins: actuarial liability at each point

critical issue as moral hazard. There have been numerous preceding studies on adverse selection in insurance markets after Rothschild and Stiglitz (1976). In addition, some of the preceding literature discussed moral hazard as well.

Using data for insurance products that are likely to be influenced by adverse selection or moral hazard, we examine whether adverse selection or moral hazard actually exists, and if so, to verify and calculate the costs associated with the two issues.

In this paper, we examine whole life insurance and term life insurance. Of those who purchase these policies, insured individuals in poor health are more likely to continue their policies. Moreover, suicide may be considered as a moral hazard. On the other hand, because information on subtle changes in the health condition and mental state of insured individuals is private, it is likely that significant costs may be involved in obtaining this type of information.

Although this is expected in theory, there has been no practical demonstration of how to avoid the significant costs associated with adverse selection or moral hazard that would make

the products unviable in the long term, or whether those risks can be reduced to a large extent by practical measures. In insurance policies, which are mature risk financing methods, 'the incentive issues due to asymmetric information' would be, in most cases, significantly mitigated by a variety of practical measures.

Considering the above-mentioned issues, we examine whether there are costs associated with adverse selection and moral hazard, and calculate costs by shedding light on insurance products that are likely to be influenced by adverse selection or moral hazard using data from individual firms. Although there are numerous theoretical as well as experimental analyses on adverse selection and some studies even analyze moral risk, to the best of our knowledge, no study has demonstrated the presence of adverse selection or moral hazard using actual company data or conducted a breakdown of the factors thereof. Through the breakdown of factors for adverse selection in this paper, adverse selection and moral hazard will be reduced, and a framework can be built upon for insurance companies capable of offering insurance policies at more reasonable prices, thus, providing benefits for consumers as well.

II. *Literature Review*

The life insurance market is a particularly interesting market to test the existence of adverse selection. First, it is an important market because of its large size. Second, moral hazard could be largely ignored in this market because the increase of the expected claim would mean shortening of the assured's life span. No one wants to commit suicide. The assureds usually do not have such an incentive except for suicide. Third, death-protection life insurance policies are relatively explicit and simple. Furthermore, none of the existing life insurance markets are free from problems of adverse selection and suicide, an extreme case of moral hazard. We examine these market problems and funding issues based in part on existing studies.

Economics of Adverse Selection and Moral Hazard. The life and healthcare insurance market can be characterized by problems of asymmetric information between the insurer and the insured as well as problems of induced supply of services by healthcare professionals. A substantial amount of theoretical research addresses these problems, and numerous studies examine the resulting failures in the insurance markets. In particular, Rothschild and Stiglitz (1976) constructed a basic model of imperfect information in insurance markets and assert that the model can be applied to many cases; for instance, where communities offer listings of public goods and taxes to which individuals refer when choosing a community. Research was largely focused on theoretical models in the first decade after the seminal paper by Rothschild and Stiglitz. Empirical studies have advanced impressively since then (Cohen and Siegelman, 2010).

Neudeck and Podczeck (1996) argued that without a rational policy of government intervention, market efficiency cannot be achieved on account of the problems of adverse selection because firms would reject applications for loss-making policies; there can be no cross-subsidization between different policies in a free-market environment. On the other hand, Crocker and Snow (1985) argued that if government intervention can improve market efficiency, and efficiency can also be achieved under oligopolistic competition in which private

firms can predict competitors' prices.

Adverse selection theory in insurance relates to the correlation between insurance coverage and risk. *Ceteris paribus*, insured individuals who know that they are at high risk (but this is not known by their insurer) are expected to choose higher insurance coverage (or no or lower deductibles). This positive coverage-risk correlation has been the major focus of empirical studies in this area. At the same time, there may be unobservable differences in insured individuals' precaution levels such that insured individuals with a higher insurance coverage have less incentive to take precautions that can reduce the loss outcome. Because of the differences in 'hidden actions,' moral hazard may also produce a positive coverage-risk correlation. Accordingly, the presence of such a correlation can be attributed to adverse selection as well as – or fully – to moral hazard, as Dionne et al. (2009) emphasized.

Several studies show evidence of adverse selection in healthcare insurance markets. Cutler and Zeckhauser (2000) observed 14 studies that identify types of adverse selection. In a separate study, Cutler and Zeckhauser (1998) compared one group of insured individuals with a traditional indemnity-based insurance arrangement to another group with a 'less generous' health maintenance organization (HMO) arrangement. From this analysis of intra-market selection, they found that the former group spent significantly more and were more likely to experience significant medical events (e.g., childbirth or heart attack) as compared to the HMO participants.

Other studies found no evidence of a positive correlation between health insurance coverage and risk (Ettner, 1997; Browne and Doerpinghaus, 1993; Buchmueller et al. 2004).[1] A positive coverage-risk correlation may also be absent or weakly observed when the insurer possesses more or better information about an insured individual's risk than the insured individual does (Chiappori and Salanie, 2000). Insurers may acquire this position of information superiority through initial and renewal underwriting.

Low risk aversion may describe the reason why high risk is correlated with an increased insurance demand. In particular, Hemenway (1990) proposed 'propitious selection' to describe an observed negative relationship between insurance demand and risk. Based largely on anecdotal evidence, he concluded that high-risk individuals are less likely to purchase insurance because they are also less risk averse. On the one hand, Fang et al. (2008) showed that US senior citizens who purchased Medigap insurance spent approximately $4,000 per year less on healthcare than those who did not purchase such a supplement to Medicare. They found that conditional on health, those covered by Medigap spent approximately $2,000 more than those insured individuals without coverage. Considered together, these findings are in stark contrast with the results of the positive-correlation test.

Manning et al. (1987) used the Rand Health Insurance Experiment to test whether individuals who were randomly assigned more coverage chose higher levels of spending. This

[1] We can observe people's proficiency in attempting to predict the outcomes of their own lives. The evidence is limited and the findings are somewhat mixed. Several studies suggest that people can fairly predict how long they will live (Hamermesh, 1985; Hurd et al. 2002). However, other studies suggest people's inability to forecast their own demise (Cawley and Philipson, 1999; Bhattacharya et al. 2003). As a prerequisite for a statistically significant risk-coverage correlation, insured individuals must not only have private information about their own risk, but also adjust their insurance consumption on the basis of that information. For example, Hurd et al. (2002) concluded that elderly respondents could predict their actual mortality fairly well, but their predictions did not systematically translate into actual retirement behavior in the manner that economic theory would predict.

study found evidence consistent with *ex post* moral hazard: individuals who bought plans with a higher coverage spent more on healthcare and therefore were more costly to their insurers.

Studying the life insurance market, Hendel and Lizzeri (2003) provided strong evidence of the existence and significance of learning over time. Their focus is on symmetric learning, in which both insured individuals and insurers gradually gain new information about the insured individual's risk of mortality. The findings of this study are supported by those of Finkelstein et al. (2005) who found that in the US long-term care market, insured individuals who discontinue their coverage are subsequently less likely to use a nursing home, and that discontinuing their coverage is at least partly a response to positive information about the insured individual's health situation.

Cawley and Philipson (1999) reported several findings that seem difficult to reconcile with the conventional theory of insurance under asymmetric information. They assumed insurance companies may understand their costs of production better than consumers in this market, as for most other products. They displayed the ratio of mortality risk of insured males to the overall population of males in 1970 and 1975, by age, which indicated that men with life insurance are at a lower mortality risk than the overall population. They also observed that relatively risky males are less likely to have insurance.

Chiappori and Salanie (2008) discovered interesting dynamic issues in insurers' strategies. When an insurance company sells a policy that commits it for the long term (e.g. a life insurance policy with a guaranteed renewal clause), it is *de facto* offering an option, the pricing and hedging of which raise delicate problems. For instance, selective attrition may be a serious concern and computing provisions is a difficult problem in life insurance.

He (2009) found a significant and positive correlation between the decision to purchase life insurance and subsequent mortality, conditional on risk classification. Individuals who died within a 12-year time span after the base year were 19% more likely to have applied for life insurance in that base year than those who survived the time window. Moreover, as might be expected, when individuals have residual private information, He found that the earlier an individual died, the more likely he/she was expected to have initially bought insurance.

Chen et al. (2008) investigated the relationship between life insurance and suicide behavior using OECD cross-country data from 1980 to 2002. Through semi-parametric instrumental variable regressions with fixed effects, they found that for the majority of observations, there is a positive relationship between the suicide rate and life insurance density (per capita premium). Because life insurance policies pay death benefits even in suicide cases after the suicide exemption period, the presence of adverse selection and moral hazard suggests an incentive effect that leads to this positive relationship. The novelty of their analysis lies in the use of cross-country variations in the length of the suicide exemption period in life insurance policies as the identifying instrument for life insurance density. Their results provide compelling evidence suggesting the existence of adverse selection and moral hazards in life insurance markets in OECD countries.

Hypothesis Development. Cawley and Philipson (1999) suggested that insurers have a clearer understanding of an insured individual's health condition than their insured individuals do. This may be based on the fact that the insurers, during the insurance process, ensure that insured individuals declare in the declaration form whether they have consulted a doctor in the past three months, if any abnormality has been found during a medical checkup in the past two

months, if they have been treated for seven days or more in the past five years, or if they have any disability. Furthermore, when the life insurance benefit exceeds a certain amount[2], the insurers restrict the sale of insurance to individuals in poor health by obtaining information such as the results of a urine test, blood pressure, height, weight, chest circumference, abdominal circumference and eyesight, so that equity among insured individuals is ensured. It is, therefore, expected that at the time of enrolment, the mortality for those who are purchasing insurance policies may be lower as compared to people in general.

He (2009) analyzed the data for a period of 12 years after insured individuals purchased their policies, and found that the mortality for those covered by insurance is much higher than the mortality of people in general. This finding, which seemingly contradicts the suggestion by Cawley and Philipson (1999), may be reconciled with it, even though at the time of enrolment, the mortality of those who purchase insurance is lower than that of people in general, because further medical selection is not carried out thereafter; those who continue their life insurance policies are likely to have higher mortality than those who cancel their policies. Although adverse selection during the insurance process can be prevented through assessment, this presumably no longer holds true once the policy is granted.

According to Chen et al. (2008), there is a positive relationship between the suicide rate and insurance density in OECD countries. In addition, they suggest this to be reasonable because life insurance benefit is to be paid even in a suicide case after the suicide exemption period. This phenomenon is called moral hazard. Moreover, in the long term, moral hazard may contribute to higher mortality for those covered by insurance than for people in general.

In light of these preceding studies, we will verify the following two hypotheses in this paper:

> **Hypothesis 1**: Because of medical selection, the mortality of insured individuals at the point of purchasing their policies is lower than that of people in general, and therefore, no adverse selection occurs.
>
> **Hypothesis 2**: During the period after the policy is granted, the mortality of the insured individual increases because of adverse selection. In addition, moral hazard contributes to this increase, resulting in the tendency for insured individuals to have higher mortality than people in general.

The model proposed by Rothschild and Stiglitz (1976) is based on the assumption that only individuals know their own health condition and private insurers cannot set the premium based purely on risk. Thus, the insurers charge the same premium reflecting the average risk in the pool. This pooled premium structure attracts more high risks than low risks, and the market is insufficiently efficient. Despite the theoretical model's innovative expression of asymmetric information, it does not accurately reflect the reality that private insurers charge different premiums based in part on the findings from the application form and underwriting.

The insurance companies manage to reduce adverse selection significantly through medical selection during the insurance process, but it appears that, in principle, neither adverse selection nor moral hazard can be avoided.

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[2] This benefit varies depending on age. For instance, with a term life insurance by LIFENET Insurance Company, the amount is 30 million yen for individuals aged 18–40, 25 million yen for those aged 41–45, 20 million yen for those aged 46–50, 15 million yen for those aged 51–55 and 10 million yen for those aged 56–64.

TABLE 3. ACTUAL MORTALITY INDEX FOR WHOLE LIFE INSURANCE (Unit: %)

Elapse (years)	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+	Total
Mortality Index	49	60	56	84	85	75	57	68	62	70	69	67

Note: Mortality index＝actual mortality rate/assumed mortality rate * 100

TABLE 4. MODEL INDEX OF MORTALITY FOR WHOLE LIFE INSURANCE (Unit %)

Elapse(years)	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+	Total
Mortality Index (1)	49	60	56	84	85	75	57	68	62	70	69	67
Suicide Index (2)	4	4	4	30	25	20	4	4	4	4	4	10
Mortality Margin (3)	6	6	6	6	6	6	6	6	6	6	6	6
Table Difference (4)	0	0	0	6	6	6	6	6	6	6	6	4
Basis＝(1)−(2)+(3)+(4)	51	62	58	66	72	67	65	76	70	78	77	68
Basis Estimated	56	59	61	63	65	67	70	72	74	76	78	67

Note: Mortality index＝actual mortality rate/assumed mortality rate * 100

III. *Model and Data*

Table 3 shows the actual mortality index for whole life insurance by an insurance company and by the number of years elapsed since granting the policy. The table shows the actual mortality index (actual mortality rate/assumed mortality rate) to be approximately 50% for the period immediately after the policy is granted, suggesting that the insurance company successfully minimizes problems of adverse selection during the period through medical selection, and as a result, higher underwriting profit is secured. However, because medical selection is not carried out except at the time of the insurance process, adverse selection presumably occurs where insured individuals in healthier condition tend to cancel their policies, whereas insured individuals whose medical condition deteriorates tend to continue their policies. Therefore, the mortality index rises every year, reaching approximately 70% after a lapse of 10 years.

As observed in Table 3, the mortality index temporarily increases during the period 3-4, 4-5 and 5-6 years. We believe this coincides with the findings of Chen et al. (2008) that the spread of life insurance leads a higher suicide rate because life insurance benefit is to be paid even for a suicide case after the suicide exemption period.

It appears that the suicide exemption period for Japanese insurance companies varies from company to company and it is normally set at 2 or 3 years in the insurance clauses. It is, however, arguable whether life insurance benefit should, even after a lapse of 2 to 3 years, be paid for a suicide committed with the main aim of the beneficiary receiving the benefit or as part of criminal activity.

Here, we calculate the basic mortality index by the number of years elapsed (against the Abridged Life Tables for Japan) excluding special factors. We find the following.

First, deaths by suicide account for 4% of the assumed mortality rate.[3] Furthermore, according to one insurance company, around 30% of deaths in the 3-6 year range (about 3

TABLE 5. COMPARISON OF LIFE TABLES (Male)

Age	Abridged Life Tables for Japan 2007 (1)	Standard Life Tables for 2007 (2)	(2) ÷ (1)	Standard Life Tables for 1996 (3)	(3) ÷ (2)
Source	Japanese Government	Institute of Actuaries of Japan		Institute of Actuaries of Japan	
25	0.00067	0.00082	1.224	0.00086	1.049
26	0.00067	0.00081	1.209	0.00085	1.049
27	0.00068	0.00080	1.176	0.00085	1.063
28	0.00070	0.00081	1.157	0.00084	1.037
29	0.00072	0.00083	1.153	0.00084	1.012
30	0.00074	0.00086	1.162	0.00084	0.977
31	0.00076	0.00089	1.171	0.00085	0.955
32	0.00079	0.00092	1.165	0.00088	0.957
33	0.00085	0.00096	1.129	0.00092	0.958
34	0.00092	0.00100	1.087	0.00098	0.980
35	0.00098	0.00105	1.071	0.00105	1.000
36	0.00105	0.00112	1.067	0.00113	1.009
37	0.00113	0.00119	1.053	0.00122	1.025
38	0.00122	0.00128	1.049	0.00133	1.039
39	0.00132	0.00137	1.038	0.00144	1.051
40	0.00143	0.00148	1.035	0.00156	1.054
41	0.00154	0.00161	1.045	0.00171	1.062
42	0.00168	0.00176	1.048	0.00188	1.068
43	0.00185	0.00192	1.038	0.00208	1.083
44	0.00205	0.00211	1.029	0.00229	1.085
45	0.00227	0.00231	1.018	0.00251	1.087
46	0.00251	0.00254	1.012	0.00273	1.075
47	0.00274	0.00277	1.011	0.00296	1.069
48	0.00297	0.00304	1.024	0.00321	1.056
49	0.00325	0.00333	1.025	0.00348	1.045
50	0.00357	0.00365	1.022	0.00379	1.038
51	0.00393	0.00401	1.020	0.00415	1.035
52	0.00435	0.00440	1.011	0.00457	1.039
53	0.00478	0.00480	1.004	0.00507	1.056
54	0.00524	0.00522	0.996	0.00564	1.080
55	0.00579	0.00567	0.979	0.00630	1.111
56	0.00639	0.00615	0.962	0.00703	1.143
57	0.00697	0.00666	0.956	0.00781	1.173
58	0.00756	0.00718	0.950	0.00864	1.203
59	0.00818	0.00774	0.946	0.00951	1.229
25～59	Average		1.058		1.056

years after the expiration of the suicide exemption term) are suicides. From this, the suicide

[3] Since both the subscribed insurance benefit amount payable at death and the number of people who commit suicide are skewed towards men, we use the share of the gross mortality rate accounted for by men (number of deaths and gross mortality rates by gender according to primary causes of death for men, 2005; Ministry of Health, Labour and Welfare; April, 2007). Incidentally, the share of suicides by men is 70–80% of all suicides aged 30–59 in 2009 (from the National Police Agency's 'Suicide Statistics' published by the Cabinet).

index — raw (2) in Table 4 — is estimated to be 4% in normal years, 30% in the 3-4 year period, 25% in the 4-5 year period, and 20% in the 5-6 year period. The above suicide factor needs to be excluded when calculating a stable basic mortality index by the number of years elapsed.

Second, the assumed mortality rate (Standard Life Tables for 2007 in Japan) that Japanese life insurance companies use is fixed with a 6% margin on average (average for the 25-59 age range, which includes a high number of people insured against death) above those presented in the 2007 Abridged Life Tables for Japan (see Table 5). Since the mortality index is 6% lower, this mortality margin must be included to account for the underestimation created by the excess margin in order to calculate the basic mortality index by the number of years elapsed (against the Abridged Life Tables for Japan) (see Table 4).

Finally, policies created before FY 2006 were drawn up using the Older Life Table in which mortality rates are higher, and therefore the death index is undervalued. According to Table 5, the mortality rates (average for ages 25-59) used in Standard Life Tables for 1996 (used for policies up until FY 2006) are 6% higher than those in Standard Life Tables for 2007 (used for policies for FY 2007 and beyond). Therefore, the mortality index used in policies up until FY 2006 is undervalued by 6%. In calculating the basic mortality index (against the Abridged Life Tables for Japan), we include a table difference (see Table 4) for policies in FY 2006 and before to correct for the discrepancy between life tables.

From these corrections, Basis ((1) − (2) + (3) + (4)) in Table 4 is derived. This basis increases steadily for the most part from 0 year elapsed (FY 2009 policies) to 10 years elapsed (FY 1999 policies), but moves erratically in one area. A simple regression of mortality index y on years elapsed x yields the following:

$$y = 56.4 + 2.2 \times x \tag{1}$$

where the p-values for the intercept and x are less than 0.001. The coefficient of determination is 0.766.

IV. *Key Findings*

Although it would be desirable to analyze, by the number of years elapsed since granting the policy, the mortality index of term life insurance, which represents a major part of life insurance in Japan, we do not have access to such a data set. However, according to the data obtained from one insurance company, the mortality index is nearly 100% for the term life insurance in force.

Assuming an average remaining life insurance term of around 10 years, we can set the total for Mortality Index (1) in Table 6 at 100. The indices for Suicide Index, Mortality Margin and Table difference in Table (6) are similar to their counterparts in Table 4 (Whole Life Insurance). From this, basis ((1)−(2)+(3)+(4)) in Table 6 is as follows:

$$Basis = Mortality\ Index - Suicide\ Index + Mortality\ Margin + Table\ Difference$$

For example, *Basis (Total)* = 100 − 10 + 6 + 4 = 100 in the table.

Assuming the mortality index for FY 0-1 is the same as for whole life insurance (56.4), and using equation (1), we derive correlation coefficient b of the regression equation in Table 6

TABLE 6. MODEL INDEX OF MORTALITY OF TERM LIFE INSURANCE

Elapse(years)	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+	Total
Mortality Index (1)	54	63	72	101	105	108	101	110	119	127	136	100
Suicide Index (2)	4	4	4	30	25	20	4	4	4	4	4	10
Mortality Margin (3)	6	6	6	6	6	6	6	6	6	6	6	6
Table Difference (4)	0	0	0	6	6	6	6	6	6	6	6	4
Basis (5)= (1)−(2)+(3)+(4)	56	65	74	83	92	100	109	118	127	135	144	100

Note: Mortality index=actual mortality rate/assumed mortality rate * 100

TABLE 7. FACTOR BREAKDOWN FOR THE MORTALITY INDEX OF THE TERM LIFE INSURANCE (Unit: %)

Elapse, t (Unit: years)	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+	Total
Selection Effect by Doctor (1)	−44	−44	−44	−44	−44	−44	−44	−44	−44	−44	−44	−44
Adverse Selection (2)	0	9	18	27	36	44	53	62	71	79	88	44
Moral Hazard (Suicide) (3)	4	4	4	30	25	20	4	4	4	4	4	10
Mortality Index: 100+(1)+(2)+(3)	60	69	78	113	117	120	113	122	131	139	148	110

Note: Mortality index=actual mortality rate/assumed mortality rate * 100

(y=56.4+b×x) as follows:

$$\Sigma(x=0,\ 10)(56.4+b\times x)=100\times 11=1{,}100.$$

Therefore, $b=8.72$.

The regression equation for (5) is $y=56.4+8.72\times x$. This derives the mortality index by the number of years elapsed for (5) in Table 6 as follows:

With the term life insurance, as shown in Table 6, the extent of adverse selection, (where insured individuals in a healthier condition tend to cancel their policies, whereas insured individuals whose medical condition deteriorates tend to continue their policies,) is worse in comparison to the whole life insurance in Table 4, where the mortality index in the basis part rises at an annual rate of 8.7%, which is four times as much as 2.2% of the whole life insurance. This is reasonable because term life insurance policies are designed only for death security, whereas whole life insurance policies are intermediate products that have features of both death security and existence security. Therefore, term life insurance policies require more attention than whole life insurance policies with respect to adverse selection control.

In Table 6, the mortality index (Basis) at the time of the insurance process is 56%, but this figure rises to 144% at years 10 and above, or 2.6 times higher. This coincides with the finding by Hendel and Lizzerei (2003) where the premium for annual renewable term life insurance (assessment is carried out only at the time of policy inception and no checkup is required upon renewal, granted at the age of 40) is, after 10 years, 2.87 times as expensive as the premium for the one-year term life insurance which requires an annual checkup.

Table 7, which shows estimated results of the basic model, is developed by breaking down the factors for the mortality index shown in Table 6.

In Table 7, the mortality index is divided into the following three items: selection effect by the doctor that has a negative impact, adverse selection that has a positive impact and moral hazard (suicide) that has a positive impact. For the first year, because of the selection effect by the doctor, the mortality index is 60%, and the index remains relatively lower at 69% and 78% for the years 1-2 and 2-3, respectively. During the years 3-4, 4-5 and 5-6, moral hazard occurs in addition to adverse selection, which leaves the mortality index more inclined to be just above 100%. After years 6-7, moral hazard ceases to exist, but because of adverse selection, the mortality index stays above 100% and reaches 148% at years 10 and above. It can be assumed that each figure will vary significantly depending on the selection policy of the doctor, the extent of adverse selection, which is determined by the extent of price competition, and the extent of moral hazard, which is determined by the amount of term life insurance benefit and how much insured individuals understand the policy concerning suicide exemption.[4] However, it is presumably obvious that the above-mentioned factors exist.

Table 7 demonstrates the relationship between Rothschild and Stiglitz's (1976) theory, the empirical analysis by Cawley and Philipson (1999) suggesting 'adverse selection does not occur because mortality decreases as the insurance benefit rises. Therefore, insurance companies successfully keep tabs on the health condition of their customers' and we hold the empirical analysis by He (2009) who found that 'adverse selection does not occur reflects short-term empirical analysis, and when looking at a long-term basis of 12 years, the mortality for those covered by insurance is higher as compared to those who are not covered.'

Furthermore, Table 7 provides an explanation of the finding by Chen et al. (2008) that the spread of life insurance leads to a higher suicide rate because life insurance benefit is to be paid even in a suicide case after the suicide exemption period.

V. *Conclusions*

This study proves Hypothesis 1, which states that the mortality for insured individuals at the point of purchasing their policies is lower than that for people in general as a result of medical selection, and thus, no adverse selection occurs, to be true. With regard to Hypothesis 2 concerning the period after the policy is granted, this study proves that the mortality for insured individuals increases because of adverse selection, and in addition, moral hazard contributes to this increase, resulting in the tendency for insured individuals having a higher mortality than people in general.

It is necessary to avoid adverse selection and reduce moral hazard in order to establish efficient life insurance services. However, it may not be feasible to carry out medical selection after the policy is granted in terms of the associated costs and the aspect of insurance effectiveness. Furthermore, regarding suicide exemption, it is arguable whether it is ideal to make the exemption effective for good.

The current status of adverse selection and moral hazard revealed to some extent in the present paper may significantly vary depending on the insurance period, the residual ratio, or

[4] Insurance companies in Japan provide information on the suicide exemption period in their insurance clauses, but do not disclose detailed operations (e.g. invalidity and precedent concerning fraud) to avoid moral hazard. However, there is information on the Internet that would increase moral hazard.

the extent of price competition, among others. The customer segment presumably varies for each insurance company, and moral hazard may be influenced by religion and economic conditions. It will be important for insurance companies to deal with information asymmetry amid the situation in which insurance products become diversified and price competition increases. Furthermore, as future prediction for adverse selection and moral hazard will be required in order to calculate the fair value for liability under the International Financial Reporting Standards, it is desirable that the present study is developed further.

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