Testing for Adverse Selection Using Micro Data on Automatic Renewal Term Life Insurance [+]

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Summary

Automatic renewal term life policies are unique in Japan in that the premium is the same whether the policy is being renewed without a medical examination or a new policy is being purchased with a medical examination. In accordance with the insurance theory, the occurrence of adverse selection is significant immediately following renewal. We also found that adverse selection declines over time after renewal as those who are in poor health die. Moreover, it is clear that adverse selection is more pronounced among the elderly and holders of high-priced policies.

In this study, we obtained data from a life insurance company on each of 9 attributes from 171,719 policies. Treating the post-renewal mortality rate difference (actual − national) as the explained variable, and the years elapsed after renewal, the attained age, amount insured by rank, and gender as the explanatory variables, we analyzed the data using ordinary least squares and weighted regression to clarify the conditions under which adverse selection is strongly generated.

Keywords: Adverse selection, Term Life insurance, Automatic renewal, weighted regression

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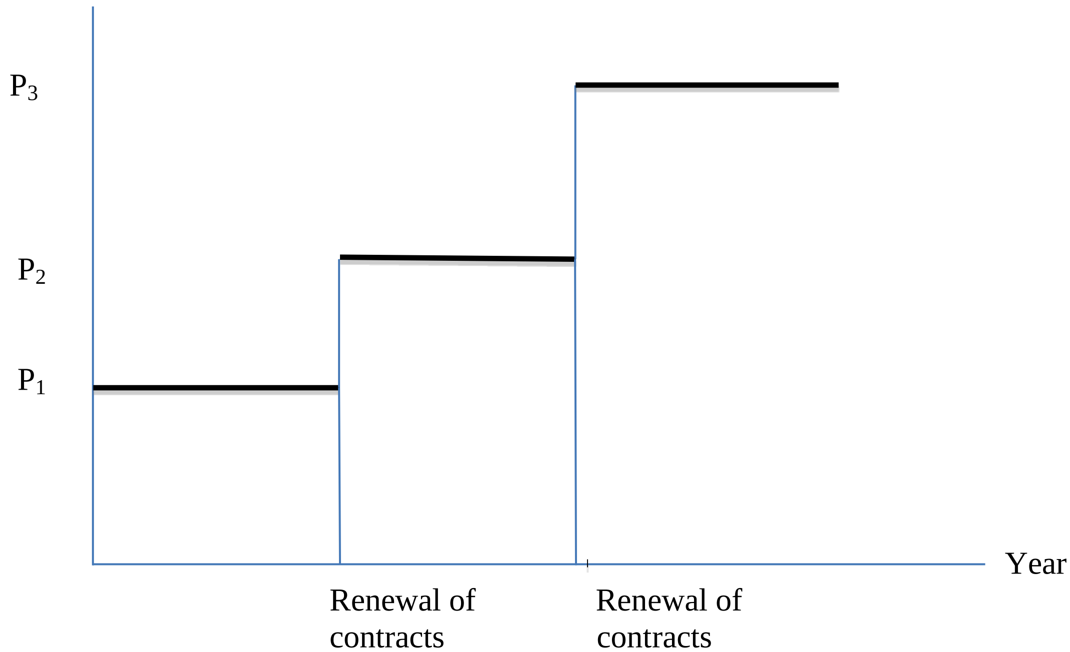
Ⅰ. INTRODUCTION

Most Japanese term life insurance policies are automatically renewed without a medical examination requirement at the time of renewal. With this type of insurance, the premiums following automatic renewal are the same as those for new policyholders who are subject to a medical examination. In the United States, however, a medical exam is usually optional when renewing a term life insurance policy, and only a few life insurance companies handle automatic renewal policies. Also in the United States, the premiums after renewing an automatic renewal term life insurance policy are much higher than those for a new optional renewal term life insurance policy.

A unique characteristic of the Japanese term life insurance market is that the majority of companies sell policies that are "automatically" renewed, without being subject to a medical examination for renewal. Optional renewal is found only in select products; for example, Daido Life's Health Discount Term Life, Mitsui Life's Term Life (Special rate for Individuals with good health), Sony Life's Nonrenewal Term Life, and AXA Life's Nonrenewal Term Life.

Most Japanese term insurance operates as if whole life, but the premiums rise every 10 (or 5) years. The structure of Japanese term life insurance is illustrated in Figure 1.

Figure 1 Insurance Premium (Term life)



Notes: (1) Premiums are leveled in the period prior to the next renewal.
(2) Renewal periods for typical life insurance are usually 10 (or 5) years.
(3) No medical examination at the renewal.

The automatic renewal provision, on the one hand, is advantageous for policyholders because the policy can be renewed, regardless of the insured's health condition. Among the risk pool, the premium charged for an unhealthy insured is the same as that for a healthy insured. On the other hand, insurance companies selling such policies are faced with the problematic possibility that their mortality rates may deviate (i.e., rise) more than initially assumed. Ceteris paribus, the more one's health declines, the higher the probability of renewal. Meanwhile, a healthier person is more likely to switch to another product or company that offers a similar, if not identical, coverage at a lower premium rate. Generally, we assume that the insured has greater knowledge about his or her expected losses (claims) and that this information asymmetry can lead to problems of adverse selection.

For our analysis, we received micro data from a life insurance company on 9 policyholder attributes for more than 170,000 term life insurance policies that had been automatically renewed. We will investigate the conditions that lead to adverse selection by ascertaining the actual mortality rates according to gender, age attained, amount covered on policy subscription, and the number of years that elapse since renewal, and then compare these mortality rates with the national mortality rates according to gender and age.

II. LITERATURE REVIEW

Cawley and Philipson (1999) report several findings that appear difficult to reconcile with the conventional theory of insurance under asymmetric information. They assume that insurers understand their costs of production better than consumers in this market, as for most other products. By measuring the ratio of mortality risk of insured males to the overall male population by age during the 1970–1975 period, they find that men with life insurance are at a lower mortality risk than the overall population. They also observe that the relatively riskier males are less likely to have insurance.

Hendel and Lizzeri (2003) used data on term life insurance contracts to examine the properties of long-term contracts. They compared the costs[1] of annual premiums for a one-year automatic renewal term life insurance policy, a one-year optional renewal term life insurance policy, and a 20-year premium level term life insurance policy (with a death benefit of $500,000). In the case of the one-year automatic renewal term life insurance policy, it is renewable regardless of the policyholder's health at the time of renewal. As the mortality rate rises with age, the premium for a policyholder aged 58 is approximately four times higher than when he/she purchased the policy at age 40 ($459). In the case of the one-year optional renewal term life insurance policy, if the policyholder passes the medical exam each year, the premium at age 58 will be only approximately three times the amount paid when they first purchased the policy at age 40 ($370). However, if the policyholder fails the medical examination at age 41, the premiums when the policyholder is 58 years of age will be 15 times that paid when they first purchased the policy at age 40 ($370). The premium levels in the 20-year term life insurance policy are higher when the policyholder enters into it at age 40, at $866. At age 58, however, the policyholder's premium remains unchanged at $866, regardless of health. Policyholders who pay a high premium in the initial stage of their policy tend to have a low cancellation rate, and the

[1] The annual premium comprises the net premium (cost), corresponding to the death benefit, and the additional premium, corresponding to the expenses. As the breakdown of the premium is not disclosed, the analysis was performed assuming that the entire premium was cost.

present value of their total premiums for 20 years is also low. Hendel and Lizzeri interpreted the results as signifying that many people who pay high premiums in the initial stage of their policy live for a long time.

Chiappori and Salanie (2008) discover dynamic and quite interesting issues in insurer strategies. When a 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 product where pricing and hedging raise some intricate problems. For instance, selective attrition may be a serious concern and computing provisions would be seen as a challenging requirement in life insurance.

He (2009) used the Health and Retirement Study (HRS) dataset and found a significant correlation between the act of purchasing term life insurance and the long-term mortality rate. Specifically, from among the cohort of people without term life insurance in 1992 (born between 1931 and 1941), 6,113 people died during the 12-year period up to 2004. When controlling for such factors as age, gender, smoker or nonsmoker, and health condition, compared to people in the same cohort who were still alive in 2004, those who died had purchased term life insurance equivalent to an extra 19% (from 1992 to 1994) (level of significance, 5%), empirically demonstrating the existence of adverse selection.

Ⅲ. Hypothesis Development

Cawley and Philipson suggest that insurers know the insured's health conditions better than the insured themselves. This may be based on the fact that the insurer's underwriting process requires that each insured specifies whether he or she consulted a doctor in the past three months, whether any abnormality was discovered during a medical check-up conducted within the past two months, whether the insured was treated for seven days or more in the past five years, and whether the insured suffered from any handicaps. Furthermore, when the life insurance benefit exceeds a certain amount, the insurance applicant must submit additional medical information such as the test results for urine, blood pressure, weight, chest circumference, and abdominal circumference to ensure equality amongst the insured individuals.[2] Therefore, it is expected that at the time of

[2] This threshold varies, depending on age. For a term life insurance policy by Lifenet Insurance Company, for example, the amount is ¥30 million for individuals aged 18–40, ¥25 million for those aged 41–45, ¥20 million for those aged 46–50 years, ¥15 million for those aged 51–55 years, and ¥10 million for those aged 56–64 years.

application, the mortality rates of those who purchase life insurance may be lower than that of the general population. Yoneyama et al. (2013) indicate that in the case of the automatic renewal of term insurance contracts, the effectiveness of medical selection effects occurring in conjunction with a new policy, and the adverse selection effects materializing after a policy was automatically renewed, disappeared after 10 years.

In light of these preceding studies, we seek to verify the following three hypotheses in this study:

Hypothesis 1: The shorter the elapsed time following the automatic renewal, the more clearly adverse selection appears. As time passes after renewal, the actual mortality rate approaches the national mortality rate.

Hypothesis 2: The older the policyholder, the more clearly adverse selection appears after the time of automatic renewal.

Hypothesis 3: In terms of the insured amount rank, when the rank is above a certain level, adverse selection appears at the time of automatic renewal.

The model proposed by Rothschild and Stiglitz (1976) is based on the assumption that only individuals know their own health conditions and private insurers cannot set accurate premiums purely on the basis of information provided by individuals. Thus, insurers charge all clients the same premium rate, which reflects the average risk of the insured pool. This pooled premium structure attracts more high-risk clients than low-risk ones because the market is not completely efficient.

Despite the theoretical model’s innovative expression of asymmetric information, it does not accurately reflect the reality that private insurers do not sell life insurance to those who are in poor health on the basis of their findings from the application forms and underwriting procedures. Although insurance companies significantly reduce adverse selection through medical selection during the policy approval process, it appears that, in principle, adverse selection cannot be avoided.

Ⅳ. AUTOMATIC RENEWAL TERM LIFE (AFTER RENEWAL) DATA IN OUR ANALYSIS

In typical insurance products in Japan, term life insurance premiums are determined only according to the product, the insurance period, the policy value, policy year, gender, and age at time of purchase; there are no differences in premiums for policyholders who smoke[3] or drink. However, people who have been treated for conditions such as cancer, diabetes, or heart disease, or people who have been hospitalized due to an illness within the past five years, are unable to purchase life insurance. Even if they are approved to purchase life insurance, very few people buy these policies because they are required to pay especially high premiums. While there are life insurance policies that sick people can purchase without passing a medical examination, the maximum amount of insurance (risk limit) is limited to approximately three million yen, and the premiums are extremely high. Moreover, if the person dies of illness within two years of purchasing the policy, no claim is paid and only the premium amount that the person has already paid is returned. Hence, this policy is not widely purchased. We analyzed life insurance targeting people of normal health. The risk categories are shown in Table 1.

We obtained anonymous cost data on 171,719 individual automatic renewal term life insurance (after renewal, in FY 2012) policies from a Japanese life insurance company. The data was in a format that included the detailed items described below.[4] Table 1 shows the data arranged by the number of years since renewal which we expected, from the previous research, to have a major effect on the presence or absence of adverse selection. Using the post-renewal mortality rate, the years elapsed after renewal, the attained age and amount insured by rank, and gender, we can first analyze the conditions under which adverse selection is strongly generated .

[3] The nonsmoker discount is sold as a health discount in special products.

[4] We could calculate the actual mortality rates (undisclosed cost data) according to sex and age. While, Hendel and Lizzerei used the entire premium (net premium + additional premium) as cost because the breakdown of the premium is not disoclosed.

TABLE 1: Risk Segmentation of Term Life after Renewal in Our Data

Variables	Definition
Product	Automatic-renewal term life insurance (After Renewal)
Insurance period	Usually 10 (or 5) years
Policy value (v)	Usually ¥1 million to ¥50 million
Gender (s)	Male or female
Age at time of purchase (x)	Unit: years
Elapsed time (t)	Unit: years
Mortality	Deceased: 1, Living: 0

The insurance period for automatic renewal term life insurance policies is usually 10 (or 5) years. But in Japan, automatic renewal without a medical examination is the norm for selection.[5] For renewals among males aged 40 and over, for whom the national mortality rate dramatically increases and their premiums rise by more than 100%, it is postulated that adverse selection is likely to occur when healthy males do not renew or reduce and unhealthy males renew their policies.

Ⅴ. EMPIRICAL PROCEDURE

Prior to determining whether the actual mortality rate is significantly high or low, it is essential to define a standard; for example, a national mortality rate calculated by age and gender. However, a comparison between the actual mortality rate for a specific product in a specific year and the general national mortality rate would not be meaningful. This is because the gender composition ratio and the age composition of a specific product in a specific year differ from those determining the national mortality rate. Thus, we must first calculate the national mortality rate that corresponds to the gender and the age and then compare the calculated value with the actual mortality rate.

Table 2 indicates the format of the data that we actually obtained. The data provide the numbers of covered incidents, coverage amounts, national mortality rate, and actual mortality rate (based on incidents and based on insured amount) by gender, years elapsed since renewal, attained age, and insured amount rank for fiscal year 2012 Using this data, we were able to perform accurate statistical analysis on the occurrence of adverse selection by gender, years elapsed since renewal, attained age, and insured amount rank.

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[5] Optional renewal is found only in selected products; for example, Daido Life's Health Discount Term Life, Mitsui Life's Term Life (Special rate for Individuals with good health), Sony Life's Nonrenewal Term Life, and AXA Life's Nonrenewal Term Life.

TABLE 2: Format of the data used

Years elapsed after renewal (t)	Attained Age (x + t)	Gender (Male:0; Female: 1)	Amount-insured rank*	National mortality rate (‰)	No. of incidents in the Elapsed time	No. of actual mortalities	Benefits paid in elapsed time (in ¥10,000)	Benefit paid on an actual death (in ¥10,000)
1	20							
1	21							
1	79							
2	20							
2	21							
2	79							
10	20							
10	79							

*) Rank 1: ￥0-¥999,999; Rank 2: ¥1,00,000-¥2,499,999; Rank 3: ¥2,500,000- ￥4,999,999;
Rank 4: ￥5,000,000-￥7,499,999; Rank 5 : ¥7,500,000-¥9,999,999; Rank 6 : \10,000,000-\19,999,999,
Rank 7: ￥20,000,000-￥29,999,999; Rank 8: ¥30,000,000-￥39,999,999; Rank 9: ￥40,000,000-￥49,999,999;
Rank10: ￥50,000,000-￥74,999,999; Rank 11 ￥75,000,000-￥99,999,999; Rank 12: ≧￥100,000,000

Our study adds value to existing studies with respect to the collection and analysis of undisclosed cost data. Specifically, we use actuarial data from an insurance company and calculate the national mortality rate and the actual mortality rate for term life (after renewal) contracts (more than 170,000 contracts), using the *Abridged Life Table 2012* from the Ministry of Health, Labour and Welfare. In this study, we aim to build on the previous analysis to clarify the conditions under which adverse selection is generated. Specifically, using the mortality rate difference after renewal (actual − national) as the explained variable, and number of years elapsed after renewal, age at year of 2012, amount insured rank, and gender as the explanatory variables, we will analyze the data using multiple regression analysis to clarify the conditions under which adverse selection is strongly generated.

TABLE 3: Descriptive Statistics

		Attained Age (Years)	Years Elapsed (Years)	Amount Insured Rank (*1)	No. of Covered Incidents (Incidents)	National Mortality Rate (‰)(*2)	Actual Mortality Rate (‰)	Difference in Mortality Rate (‰)
Male	Average	53	5.0	4.9	51	5.7	6.8	1.1
	Standard Deviation	10	2.8	2.0	41	4.7	16.1	15.3
	Minimum	30	1.0	2.0	10	0.6	0.0	−18.2
	Maximum	70	10.0	10.0	238	18.2	200.0	188.0
Female	Average	53	4.7	4.3	29	2.5	4.0	1.6
	Standard Deviation	10	2.7	1.7	19	1.7	14.2	14.0
	Minimum	30	1.0	2.0	10	0.3	0.0	−7.6
	Maximum	70	10.0	7.0	178	7.6	133.0	129.5

(*1) Amount Insured Rank 2:¥1,000,000～2,499,999, 3：¥2,500,000～4,999.999、
4：¥5,000,000～7,499,999、 5：¥7,500,000～9,999,999、6：¥10,000,000～19,999,999、
7：¥20,000,000～29,999,999, 8：¥30,000,000～39,999,999、9：¥40,000,000～49,999,999、
10：¥50,000,000～74,999,999

(*2) Abridged Life Table（Ministry of Health, Labour and Welfare, 2012）.

As shown in Table 2, we obtained data of those aged between 20 and 79. Despite the large number of covered incidents for analysis (171,719, of which 118,880 were male and 52,839 were female), some of the cells had a low number of covered incidents. In such case, the actual mortality rate could largely fluctuate, distorting the analysis. Therefore, we opted to analyze only those of an attained age between 30 and 70 and with 10 or more covered incidents within the relevant cell, as shown in Table 3. Excluding nontypical policies of those in their 20s and over 70 (term policies with only a death benefit and policies in categories) and fewer than 10 incidents in the table cells (with low mortality), the resulting analysis should be more stable, despite more than a 10% decline in the number of analyzed incidents (150,648, of which 107,196 were male and 43,452 were female). As a result, amount insured rank 1, 11 and 12 were eliminated.

Table 3 shows that the average age of both males and females covered under automatic renewal term life insurance policies is 53 and the average number of years elapsed since renewal is 5. From this, we see that the coverage period for most policies is 10 years. On the other hand, the average amount insured rank for males (7,500,000–9,999,999) exceeds that for females (5,000,000–7.499,999).

The number of analyzed policies for males (107,196) was more than double the number for females (43,452). Although the average attained age was the same, the national mortality rate after accounting for age of policy holders was more than twice as high for males (5.7‰) as it was for females (2.5‰). The difference in mortality rate (actual mortality rate − national mortality rate) was lower for males (1.1‰) than for females (1.6‰). This is attributable to the average number of covered incidents being 51 for males and 29 for females, and the reason that the difference in male mortality rates is lower than the difference in female mortality rates is presumed to be due to the law of large numbers.

Figure 2: National Mortality Rate by Gender (2012 Abridged Life Table)(Ages 30-70)

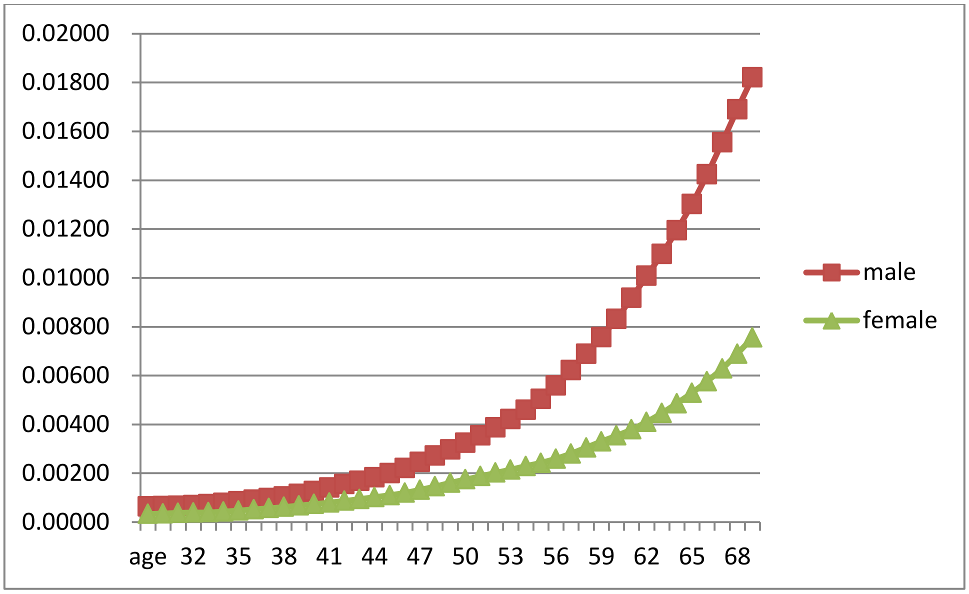

Figure 2 graphically depicts national mortality rates by gender for those aged between 30 and 70. The mortality rate for males increases 28-fold from 0.00064 (0.64‰) at age 30 to 0.018 (18‰) by age 70. For females, the mortality rate increases 23-fold from 0.00033 (0.33‰) at age 30 to 0.0076 (7.6‰) by age 70.

Figure 3: 1 Year Term Premiums and 10 Year Automatic Renewal Term Premiums for Males (per insurance increment, ages 30–70)

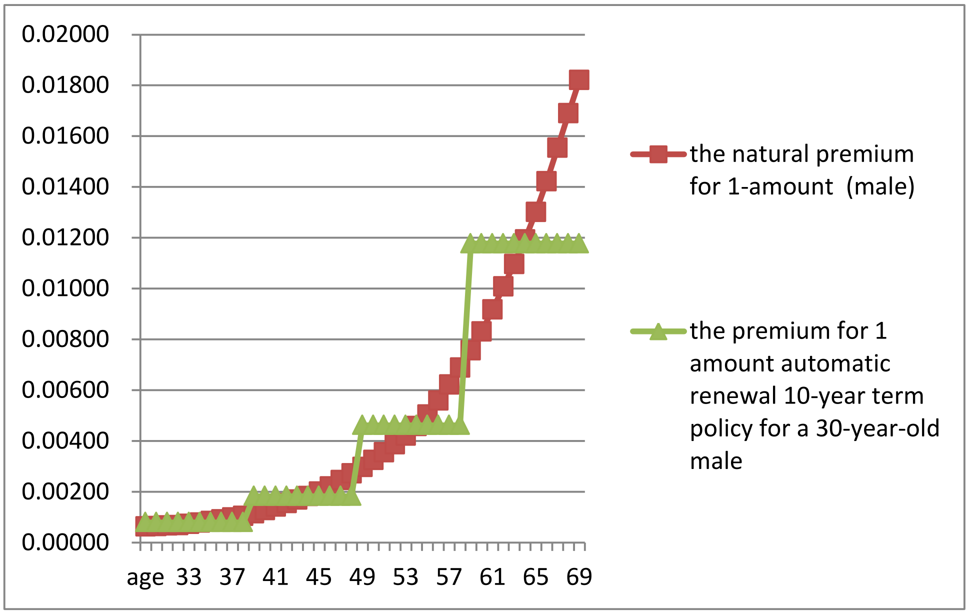

Figure 3 is a graph comparing the natural premium (premium for 1-amount of 1-year term coverage–matches Figure 2) with the premium for 1-amount of automatic renewal 10-year term policy for a 30-year-old male and assuming that the premium for term coverage is the net premium (calculated using only the national mortality rate and not including administrative expenses or interest).

From this, we can surmise that the premium upon renewal (not including administrative expenses or interest) is approximately 2.3 times higher for a male renewing at age 40 than the premium purchasing a new 10-year term policy at age 30, and approximately 2.5 times higher (excluding operating expenses) upon renewing at age 50 (60) than the premium purchasing a new 10-year term policy at age 40 (50). Assuming that the desirable death benefit would equal the amount of earnings prior to retirement at age 60–65, it is not rational to pay 2.3–2.5 times the amount for the same coverage upon renewal at ages 40, 50, or 60 while the desirable death benefit is decreasing with age. Hence, it is understandable that adverse selection would occur as individuals who are on the brink of death would renew the same coverage amounts while healthy individuals would tend to reduce or drop their coverage.

There are factors other than adverse selection that can explain the differences between the national and actual mortality rates, but they have not had much effect on life insurance calculations owing to the law of large numbers. For example, according to the Ministry of Health, Labour and Welfare, the national mortality rate of Japan in 2011 was 10.0 per 1,000 people, which slightly exceeded the rate of 9.5 per 1,000 people in 2010, despite the Great East Japan Earthquake.

Ⅵ. MODEL

Taking the model where the termination event is limited to two possibilities—death and surrender—the national survival rate of an *x*-year old (denoted as p_x) insured at policy inception is

$$p_x = 1 - q_x ,$$

where x is the age at entry, q_x is the national mortality rate. Then, the actual survival rate (p'_x) is

$$p'_x = 1 - q'_x - w_x,$$

where q'_x is the actual death rate and w_x is the actual surrender rate.

We used the following four explanatory variables: national mortality rates conditional on sex and the attained age; years elapsed after renewal; the age at the time of renewal; and the insured amount rank.

The dependent variable is the actual mortality rates in the analysis summarized in Table 4, and is the difference in the actual and the national mortality rates for the analysis in Tables 5 and 6.

Our data is a set of contracts in force for a particular product (total subscriptions for fiscal year 2012). The national mortality rates are from the *Abridged Life Table 2012*, published by the Ministry of Health, Labour and Welfare.

The analysis in the next section proceeds as follows. First, we regress the actual mortality rates using multiple regressions (see Table 4). Then in Table 5 and Table 6, instead of using the actual mortality rate, we regress the difference between the actual and the national mortality rate. Then, we analyse the difference between their actual and the national mortality rate. Table 5 shows the results from multiple regression. Finally, Table 6 shows the results from weighted regression[6] to deal with the problems of heteroscedasticity due to difference in the number of samples between cells.

Ⅶ. ESTIMATION OF ADVERSE SELECTION

In our initial analysis, the results from the estimation of the actual mortality rate using the multiple regression analysis are shown below. Table 4 is the result of ordinary least squares regression with actual mortality rate as the explained variable.

For males, ordinary least squares regression with actual mortality rate as the explained variable and national mortality rate, attained age, years elapsed, and amount insured rank as the explanatory variables results in positive coefficients for the explanatory variables of national mortality rate and amount-insured rank at a significance of 1%, and a negative coefficient for years elapsed at a significance of 1%. Because multicollinearity between national mortality rate and attained age is assumed, when either national mortality rate or attained age is excluded as an explanatory variable, the coefficients of all explanatory variables become significant either positively or negatively in accordance with insurance theory.

For females, ordinary least squares regression analysis with actual mortality rate as the explained variable and national mortality rate, attained age, years elapsed, and amount insured rank as the explanatory variables results in a positive coefficient for the explanatory variable of amount-insured rank at a significance of 1%, and a negative coefficient for years elapsed at a significance of 1%. Because multicollinearity between national mortality rate and attained age is assumed, when either national mortality rate or attained age is excluded as an explanatory variable, the coefficients of all explanatory variables become significant either positively or negatively in accordance with insurance theory.

To completely eliminate multicollinearity among the explanatory variables, a second multiple regression analysis was performed with difference in mortality rate (actual mortality rate − national mortality rate) as the explained variable and attained age, years elapsed, and amount insured rank as explanatory variables.

[6] Number of covered incidents within cells were weighted.

Table 4: Results of Ordinary Least Squares of Actual Mortality Rates

Male

	Model 1		Model 2		Model 3	
	Coefficient (standard deviation)	P value	Coefficient (standard deviation)	P value	Coefficient (standard deviation)	P value
National Mortality Rate	1.027 (0.180)	0.000 ***			1.149 (0.732)	0.000 ***
Attained Age	0.00064 (0.00086)	0.458	0.00512 (0.00035)	0.000 ***		
Years Elapsed	−0.00040 (0.00127)	0.002 ***	−0.00048 (0.00127)	0.000 ***	−0.00038 (0.00124)	0.002 ***
Amount-Insured Rank	0.00493 (0.00168)	0.003 ***	0.00299 (0.00166)	0.072 *	0.00513 (0.00166)	0.002 ***
Number of Observations	2107		2107		2107	
Prob (F-statistic）	0.000		0.000		0.000	
Adjusted-R^2	0.104		0.090		0.090	

Female

	Model 1		Model 2		Model 3	
	Coefficient (standard deviation)	P value	Coefficient (standard deviation)	P value	Coefficient (standard deviation)	P value
National Mortality Rate	0.812 (0606)	0.180			1.343 (0.215)	0.000 ***
Attained Age	0.00010 (0.00011)	0.348	0.00024 (0.00039)	0.000 ***		
Years Elapsed	−0.00048 (0.00144)	0.001 ***	−0.00051 (0.00142)	0.000 ***	−0.00445 (0.00139)	0.001 ***
Amount-Insured Rank	0.00070 (0.00022)	0.001 ***	0.00656 (0.00217)	0.003 ***	0.00724 (0.00218)	0.001 ***
Number of Observations	1473		1473		1473	
Prob(F-statistic）	0.000		0.000		0.000	
Adusted-R^2	0.031		0.030		0.031	

(Note） ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Results of Ordinary Least Squares Regression for Difference in Mortality Rate

	Male		**Female**	
	Coefficient (Standard Deviation)	P value	Coefficient (Standard Deviation)	P value
Attained Age	0.000076	0.030 **	0.000071	0.069 *
	(0.000035)		(0.000039)	
Years Elapsed	−0.00040	0.002 ***	−0.00047	0.001 ***
	(0.00126)		(0.00014)	
Amount-Insured Rank	0.00049	0.003 ***	0.00071	0.001 ***
	(0.00016)		(0.00022)	
Number of observations	2107		1473	
Prob (F-statistic)	0.000		0.000	
Adjusted-R^2	0.007		0.012	

(Note) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 5 shows the results of the ordinary least squares regression with difference in mortality rate (actual mortality rate − national mortality rate) as the explained variable and attained age, years elapsed, and amount insured rank as explanatory variables. For males, attained age as an explanatory variable results in a positive coefficient at a significance of 5%, while years elapsed results in a negative coefficient at a significance of 1% and amount insured rank results in a positive coefficient at a significance of 1%.

The results were similar for females.

The negative coefficient for years elapsed clearly demonstrates an extremely strong tendency toward adverse selection immediately after renewal as most Japanese life insurers automatically renew term life insurance policies without requiring medical exams so that healthy individuals tend to reduce or drop their coverage in reaction to the higher premiums upon renewal while only unhealthy individuals accept automatic renewal at higher premiums. Incidentally, Yoneyama (2013) set only years elapsed as the explanatory variable, which resulted in a mortality rate of about double that of the national mortality rate immediately after renewal. This extremely strong tendency toward adverse selection gradually decreases as those who are sick die.

Moreover, the higher the attained age, the more pronounced is the adverse selection of unhealthy individuals upon automatic renewal. This is assumed to be caused by greater disparities in health as people age. In addition, the adverse selection mentioned above is more pronounced as the amount insured rank increases. These examples of adverse selection are in accordance with the assumptions of insurance economics.

Finally, weighted regression estimations for difference in mortality rate were conducted. The results shown in Table 6 slightly differ from those in Table 5. The average number (standard deviation) of covered incidents in one cell is 51 (41) for males and 29 (19) for females. While the impact of weighting the number of incidents is expected, agreement in coefficients and similar P-values in Table 5 and Table 6 demonstrate a certain level of robustness in the results.

Table 6: Weighted Regression Estimates for Difference in Mortality Rate

	Male		Female	
	Coefficient (Standard Deviation)	P value	Coefficient (Standard Deviation)	P value
Attained Age	0.000056 (0.000031)	0.073 *	0.000065 (0.000034)	0.054 *
Years Elapsed	−0.00027 (0.00010)	0.008 ***	−0.00033 (0.00012)	0.009 ***
Amount-Insured Rank	0.00060 (0.00015)	0.000 ***	0.00061 (0.00019)	0.001 ***
Number of Observations	2107		1473	
Prob (F Statistic)	0.000		0.001	
Adjusted R^2	0.008		0.009	

(Note) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The above results support Hypothesis 1 (strong tendency toward adverse selection immediately following automatic renewal, which subsequently diminishes). This is believed to be due to the actual mortality rate approaching the national mortality rate as sick individuals pass away over time. Hypothesis 2 (the older the policyholder, the stronger the tendency toward adverse selection) is also supported. This is assumed to be due to greater disparities in health as people age, which makes it possible to predict the mortality rate of the insured. Hypothesis 3 (adverse selection tends to occur when the insured amount rank is higher) is also supported. It is believed that this is because individuals with expensive coverage have a stronger awareness of their own health situation. In addition, when we compare the data of male and female, the size of the coefficient is similar. The tendency of adverse selection seems to be similar between male and female. This is because adverse selection occurs regardless of income differences between males and females.

Ⅷ. CONCLUSION

From the data provided by insurance companies, it is clear that for automatic renewal term life insurance policies where the premium is the same whether one is renewing coverage without a medical exam or buying a new policy with a medical exam (a product that is unique to Japan), the occurrence of adverse selection is significant immediately following renewal, which is in accordance with the insurance theory. We also found that adverse selection declines over time after renewal as those who are in poor health die. Moreover, it is clear that adverse selection is more pronounced among the elderly and among holders of high-priced policies. These results were obtained from the analysis of internal corporate data on 170,000 policies, which reflect large differences in national mortality rates and actual mortality rates by age and gender.

It is assumed that the widespread diffusion of the automatic renewal system, which does not consider adverse selection, is due to the fact that term life insurance has not always been the main insurance product in Japan. Now that term life insurance is becoming the main product, a more equitable insurance system needs to be formulated to eliminate adverse selection as soon as possible by adopting renewal premiums for both automatic renewal term life insurance and optional renewal term life insurance, as has been done in the United States.

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