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Proposal for a New Solvency Index for Life Insurance Companies
—Detection of Insolvent Companies at an Early Stage by means of Adjusted Basic Profit and Solvency CI

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— Detection of Insolvent Companies at an Early Stage by means of Adjusted Basic Profit and Solvency CI

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Abstract

In light of the experience gained from seven insolvencies out of 40 life insurance companies in Japan, this research paper proposes a new approach to the prior detection of insolvent life insurance companies since such detection is considered difficult only with the risk-based capital method (hereinafter referred to as the "RBC method"), the world's mainstream soundness criteria.

The Solvency II, new framework to supervise the soundness being studied by the EU, takes the Basel II Capital Accord as the basic concept and emphasizes the following three points: ① quantitative capital requirements consisting of the minimum capital and target capital; ② identification of insurance companies that take high risks in terms of financial and organizational situation and monitoring them by supervisory authorities; and ③ market discipline by promotion of disclosure. However, merely an extension of the RBC method does not make the points ② and ③ fully functional because of the difficulties in continuous monitoring, in judgment by market participants, and others.

The soundness index developed this time puts importance on the life insurance company's primary profit, that is, the transition of the income statements, while the RBC method is based on the balance sheet and risk factors. This index is designed to identify, in advance and from various angles, the phase where the soundness risk of life insurance companies is likely to come to the surface and to detect an individual company with a high probability of insolvency, using the "Adjusted Basic Profit," "Solvency CI," etc. described afterwards.

KEY WORDS:

Solvency margin criteria, adjusted basic profit, composite index, solvency CI, continuous monitoring

1. Introduction

It was believed in Japan that life insurance companies would never become insolvent because the entry into the market was limited to a small number of large-sized companies (about 40 companies) by regulations and they were under severe supervision by the government. Seven of them, however, have become insolvent one after another in merely four years since Nissan Mutual Life Insurance Co. declared insolvent in fiscal year 1997. The news caused a major disruption since the total net asset deficiency of those seven companies was 2,623.5 billion yen (23.8 billion U.S. dollars), and the number of their total insurance contracts (20 million) accounted for 17.1 % of the entire market at the end of fiscal year 1996. The Insurance Business Law, amended in 1996, introduced the solvency margin control in fiscal year 1996, which is the RBC control in Japanese version, and started the early corrective measures in 1999, in order to assure the soundness of life insurance companies. The reliability of the solvency margin criteria, however, was questioned for a while, because ① it was not disclosed in the beginning (though the ratio and breakdown were to be disclosed in the financial statements starting from fiscal year 2001 after a revision of the criteria); and ② the solvency margin ratio of five out of those seven insolvent companies exceeded 200% in the fiscal year immediately prior to the insolvency.

Mr. Mitsuhiro Fukao and others previously researched the problems concerning the Japanese solvency margin criteria. The improvements can be summarized as follows: ① to promote the evaluation of assets at market values; ② to raise the risk weight (from 10% to 30% for the domestic and foreign securities, from 5% to 10% for the real estate, etc.); ③ to switch from the book basis to recovery basis, for example, the reduction of accrued profits and deferred tax assets; and ④ to revise the assumed interest rate risk. The solvency margin criteria improved by this revision, however, still leaves the following essential issues.

① Adequacy of risk factors. The risk factors, based on the standard deviation of assets, vary depending on the period of estimate and indices in use. In addition, it is doubtful whether or not the definition of assumed interest rate risk and the method of risk calculation are reasonable.

② The asset degradation of potentially insolvent companies may be faster than the calculation of their solvency margins that requires the closing of financial accounts.

③ Confusion caused by the fact that the supervisory authorities have adopted another method, "actual net assets criteria" (see Note 1), for the determination of insolvency

④ It is impossible to grasp soundness from various aspects only with the solvency margin ratio.

2. Hypothesis for New Criteria of Soundness

The change in risk preferences or management strategies of life insurance companies brings about some changes in the transition of profits, as is the case for ordinary businesses. However, it is difficult to get a clear grasp of life insurance companies' profits due to the uniqueness of their income statements.

Accordingly, the total amount of the following three gains is taken into account as a profit index to measure the fundamental soundness of life insurance companies (hereinafter referred to as the "Triple Gains"): ① the interest rate gain obtained from the difference between the assumed interest rate and the actual investment yield; ② the death rate gain obtained from the difference between the estimated and actual death rate; and ③ the cost gain obtained from the difference between the estimated and actual operating expenses. The Life Insurance Association of Japan has disclosed the "Basic Profit", which is a concept similar to the Triple Gains, since fiscal year 2000 in response to the criticism that the profit of insurance companies was unclear.

The long-term index for life insurance companies' profits, which is similar to the Basic Profit (almost the same as the Triple Gains), is newly created here since it is not disclosed (hereinafter referred to as the "Adjusted Basic Profit"). The calculation is attempted for the period of 44 years starting from fiscal year 1960 to the latest fiscal year 2003 using the past income statements. Because the criteria for income statements were considerably amended in fiscal year 1975, 1989 and 1991, adjustments are made when an account title itself does not exist or is changed.

The Adjusted Basic Profit is obtained by deducting the "Basic Expenses" from the "Basic Revenues." The Basic Revenues are obtained by deducting the gain on sale of marketable securities, gain on foreign exchange, revenues from derivatives, and reversal of contingency reserve; from the ordinary revenues in the income statements. The Basic Expenses are obtained by deducting the provision for contingency reserve, loss from sale of securities, loss from appreciation of securities, bad debt expenses, provision for allowance for uncollectible accounts, loss from foreign exchange, cost of derivatives, and operating expenses; from the ordinary expenses.

The entire industry's Adjusted Basic Profit in fiscal year 2003 thus computed is 2,163.3 billion yen, 14 times as big as the Adjusted Basic Profit level in fiscal year 1960 (154.7 billion yen) and approximately half of its peak in fiscal year 1991.

The Adjusted Basic Profit is based on the business performance and asset management yield including the total amount of insurance in force and asset values, but does not include the profit and loss on sales and appreciation of the asset management, which makes the profit relatively stable. It represents very well the characteristics of the insurance business model that aims the risk distribution and profit earning through long-term accumulation of

many contracts, but the Adjusted Basic Profit of a single year may increase by the bulk sale of single premium endowment policies under a single-year sales strategy or "booming" profits due to reckless management by executives. The sharp rise in single premium endowment policies includes the advancement of future revenues. Moreover, the short-term income easily increases once the risk control is relaxed.

Therefore, a single-year's significant profit deviations from the average structure of Adjusted Basic Profit in certain period suggest the abnormal managerial situation. The average profit structure is derived from the long-term average structure of single year's Adjusted Basic Profit, and it can also be expressed as the estimated value of the structure model to explain the Adjusted Basic Profit (hereinafter referred to as the "Theoretical Value").

In other words, the hypothesis is drawn that the problem in the soundness of a life insurance company creates a significant divergence between the actual Adjusted Basic Profit in a single year and the estimated value showing its average structure.

In the next chapter, the Adjusted Basic Profit model is formed from limited cases in Japan to verify this hypothesis through an empirical analysis.

3. Empirical Analysis

From a viewpoint of the Triple Gains, the Basic Expenses of the "Adjusted Basic Profit" are classified into the "Operating Expenses" and others. The "Operating Expenses" correspond to the cost gain, consisting of the pay to salespersons for solicitation and the costs for offices and systems of insurance companies. Accordingly, the basic structure is explained as this equation: "Adjusted Basic Profit" = "Basic Revenues" – ("Basic Expenses other than the Operating Expenses" + "Operating Expenses").

Firstly, since the "Basic Revenues" consist of the insurance operation revenues and the asset management yields, three predictor variables are used: ① total amount of individual insurance in force; ② the converted premium which is obtained by converting the earned premium of each product with margin percentage and aggregating it; and ③ difference in the interest of 10-year government bond between the current fiscal year and two years ago (duration of bond portfolio of a life insurance company).

Secondly, since the "Basic Expenses other than Operating Expenses" consist mainly of the death rate loss and the interest rate loss and they involve the provision of premium reserve and the payment of claims and benefits, the following two predictor variables are used: ① total amount of individual insurance in force and ② converted premium. Lastly, since the "Operating Expenses" consist of a medical examination fee and sales commission for winning a new contract and the management cost of contracts in force, the following two

predictor variables are used: ① value of new contract (including net increase due to conversion of contract); and ② converted premium.

Since the period of estimate is as long as 44 years from fiscal year 1960 to fiscal year 2003, the estimate with the least square method probably results in a low Durbin-Watson's ratio and in a serial correlation. For this reason, the following model is used with combination of multiple regression model and autoregressive model. The formula for estimate is selected on the basis of the Akaike's information criterion, t-values for each predictor variable, etc.

$$Log\,(R_1) = \alpha_1 + \alpha_2\,Log\,(H_t) + \alpha_3\,Log\,(KP_t) + \alpha_4\,(I_t) + r_t \qquad r_t = \alpha_5\,r_{t-1} + u_t$$

$$Log\,(E_t) = \beta_1 + \beta_2\,Log\,(H_t) + \beta_3\,Log\,(KP_t) + \beta_4\,(DMY) + r_t \qquad r_t = \beta_5\,r_{t-1} + u_t$$

$$Log\,(C_t) = \gamma_1 + \gamma_2\,(J_t) + \gamma_3\,(\%RCL\,(KP_t)) + r_t \qquad r_t = \gamma_4\,r_{t-1} + u_t$$

$$P_t = EXP\,(R_t) - (EXP\,(E_t) + EXP\,(C_t))$$

R_t, E_t and C_t represent the adjusted revenues in the term t, the modified expenses in the term t excluding the operating expenses, and the operating expenses, respectively. P_t, H_t, and KP_t represent the Adjusted Basic Profit in the term t, the total amount of individual insurance in force in the term t, and the converted premium revenues in the term t, respectively. DMY represents the dummy variable for significant change in the income statements, with a value of 1 in and before the fiscal year 1974 and 0 in and after the fiscal year 1975. $\%RCL(KP_t)$, I_t, J_t, r_t and u_t represent the growth rate of the converted premium revenues in the previous fiscal year, the difference in 10-year government bond yield from that of two years ago, the value of new contract + net increase due to conversion in the term t, the residual error, and the white noise, respectively. The Basic Revenues and the Basic Expenses are as defined above. Data sources are the "INSURANCE, Life Insurance Statistics Issue," "Nikkei NEEDS – Financial QUEST (Feb, 2005)."

The result of estimate is shown in Table 1. For the serial correlation of R_t, E_t and C_t, every formula shows that the P level under the Liung-BoxQ-Statistics is beyond the level of significance of 5% (Table 1 shows the data for up to five terms while actual tests are conducted for 16 terms.) and the hypothesis H_0 (the residual error is the white noise) cannot be rejected. The residual error, therefore, is the white noise. Although the interest rate is weak as a predictor variable, it is left to clarify the interest rate gain in terms of the Triple Gains. The estimate with two variables except the interest rate does not make a large difference in the results.

Table 1: Estimate Result of Adjusted Basic Profit

		Coefficient	Std. Error	t-statistic	Log Likelihood	AIC	Lag	AREG	Liung-Box Q-Statistics	P level of the test
R_t	α_1	-1.013447	0.159	-6.379	82.005	-154.011	1	-0.16	1.206	0.272
	α_2	0.2104608	0.085	2.463			2	0.2	3.136	0.208
	α_3	0.8303319	0.102	8.125			3	-0.006	3.138	0.371
	α_4	0.0029504	0.007	0.405			4	0.52	3.276	0.513
	α_5	0.5771986	0.127	4.541			5	0.172	4.812	0.439
E_t (including dummy variable)	β_1	-4.158749	0.287	-14.478	-100.224	-93.088	1	-0.112	0.595	0.44
	β_2	0.2915585	0.094	3.103			2	0.239	3.345	0.188
	β_3	0.9048751	0.111	8.145			3	-0.026	3.379	0.337
	β_4	-3.847594	0.046	-8.37			4	0.112	4.016	0.404
	β_5	0.5583643	0.124	4.513			5	0.012	4.024	0.546
C_t	γ_1	1.232316	0.847	1.455	-139.538	-132.493	1	0.009	0.003	0.953
	γ_2	0.725328	0.043	16.758			2	0.064	0.199	0.905
	γ_3	0.206099	0.131	1.577			3	-0.21	0.221	0.974
	γ_4	0.99517	0.007	133.566			4	-0.63	0.415	0.981
							5	-0.08	0.418	0.995
(Reference) E_t (not including dummy variable)	β_1	-6.062924	0.303	-20.003	-100.224	-93.088	1	-0.08	0.03	0.955
	β_2	0.395565	0.159	2.49			2	0.07	0.238	0.888
	β_3	0.889649	0.19	4.694			3	-0.095	0.682	0.877
	β_4	0.590423	0.122	4.823			4	0.37	0.753	0.945
							5	-0.38	0.83	0.975

Figure 1, which shows the estimated value computed on the basis of this parameter (hereinafter referred to as the "Theoretical Value"), the actual Adjusted Basic Profit and the divergence [(actual value – Theoretical Value) ÷ actual value], has three characteristics.

Firstly, the actual value and the Theoretical Value show a significant divergence in fiscal year 1989 through 1991 although they progressed in parallel till fiscal year 1988. The expansion of bubble economy increased the profit well over the average profit indicated by the Theoretical Value which should have been earned. This is largely due to the bulk sale of single premium endowment policies as aforesaid and also due to the excessive demand for products with higher assumed interest rate. The divergence of more than 25% clearly indicates that reckless management was conducted during the period.

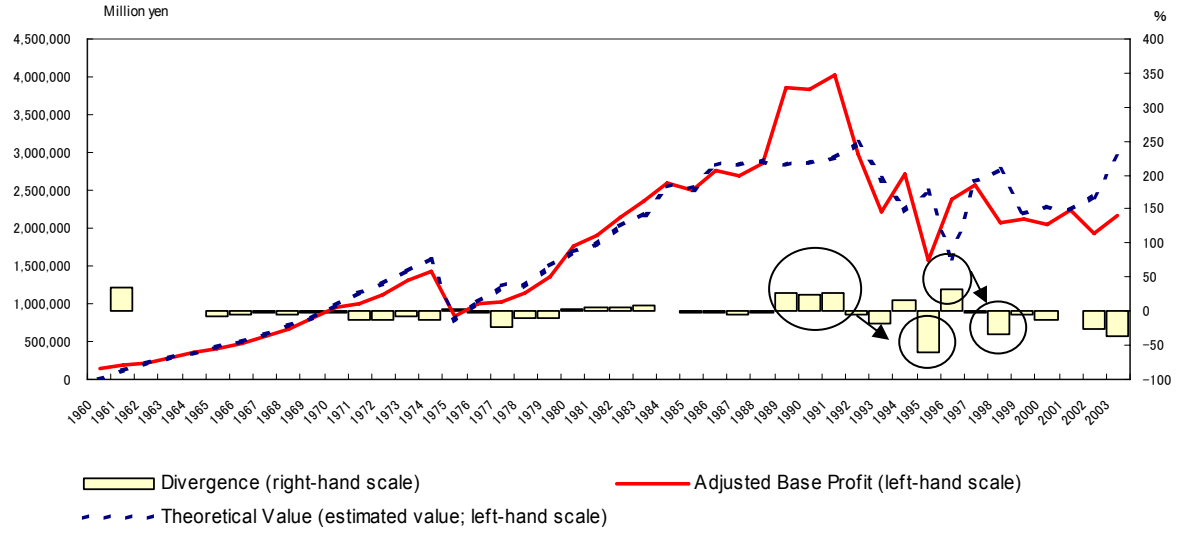
Secondly, the Adjusted Basic Profit subsequently decreased by 61.1% in five years from 4,000 billion yen in fiscal year 1991 to 1,600 billion yen in fiscal year 1995, while the Theoretical Value significantly decreased by 48.9% from 3,100 billion yen in fiscal year 1992 to 1,600 billion yen in fiscal year 1996.

Thirdly, the trend of the positive-value divergence between the fiscal year 1989 and 1991 changed to the substantially negative value of 59.4% in fiscal year 1995. Similarly, the divergence changed from the positive value of 32.8% in fiscal year 1996 to a substantially negative value of 33.2% again in fiscal year 1998. The negative divergence indicates that insurance companies face a difficult situation where they cannot earn theoretically expected

profits. The fiscal year 1995 happens to be two years before the fiscal year 1997 when a Japan's life insurance company became financially impaired for the first time in the postwar period; and likewise, the fiscal year 1998 is two years before the fiscal year 2000 when five life insurance companies declared insolvent. It means that insurance companies became insolvent two years after a substantially positive value of the divergence had switched to the substantially negative value.

In conclusion, what Japan experienced so far supports the hypothesis stated in Chapter 2, that is, "the problem in the soundness of a life insurance company creates a significant divergence between the actual Basic Profit in a single year and the estimated value showing its average structure." However, since there may be other possibilities in the future, it is necessary to understand various aspects of the situation where the insolvency risk increases.

Figure 1: Estimate of Adjusted Base Profit (Fiscal Year)



4. Development of Solvency CI to Grasp the Soundness from Various Aspects

Since complexly interrelated multiple factors, rather than a single factor, impair the soundness of insurance companies, the situation should be judged comprehensively from various aspects.

This is, in a sense, similar to the macro economic view, by which the economy is judged to be expanding, even if one index shows the recession, when many other indices show the business uptrend. The "current diffusion index" announced by the Cabinet Office is used for such multifaceted judgment. The current diffusion index consists of DI (Diffusion Index) and CI (Composite Index); both of them are based on the monthly data to select and determine

the indices from a viewpoint of statistics availability, compatibility with economic cycle, etc. DI, as an indicator of the economic turning point, is composed of the Leading Index, Coincident Index and Lagging Index, each of them consisting of 12, 11 and 7 indices, respectively. DI represents the proportion of number of indices showing economic expansion to the entire indices. DI more than 50% indicates the economic expanding phase as well as the expansion of "individual economies" represented by relevant indices. On the contrary, DI less than 50% indicates the economic recession.

On the other hand, CI grasps the economic volume by combining the variations of selected indices. Such variations are averaged with the weighted average method, accumulated, and then indexed to obtain CI.

While the conditions, which lead to a higher financial risk, can be probably detected by analyzing the transitions of Adjusted Basic Profit as shown in the preceding chapter, ① the judgment in more various aspects and ② grasping the "level of financial seriousness" will certainly contribute to change of the insurance supervising agency and policyholders' self-defense.

For this reason, the " Solvency CI" is introduced as an index to show a variation in terms of volume and speed of financial risks. The absolute value of the Solvency CI indicates the level of soundness, that is, the higher numeric values mean improvement of soundness and the lower numeric values mean deterioration of soundness. The Solvency CI prepared this time is basically structured as follows.

$x_i(t)$ represents the rate of change in an individual index at the point *t*. $d_i(t)$ is the value of the *i*-th index at the point *t*.

$$x_i(t) = 200 \times \frac{(d_i(t) - d_i(t-1))}{(d_i(t) + d_i(t-1))}$$

If the individual index is 0 or negative value, or if the index represents a proportion, the difference is computed as below.

$$x_i(t) = d_i(t) - d_i(t\text{-}1)$$

Next, the average rate of change in the individual index for the past five years, its standard deviation, and the rate of change in standard deviation are represented by $\mu_i(t)$, $\sigma_i(t)$, and $z_i(t)$, respectively.

$$\mu_i(t) = \frac{\sum_{n=t-19}^{t} x_i(n)}{20},\ \sigma_i(t) = \sqrt{\frac{\sum_{n=t-19}^{t} (x_i(n) - \mu_i(t))^2}{20}},\ z_i(t) = \frac{(x_i(t) - \mu_i(t))}{\sigma_i(t)}$$

The average of $\mu_i(t)$, $\sigma_i(t)$ and $z_i(t)$ for the k (quantity of) indices is obtained as follows.

$$\overline{\mu(t)} = \frac{\sum_{i=1}^{k} \mu_i(t)}{k},\ \overline{\sigma(t)} = \frac{\sum_{i=1}^{k} \sigma_i(t)}{k},\ \overline{z(t)} = \frac{\sum_{i=1}^{k} z_i(t)}{k}$$

And the combined variation rate for the individual index $V(t)$ is obtained by combining the above values.

$$\boldsymbol{V(t) = \overline{\mu(t)} + \overline{\sigma(t)} \times \overline{z(t)}}$$

This combined variation rate $V(t)$ is accumulated to obtain the index $I(t)$ when the base year is 100.

$$I(t) = I(t-1) \times \frac{(200 + V(t))}{(200 - V(t))},$$

$$I(t) = {}^{I(t)}\!/_{I} \times 100$$

Note: I represents $I(t)$ of the base quarter.

In this case, the Solvency CI adopted 8 individual indices (k = 8) which influence the profitability and soundness of insurance companies known from the past analyses, that is, (i) Adjusted Basic Profit; (ii) actual net capital ratio {(Adjusted Basic Profit + Capital – Risk amount) / Total assets}; (iii) converted premium; (iv) total amount of individual insurance in force; (v) total amount of newly insured individual policies (including the net increase due to the conversion of contract); (vi) cash surrender value; (vii) difference in interest (of 10-year government bond from that of two years ago); and (viii) the Nikkei Stock Average. The items (i) and (ii) represent the comprehensive risk; whereas the items (iii), (iv) and (v), the profitability; the items (vi) and (vii), the assumed interest rate risk; the item (viii), the risk of asset management.

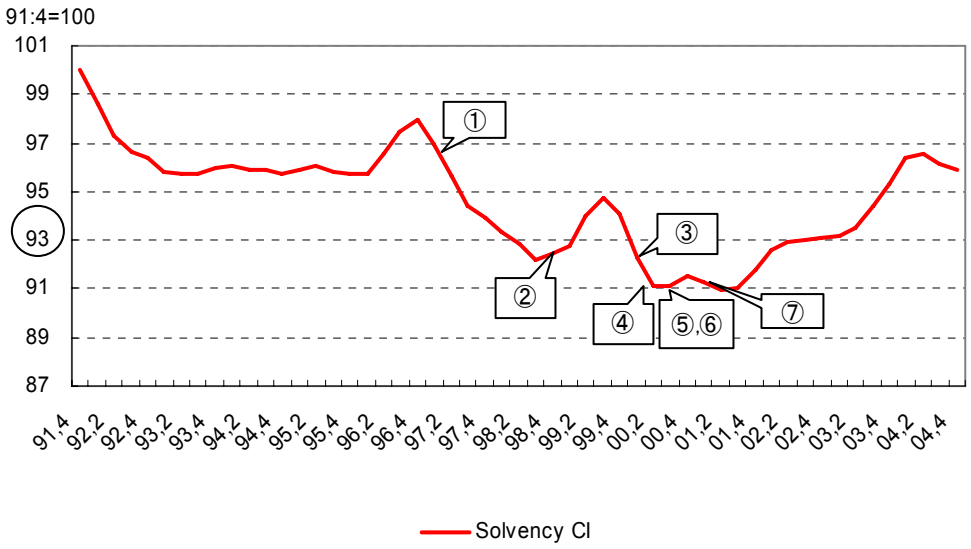
In the data processing, the multiplicative model (see Note 2) excludes seasonal factors and irregular factors from the time series data. The remaining trends and circulating portion, of an index that includes a trend, is excluded by adjustment with the year-to-year comparison. The stock data indices of (iv), (v) and (vi) adopt the year-to-year comparison, which converts all the time series data to the stationary time series data. The rate of change ranges over five years (20 quarters) in average, and the base quarter is the fourth quarter of fiscal year 1991 (Jan – March quarter in 1992 = 100).

The Solvency CI thus obtained is shown in Figure 2. The numbers in the figure show the time when insurance companies became insolvent. The lower points in the graph represent higher financial risks. The cases of insolvencies are concentrated on the CI level below 93 except one case in fiscal year 1997. Particularly, ⑤, ⑥ and ⑦ are concentrated on the CI level of 91s. At this level, many of insurance companies are confronted with managerial problems and financially ailing companies become insolvent.

Accordingly, the supervisory authorities need to reinforce the supervision and guidance at the level of early 90s of CI and to prepare the proactive measures on the assumption that

some companies result in insolvency if the level is less than 93 of CI. Incidentally, the Japanese insurance industry's soundness shows more than 95 at present, which means that the soundness risk is moderate.

Figure 2: Transition of Solvency CI



Note: The number shows the time when each of seven insurance companies declared insolvency.

5. Characteristics of Insolvent Companies and Soundness Check of Individual Company

So far, the conditions to increase the soundness risk have been examined for the entire insurance industry using the Adjusted Basic Profit. However, this profit concept can be applied to screen an individual life insurance company that is likely to be financially impaired.

Four out of seven insolvent companies in Japan had assets of more than 2,000 billion yen, which shows the magnitude of insolvency compared with the cases in the U.S. such as the Mutual Benefit Life Insurance Co. Seven companies had as much as 2,600 billion yen in the total net asset deficiency in total, while their transfer of businesses amounted to 1,100 billion yen, which suggests that the insolvent companies had great values in sales channel, etc. These companies would have a better chance of survival if their management had been more rationalized. The reorganization plan includes ① a substantial reduction of the assumed interest rate to 1 through 2.75% level and ② 10% reduction of policy reserve, shifting a heavy burden onto the policyholders. The deterioration of financial status to such a level clearly indicates the absence of ALM (Asset Liability Management) and the existence of long-term peculiar sales and financial strategies by those insolvent companies.

To clarify the characteristics of insolvent companies, the profit value of each company is estimated by the panel analysis for each fiscal year from 1991 to 2003. The panel data for these 13 years is combined for the cross-sectional analysis by pooling. The result of estimate is shown in Figure 3. The sample size of Adjusted Basic Profit computed in accordance with the aforesaid formula is 503 in total, of which 63 are for seven insolvent companies and 440 for other companies. The model structure used for the pooling analysis is as follows.

$$R_{tk} = \alpha_1 + \alpha_2(H_{tk}) + \alpha_3(KP_{tk}) + r_{tk} + Dmy_1 + Dmy_2 + \ldots + Dmy_{t-1}$$

$$E_{tk} = \beta_1 + \beta_2(H_{tk}) + \beta_3(KP_{tk}) + r_{tk} + Dmy_1 + Dmy_2 + \ldots + Dmy_{t-1}$$

$$C_{tk} = \gamma_1 + \gamma_2(HN_{tk}) + \gamma_3(KP_{tkt}) + \gamma_4(J_{tk}) + r_{tk} + Dmy_1 + Dmy_2 + \ldots + Dmy_{t-1}$$

$$P_{tk} = R_{tk} - (E_{tk} + C_{tk})$$

R_{tk}, E_{tk}, C_{tk} and P_{tk} represent the Basic Revenues of the k-th company during the term t, the Basic Expenses excluding Operating Expenses of the k-th company during the term t, the Operating Expenses of the k-th company during the term t, Adjusted Basic Profit of the k-th company during the term t, respectively. H_{tk}, KP_{tk}, HN_{tk}, J_{tk} and r_{tk} show the total amount of individual insurance in force of the k-th company during the term t, the converted premium revenues of the k-th company during the term t, the number of individual insurances in force of the k-th company during the term t, the new contract amount + net increase due to conversion of the k-th company during the term t and the residual error, respectively. Dmy represents a dummy variable where Dmy_1 takes 1 for the actual values in fiscal year 1991 and otherwise takes 0; and Dmy_{t-1} takes 1 for fiscal year t-1's actual values and otherwise takes 0. Since the period for estimate is 13 years this time, t equals 1 through 12.

The result of analysis by pooling is shown in Table 2. The estimate result is stable for all the companies except for those seven insolvent companies, for which the result is less predictable. Accordingly, two patterns of the estimate are made for the adjusted revenues R_{tk} and adjusted expenses E_{tk}. One formula contains the less predictable contracts as a predictor variable, and the other does not include them. The estimate result by pooling is shown in Table 2.

See the parameters of insolvent companies in the column "Estimate 1" of Table 2 where the structure is simplified. The coefficient of converted premiums from the Basic Revenues is 1.97300, 0.2 percentage point higher than 1.76526, that of the companies except those seven companies. It shows the structure where the increase of converted premium is likely to cause the increase of Basic Revenues, that is, the products whose future income is incorporated in advance, such as single premium endowment policies, have a high

percentage. Also the parameters of Basic Expenses show a great difference between 1.73362 of seven insolvent companies and 1.45584 of the other companies, which shows a structure where the products of highly assumed interest rate and the single premium insurances have a high percentage and the large-scale provision of premium reserve. The parameter of the converted premium of the operating expenses shows 0.00449, which is higher than 0.01035 of companies except those seven for the same reason.

The insolvent companies have higher parameters for the income and cost functions than sound insurance companies do, which means that the former companies have a high proportion of the products which are both costly and significantly contributing to the earnings. Although such types of portfolio instruments themselves are not harmful, the companies with this product strategy require far more conservative and careful ALM than those without it.

Table 2: Estimate Result of Adjusted Basic Profit by Pooling

			Estimate 1			Estimate 2		
			Seven Insolvent Companies	All the Companies except the Left		Seven Insolvent Companies	All the Companies except the Left	
Number			63	440	503	63	440	503
R_{tk}	Adjusted-R^2		0.792	0.983	0.978	0.792	0.983	0.978
	α_1	Coefficient	-120796	-26031	-1777	74480	-34469	-9565
		t-statistic	-1.09100	-0.772	-0.051	0.707	-1.031	-0.278
		Std. Error	110,767	33,714	34,655	105,356	33,418	34,436
	α_2	Coefficient	Excluded from predictor variables			0.00479	0.00138	0.00139
		t-statistic				1.020	3.338	3.134
		Std. Error				0.005	0.000	0.000
	α_3	Coefficient	1.97300	1.76526	1.76117	1.67561	1.66264	1.65826
		t-statistic	14.739	157.226	147.900	5.223	50.872	47.529
		Std. Error	0.134	0.011	0.012	0.321	0.033	0.035
E_{tk}	Adjusted-R^2		0.768	0.978	0.970	0.765	0.978	0.970
	β_1	Coefficient	-126,768	-13,274	9,538	80,362	-16,920	6,303
		t-statistic	-1.195	-0.417	0.287	0.792	-0.531	0.189
		Std. Error	106,050	31,803	33,215	101,491	31,846	33,274
	β_2	Coefficient	Excluded from predictor variables			0.00288	0.00060	0.00058
		t-statistic				0.636	1.513	1.347
		Std. Error				0.005	0.000	0.000
	β_3	Coefficient	1.73362	1.45584	1.45137	1.55504	1.41151	1.40863
		t-statistic	13.527	137.462	127.166	5.032	45.319	41.784
		Std. Error	0.128	0.011	0.011	0.309	0.031	0.034
C_{tk}	Adjusted-R^2		0.960	0.992	0.991	0.960	0.992	0.991
	γ_1	Coefficient	4,811	4,880	6,035	4,811	4,880	6,035
		t-statistic	1.211	2.108	2.708	1.211	2.108	2.708
		Std. Error	3,973	2,315	2,229	3,973	2,315	2,229
	γ_2	Coefficient	0.00186	0.00620	0.00562	0.00186	0.00620	0.00562
		t-statistic	1.223	17.062	16.077	1.223	17.062	16.077
		Std. Error	0.002	0.000	0.000	0.002	0.000	0.000
	γ_3	Coefficient	0.12594	0.06955	0.07478	0.12594	0.06955	0.07478
		t-statistic	10.231	21.384	23.951	10.231	21.384	23.951
		Std. Error	0.012	0.003	0.003	0.012	0.003	0.003
	$\gamma 4$	Coefficient	0.00449	0.01035	0.00999	0.00449	0.01035	0.00999
		t-statistic	3.061	34.011	33.711	3.061	34.011	33.711
		Std. Error	0.001	0.000	0	0.001	0.000	0

Note: Estimate 1 shows the results estimated excluding less predictable contract amount in force from the predictor variables. Estimate 2 shows the results estimated with all the predictor variables.

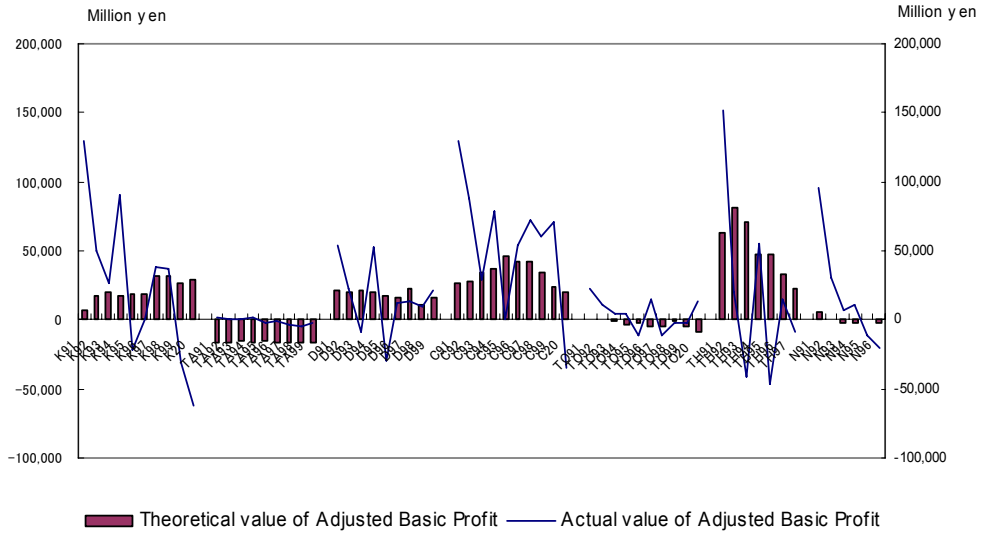
Figure 3 illustrates the Adjusted Basic Profit value and the Theoretical Value (estimated value) for each of those seven insolvent companies for the period between fiscal year 1991 and the fiscal year immediately prior to the year of insolvency. These values are calculated with the parameters of all pooling companies shown in the Estimate 2 of Table 2. The theoretical value of the Adjusted Basic Profit shows the level of basic profit according to the total amount of insurance in force and sales of each company on the basis of the industry's average structures of income and expenditures computed from 500 Adjusted Basic Profit samples that have been calculated for 13 years.

The result shows two patterns that lead to insolvency of an individual company. One of them is the significant drop in the actual value of Adjusted Basic Profit below the Theoretical Value. The other is the continuous negative Theoretical Value of Adjusted Basic Profit, which suggests a serious deterioration in management vitality.

The Adjusted Basic Profit above the industry's average is obtained through active sales, followed by the sharp drops due to insufficient ALM. Although this is the case for the entire industry, the pattern is more striking for the insolvent companies.

Thus, careful and long-term observation of the actual value and Theoretical Value of the Adjusted Basic Profit of an individual company allows early detection of symptoms of its financial deterioration.

Figure 3: Actual and theoretical values of Adjusted Basic Profit of seven Insolvent companies



Note: K, TA, D, C, TO, TH and N on the horizontal axis indicate the initials of insolvent companies and the following number indicates the fiscal year.

6. Conclusion

It is difficult to grasp the soundness of life insurance companies because of its abundant cash flows. In most cases, the conditions are already severe when they are detected like chronic disease. Therefore, the supervisory authorities need to grasp the symptoms carefully at a very early stage. People as well as the supervisory authorities need tools to judge the soundness of life insurance companies at an earlier stage and from more various aspects.

The Adjusted Basic Profit and the Solvency CI supplemented by multifaceted judgment, which are proposed here, enables us to detect the conditions where a life insurance company gets financially impaired and to screen potentially insolvent companies. They contribute to the framework in Japan, as well as to frameworks such as "Solvency II" aimed by the EU. It is important to set the target of the total net worth with the Tail-Var, which adequately indicates the distorted distribution, and others on the basis of the RBC method. However, considering the fact that most of insolvencies of the life insurance companies were caused by erroneous managerial judgment, such as in ALM, it is imperative to first grasp the soundness risk carefully from the changes in income statements where the managerial judgment is clearly reflected. The Adjusted Basic Profit and the Solvency CI, herein proposed, can be provided on a quarterly or monthly basis, which allows the supervisory authorities to monitor the conditions all the time.

I hope that the creation of a stable index by further adding practical factors based on this theory model will contribute to early detection of insolvency and more effective supervision of soundness by the supervisory authorities.

1) The actual net assets are obtained by deducting liabilities at the book value from the assets evaluated at the market value. They show the amount at which the company's assets are sold in the market for the payment to policyholders in case of dissolution.

2) Although multiplicative model is a time-series model expressed by $X(t) = T(t) \times C(t) \times S(t) \times I(t)$, S(t) and I(t) is excluded after factors are broken down. T(t) means trend; C(t), cyclical fluctuation; S(t), seasonal fluctuation; and I(t), irregular fluctuation.

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