

Risk Management of Life Insurance Liability reflecting the Service Contract Aspect

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Abstract

Life insurance has characteristics of service contract as well as those of financial products, in which it provides insurance protection to those individuals who don't have enough risk capacity.

Life insurance differs from other financial products, because policyholders have utility for insurance protection, and therefore insurance provides something more than economic value of other financial products. Accordingly, policyholders' behavior is different from that of other financial market participants. For example, rational judgment and arbitrage trading are always being made in financial market depending on economic conditions, while they are not with life insurance.

In this paper, I am going to point out that there is a component in life insurance that does not change in value because of the service contract characteristics of the product, and that the liability which corresponds to this component could be regarded as a core deposit which would remain, without any value changes, in the company almost indefinitely. Finally, I am going to analyze a risk management method for life insurance that recognizes the existence of such core deposit.

Keywords: Financial contract aspect, Service contract aspect, Core deposit

1. Introduction

In the discussions of IFRS, various arguments are discussed on how to value insurance liability. In these arguments, there is a stream in which life insurance is similar to financial products and should be valued accordingly. On the other hand, life insurance has characteristics as service contracts, unlike other financial products such as bonds and stocks. Therefore, valuation of insurance liability and risk management reflecting such characteristics are important.

2. Characteristics of life insurance contracts

2.1 Service contract aspect of life insurance

Life insurance companies are generally regarded as financial institutions like banks and securities companies. However, the products that they provide, life insurance, have characteristics of service contract as well as those of financial products.

2.1.1 Life insurance as financial product and service contract

2.1.1.1 Financial product aspect of life insurance

Life insurance has characteristics of financial products, on that policyholders pay premiums in return of life insurance protection. And they also have characteristics of derivatives, on that they guarantee the surrender value regardless of future interest rate¹, and that they pay dividends when investment performance is good, while minimum interest rate is guaranteed.

Life insurance products are priced, taking such options into consideration. And in this point, they undoubtedly have characteristics as financial products.

2.1.1.2 Service contract aspect of life insurance

On the other hand, life insurance could also be regarded as service contract, on that

¹ Surrender value of most Japanese traditional products is guaranteed.

they provide policyholders with the utility of protection. By buying life insurance, policyholders can feel a sense of relief for their future, which it is difficult to value in terms of currency.

According to this standpoint, life insurance can have characteristics of service contract like cell phone contracts. In other words, policyholders continuously receive the service of insurance protection in return of paying premium.

2.1.2 Why can insurance have characteristics as service contract?

There may be no doubt that life insurance has characteristics of financial product, but why can life insurance, unlike other financial products, have characteristics of service contract as well? It is because policyholders can get the utility of insurance protection, in other words, “a sense of relief”, by buying life insurance, and the utility is difficult to value in terms of currency.

In the opinion to IASC’s issue paper, the Japanese Institute of Certified Public Accountants defined insurance as follows, “Insurance is a set of management process to reduce risk, in which insurer accept enough amount of similar risk, pool it in terms of time and amount, and mitigate it.”

Most people are anxious that in case of their death, their family will have hard time financially. They cannot make provisions for such risks by themselves, but by pooling such risks, insurers can mitigate the risk and provide their policyholders with insurance protection with reasonable premium. In this way, insurers provide the service of insurance protection, as well as financial utility.

The words, “insurers provides the service of protection”, are sometimes regarded as sales talks that insurers use to appeal their policy, but actually it is not everything. Policyholders feel utility for reducing their risks, alongside with economic value, and they make decisions based on these two components.

Now, let’s think lottery as an example. The expected rate of payback is less than 100%, so if people make rational decisions financially, nobody will buy it. But the need for lottery actually exists, and they can be sold without aggressive sales activities. This is because lottery can provide some people with the utility of thrill or dream.

In this way, there are people who feel utility apart from economic value of the products.

2.1.3 Policyholders' behavior

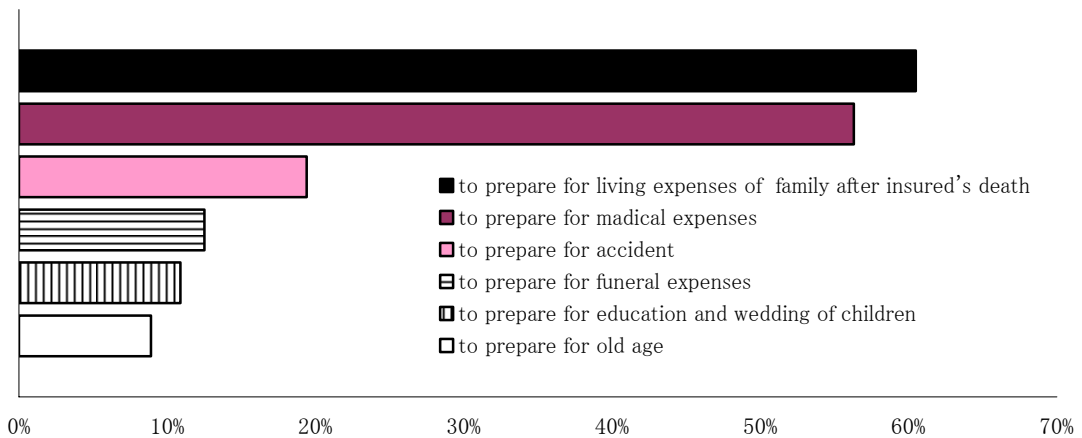
To support what I have stated, the service contract aspect of life insurance, I'm going to examine the policyholders' behavior from past data.

2.1.3.1 Purpose

According to the survey made by JILI, the main purpose of buying life insurance is

- to prepare for living expenses of family after insured's death(60.5%)
- to prepare for medical expenses(56.3%)
- to prepare for accident(19.4%)
- to prepare for funeral expenses(10.9%).

Fig.1 Main purpose of buying life insurance



Each of the above seems to be related to the utility of insurance protection, a sense of relief. This means that insurers provide each individual with the service of protection which he can not prepare on his own.

When such utility is the main purpose, financially rational behavior is not always taken. Rather, people possibly make their decision totally, based on the convenience of buying one or on the balance between necessary amount of coverage and their premium payment capability.

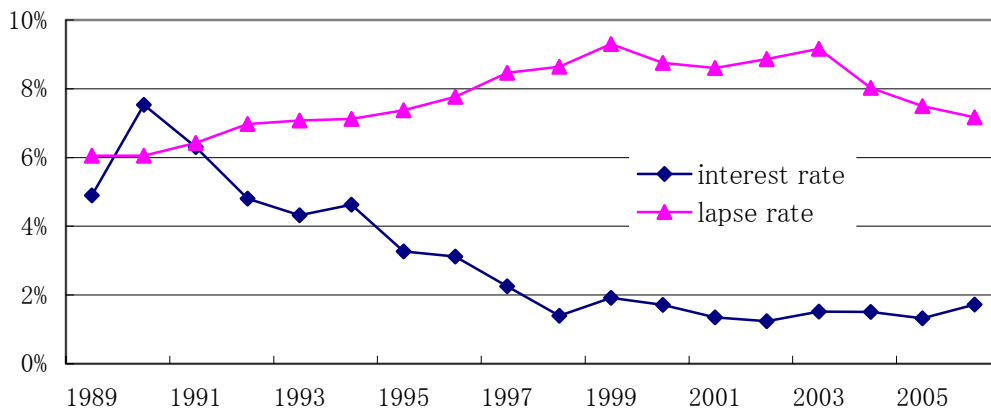
2.1.3.2 Policyholder's behavior after buying insurance

The economic value of life insurance decreases when market interest rate goes up, since assumed interest rate is fixed². The guaranteed surrender value can be regarded as a kind of option, and if life insurance is a complete financial product, the right of the option will be exercised completely when the option is in the money. But this is not necessarily expected with life insurance³, though the rise of lapse is easily expected.

This is because life insurance provides policyholders with the utility of protection and when policyholders lay importance on this utility, they do not surrender their policy only based on the changes of economic value.

Fig.2, which shows the interest rate of Japanese government bond and lapse rate⁴ of certain insurance company(D).

Fig.2 historical interest rate and lapse rate



If life insurance is a complete financial product, lapse rate will become lower when interest rate goes down, and vice versa. However, historical experience of lapse does not show such feature⁵.

In this way, policyholders do not necessarily decide their behavior, only based on economic value of life insurance.

² It is so, in case of traditional products such as whole life and endowment.

³ It is true that in the U.S, life insurance industry experienced a disintermediation in 1970's, but this does not mean that every policy was canceled, but the drastic rise of lapse.

⁴ Lapse rate is defined as the percentage of lapse policies to policies due in the beginning of the year.

⁵ Because low interest rate is usually observed when economic condition is bad, the lapse of policies will increase due to the burden of paying premium and unrest for insurance companies.

2.2 Other characteristics of life insurance

- No existence of secondary market

Life insurance is a contract between insurance company and each individual, and there is no secondary market in which life insurance is traded actively. So each policyholder has no choice but hold the contract or surrender it, when financial environment changes. Therefore, when the main purpose of insurance protection becomes unneeded, it is possible that they cancel the contract, even when it is an unfavorable deal to them.

- The existence of underwriting

Healthiness is needed to buy life insurance, and it is sometimes difficult to buy new one due to the health problem. And even when possible, the process of buying new policy is troublesome. This could be one reason why policyholders keep their policy after economic value as financial product goes down.

- Relationship with sales people⁶

The reason why policyholders buy the policy is sometimes related to the relationship with sale people. This seems to be because the need for life insurance is potential, though the need itself actually exists.

Most people have need for life insurance, but they do not think it often due to the characteristic of life insurance, and the need remain potential. Therefore, sales to cultivate such need are required to sell life insurance.

For ordinary people, the chance to think such need is not common, and therefore, when proposal which grip such need is done, they buy insurance based on the reliance on the sales people. And if the policy is signed in this way, policyholders tend to keep it, due to the reliance on sales people.

2.3 Conclusion

To summarize what I have stated so far, the reason why policyholders' behavior is different from other financial market participants is as follows.

⁶ This is often referred to as a characteristic of Japanese traditional insurance companies.

- Life insurance has characteristics of service contract which provides the utility of insurance protection
- Life insurance is a contract between insurer and policyholder, and it is not traded in another way.
- Re-entry to a new policy is sometimes impossible due to the health problem.
- Relationship with sales people are sometimes regarded as important.

As a result, life insurance has the following characteristics.

- The decision of buying insurance is sometimes based on the service contract aspect, unlike other financial products.
- The decision on whether policyholder keep or cancel their policy is sometimes related to the utility of insurance protection, which is their main purpose, and not necessarily on financial environment.

3. Investment strategy including future premium

3.1 Characteristics of life insurance liability

Life insurance is a long term contract, sometimes over 50 years, and therefore the duration of liability is very long. Because contractual conditions are fixed during this long term, future cash flow is expected to be very stable, and therefore, less care for liquidity are required for insurance companies.

And for level premium policies, life insurance companies can earn premium from current holding policies in future. This is also the case in banks and other financial institutions, but their contractual conditions such as interest rate are not fixed at this point of time. In this point, future premium which will be earned by current holding policies has very important meaning.

3.2 Investment strategy including future premium of current holding policies

It is said that level premium insurance policies has higher investment risk, because the interest rate of future premium is fixed. But at the same time, the stability of future cash flow is enhanced by this feature.

If you treat the future premium separately from the cash flow of current holding assets, you will have some investment risk on future premium, due to the changes of future interest rate, but if you treat it altogether and buy longer term bonds, risk can be mitigated totally. This is similar to the cash flow ladder analysis which is carried out in the liquidity risk management.

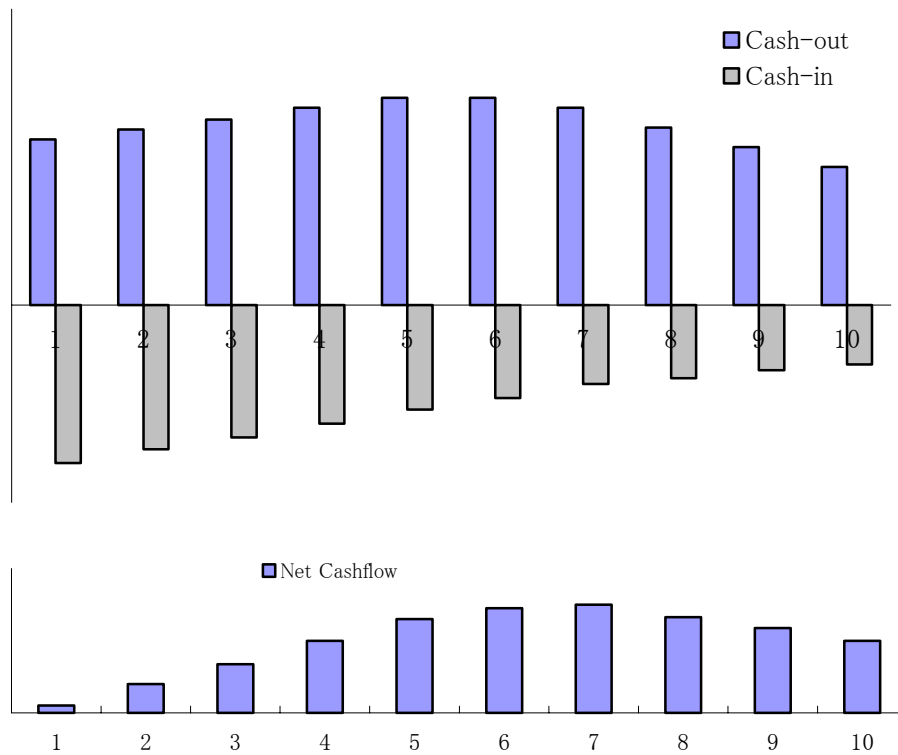
Fig.3 shows the image of future cash flow. Charts upside is cash-out and charts downside is cash-in. And the present value of these differences is held as a policy reserve now.

If you plan investment strategy excluding future premium, you should invest in bonds whose maturity corresponds to the timing of cash out. In this strategy, you pay benefits by the maturity of bonds, and buy new bonds by the cash from premium at the same time. If the interest rate of that point becomes lower, you cannot buy bonds which satisfy the assumed interest of the policy.

But you can also plan investment strategy including future premium. In this case, you hold the bonds whose maturity corresponds to the net cash out. This means that part of future benefit is paid by the cash-in from future premium. The advantage of this

investment strategy is that you can fix the contractual conditions of future cash flow by buying longer term bonds.

Fig.3 Future cash flow of current holding policies



To enable such investment, two conditions have to be satisfied, besides that the future premium is fixed.

- Lapse rate will not completely be affected by interest rate change.
- Some of future premium is supposed to be paid regardless of interest rate change.

As I have already suggested, the economic value of life insurance changes depending on market interest rate. If every policyholder is supposed to behave rationally, insurance companies have to invest in liquid asset. And if future premium will not be paid in future due to the market interest rate rise, insurance companies cannot offset the future cash out and cash in. Therefore, these two conditions are required to stable the cash flow, and as I have already pointed out, these conditions seem to be satisfied partly with life insurance companies.

4. Existence of core deposit⁷

4.1 Premium from future new policies

We considered only future premium from holding policies so far, but insurance companies are supposed to acquire new policies in future. Is it possible to take such premium into consideration when planning investment strategy?

The future premium from holding policies and future premium from future new policies have something in common, in that they are not earned yet and instable, but there is one thing that is importantly different. Condition of former premium is fixed while that of latter is not. The reason why we could take future premium from current holding policies into consideration is not only due to the stability of cash flow, but fixed conditions of the premium. Premium from future new policies does not satisfy this requirement.

But we also have to remark that the premium from future new policies will not be determined only based on economic value. Usually premium is set conservatively to prepare for future uncertainty, and we also set some assumed profit as a reward for providing the utility of insurance protection⁸. In such cases, it is likely that we could treat some of the premium from future new policies as if fixed currently.

Let's assume a condition in which we can set assumed interest rate by 4% when market interest rate is 5%. We can satisfy the assumed interest by investing 80% of asset in bonds⁹.

In this way, when insurance companies are supposed to acquire new policies in future and the right to determine the premium is owned by insurance companies, we possibly plan future investment strategy including the premium from new policies.

4.2 Existence of core deposit

Due to such features of life insurance business, there seems to be some assets which remain in life insurance companies almost permanently.

To make it easier, let me show you an example of Mt. Fuji. Top of the mountain are capped with permanent snow, but it is no use to argue when the snow fell. Every winter

⁷ In this paper, "core deposit" means the asset which remains in insurance companies permanently.

⁸ The premium of life insurance is not priced only based on expected value. We can expect some profit in future as a reward for providing the utility of insurance protection.

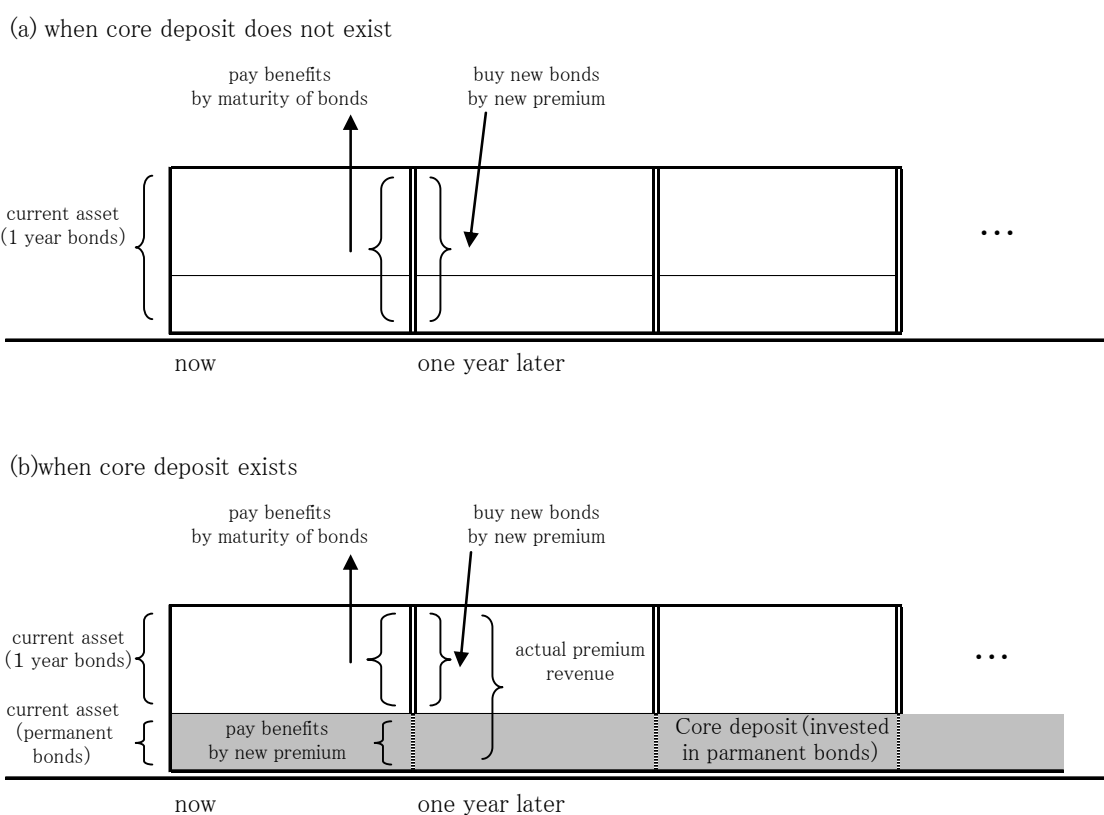
⁹ $80 \times 1.05 \text{ plus } 20 = 104$, which means that we can achieve 4% total return without investing 20.

snow falls and in summer, some of it melts. What is important now is the fact that it exists all the time.

The assets in insurance companies are similar to this permanent snow on Mt. Fuji. They always have cash-out and cash-in, but in total, the balance of asset is very stable. And as the preference for higher interest is not so popular with general public, some of the premium from future policies can form core deposit.

Fig.4 shows the image of this, in case of one year policy.

Fig.4



(a) shows the future cash flow when core deposit does not exist. The asset currently held is one year bond and the benefit will be paid by the cash from the maturity of the bonds. And in the same year, another one year bond will be purchased by the cash from new premium.

Because the contractual condition is not fixed with future new policies, and the assumption that we continue to acquire new business is not clear, these two types of money are separated.

(b) shows the future cash flow when core deposit exists. When some of the future premium does not have to be separated from the asset currently held, this part can be regarded as an asset which remain in the companies almost permanently. If a company is in a completely stable condition, the investment can be separated from cash flow completely, and this means that every asset is core deposit.

Of course such stable environment is impossible in actual market, but what is important now is the fact that life insurance companies possibly have some portion of core deposit.

5. Investment strategy including premium from future new policies

5.1 Amount of core deposit

The amount of core deposit depends on various conditions such as current interest rate, future interest rate, and future assumed interest rate of new business. Therefore, it is not easy to determine it. But let's think it using a simple model.

- The maturity of holding policies is 1 year.
- Think only cash flow of 1 year later.¹⁰
- Current interest rate of maturity n is $i_0(n)$
- Interest rate of longer bonds is higher than that of shorter bonds ($i_0(1) > i_0(2)$)¹¹
- The expected interest rate at time 1 is $i_1(n)$
- Assumed interest rate of new policies at time 1 is $i_1(n) - \Delta i_1$

If financial environment is completely stable, and there will be no change in interest rate, the following investment strategy is possible.

$t=0$ hold 2 year bonds.

$t=1$ pay benefits (for policies acquired at $t=1$) by new premium and hold the bonds above.

$t=2$ pay benefits (for policies acquired at $t=2$) by the maturity of the bonds above.

Assuming that $i_0(1)=2.0\%$, $i_0(2)=2.1\%$, and $i_1(1)=2.0\%$, which means that interest rate does not change, we can achieve extra investment profit by 0.1%, which corresponds to liquidity premium.

However, if interest rate goes up, $i_1(1)=3.0\%$, assumed interest rate of new policies goes up accordingly. Assuming $\Delta i_1=0.1\%$, which means contractual assumed interest rate is 2.9%, we can earn extra profit by 0.1% in the 1st year, but in the 2nd year, we have negative spread by 0.8%. From this simple example, we can easily understand that we cannot invest all assets in 2 year bonds.

Then let's think that we invest $x (< 1)$ in 2 year bonds. In this case, we can expect extra profit of $\{i_0(2) - i_0(1)\}x$ in the 1st year, and in the next year, we can expect return of $i_0(2)x + i_1(1)(1-x)$, which means that we can expect the investment profit of $i_0(2)x + i_1(1)(1-x) - (i_1(1) - \Delta i_1)$, therefore, the following formula is required.

¹⁰ Actually, new policies can be expected after 1 year, but we neglect them here to make it simple.

¹¹ The spread between longer bonds and shorter bonds should be limited to liquidity premium here.

$$\{ i_0(2) - i_0(1) \} x + \{ i_0(2)x + i_1(1)(1-x) - (i_1(1) - \Delta i_1) \} \geq 0$$

$$x_{\max} = \frac{\Delta i_1}{i_0(1) + i_1(1) - 2i_0(2)} \quad (\text{when } i_0(1) + i_1(1) - 2i_0(2) \geq 0)$$

Fig.1 shows the amount of core deposit in various environments¹². Now that $i_1(n)$ is not fixed at this point, it is defined as the maximum interest rate which will be possible 1 year later¹³.

Table 1 Percentage of core deposit

	current interest rate		interest rate of 1 year later		percentage of core deposit (x)
	duration 1 ($i_1(1)$)	duration 2 ($i_1(2)$)	market interest rate of duration 1 ($i_2(1)$)	assumed interest rate $i_1(1) - \Delta i_1$	
	2.00%	2.10%	2.00%	1.90%	1.000
(a)	2.00%	2.10%	3.00%	2.90%	0.125
(b)	2.00%	2.10%	3.00%	2.80%	0.250
(c)	2.00%	2.10%	3.00%	3.00%	0.000
(d)	2.00%	2.10%	3.50%	3.40%	0.077
(e)	2.00%	2.10%	2.50%	2.40%	0.333
(f)	2.00%	2.20%	3.00%	2.90%	0.167
(g)	2.00%	2.00%	3.00%	2.90%	0.100

This table shows the following results.

- If we can put larger margin into future premium, the percentage of core deposit(x) becomes higher.((a) and (b)(c)) And when we cannot put any margins, there will be no core deposit. (when $i_0(1) + i_1(1) - 2i_0(2) \geq 0$)
- If we assume future interest rate rise seriously, x becomes lower.((a) and (d)(e))
- If the spread between longer bonds and shorter bonds is larger, x becomes higher.((a) and (f)(g))

In this way, we can plan investment strategy including the premium from new policies,

¹² Margins are included not only in interest rate assumptions, but mortality and expense assumptions. Taking these margins into consideration, actual risk capacity will be greater.

¹³ By assuming the distribution of interest rate at time 1, certain percentile point is adopted as $i_1(n)$.

assuming the spread between longer bonds and shorter bonds, and margins in future premium.

5.2 Example in a simple model company

In the last subsection, I only treated the cash flow of 1 year later, but actually, cash flow is expected after 2 years later. To take such cash flow into consideration, let's assume the following simple company.

- Sell only 1 year endowment policies.
- The amount of future new policies will be stable.
- No death and no surrender.
- Current interest rate of duration n is $\{2.0 + 0.05 \cdot (n-1)\}\%$
- Maximum interest rate possible at t is $\{\text{current interest rate} + 1.0 + 0.1 \cdot (t-1)\}\%$
- Assumed interest rate is (market interest rate of duration 1 at each time -0.3%)

Table 2 shows the amount of core posit in future premium, and the portfolio of bonds in this assumptions.

Table 2(a) percentage of core deposit in premium which is earned at time t

t	0	1	2	3	4	5	6	7	8	9	...
percentage of core deposit	100.0%	32.6%	31.9%	31.3%	30.6%	30.0%	29.4%	28.8%	28.3%	27.8%	...

Table 2(b) Portfolio of bonds

t	1	2	3	4	5	6	7	8	9	10	...
percentage of bonds with maturity t	67.4%	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	...

Duration of asset: 3.2 years

Though the duration of every policy is 1 year, the duration of asset can be 3.2 years, when we assume the core deposit.

Unlike general insurance companies, most of whose policies are one year contracts, life insurance companies have very complicated future cash flow, and therefore, it is difficult how to plan such investment strategy. What is important here is not practical investment strategy, but the existence of such core deposit.

5.3 Conclusion

When the following conditions are satisfied, investment strategy taking core deposit into account can be possible.

- Not every policy will be canceled in the environmental changes.
- Some portion of future premium will be paid after the environmental changes.
- Future cash flow is expected to be stable.
- Acquiring new policies is expected in the future.
- Future premium will be priced not only economic value, but also some margins.

6. Risk management reflecting the features of life insurance companies

As I have stated, life insurance companies have feature that cash flow of the companies is stable and policyholders' preference to higher interest rate is not severe. Thanks to this feature, life insurance companies possibly aim higher return with less risk taking.

As an example, I considered the investment strategy to aim higher profit by buying longer bonds, assuming that there is some amount of core deposit in life insurance companies. Investing in real estates and stocks is also possible instead of longer bonds, though I did not discuss it. Right and wrong of holding such assets are discussed so far, but this should be determined not only based on capital, but on the existence of such core deposit.

There are other types of investment strategy reflecting the feature of life insurance companies. The examples are aiming for liquidity premium by buying less liquid bonds such as government guarantee bonds instead of government bonds, aiming credit premium by buying low rated bonds¹⁴. Through such strategy, life insurance companies can earn higher profit with less risk, due to the feature of their liability.

When we think such features of life insurers' liability, risk free rate which is used widely, does not necessarily reflect the real business of insurance companies. When we think pricing strategy and risk management strategy, it is important to think such characteristics of liability which are caused by life insurance's service contract

¹⁴ This is possible due to the scale of life insurance companies. They can invest in diversified bonds.

aspect.

7. Conclusion

The products that life insurance companies provide have characteristics of service contract unlike other financial products such as stocks and bonds. And to reflect the actual business conditions correctly, it might be useful to plan investment strategy, taking the existence of core deposit into account.

On the other hand, it is not easy to quantify the amount of core deposit in a situation in which the cash flow of life insurance companies is very complicated, and future contractual conditions and the amount of new policies are not clear. And when planning to invest in stocks and real estates instead of longer bonds, the amount of core deposit might be very small, depending on the assumption of the risk.

In this way, though I recognize the existence of core deposit, there are a lot of problems when applying to actual risk management. I hope there will be some useful discussions on this matter in the future.