

Life Insurance Asset-Liability Management: An International Survey

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1. Introduction

Despite the considerable attention for risk management by financial institutions in general and life insurance companies in particular, there are few empirical results on the management of financial risks by corporations. This seems to be at odds with the relevance of financial risk management to regulators, policymakers and managers. New risk management techniques are devised by regulators and implemented even though little verifiable evidence about the current state of financial risk management exists.

In this article we direct the attention to asset-liability management (ALM) as part of the financial risk management by insurance corporations. ALM involves the management of risks arising from simultaneous effects of financial market moves on both assets and liabilities. Considering that approximately 90% of asset portfolio return variability results from asset-allocation policy decisions, e.g. Brinson et al. [1995], asset-allocation decisions arising within an ALM framework are of strategic concern to financial institutions.

As argued by Lamm-Tennant [1989], before implementing a comprehensive ALM process, the institution should complete a strategic planning process involving situation analysis, strategy formulation and implementation. To date the Lamm-Tennant study is the only

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academic analysis of this process. In this article we provide further results on the implementation of ALM by life insurance companies. Our results are based on an international survey among life insurance corporations where we have asked about the corporations' current ALM practice.

Lamm-Tennant argues that there are four operational modes for integrating the ALM process into the investment strategy. These operational modes differ with respect to their investment philosophies and required resources. Whereas Lamm-Tennant's analysis is essentially static, we pay greater attention to the dynamics of the ALM process. We distinguish between the sophistication of ALM strategies and techniques, and relate these to changes in management and perceived success of the ALM process. Further, we do not only consider the U.S. but pay attention to six major life insurance nations. By considering international differences in the ALM practice, we gain greater insight into institutional factors affecting ALM. Finally, with respect to the U.S. we compare the results on the operational status of several techniques with those from the study of Lamm-Tennant.

2. Survey method and data description

The present survey consists of eight subsections devoted to the type and location of the organization, its products, its general objectives, its ALM policy, the status of ALM techniques or strategies, its investment strategy and its environment. Moreover, we asked about the opinion of the respondent regarding some statements on ALM.

The survey was conducted during 1994 in six countries: France, Germany, Japan, the Netherlands, the U.K. and the U.S. These countries generate approximately 70% of world premium income in life insurance and have substantially different institutional structures. The markets in the U.S. and the U.K. are relatively open and competitive. The French, German and Japanese markets are subject to substantial regulation, while the Dutch market is at a more or less intermediate position.

2.1. Companies included in the sample

The 287 companies in the sample represent a diverse set of large and small companies. The distribution of the sample and the respondents with regard to nationality is presented in table 1. The sample includes a substantial fraction of the world's largest life insurance companies. The sample size varies by country. This is due to the fact that both the number of active life insurance companies and the size of the companies under consideration is varying.

Table 1: Sample distribution with respect to nationality

Country:	Number of companies in sample:		responding:		Market Share Top		
	number	Note:	number	proportion:	#	Share %	Year:
France	15	top-5	6	40%	3	39%	1990
Germany	56		20	36%	3	26%	1990
the Netherlands	54		27	50%	5	74%	1990
U.K.	42		14	32%	10	47%	1990
Japan	5	top-5	5	100%	5	47%	1990
U.S.A.	115	top-100+	30	26%	3	15%	1990
Total	287		102	36%			

The samples for Japan and France are biased towards the largest companies as a result of a filtered sampling procedure: for these countries the sample was determined by the national life associations. Presumably, the remainder of the companies in these countries do not actively engage in an ALM policy. For the other countries, at least the top 80% (both with respect to gross premium income and value of assets) has been included in the sample in all three cases.

2.2. *Sampling methods*

Sampling consisted of a first mailing with an update to non-responding companies after approximately one month. Non-responding companies have been approached telephonically, and when appropriate, a third additional mailing was sent. In France the first mailing was organized by the French Life Insurance Association and in Germany the German AFIR section acted similarly. Both in Japan and France companies were preselected by the National Life associations (as discussed above).

3. **Survey results**

3.1. *ALM policy*

We first consider whether companies actually engage in an ALM policy and how this policy is implemented in the organization. With respect to the question: “does your company have an ALM policy, and if yes, is this a written down and formalized policy?” the answers are presented in table 2. The majority of the respondents indicate that their company has a formalized ALM policy.

Figure 1

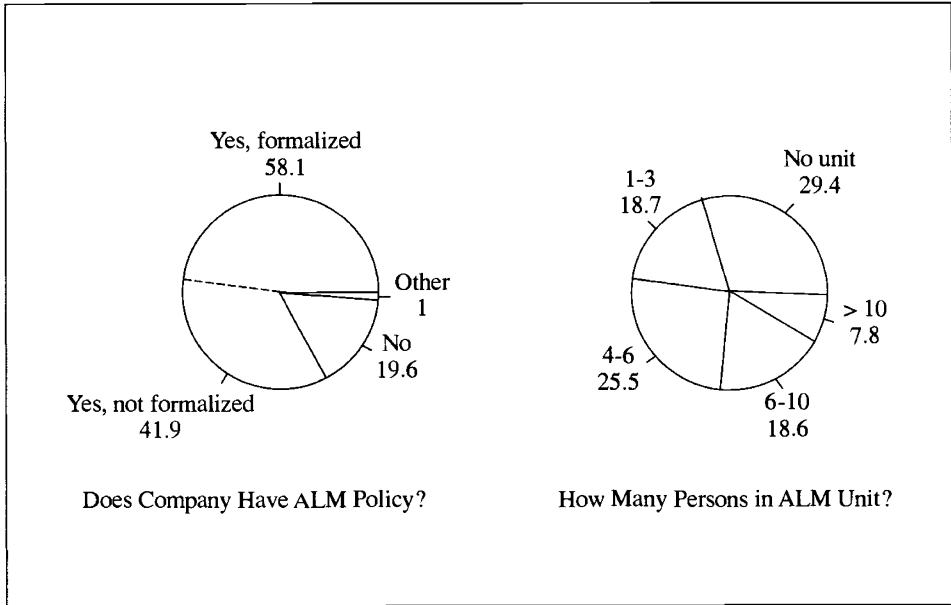
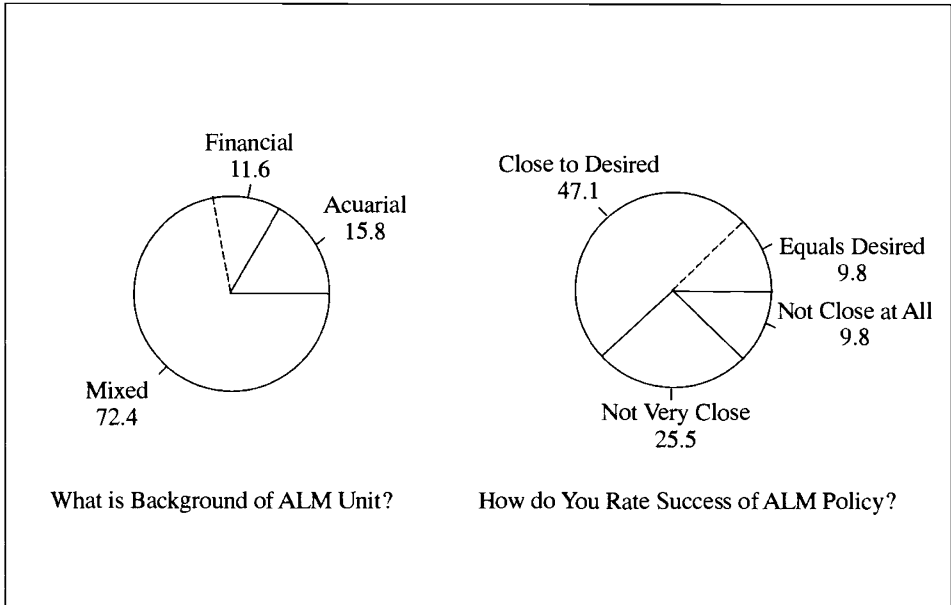


Figure 2



Further, most of the companies with an ALM policy have an ALM unit in place. The background of this unit is generally mixed between actuaries and finance professionals. Typically, actuaries are more prominently present in the U.S. and the U.K. This is in accordance with the general view that the actuarial discipline (and training) in these countries is more strongly directed to the fields of investments than on the continent. Most of the respondents indicate that the success of their ALM policy is at least close to desired. Ten percent of the respondents state that their current ALM policy is not close at all to the desired policy.

3.2. Strategies and techniques used

We now consider the current operational status of several concepts generally considered to be relevant for ALM. These techniques and strategies have been discussed in greater detail in Lamm-Tennant [1989], LOMA [1993], Shiu [1993], Van der Meer and Smink [1993] and Smink [1995]. The respondents were asked to indicate the use and importance of the strategies, techniques and concepts listed in table 2.

Asset-liability cash flow projections and investment performance measurement are widely used tools. These techniques are not used by respectively 24.5% and 22.5% of the respondents. All U.S. respondents incorporate cash flow projections using scenario analysis in their ALM practice. Presumably, this is an immediate consequence of the U.S. regulatory system.

Table 2: Strategies and techniques

Strategy or technique	Operational status				Other:		
	Currently in use very important	moderately important	not important	Currently not used: not important		not considered important	not familiar
1. Asset/Liability projections using scenarios:	42.2%	31.4%	2.0%	2.0%	17.6%	2.0%	2.9%
2. Integrated ALM software:	13.7%	21.6%	2.0%	2.0%	24.5%	18.6%	2.9%
3. Cash flow matching:	28.4%	32.4%	2.0%	7.8%	23.5%	2.0%	3.9%
4. Segmentation of assets and liabilities for product groups:	35.3%	22.5%	4.9%	9.8%	19.6%	3.9%	3.9%
5. Asset/Liability interest rate duration analysis:	31.4%	28.4%	2.9%	6.9%	21.6%	5.9%	2.9%
6. Hedging with derivative instruments:	13.7%	18.6%	17.6%	11.8%	27.5%	7.8%	2.9%
7. Risk-return analysis:	20.6%	26.5%	8.8%	6.9%	24.5%	9.8%	2.9%
8. Internal coupon stripping:	2.9%	15.7%	2.9%	42.2%	3.9%	29.4%	2.9%
9. Financial pricing of liabilities:	10.8%	17.6%	3.9%	20.6%	19.6%	22.5%	4.9%
10. Interest rate immunization:	10.8%	23.5%	3.9%	25.5%	25.5%	6.9%	3.9%
11. Active bonus/dividend policy:	15.7%	20.6%	4.9%	22.5%	5.9%	25.5%	4.9%
12. Embedded value evaluation:	28.4%	18.6%	2.0%	11.8%	19.6%	13.7%	5.9%
13. Reinsurance:	21.6%	22.5%	15.7%	23.5%	6.9%	2.9%	6.9%
14. Investment performance measurement:	38.2%	32.4%	6.9%	3.9%	13.7%	2.0%	2.9%

Table 3: Opinions on ALM issues

Statements:	Opinion			
	Strongly agree	More or less agree	Strongly disagree	Other:
1. The nature of my company's products makes ALM unimportant:	3.9%	10.8%	53.9%	2.9%
2. The company's realized and unrealized surplus, and the profitability of existing products makes ALM unimportant:	3.9%	2.9%	54.9%	2.0%
3. The spread between the yield on assets and the rate required by liabilities and expenses is the only figure to manage:	2.9%	7.8%	46.1%	3.9%
4. Duration matching is a more desirable way of implementing ALM than cash flow matching:	7.8%	26.5%	11.8%	2.0%
5. Better models are needed to implement ALM:	30.4%	28.4%	2.9%	2.0%
6. External expertise is needed to implement ALM:	4.9%	17.6%	20.6%	2.0%
7. Adequate profitability can be achieved without taking credit risks:	2.0%	22.5%	18.6%	2.9%
8. Active trading should be limited to a very small proportion of the investment portfolio:	12.7%	18.6%	14.7%	2.0%
9. The liquidity of the investment portfolio is of critical concern:	7.8%	27.5%	9.8%	2.9%
10. The use of derivatives, such as swaps, futures and options, is severely limited by their accounting treatment:	11.8%	24.5%	3.9%	6.9%
11. Insurance company regulations are an important limitation to effective ALM:	15.7%	23.5%	10.8%	2.9%
12. The capital markets provide sufficient instruments for effective ALM:	10.8%	50.0%	7.8%	4.9%

Cash flow matching, segmentation, interest rate duration analysis and reinsurance are frequently utilized techniques. These techniques are not utilized by 37.2% (first three) and 40.2% (reinsurance) of the respondents, or alternatively these respondents are unfamiliar with these techniques. Segmentation is considered as one of the most important techniques, jointly with cash flow projections and performance management.

Relatively unknown or unpopular are more sophisticated strategies and techniques: the use of integrated ALM software, internal coupon stripping, financial pricing of liabilities and interest rate immunization. In each case at least 60% of the respondents state that their company does not utilize these techniques or is unfamiliar with these techniques. Interestingly, the opinion regarding the importance of these techniques varies strongly. Among the non-users, the number favouring the technique nearly balances the number rendering the technique as unimportant.

Of course, the importance of each of the methods varies. Further, there are differences between the use of techniques in the various countries. In the following we will attempt to explain these differences.

3.3. *Opinions on ALM*

In table 3 we present the opinions of the respondents regarding statements on ALM issues. The first three statements refer to the relevance of ALM to the financial management of the companies. With little exception ALM is considered highly relevant.

The opinion on the desirability of interest rate duration matching versus cash flow matching (statement 4) varies, and so does the opinion on active management (statement 8) and portfolio liquidity (statement 9).

Statements 5 and 6 are directed to the state of the art and experience of the company with ALM. Most companies think they need better models for ALM but do not necessarily require outside expertise to develop these.

Regulations and accounting standards do not seem to result in too severe constraints on the ALM policy as is clear from statements 10 and 11. Further, the institutional constraints imposed by the capital markets seem rather immaterial.

Attitude towards risk and investment policy

We have asked about the tolerance for various sources of risk. Active investment management will lead to acceptance of risk in order to achieve additional expected return. Although risk premia may be earned from exposures to various risks, the attitude towards

Table 4: Attitude towards risk

Active element : ¹	Important :		No :	Undesirable		No opinion :
	Yes	Normal :		Yes	Normal :	
	Very :			Very :		
1. Credit risk	23.5	33.3	16.7	15.7	4.9	5.9
2. Currency risk	3.9	20.6	35.5	24.5	11.8	4.0
3. Equity/real estate	22.5	55.9	6.9	7.8	4.9	2.0
4. Interest-rate risk	22.5	50.0	11.8	8.8	2.9	4.0
5. Security lending	3.9	28.4	40.2	7.8	1.0	18.6

¹ The question stated in the survey reads: "How would you rate the following investment strategies for enhancing investment portfolio returns? Selectively taking:..".

different exposure types is different. Credit risks, equity and real estate investments as well as selective interest rate risk (read : anticipation of perceived interest rate changes by modifications in the portfolio) are rated as important. Currency risks are generally considered as not very important or even undesirable. Enhancing portfolio returns by means of security lending is relatively unknown and not very important.

4. Analysis of results

In the analysis we use four transformed variables based on the responses regarding the utilization of the strategies and techniques in table 2. First, we define a general utilization indicator, $S\&T_ALL$, corresponding to the number of techniques actually used by the responding company. Thus the values of this indicator range between 0 and 14.

Next we define three indicators corresponding to strategies and techniques with increasing levels of technical complexity. These indicators are supposed to provide some insight into the different stages of implementing ALM that companies may have reached. We assume that companies in the first place utilize portfolio segmentation and pursue a strategy based on cash flow matching. This importance indicator, $S\&T_S1$, is now defined as the 0 to 3 average score on these two techniques : 3 when a technique is rated “used and very important”, down to 1 for “used, but not important” and 0 when the technique is not utilized.

The second indicator, $S\&T_S2$, refers to scenario analysis, interest rate duration analysis and hedging, instead of cash flow matching and segmentation. The third indicator, $S\&T_S3$, is defined to include the use of integrated software for asset-liability management, financial pricing of liabilities and the use of interest rate immunization strategies.

In these indicators we have omitted the other techniques : risk-return analysis, internal coupon stripping, active bonus/dividend policy, embedded value evaluation, reinsurance and performance measurement. Although these techniques are all highly relevant to the ALM process it is difficult to classify them with respect to technical complexity. In addition to the three indicators, for each strategy or technique a utilization score is determined. The values of these utilization indicators are constructed using two values 0 (not used) to 1 (used) for responses of each company.

4.1. Organizational form and objectives

We first consider whether the organizational form and company objectives matter with regard to the perceived success of ALM and the use of strategies and techniques. From the responses there is little evidence of an organizational structure effect. Mutuals tend to rank the protection of policyholder benefits higher as a corporate objective, while shareholder value and return on equity are ranked importantly lower.

When considered as the single explanatory variable, the relationship between the utilization of technique and organizational form is found unimportant. Only the utilization score for segmentation is less for mutuals than for stock owned firms. Of the constructed variables, $S\&T_ALL$ and the three stage indicators are insignificantly related to organizational form.

4.2. International differences

Institutional differences exist due to the state and structure of the national financial systems, the local security markets and the role of regulation in the countries under consideration. There are several examples of the relevance of these issues.

For instance, the utilization of cash flow projections by U.S. companies, which is practically mandatory under a.o. the State of New York Insurance regulations (U.S. 100% utilization rate versus 78.3% overall average utilization rate) and the utilization of internal coupon stripping by Dutch insurance companies, probably due to the relatively small security market with nearly no traded zero coupon bond issues (Dutch : 59.3% utilization rate versus 24.5% overall average utilization).

Further, differences exist in the product portfolios and the type of products issued by the companies from the six countries. German companies have been heavily regulated with regard to the design of products and as a result tend to issue rather standard and low risk products. This is reflected in the German companies' portfolio balances of traditional products. Similar observations hold for the five Japanese companies.

In contrast U.S. companies tend to deal with complex and competitively priced products with many embedded options, e.g. SPDA's and Universal life products. Indeed the U.S. companies in the sample tend to have larger portfolio balances in annuities and universal life policies than do the companies from the other countries. Further, companies with relatively large numbers of unit-linked policies may feel to have shifted the risks resulting from asset-liability mismatches sufficiently to the policyholders. Of the sample companies, the U.K. companies tend to hold relatively large proportions of unit-linked policies.

We test whether differences in utilization of strategies and techniques exist at the country level using the *Kruskal-Wallis* non-parametric test.¹ This test is based on the ranking of the responses differentiated with regard to a country specific grouping. Based on this test we find significant differences between the six countries in the utilization rates for 10 out of 14 strategies and techniques at the 10% confidence level.² The results are summarized in table 5. In all cases significant at the 5% level, U.S. companies on average rank among the companies with highest utilization of the techniques. This is not the case for performance measurement. Table 6 provides the average scores on the four constructed indicators and their significance based on the *Kruskal-Wallis* test on country differences.

Although by construction the scores on the utilization indicator are unambiguous, the scores on the importance indicators are not.³ Therefore, the latter must be interpreted with

¹ The Kruskal-Wallis test is based on the statistics:

$$S = \sum_{k=1}^K \frac{N_k \left(\bar{R}_k - \frac{1}{2}(N+1) \right)^2}{\frac{1}{12}(N^2 - 1)}$$

where N is the total number of observations, N_k is the number of observations for country k , $k = 1..6$, and R_k is the ranking of the response for country k . In the statistic S the average ranking is used. Now, the statistic $H = (N-1)S/N$ has an asymptotic χ^2 distribution with $k-1$ degrees of freedom under the null hypothesis that the distributions of the responses is equal for all the groups (countries) considered. See also: Kendall and Stuart [1961], p. 504.

² Based on the test statistic corrected for ties in the ranking figures. The uncorrected significance level is generally lower.

³ Recall that the aggregate utilization indicator corresponds to the number of strategies and techniques used. The importance indicator represents a somewhat arbitrary weighted average of users and non-users.

care. In any case, a value below 1 indicates that the majority of the companies does not use the strategies and techniques incorporated in the indicator, while a value above 1 suggests that at least a considerable proportion of the companies does. However, alternative weighting schemes do not seem to alter the results.⁴

Table 5: Country comparison strategies and techniques

<i>Confidence level:</i>	<i>Strategies techniques:</i>
- 5%	Scenario projections, integrated ALM software, cash flow matching, segmentation, duration analysis, internal coupon stripping, performance measurement.
- 10%	Embedded value evaluation.
Not significant:	Hedging with derivatives, financial pricing, immunization, bonus/dividend policy, reinsurance.

From these indicator scores and the utilization rates on individual strategies and techniques it appears that the companies can be split into three groups. The first group is presented by the companies from the U.S. with (on average) the highest utilization rates. The second group is presented by companies from three European countries: France, the Netherlands and the U.K. The third group with the lowest utilization rates comprises Germany and Japan.

Table 6: Country comparison: aggregated indices

Country:	Index: ¹			
	<i>S&T_ALL</i>	<i>S&T_S1</i>	<i>S&T_S2</i>	<i>S&T_S3</i>
France	8.00	1.17	1.06	0.28
Germany	6.70	0.73	0.78	0.42
Japan	4.20	0.00	0.73	0.07
Netherlands	7.63	1.15	0.81	0.60
U.K.	8.28	1.00	0.76	0.35
U.S.A.	9.07	1.28	1.22	0.86
Significance:	5%	5%	5%	5%

¹ average index values.

The German companies in particular tend to be less concerned regarding ALM. Jointly with the smallest Dutch companies these companies are the least experienced and presumably require the most external expertise.

On average German and Japanese companies tend to be the most optimistic regarding the profitability of their products. Active trading is less favoured in these countries. Portfolio liquidity matters most to French, German and U.S. companies, the least for Japanese companies. The impact of insurance regulations seems to matter most to German and U.S. companies.

Further there seem to be differences with regard to the tolerance for particular risks. Credit risks are considered as an important source of value from active management in Japan and the U.S. In contrast French and German companies tend to disqualify this type of risk.

⁴ See Mosteller and Tukey [1977] who suggest the use of alternative data transformations to deal with such scaling problems. Here we have only considered the square of the data values as an alternative with the result stated.

Currency risks are acceptable and relatively important to Japanese and U.K. companies but not to the other companies. Equity and real estate investments are considered relatively important on the European continent, while interest rate mismatches are highly valued in Germany and the U.K.

ALM as a change driven process

When considering ALM as a dynamic process involving various stages of development, it is relevant to consider whether companies have a strong incentive to engage in such a process. A driving force behind the management of financial risks is the awareness that the company increasingly faces financial risks and that it has to manage these risks in a structured manner. When asked whether during the past five years the financial risks of the company and its products have increased, 66% of the companies indicate that this is true. Notably for German companies only little changes in the financial product risks have emerged. Here, we consider the relationship between changes in the management of financial risks and the utilization of the strategies and techniques above.

The average score on the *S&T_ALL* indicator for companies indicating that important changes in the management of their financial risks had been introduced during the past five years equals 8.22 versus 7.00 for the companies with no important changes in management. This represents a significantly higher utilization of the strategies and techniques under consideration.⁵ For the importance indicators, a significantly higher score on the *S&T_S2* indicator results.

For the individual strategies and techniques, the average utilization rates are presented in table 7. From this table it is clear that segmentation, cash flow matching, interest rate duration analysis and embedded value calculations are particularly popular among the companies who have made important changes in their financial risk management. The results suggest that techniques have become part of the companies' ALM process.

Table 7: Utilization rates and changes in management

<i>Strategy:</i>	<i>Management changes</i>		<i>Strategy:</i>	<i>Management changes</i>	
	<i>Yes:</i>	<i>No:</i>		<i>Yes:</i>	<i>No:</i>
Cash flow projections:*	83.3%	70.5%	Integrated software:	45.5%	29.4%
Matching:*	66.7%	60.0%	Segmentation:**	74.2%	52.9%
Duration analysis:**	72.7%	52.9%	Hedging:	57.6%	44.1%
Risk-return analysis:	59.0%	58.8%	Coupon stripping:	21.2%	29.4%
Financial pricing:	40.9%	26.4%	Immunization:	47.0%	32.3%
Bonus/dividend policy:	48.4%	41.1%	Embedded value:**	62.1%	41.1%
Reinsurance:	60.6%	76.5%	Performance measurement:	83.3%	76.4%
<i>Index:</i>	<i>Management changes</i>		<i>Index:</i>	<i>Management changes</i>	
	<i>Yes:</i>	<i>No:</i>		<i>Yes:</i>	<i>No:</i>
<i>S&T_ALL</i> **	8.22	7.00	<i>S&T_S2</i> *	1.00	0.76
<i>S&T_S1</i>	1.07	0.93	<i>S&T_S3</i>	0.56	0.49

* Significantly different, 10% level.

** Significantly different, 5% level.

⁵ Using a standard *t*-test.

5. A taxonomy of the results

What do we conclude from these results? Most of the companies seem to be involved with ALM at least at a basic level. Typically the German and Japanese companies appear to be lagging behind with respect to the implementation of ALM techniques. In this section we first consider differences between the companies based on the perceived success of their ALM policy. Second, we compare our results with those from previous studies.

5.1. Success and ALM

A majority of the companies regard themselves as successful or nearly successful in achieving their desired ALM policy. Here we consider the differences between successful and (according to their own standards) unsuccessful companies in greater detail.

Table 8 presents the nationality distribution with regard to the perceived success of the ALM policy. German companies are relatively over-represented in the extreme classes; the reverse is true for the French companies. The Japanese companies tend to consider themselves as currently not successful. Companies from the U.S. and Britain are more optimistic regarding the success of their ALM policies, while in the Netherlands successful and unsuccessful companies are balanced.

The number of strategies and techniques used by companies from different success classes tends to vary. In table 9 we show differences between the classes and the *S&T_ALL* indicator. For all pairs of success classes the two corresponding indicator values are presented. The indicator value increases with the degree of success of the classes. The differences in the average per class indicator values are significant when these concern successful versus non-successful classes.

Table 8: Success and nationality

Success (relative to desired policy)	Nationality:					
	France	Germany	Japan	Neths.	U.K.	U.S.A.
Equal:	0.0%	15.0%	0.0%	11.1%	14.3%	6.6%
Close:	50.0%	35.0%	0.0%	33.3%	71.4%	63.3%
Subtotal:	50.0%	50.0%	0.0%	44.4%	85.7%	69.9%
Not very close:	33.3%	15.0%	80.0%	33.3%	7.1%	23.3%
Not close at all:	0.0%	15.0%	20.0%	7.4%	7.1%	3.3%
Subtotal:	33.3%	30.0%	100.0%	40.7%	14.2%	26.6%
Not responding:	17.0%	20.0%	0.0%	14.8%	0.0%	3.3%

When we consider the type of strategies and techniques used, the more sophisticated techniques tend to be used less by the less successful firms. The techniques used significantly more are:⁶ cash flow projections, integrated ALM software, cash flow matching, duration analysis, interest rate immunization, embedded value evaluation and performance analysis.

⁶ Significance based on *t*-tests.

Table 9: Success and S&T_ALL

	Close to equal:	Not very close:	Not at all close:
Equals desired:	9.60 \ 8.41	9.60 \ 6.46**	9.60 \ 5.12**
Close to equal:		8.41 \ 6.46**	8.41 \ 5.12**
Not very close:			6.46 \ 5.12

a \ b a denotes the score for the row class, b the score for the column class

** significantly different at 5% level.

The first of the paired values corresponds to the row, the second to the column.

There do not seem to be any systematic differences in the opinions regarding ALM or the attitude towards risk and risk classes. There are differences however with regard to the perceived changes in the riskiness of the company's products and the changes that have appeared in the management of these risks.

Table 10: Success and importance indices

Success:	S&T_S1	S&T_S2	S&T_S3
Equals desired:	1.30	0.93	0.73
Close to desired:	1.14	1.11	0.56
Not very close:	0.72	0.68	0.33
Not close at all:	0.50	0.46	0.42

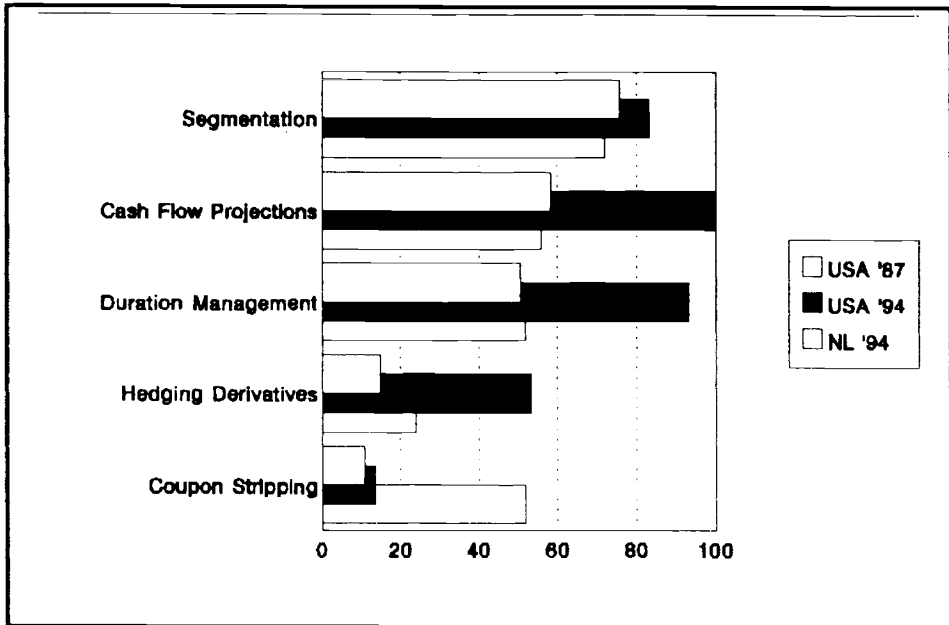
The companies in the class "current policy equals desired" experienced on average the least changes in the financial risks of the product portfolio. The companies in this class rank average with regard to changes in the management of risks. The companies in the classes "close to desired" and "not very close to desired" experienced on average important changes in financial risks. Of the companies in these two classes, the companies in the "close to desired" class were on average the most eager to respond to these increases in risk by changes in management. The companies in the class "not close at all to desired policy" rank lowest with regard to changes in the management of financial risks.

5.2. Comparison of results with previous studies

It is of interest to relate the results of this survey to those from the previous study by Lamm-Tennant [1989]. We find that all the techniques discussed in Lamm-Tennant [1989] are used and their use has increased during the past 5 year period. The importance of coupon stripping and hedging is still relatively low, yet only few U.S. companies have not considered these techniques. As already noticed above, cash flow projections are used by all the U.S. respondent companies.

Inspired by the phenomenal growth in the U.S. collateralized mortgages and fixed income derivatives' markets the sophistication of interest rate models has rapidly increased. Integrated asset- and liability modelling and management of interest rate guarantees has become feasible. Clearly, these developments have also encouraged hedging transactions using derivatives. Of the U.S. companies only few have not considered the strategies and techniques on the list for implementation.

Figure 3



On average the companies from the other five countries have started to follow the example set by the U.S. companies. As an example, when we compare the Dutch companies with those from the U.S. we note that for the three most frequently used techniques the operational status is roughly comparable to that in the U.S. five years ago. Given that most of these techniques are considered important, it is likely that their use will increase in years to follow.

6. Summary and conclusions

In this article we have examined the implementation of ALM policies by life insurance companies. Based on the results of a survey among 287 life insurance companies from France, Germany, Japan, the Netherlands, the U.K. and the U.S. we consider the use of ALM strategies and techniques and investigate the differences in utilization.

The majority of respondent companies is implementing an ALM policy. In general, an ALM unit or committee is active, with members from both actuarial and financial disciplines. The current state of ALM seems to differ substantially among the various companies and countries. We find no evidence of an organizational form effect with respect to the implementation of ALM, even though company objectives differ between stock owned and mutual firms. The attitude towards financial risks is different however, notably between companies from different countries.

Institutional elements seem to matter, particularly when we consider the use of scenario models for cash flow projections. Scenario models are used by all the respondents from the U.S. while utilization rates in the other countries are substantially lower. On average, the U.S. companies are in the lead with respect to the implementation of ALM. We find that in comparison to an earlier study by Lamm-Tennant the use of ALM techniques has increased in the U.S. Since there are no other publicized investigations, there is no opportunity for comparison of the utilization of these techniques in other countries.

The implementation of ALM techniques such as cash flow projections, matching of assets and liabilities, duration analysis, segmentation and embedded value analysis, are most frequently associated with the changes in the management of financial risks. These management changes have been inspired by increased awareness of financial risks in the life insurance asset-liability portfolio. Companies considering their ALM policy to be relatively successful appear to have been among the first to implement these management changes and have made several of these ALM techniques part of their risk management policy.

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