THE DETERMINANTS OF THE USE OF DERIVATIVES IN JAPANESE INSURANCE COMPANIES

Atsushi TAKAO*, I Wayan Nuka LANTARA**
Graduate School of Business Administration, Kobe University, Japan*
Faculty of Economics and Business, Universitas Gadjah Mada, Indonesia**

***ABSTRACT*:** The purpose of this study are to investigate the patterns of the use of derivatives by Japanese insurance companies, and to examine which firms-specific factors determine the decision of Japanese insurance companies to use derivatives. Using a sample of Japanese life insurance and non life insurance companies during the period of 2001-2008, we find that the participation rate for the use of derivatives by insurance companies in Japan is 72.4%, much higher than those found in the US, the UK or Australia. Using probit regression models, we examine the determinants of the use of derivatives, and we find that the decision to use derivatives by insurance companies is positively associated with firm size, leverage, and proportion of asset invested in stock, but negatively related with asset liability mismatch. We also find that the decision of Japanese insurance companies to extend their markets to operate globally increase the need to use derivatives.

KEYWORDS: risk management and derivatives, insurance companies

1. INTRODUCTION

Insurance is a form of risk management which spreads risk of many people or businesses in exchange for a small payment from policyholders. Insurance companies are characterized by some uniqueness in term of its financing and investment decision. Generally, the main sources of fund are obtained by issuing more contracts with policyholders, rather than raising fund from capital market. Hence, insurance companies tend to be relatively highly leveraged firms. In term of investment, insurance companies generally invest the money into financial market and/or real market, which is also subject to risk.

Some types of risk can be diversified away using certain risk management tools or risk pooling. Insurance companies usually employ reinsurance, coinsurance, geographic distribution, and product distribution in order to minimize its business risks (Cummins *et al.* 1997). However, there are some other risks such as market risk, exchange rate risk or interest rate risk that can be appropriately minimized by using other tools, such as derivatives. Hodgson (1999) and Shiu (2007) suggest that the main advantage of using derivatives is that it provides a relatively inexpensive and effective method to reduce risk. The use of derivatives also provides other benefits such as to manage income, to lower taxes, and sometimes as a means of income generation.

The previous empirical evidences on the use of derivatives by non-financial firms has been conducted in various countries around the world, such as Bodnar *et al.* (1995; 1998) in the US,

Bodnar and Gebhardt (1998) in Germany, Grant and Marshall (1997) and Mallin *et al.* (2001) in the UK, Alkeback and Hagelin (1999) in Sweden, De Ceuster *et al.* (2000) in Belgium, Berkman and Bradbury (1996) in New Zealand, Heaney *et al.* (1999) in Japan, and Nguyen and Paff (2002) in Australia. However, only few studies examining the topic on financial firms, especially on insurance companies, has been documented, such as: Colquitt and Hoyt (1997) and Cummins *et al.* (1997, 2001) in the US, Hardwick and Adam (1999), and Shiu (2007) in the UK, and De Ceuster *et al.* (2003) in Australia.

More empirical researches from other countries, including Japan, are still needed to obtain more empirical evidence on the use of derivatives by insurance companies. This study is expected to be one of the first studies that provide Japanese empirical evidence on two main ideas. First, to explore the pattern of the derivatives usage by Japanese insurance companies, with respect to: the percentage of users Vs non-users of derivatives, life insurance Vs non-life insurance, big-size Vs small-size insurance companies, mutual Vs stockholding insurance companies, and domestic operating Vs both domestic and foreign operating insurance companies. Second, to investigate which firms-specific factors determine the decision for Japanese insurance companies to use derivatives.

This study extends the existing empirical evidences by examining two issues that have rarely been tested in the previous researches. First, as one of the largest industries in the world, Japanese insurance companies not only serve its domestic market, but also operate internationally, that could increase the types and magnitude of risk faced by insurance companies. Therefore, this study also examines the relationship between international business operations of Japanese insurance companies and the decision to use derivatives.

Second, this study also investigates the relationships between the ability of insurance company to meet all payments[1] and the decision to use derivatives by Japanese insurance companies. While some previous studies only use certain measurement for specific risk, such as liability risk or catastrophic risk, this study employ more comprehensive measurement of insurance company's ability to meet all the payments.

2. LITERATURE REVIEW AND HYPOTHESES

Cummins *et al.* (1997) state that insurance companies serve two primary functions in the economy; (a) as a risk-bearing and risk-pooling function, and (b) financial intermediation function. In the first function, insurance companies provide a mechanism to transfer the risk of individual or businesses in exchange for some amount of premium payment. In the intermediation function, insurance companies raise fund by issuing written debt contract and invest the funds in financial markets, which also contain some types of market risks.

Furthermore, Cummins, *et al.* (1997) extend

[1] We use 'solvency margin ratio' as a proxy for the ability of insurance company to meet all payments in the event risks exceed the normal anticipated level of risk. The ratio is computed by dividing the solvency margin total to the aggregate risk amount. The data can be obtained from NEEDS-Financial Quest 2.0 Database.

that both functions will trigger the problem of difference in asset and liability cash flow, because the cash flows of the liabilities issued by insurance companies have different patterns and characteristics than the cash flows of the assets they invest in. Smith (1982) depicts that insurance contracts can be viewed as a package of options contract, which need to be well managed in order to minimize the negative consequences for the companies in future.

Insurance companies generally manage risk by implementing insurance pooling, reinsurance, coinsurance, geographic distribution, and product distribution to minimize risks (Cummins *et al.* 1997). However, some types of financial market risks cannot be diversified away using standard procedures. Hodgson (1999) and Shiu (2007) suggest that the use of derivatives will provide a cost effective vehicle to hedge against financial market risks. It will also offer other benefits such as to smooth accounting earnings, to lower taxes, and to reduce expected costs of financial distress. Sometimes, insurance companies might also use derivatives to speculate in order to yield more return.

Colquitt and Hoyt (1997) note that in order to minimize financial risk, managers of insurance companies generally diversify the risk by holding balanced portfolios of investment. However, Berkman and Bradbury (1996) argue that it is also possible that managers of insurance companies could be less efficient in diversifying financial risk, which then could potentially increase the prospect of insolvency and generate cost of financial distress.

There are two possible alternatives to overcome the problem. First, from the perspective of agency theory, the owner of insurance companies will have to compensate their managers by giving more attractive compensation packages so that manager will manage company's portfolio more efficiently (Kleffner and Doherty, 1996). Secondly, by shifting the risk of insolvency to the financial derivatives markets by using derivatives instrument (Berkman and Bradbury, 1996). Hardwick and Adams (1999) also point out that modern finance theory suggests that the use of derivatives will provide benefit for manager to alleviate market imperfections and reduce firm-specific exposure to financial risk, which could then minimize the volatility of company's cash flow and create value to shareholders.

2.1. Firm Size

As companies become bigger and their operations become more complex, information asymmetries between various contracting groups will be worsen (Jensen and Meckling, 1976). Hence, agency costs will increase in order to prevent opportunistic behavior by managers. In order to minimize the problem, shareholders could improve the compensation package for managers, so that managers will be better on manage company's portfolio diversification (Kleffner and Doherty, 1996). However, Nance *et al.* (1993) and Cummins *et al.* (1997) argue that hedging could also be an effective mechanism by which agency incentive conflicts inside larger firms can be alleviated.

Colquitt and Hoyt (1997), Cummins *et al.* (1997, 2001), De Ceuster *et al.* (2003) and Shiu (2007) find that larger insurance companies are more likely to use derivatives and the usage by large insurance companies is much more pervasive. The finding is associated with the advantage of larger insurance companies which

has more substantial economics of scale to running derivative operation. Large insurance companies tend to have technical knowledge and potential trading volume to warrant an investment in a portfolio of derivatives. In other words, large insurance companies or those with higher-than average risk exposure would find it meaningful to bear the fixed cost of using derivatives. Hence, it can be hypothesized that the larger the insurance companies the more likely they employ derivatives, since they tends to have the necessary resources. The first hypothesis of this study is:

H_1: There is a positive relationship between the size of insurance company and the use of derivatives.

2.2. Proportion of Asset Invested in Stock

Cummins *et al.* (1997) suggest that one of the main functions of insurance companies is financial intermediation. In this function, insurance companies raise fund from many policyholders by issuing written debt contract and invest the funds in financial markets, which also subject to some types of market risks. In order to minimize the volatility of cash flow from their investment in stock, insurance companies could employ derivatives.

Cummins *et al.* (1997) and Shiu (2007) argue that insurance companies may want to account for the degree of market risk exposure they faces, via their holding of equity. They also suggest that the more the proportion of asset invested in stock, the more the need of insurance companies to hedge their investment in stock by employing derivatives. Hence, we could expect the proportion of asset invested in stock will be positively associated with derivatives usage by insurance companies, as stated in the following hypothesis:

H_2: There is a positive relationship between the proportion of assets invested in stock and the use of derivatives.

2.3. Leverage

Colquitt and Hoyt (1997), Hardwick and Adams (1999), and De Ceuster (2003) state that the increasing of leverage will increase the expected costs of financial distress and insolvency risk. Froot *et al.* (1993) argue that for a given level of debt, hedging can reduce the probability of financial distress, and it also can be used as a means to increase debt capacity.

Nance *at al.* (1993) state that by hedging with derivatives, insurance companies can decrease the variance of firm value and also alleviating the underinvestment problem caused by the increase of leverage of the firm. Cummins *et al.* (2001) also notes that one important theory of corporate risk management is that the reason why firm hedging with derivatives is because they want to avoid the direct and indirect cost of financial distress.

Colquitt and Hoyt (1997) argue that the higher the leverage of insurance companies, the more likely they will use derivatives in order to decrease the volatility of firm value. They also suggest that firms with higher leverage are expected to gain more degree of benefit from hedging than firms with lower leverage. Hence, following the hypothesis of Colquitt and Hoyt (1997), the third hypothesis of this study is:

H_3: There is a positive relationship between leverage and the use of derivatives.

2.4. Reinsurance

Berger *et al.* (1992) describe reinsurance as an arrangement whereby an insurance company transfer all or part of its liabilities arising from the customer market to another insurance company (reinsurer). As an exchange for the risk transferring services, there will be a reinsurance premium paid to the reinsurer. Therefore, reinsurance will give benefit for insurance companies to hedge against liquidity risk and insolvency risk.

Colquitt and Hoyt (1997) suggest that even though the risk transferred through the use of reinsurance and the use of derivatives is different, both instruments have the same purposes, which is to reduce the variance of firm's value and taxable income. Therefore, when the variances can be reduced adequately by using reinsurance, the need to hedge risk using derivatives would be reduced. Therefore, we use the following hypothesis to test the relationship between the degree of reinsurance and the use of derivatives:

H_4: There is a negative relationship between the degree of reinsurance and the use of derivatives.

2.5. Asset-liability Mismatch

Hodgson (1999) states that asset-liability mismatch will increase the net value impact from the movement in interest rates, which then put the firm into the higher level of interest rate risk. The more long-term asset outweighed long-term liabilities, the more likely an insurance company will use derivatives to hedge against interest rate risk. De Ceuster (2003) concludes that asset-liability mismatch will increase the amount of interest rate risk, and hence will trigger insurance companies to employ more derivatives.

Colquitt and Hoyt (1997) argue that in the case where the duration of asset and liabilities of insurance companies are matching, they will have less need for hedging with derivatives to reduce economic risk. In other words, the higher the asset-liability mismatch, the more likely insurance companies will use derivatives to hedge against risk. Hence, the fifth hypothesis of this study is:

H_5: There is a positive relationship between asset-liability mismatch and the use of derivatives.

2.6. Organizational Form

Mayer and Smith (1988) argue that stock held insurance companies tends to have more closely relationship between stockholders and managers, and therefore, they will be more efficient in writing agency contracts and more closely control the behavior of management. In contrast, since mutual held insurance companies are only held by its policyholders, who usually do not have voting rights, there will be insufficient power to control manager. Furthermore, Hodgson (1999) extends that stock held insurance companies have more reasons to use derivatives than mutual held insurance companies because they have a higher probability of being involved in more complex and risky business. Therefore, it can be expected that stock held insurance companies will have more advantage to engage with derivatives than mutual held insurance companies, as the following hypothesis:

H_6: There is a positive relationship between stock form ownership and the use of derivatives.

2.7. Solvency Margin

Yamori and Kobayashi (2004) explain that Japanese Insurance Business Law has been revised several times in order to: (a) promote competition and enhance business efficiency through deregulation, (b) preserve the soundness of business, and (c) ensure fairness and equity in business operations. One of the main points on the regulation requires Japanese insurance companies to report their total risk and solvency margin ratio, so that related parties such as policyholders, government or investors could obtain information about the riskiness and solvency of insurance company.

The solvency margin ratio is one of the main indicators used by the supervising administrative agency to ascertain the ability of insurance company to cover the total amount of payment arising from total risks by using total of capital and other internal reserve as well as unrealized gains from securities and other assets (total solvency margin). The solvency margin ratio is the total value of the solvency margin divided by the quantified value of all risks exceeding those that can normally be forecast, such as those arising from major earthquakes or collapses in the stock market.

Hentschel and Smith (1997) suggest that the ability of insurance companies to manage its total risk will reduce the probability of financial distress, so that it will improve their reputations for prudent management and also increase the average level of premium willing to be paid by policyholders. Hardwick and Adams (1999) also note that insurance companies need to transfer its risk to the financial derivatives markets, in order to reduce the amount of risk and the probability of bankruptcy. Therefore, we can expect that the higher the ability of insurance companies to cover all of its payments, the lower the need to engage with derivatives, as stated in the following hypothesis:

H_7: There is a negative relationship between solvency margin and the use of derivatives.

2.8. Foreign Business Operation

Japan is acknowledged as one of the world's highest market penetrations for insurance, especially life insurance, with 90% of households owning a life insurance policy (Inoue, 2009). However, as a result of the declining in Japanese economic growth rate and graying of the population, Japanese insurance companies have to revise their business strategy. One of the main possible strategies is to extent the market by serving not only domestic market, but also international market, such as by opening foreign branches or subsidiaries or conducting joint venture with foreign insurance companies.

Berkman and Bradbury (1996) and Joseph and Hewins (1997) argue that the nature of operations of firms can also influence the level of derivatives used. The more the companies engage in international operation, the more likely they use derivatives to manage foreign currency exposures. Therefore our last hypothesis of this study is:

H_8: There is a positive relationship between the level of foreign business activity and the use of derivatives.

3. METHODOLOGY

We use the data of all Japanese life insurance and non-life insurance companies that are available in NEEDS-Financial Quest 2.0 Database, covering 8 years of study period (2001-2008). Although the

data from NEEDS-Financial Quest 2.0 Database also include data of Japanese insurance companies before 2001, however it does not contain data of derivatives before the year 2001. The total number of insurance companies is 42 firms. We excluded 4 insurance companies from the samples due to the unavailability of data on NEEDS-Financial Quest 2.0 Database. Total numbers of samples are 38 with firm-year observations of 199.

In order to examine the hypotheses, we employ a Probit regression model, since the dependent variable of this study is a dummy variables which consists of the value equal to 1 when the sample use derivatives, and otherwise 0 when not use derivatives. An insurance company is classified as a derivatives user if they report any use of derivatives in their financial statement. The probit regression model to be estimated in this study, with *n* observations and *m* variables is as follows:

$$Y_j = \beta_0 + \sum_i \beta_i X_{ij} + \varepsilon_j \qquad j = 1,....,n,\ \mathrm{i} = 1,....,\mathrm{m}$$

where

Y_j is the decision of insurance companies to use or not to use derivatives,

β_0 is the constant term,

$\beta_{1,....}\ \beta_m$ is the coefficient of the independent variables,

X_{ij} is a vector of independent variables, and

ε_j is error term associated with observation j.

The dependent variable and independent variables, its definition, and the expected sign to be examined in this study can be described as shown in Table 1

The summary of descriptive statistics for users and non users of derivatives can be found in Table 2, which contains the means, standard deviations, and minimum and maximum values of the independent variables included in this study. We also employ the Mann-Whitney *U* test to examine the mean difference of each variable between user and non user of derivatives.

The results indicate that the mean values of the sample of derivatives user tends to be larger than non user, in terms of firm's size, proportion of asset invested in stocks, leverage and solvency margin. They also tend to be more aggressive to engage in international business than non user of derivatives. The result of mean difference test indicates that most of the independent variables are statistically significant, which imply that the mean values of those variables are statistically different between user and non user of derivatives.

4. EMPIRICAL RESULT

The trend and pattern of derivatives usage by Japanese insurance companies in this study is conducted based on: trend of participation rate during the study period, the percentage of users Vs non-users of derivatives, life insurance Vs non-life insurance, big-size Vs small-size insurance companies, and mutual holding Vs stock holding insurance companies.

The trend of participation rate can be seen in Figure 1. During the study period, the participation rate of derivatives by Japanese insurance companies is 72.4%, which range from 66.67% to 82.61%. Surprisingly, this finding is much higher than the finding of participation rate in the US insurance industry, which around 11.93% (Cummins *et al.* 1997) and 13.3% (Colquitt and Hoyt, 1997), and in the UK of 57% (Hardwick and Adam, 1999), or in Australia by De Ceuster (1999) which around 58%.

As also shown in Figure 1, the trend of participation rate tends to slightly decline after 2001. One of the possible reasons is because Japanese insurance companies might put more emphasize on underwriting results than on investment results, and on the other hand the need to use derivatives is slightly declining. Inoue (2009) argues that because of the contraction of domestic insurance potential market in Japan as a result of the declining in the Japanese economy's potential growth and the shrinking of population. As a consequence, Japanese insurance companies have to revise their business model, by putting more attention to be more focus on increasing underwriting results, such as by extending product and or market.

Table 3 shows the pattern of derivatives use with respect to: users Vs non-users of derivatives, life insurance Vs non-life insurance, big-size Vs small-size insurance companies, and mutual Vs stockholding insurance companies. The results indicate that 72.4% of total samples use derivatives. With respect to firm's size, the participation rate of big insurance companies is relatively higher than small insurance companies. In term of the type of insurance, the use of derivatives by life insurance companies is relatively higher than those in non life insurance companies. The result also shows that insurance companies which operate internationally have much higher participation rate than those which only serve domestic market.

Surprisingly, in term of organizational form, the participation rate of derivatives on mutual held insurance companies tend to be higher than those on stock held insurance companies. One of the possible reasons is because all of the samples of life insurance companies included in this study are also mutual holding companies. Hence, the finding that mutual held insurance companies use more derivatives is in line with the result that life insurance companies tends to have higher participation rate to use derivatives than non life insurance companies.

This finding is not consistent to the so called managerial-discretion hypothesis (Mayers and Smith, 1981; Cummins *et al*., 1997) which argue that stock held insurance companies are expected to use more derivatives than mutual held insurance companies, because stocks held insurance companies are more likely to be engaged in more complex and risky business that could increase the need to use derivatives. On the other side, this finding is in line with the argument of Colquitt and Hoyt (1997) and Hardwick and Adams (1999), which suggest that as non listed companies, mutual insurance companies are not subject to the discipline of the market for corporate control, which then put them in a situation to have more freedom to use imprudent investment including the use of derivatives.

The result of Tobit regression can be seen in Table 4. The findings indicate that the coefficients for firm size, proportion of asset invested in stock, and foreign business activity are in the expected direction and are significant at the 1% level. Correspondingly, the coefficient for leverage is significant at the 5% level. However, we do not find any significant relationship between the use of derivatives with reinsurance dependence, organizational form, and solvency margin ratio.

We also find that asset mismatch is statistically significant to influence the decision to use derivatives. However, the result is not consistent with the hypothesis, where we expect

to find positive relationship as found by Colquitt and Hoyt (1997). The finding of this study instead supports the results of Cummins *et al.* (2001) and De Ceuster (2003), who also find a negatively significant association between the use of derivatives and asset liability mismatch.

One of the possible reasons suggested by De Ceuster (2001), who argues that the negative relationship between the use of derivatives and asset liability mismatch could be explained for a situation when an insurance company uses derivatives to hedge against risk as well as to generate higher income. Since speculation motives is riskier than hedging motives, we could expect that insurance companies will be eager to use more derivatives when they feel that other sources of risk such as asset liability mismatch is decreasing. In other words, the use of derivatives will decrease when insurance companies feel that other risk including asset liability mismatch increase.

Overall, the result in Table 4 provides strong support that the decision of insurance companies to use derivatives is positively related with firm size, leverage, and proportion of asset invested in stock, and negatively related with asset liability mismatch. Furthermore, this study also find that the decision of insurance companies to operate internationally increase the need to use derivatives. We find no relation between the use of derivatives by insurance companies to reinsurance dependence, organizational form, and solvency margin.

5. CONCLUSION

This study investigates the patterns of the derivatives usage in Japanese insurance companies and also examines which firms-specific factors determine the decision of Japanese insurance companies to use derivatives. Using a sample of life insurance and non life insurance companies in Japan from 2001 to 2008, we find that on average, the percentage of the use of derivatives by samples of Japanese insurance companies is 72.4%, much higher as compared to those found in other countries such as in the US, the UK and Australia.

We have examined some independent variables that might be expected to influence the decision to use derivatives by insurance companies. The finding of this study provide empirical evidence that the decision to use derivatives by insurance companies is positively related with firm size, leverage, and proportion of asset invested in stock, but negatively associated with asset liability mismatch. We also find that the decision of Japanese insurance companies to extend their market to operate globally increase the need to use derivatives.

The issue to operate globally will be interesting to be investigated further in future research. Due to data limitations, we only used dummy variable as a measure for whether insurance companies operate globally or not. Finding and including of more appropriate proxy for this variable would be an interesting idea to be conducted in future research.

Results of some researches on the relationship between asset-liability mismatch are remain controversial. Hence, there is a need to use a better proxy for asset and liability mismatch, which could measure not only the amount mismatch of asset and liability, but also the mismatch of its duration.

REFERENCES

Alkeback, P., and Hagelin, R., 1999. Derivatives Usage by Nonfinancial Firms in Sweden with an International Comparison. *Journal of International Financial Management and Accounting*, 10, 105-120.

Berger, L.A., Cummins, J.D., and Tennyson, S. 1992. Reinsurance and the Liability Insurance Crisis. *Journal of Risk and Uncertainty*, 5, 253-272.

Berkman H., and Bradbury, M.E. 1996. Empirical Evidence on the Corporate Use of Derivatives. *Financial Management,* 25, 2, 5-13.

Bodnar, G.M., Hayt, G.S., and Marston, R.C. 1995. Wharton Survey of Derivatives Usage by US Non-Financial Firms. *Financial Management,* 24, 104-114.

Bodnar, G.M., Hayt, G.S., and Marston, R.C. 1998. 1998 Wharton Survey of Derivatives Usage by US Non-Financial Firms. *Financial Management,* 27, 70-91.

Bodnar, G.M., Gebhardt, G. 1998. 1998 Wharton Survey of Derivatives Usage by US Non-Financial Firms. National Bureau of Economic Research Working Paper.

Colquitt, L. L. and Hoyt, R. E. 1997. Determinants of corporate hedging behavior: evidence from the life insurance industry. *Journal of Risk and Insurance*, 64, 649–71.

Cummins, J. D., Phillips, R. D. and Smith, S. D. 1997. Corporate hedging in the insurance industry: the use of financial derivatives by US insurers. *North American Actuarial Journal*, 1, 13–40.

Cummins, J. D., Phillips, R. D. and Smith, S. D. .2001. Derivatives and corporate risk management: participation and volume decisions in the insurance industry. *Journal of Risk and Insurance*, 68, 51–91.

De Ceuster, M., and Flanagan, L., 2003. Determinants of Derivatives Usage in the Life and General Insurance Industry: The Australian Evidence, *Review of Pacific Basin Financial Markets and Policies*, 6, 405-431.

Froot, K.A., Scharfstein, D.S., and Stein, J.C. 1993. Risk Management: Coordinating Corporate Investment and Financing Policies. *The Journal of Finance.* 48, 1629-1658.

Hardwick, P. and Adams, M. 1999. The determinants of financial derivatives use in the United Kingdom life insurance industry. *Abacus*, 35, 163–84.

Heaney, R., Koga C., Oliver, B., and Tran, A. 1999. “The Size Effect and Derivative Usage in Japan”, Working Paper Series in Finance, Australian National University.

Hentschel, L., and Smith, C.W. 1997. Risks in Derivative Markets: Implication for the Insurance Industry. *The Journal of Risk and Insurance,* 64, 323-345.

Hodgson, A., 1999. Derivatives and Their Application to Insurance: A Retrospective and Prospective Overview. In N.R. Britton, ed. *The Changing Risk Landscape: Implications for Insurance Risk Management.* Proceeding of a conference sponsored by Aon Group Australia Limited, 151-172.

Inoue, T., 2009. Japan's Life Insurance Industry Gains Strength by Overcoming Financial Crisis. *Nomura Journal of Capital Markets,* 1, 1-5.

Jensen, M.C., and Meckling, W.H. 1976. Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics*, 3, 305-360.

Joseph, N.L., and Hewins, R.D. 1997. The Motives for Corporate Hedging Among UK Multinationals. *International Journal of Finance and Economics*, 2, 151-171.

Kleffner, A.E., and Doherty, N.A. 1996. Costly Risk Bearing and the Supply of Catastrophic Insurance. *Journal of Risk and Insurance.* 63, 657-671.

Mallin, C., Ow-Yong, K., and Reynolds, M. 2001. Derivatives Usage in UK Non-Financial Listed Companies. *European Journal of Finance*. 7, 63-91

Mayers, D., and Smith, C.W., Jr. 1981. Contractual Provisions, Organizational Structure, and Conflict Control in Insurance Markets. *Journal of Business*, 54, 407-434.

Nance, D.R., Smith, C.W., and Smithson, C.W. 1993. On the Determinants of Corporate Hedging. *Journal of Finance*, 48, 267-284.

Nguyen, H. and Paff, R. 2002. On The Determinants of Derivative Usage by Australian Companies. *Australian Journal of Management.* 27, 1-24

Shiu, Y. 2007. An empirical investigation on derivatives usage: evidence from the United Kingdom general insurance industry. *Applied Economics Letters*, 14, 353–360.

Smith, M.L. 1982. The Life Insurance as an Options Package. *Journal of Risk and Insurance.* 49, 4, 583-602.

Yamori, N., and Kobayashi, T. 2004. Does Regulation Benefit Incumbent Firms? An Investigation of Japanese Insurance Market Deregulation. *Journal of Insurance Regulation*, 22, 35-48.

APPENDIX

Table 1. Variables description, expected sign and proxies

Variables		**Proxies**
Dependent Variable		
Derivative usage (DER)		Dummy variable, where: Derivatives user = 1, Derivatives non-users = 0
Independent Variables (expected sign)		
Firm's size (SIZE)	(+)	Natural logarithm of total assets
Proportion of asset invested in stock (PAS)	(+)	The ratio of investment in stock to total asset
Leverage (LEV)	(+)	The ratio of the total long-term liabilities to total assets
Reinsurance (REIN)	(-)	The ratio of total reinsurance premiums to total premiums
Asset Mismatch (ASSMISS)	(+)	Asset Mismatch = [(Non current asset – Non current liabilities)] / Total asset (only if a positive value is found, otherwise LIABM)
Liability Mismatch (LIABMISS)	(+)	Liabilities Mismatch = [(Non current liabilities – Non current asset)] / Total asset (only if a positive value is found, otherwise ASSM)
Organizational form (OF)	(+)	Dummy variables, where: Stock held insurer = 1, Mutual held insurer = 0
Solvency Margin (SOLV)	(-)	Natural Logarithm of solvency margin ratio.
Foreign Business Operation (FOREIGN)	(+)	Dummy variable, where: Have foreign branches and or subsidiaries = 1, otherwise, No foreign branches and or subsidiaries = 0

Table 2. Descriptive statistic and mean differences

	Mean	**SD**	**Minimum**	**Maximum**	**Mean difference**
A. TOTAL SAMPLES					
Firm size (SIZE)	14.38	1.64	10.16	17.77	-6.83**
Proportion of asset invested in stock (PAS)	0.18	0.13	0.00	0.44	-7.46**
Leverage (LEV)	0.04	0.04	0.00	0.20	-7.39**
Reinsurance (REINDEP)	0.09	0.09	0.00	0.30	-1.33
Asset mismatch (ASSMIS)	0.06	0.08	0.00	0.34	-2.05*
Liability mismatch (LIABMIS)	0.02	0.06	0.00	0.48	-0.15
Organizational form (OF)	0.86	0.35	0	1	-3.06**
Solvency margin (SOLV)	9.23	6.94	3.13	98.16	-5.01**
Foreign business operation (FOREIGN)	0.74	0.44	0	1	-9.94**

B. USER OF DERIVATIVES				
Firm size (SIZE)	14.88	1.48	12.12	17.77
Proportion of asset invested in stock (PAS)	0.23	0.12	0.00	0.44
Leverage (LEV)	0.05	0.04	0.004	0.20
Reinsurance (REINDEP)	0.10	0.09	0.00	0.25
Asset mismatch (ASSMIS)	0.07	0.08	0.00	0.34
Liability mismatch (LIABMIS)	0.03	0.07	0.00	0.48
Organizational form (OF)	0.81	0.39	0	1
Solvency margin (SOLV)	9.94	7.84	3.15	98.16
Foreign business operation (FOREIGN)	0.93	0.26	0	1
C. NON-USER OF DERIVATIVES				
Firm size (SIZE)	13.07	1.27	10.16	15.43
Proportion of asset invested in stock (PAS)	0.07	0.09	0.00	0.29
Leverage (LEV)	0.02	0.016	0.00	0.06
Reinsurance (REINDEP)	0.08	0.09	0.00	0.30
Asset mismatch (ASSMIS)	0.03	0.05	0.00	0.19
Liability mismatch (LIABMIS)	0.02	0.03	0.00	0.13
Organizational form (OF)	0.98	0.14	0	1
Solvency margin (SOLV)	7.36	2.98	3.14	21.24
Foreign business operation (FOREIGN)	0.24	0.43	0	1

** Statistically significant at 0.01 level (2-tailed).

* Statistically significant at 0.05 level (2-tailed).

Figure 1. Participation rate of derivatives usage by Japanese Insurance Companies

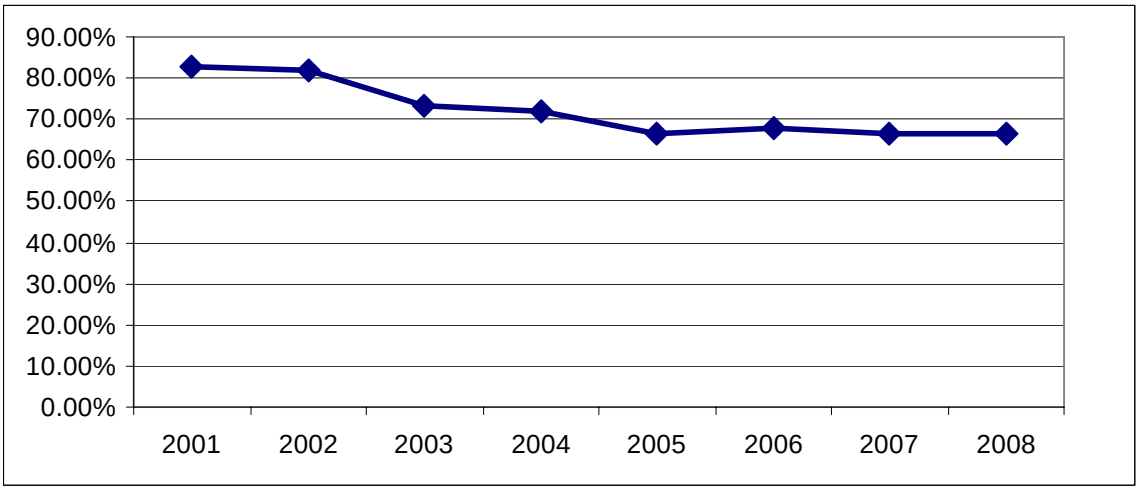

Table 3. Proportion of user and non-user of derivatives

	User of derivatives	Non-user of derivatives
Total sample	144 (72.4%)	55 (27.6%)
FIRM'S SIZE		
Big size	88 (88.9%)	11 (11.1%)
Small size	56 (56.0%)	44 (44.0%)
TYPE OF INSURANCE		
Life insurance	54 (84.4%)	10 (15.6%)
Non life insurance	90 (66.7%)	45 (33.3%)
ORGANIZATIONAL FORM		
Mutual held	27 (96.4%)	1 (3.6%)
Stock held	117 (68.4%)	54 (31.6%)
FOREIGN OPERATION		
Domestic only	10 (19.2%)	42 (80.8%)
Domestic and foreign	134 (91.2%)	13 (8.8%)

Table 4. Probit regression result

Dependent variables	Expected sign	Coefficient	Z-statistic
Firm size (SIZE)	+	0.30	2.70**
Proportion of asset invested in stock (PAS)	+	7.76	2.76**
Leverage (LEV)	+	11.84	2.13*
Reinsurance (REINDEP)	-	-5.57	-1.52
Asset mismatch (ASSMIS)	+	-3.61	-2.84**
Liability mismatch (LIABMIS)	+	0.20	0.11
Organizational form (OF)	+	0.14	0.23
Solvency margin (SOLV)	-	-0.00	-0.02
Foreign business operation (FOREIGN)	+	1.66	4.81**
Number of observations	199		
Chi square	65.50**		
Pseudo-R^2	0.61		

** Statistically significant at 0.01 level (2-tailed).

* Statistically significant at 0.05 level (2-tailed).