The Geneva Papers, **2011**, **36**, (186–196)

www.genevaassociation.org

What Motivates Insurers to Use Derivatives: Evidence from the United Kingdom Life Insurance Industry

Yung-Ming Shiu
Department of Risk Management and Insurance, National Chengchi University, Taiwan.

Using firm-specific variables that proxy for the motivations of life insurers' decision to participate in derivative transactions, we examine existing theories of corporate hedging behaviour. Our findings support the evidence of previous research that risk management and scale factors explain the use of derivatives. We observe a substitution effect that insurers use on-balance-sheet hedging through structuring their assets and liabilities to reduce price risks.
The Geneva Papers (2011) **36,** 186–196. doi:10.1057/gpp.2011.4

Keywords: derivatives; hedging; life insurers

Introduction

Insurers are in the business of risk. In order to meet the obligations to their policyholders, insurers manage the underwriting and investment risks to which they are exposed. The common approaches employed by insurance firms to managing underwriting risks include reinsurance, coinsurance and geographic/product diversification. Similar to banks and non-financial firms, insurers also use derivatives to hedge investment risks.[1] Moreover, capital market-traded derivative instruments can also be utilised to cover the risks associated with insurance products. For example, life insurers may use interest rate derivatives to hedge the interest rate exposure arising from products embedded with guaranteed annuity options, and/or use currency derivatives to hedge the foreign exchange risk arising from overseas revenues.

In 2008, the United Kingdom (U.K.) life insurance industry generated annual premiums of £184.995 billion (US$ 342.759 billion), accounting for 13.76 per cent of total worldwide life insurance premium income, and this market was ranked first in Europe and third in the world.[2] During the analysis period 1994–2008, the changes in legislation in the U.K. do not have significant effects on how insurers operate.

[1] Both banks and non-financial firms have the need for hedging using derivatives. However, some differences may exist. For instance, unlike their counterparts in the non-financial sector, managers in the banking industry with high equity holdings use less derivative hedging to capitalise on the risk-shifting opportunities provided by deposit (Whidbee and Wohar, 1999). Interested readers are referred to Whidbee and Wohar (1999), Sinkey and Carter (2000) and Shiu and Moles (2010) for banks, and Nance *et al*. (1993) and Bartram *et al*. (2009) for non-financial firms. In this paper, we will mainly focus on theories and evidence in insurance literature.

[2] Swiss Reinsurance Company (2009, pp. 38–39).

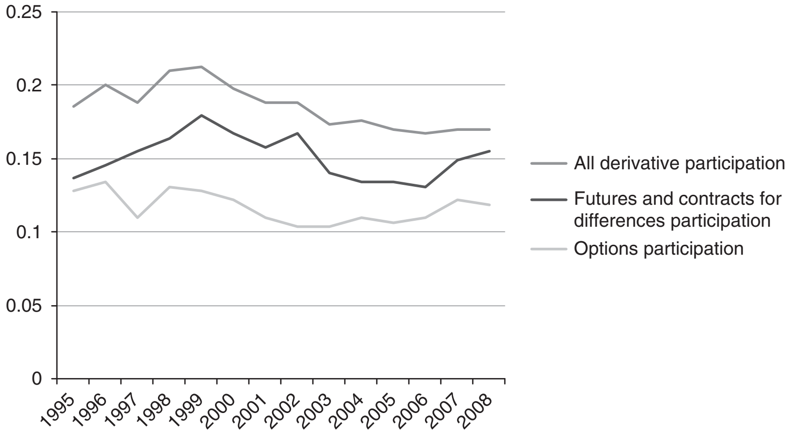

Figure 1. Derivative participation rate.

Moreover, the U.K. insurance markets are relatively less regulated compared with other main insurance markets across the world.[3] The associated potentially confounding legal effects are accordingly minimised.

U.K. insurers are only allowed to hold derivative contracts either for reducing investment risks or for efficiently managing portfolios.[4] This rule gives insurers a certain degree of flexibility when engaging in derivative transactions. A derivative transaction that does not reduce investment risks may still be regarded as being for the purpose of efficient portfolio management if it will assist the insurer to achieve its investment goals.

Our data is statutory returns from SynThesys Life 2010 (Version 10.1). The derivative data contained in this data set is year-end accounting values of assets and liabilities reported by U.K. life insurers. At the end of a given financial year, derivative contracts are reported as assets or liabilities depending on whether their value to the insurer is positive or negative respectively. As shown in Figure 1, the all-derivative participation rate, measured as the number of insurers that use derivatives divided by the number of insurers, remains steady and averages 19 per cent during the period of 1994–2008. According to Form 17 of the statutory returns, derivative instruments can be classified into two main types of contract: futures and contracts for differences, and options. We also find that the futures and contracts for differences participation rate is higher than the options participation rate through these years.

As discussed later, Hardwick and Adams[5] also examine the determinants of derivative use by U.K. life insurers. However, several major differences exist between their study and ours. First, Hardwick and Adams[5] only use a sample of 88 life insurers in 1995, while we use 3,252 firm-year observations for 329 life firms from 1994 to 2008.

[3] Wang (2002).
[4] Philpott (2009).
[5] Hardwick and Adams (1999).

Our sample covers a wider range of life insurers and a longer period of time. Second, in our analysis we consider more possible determinants than those used by Hardwick and Adams.[5] Specifically, we take account of the solvency, tax convexity, asset structure and product mix variables that do not appear in their model.

Our study adds to the literature on several grounds. First, this paper fills the gap in the literature on derivative use. Most prior studies that have attempted to examine derivative use have focused on U.S. firms. A study on corporate derivative use by U.K. life insurers over a long period of time has not yet been conducted before. Our results can then be compared with those of previous studies in the insurance industry or other financial sectors across the world. Second, this research can update insurance managers and regulators on derivative use in the market. The identification of the determinants is instrumental in providing insights into the relations between the decision to use and the determinants, which could help actuaries to make relevant decisions and industry regulators to evolve new policies on the derivative use by life insurance firms.

The paper proceeds as follows. In the following section, we review literature to examine the motives for the corporate use of derivatives. We describe the data, variables and methodology in the subsequent section, and the empirical results and robustness checks are provided thereafter. The final section concludes.

Motives for the use of derivatives by insurers

Most prior studies on derivative determinants have focused on non-financial firms.[6] Little research uses data from banking firms.[7] In this section, we mainly focus on, but are not limited to, literature on the determinants affecting participation decisions to use derivatives by insurers.[5,8,9,10,11,12]

Bankruptcy costs/economies of scale

The financial distress costs theory suggests that derivative hedging reduces the probability of insurer insolvency, and thereby reduces the expected bankruptcy costs. Warner[13] argues that smaller firms have higher bankruptcy costs than larger companies, and therefore smaller firms have stronger incentives to hedge risks. Moreover, larger insurers may have less need for derivatives as they normally have greater capacity for dealing with adverse market fluctuations than smaller firms. The above reasoning suggests that firm size is negatively related to the propensity of using derivative.

[6] (e.g. Berkman and Bradbury, 1996; Géczy *et al*., 1997; Bodnar *et al*., 1998; Bartram *et al*., 2009).
[7] (e.g., Whidbee and Wohar, 1999; Sinkey and Carter, 2000; Adkins *et al*., 2007).
[8] Hoyt (1989).
[9] Colquitt and Hoyt (1997).
[10] Cummins *et al*. (1997).
[11] Cummins *et al*. (2001).
[12] De Ceuster *et al*. (2003).
[13] Warner (1977).

However, a competing argument relating to economies of scale exists. Empirical evidence shows that large insurers generally have scale and informational economies, and thereby are more likely to use derivatives.[5,10–12] Moreover, large insurers usually can relatively easily recruit able employees with professional knowledge of derivative transactions compared to small insurers. On the basis of the above discussion, there is no prior expectation about the direction of the relation between firm size and the decision of using derivatives.

Underinvestment hypothesis

The underinvestment problem results from agency costs. As stockholders and policy-holders, similar to debtholders in ordinary companies, have conflicts of interest, managers have a propensity to decline positive Net Present Value (NPV) projects, thus leading to the underinvestment problem. This problem can be alleviated through derivative hedging.[14] As the underinvestment problem deteriorates for highly leveraged firms, we expect that insurers with higher leverage are more likely to use derivatives.[15]

Leverage can be viewed as an inverse measure of solvency. Insurers with greater solvency are more able to assume risks and absorb large unexpected losses, and thus are less affected by the underinvestment problem. These insurers may be in less need of hedging by using derivatives. It is therefore expected that more solvent insurers are less likely to use derivatives.[16]

Reduction in expected tax payments

The income volatility reduction argument suggests that firms can lower the expected tax payments by reducing variability in their profits through hedging when corporate tax rates are progressive.[17] Except Cummins *et al.*[11] who find that derivative hedging is motivated by the corporate tax, however, determinants studies on insurers' derivative use either do not include the tax variable in their model[5,10,12] or do not find this variable significant.[9] Moreover, Hardwick and Adams[5] indicate that the unique taxation base used in the U.K. insurance industry may confound the empirical results. Notwithstanding the reasons mentioned above, the income volatility reduction argument may hold in the U.K. life insurance sector. We, therefore, expect that life insurers facing a higher level of tax convexity are more likely to use derivatives.

---

[14] Nance *et al.* (1993).

[15] Literature suggests that insurers with higher leverage have higher probability of insolvency (Carson and Hoyt, 1995), and therefore are more likely to use derivatives to lower bankruptcy costs by reducing the probability of insolvency (Colquitt and Hoyt, 1997; Hardwick and Adams, 1999).

[16] It can be argued that leverage and solvency are closely related and may be difficult to disentangle. In earlier tests, we included both variables in our models. We find that the coefficients on solvency are all statistically significant at the 0.01 level, whereas the coefficients on leverage are all insignificant (probably because their effects were captured by the solvency variable). Dropping the leverage variable did not qualitatively affect the results on other variables. Therefore, we do not include it in the models reported below.

[17] Smith and Stulz (1985).

Managerial risk aversion/managerial discretion

The managerial risk aversion hypothesis suggests that mutual insurers are more likely to engage in derivative hedging than stock insurers because mutual insurers are largely controlled by risk-averse managers, and lack mechanisms (e.g., market-based incentive compensation plans) for owners (policy-holders) to control managers.[5] However, the managerial discretion hypothesis states that stock insurers are more likely to use derivatives than mutual insurers. Compared with their mutual counterparts, stock companies are likely to engage in more complex and riskier activities, and thus in more need of derivative hedging.[9] We therefore do not have prior expectation about whether the derivative participation decision differs between stock and mutual insurers.

Substitutes/complements for hedging

Firms with different asset and liability portfolios may present different risks. We therefore include asset structure and product mix in our model. Literature further suggests that investment in liquid assets (e.g., cash, bonds and equities) reduces the need for derivative hedging.[14] However, high investment in bonds and equities indicates high exposure to bond and equity price movements. Insurers with greater such exposure are more likely to engage in derivative transactions to hedge the associated risks.

We also include the percentage of reserves in lines of insurance in the regression model to control for liability structure. We expect that insurers with more reserves in life insurance and pension are more exposed to the interest rate risk, and therefore are more likely to use derivatives.

Reinsurance could serve as a substitute for derivative hedging. Insurers that depend heavily on reinsurance have less variability of firm value and therefore have less need for derivative hedging.[5,10,12] However, reinsurance and derivatives might complement each other. The rationale is that firms that use more reinsurance generally have lower risk tolerance and thus they have a predisposition to hedge their risk by using derivatives.[9] Thus, the relation between reinsurance and decision to use derivatives is an empirical question.

Currency risk exposure

Insurers with overseas operations have overseas premiums income. These multinational insurance firms inevitably face currency risk, and therefore are more likely to use derivatives to manage currency risk than domestic firms.[5]

Data, variables and methodology

Data

We begin with all 350 insurers in SynThesys Life 2010 (Version 10.1). This data set contains the statutory returns filed by life insurers with the Financial Services

Authority (FSA), the U.K. insurance regulator, for the period of 1985–2008. It is worth noting that the implementation of the European Union Third Insurance Directives (becoming effective from 1 July 1994) leads to the relaxation of derivative use[18] and a considerable opening up of derivative use for U.K. insurers.[19] We therefore select the period of 1994–2008 for our analysis. In order to reduce the possible confounding effects arising from government legislations and industry practices on the empirical results, this study focuses on the U.K. life insurance industry, and thus insurers submitting global returns are excluded. We also delete firms whose statutory returns are so incomplete that we lack sufficient data to compute the variables employed in this study. We then exclude insurers with negative total admissible assets and net-earned premiums written in any of the three lines of business, including life and general annuity, pension insurance and permanent health insurance. As we include all the insurers that had ever existed during the analysis period even if they failed to survive until 2008, our study is thus relatively unlikely to be subject to survivorship bias. In addition, following Géczy *et al.*,[20] we lag the explanatory variables to correct the possible problem of endogeneity, leading to the loss of one more year's data.[21] The resulting sample comprises 3,252 firm-year observations for 329 life insurers.

Dependent variables

We have three dependent variables in our empirical analysis. The first dependent variable takes on the value of 1 if the insurer reports any derivative holdings at the end of a given financial year, and 0 if it does not. The remaining dependent variables represent participation in derivatives by contract type (futures and contracts for differences, and options).

Explanatory variables

We choose explanatory variables based on their theoretic relation with the dependent variable and empirical evidence found in the literature.

(a) *Firm size*: We measure firm size as the natural logarithm of total of admissible assets.
(b) *Solvency*: We measure the solvency variable as the free asset ratio, proxied by excess (deficiency) of available assets and implicit items over the required minimum margin, divided by the sum of long-term insurance business assets and other than long-term insurance business assets allocated towards long-term insurance business required minimum margin.

---

[18] Campbell *et al.* (2003).
[19] Philpott (2009).
[20] Géczy *et al.* (1997).
[21] We conduct the Wu (1973) test for endogeneity for the explanatory variables. The unreported results show that the endogeneity problem exists. We therefore use lagged values for the explanatory variables in our models. Lagged endogenous variables can be viewed as predetermined variables and the endogeneity problem then mitigated (Studenmund, 2001, p. 464).

Table 1 Summary statistics and equality tests for derivative users and non-users

	Total sample		*Users*		*Non-users*		*t-statistic*
	Mean	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*	
Firm size	12.8382	2.8809	15.1172	1.6432	11.9400	2.7665	31.315***
Solvency	0.1388	0.3853	0.0889	0.1157	0.1593	0.4503	−4.481***
Tax convexity	0.0792	1.1363	0.1094	1.1291	0.0673	1.1394	0.751
Stock insurer	0.1500	0.3600	0.1963	0.3974	0.1381	0.3451	4.058***
Cash	0.1052	0.1968	0.0497	0.0992	0.1287	0.2216	−9.889***
Bonds	0.3228	0.2605	0.3080	0.2041	0.3299	0.2836	−1.992**
Equities	0.2351	0.2266	0.2716	0.2185	0.2121	0.2287	5.467***
Life insurance reserves	0.6611	0.3334	0.4824	0.2716	0.7450	0.3271	−19.628***
Pension reserves	0.5758	0.3440	0.5462	0.2746	0.5941	0.3797	−3.099***
Reinsurance	0.2408	0.9911	0.3188	1.4126	0.2021	0.6902	2.727***
Foreign exchange risk	0.1557	0.2556	0.0814	0.1536	0.2439	0.3187	−3.936***

Notes: S.D. denotes standard deviation.
The equality test for means is performed using an independent samples *t*-test.
***, ** and * indicate statistical significance at the 0.01, 0.5 and 0.1 levels, respectively.

(c) *Tax convexity*: Following Adams *et al.*,[22] we measure this variable as the excess of marginal tax rate (=top rate if prior year's net operating loss =0 and current year's taxable income >0; =0 otherwise) over the annual effective tax rate (=total tax expense $\div$ annual taxable income).
(d) *Stock insurer*: We define the stock insurer variable as a dummy variable labelled 1 for a stock insurer and 0 for a mutual insurer.
(e) *Asset structure*: The asset structure variable is proxied by the ratio of cash to total admissible assets, the ratio of bonds to total admissible assets and the ratio of equities and other shares to total admissible assets.
(f) *Product mix*: The product mix variable is proxied by both the ratio of life insurance to total reserves and the ratio of pension insurance reserves to total reserves.
(g) *Reinsurance*: This variable is measured as the ratio of reinsurance premiums to gross written premiums.
(h) *Foreign exchange risk*: We measure the foreign exchange risk variable as the ratio of overseas premiums to total premiums.

Table 1 presents descriptive statistics for the variables. We also use a *t*-test to examine whether there is any difference in means between derivative users and non-users. The significance test results are also reported in Table 1. With the exception of the tax convexity variable, all other explanatory variables are statistically significant at the 0.01 level, indicating substantial differences in these firm attributes of the life offices that use derivatives and those that do not.

[22] Adams *et al.* (2008).

Methodology

We estimate probit regressions to distinguish among the possible motivations for derivative participation. The probit model takes the form:

$$P_{i,t} = F^{-1}\left(\mathbf{Z}_{i,j,t-1}\right), \tag{1}$$

where $P_{i,t}$ is the probability that insurer i in year t participates in derivative activities; $\mathbf{Z}_{i,j,t-1}$ is the vector of explanatory variables for insurer i in year $t-1$; j is the index of explanatory variables; F^{-1} is the inverse of the normal cumulative probability function.

Empirical results and robustness checks

Table 2 presents the results of probit regressions of a dichotomous variable representing derivative participation on the explanatory variables. The chi-squared test statistics for the overall statistical goodness-of-fit of the models are all significant at the 0.01 level, confirming that the fitted models are better than a null model without explanatory variables. The McFadden R-squared ranges from 0.21 to 0.30. All the hit ratios are more than 78 per cent, indicating a reasonable accuracy of estimated models.

Consistent with the bankruptcy costs theory, negative and significant coefficients are obtained on firm size, suggesting that smaller insurers are more likely to engage in

Table 2 Probit regressions for the period 1994–2008

Variable	*Expected sign*	*All derivative participation*	*Futures and contracts for difference participation*	*Options participation*
Constant		0.6757***	0.4557***	0.5908***
Firm size	+/–	–0.0028***	–0.0024***	–0.0040***
Solvency	–	0.0010***	0.0008***	0.0013***
Tax convexity	+	0.0002***	0.0002***	0.0001
Stock insurer	+/–	0.0388	0.0997	–0.1572
Cash	–	0.0004**	0.0005***	0.0003***
Bonds	+/–	0.0009***	0.0008***	0.0008***
Equities	+/–	0.0008***	0.0007***	0.0011***
Life insurance	+	0.0003**	0.0002*	0.0008***
Pension reserves	+	0.0012***	0.0010***	0.0015***
Reinsurance	+/–	0.0002*	0.0001	0.0003*
Foreign exchange risk	+	0.0005***	0.0006***	0.0008***
Number of observations		3,252	3,252	3,252
Chi-squared		976.0029	712.1464	866.1118
		[0.000]***	[0.000]***	[0.000]***
McFadden R-squared		0.26034	0.21071	0.29686
Hit ratio (%)		78.81	79.77	84.38

Notes: p-values are in brackets.
***, ** and * indicate statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

derivative transactions than larger firms. These results lend support to the view of Warner[13] that smaller firms have higher probability of bankruptcy (thus larger bankruptcy costs) and accordingly are more likely to participate in derivative activity.

Contrary to our prediction, we find that solvency has a significant and positive effect on the participation decision. This is probably due to the fact that insurers with lower solvency are not encouraged by the FSA to engage in derivative transactions because of the perception that such transactions are highly leveraged and thus a potential threat to insurer solvency.

The coefficients on the tax convexity variable are positive and highly significant in the all-derivative participation, and futures and contracts for difference participation models. This lends some support for the income volatility reduction argument that insurers facing convex tax schedules have incentives to hedge using derivatives.

The estimates of the stock insurer variable are mixed and insignificant across the models. Our data does not support either the managerial risk aversion or the managerial discretion hypotheses.

Inconsistent with our hypothesis, we find that the coefficients on the cash variable are positive and significant. This indicates that insurers with more cash holdings are more likely to engage in derivatives transactions. The coefficient estimates on the bonds and equities variables are also positive and significant, suggesting that firms with a higher proportion of assets in bonds and equities are more likely to use derivatives contracts. We explain this by the fact that, in the U.K., life insurers often write call options on shares that they own. Moreover, insurers with more bonds in their asset portfolios are likely to use interest rate derivatives to manage the interest rate risk.

With respect to the product mix variables, both measures for life insurance and pension reserves are positive and significant, indicating that liability structure is important in determining the use of derivatives.[11] These results suggest that insurers with higher levels of life insurance and pension reserve ratios tend to participate in derivative markets. This is possibly because life insurance and pension insurance are long term and highly exposed to the interest rate risk.

We document weak evidence that reinsurance exerts a positive impact on a life insurer's decision to use derivatives. This lends some support to the notion that derivative hedging is viewed as a complement, rather than a substitute, for reinsurance in the life insurance industry. This result also provides weak evidence that the insurer's use of reinsurance serves as a signal that an insurer is predisposed to hedging activity.[9]

As expected, foreign exchange risk is significantly positively related to the propensity to use derivatives across all models. This result lends support to the notion that insurers that are exposed to currency risk are more likely to use derivative instruments. Our finding is consistent with that of Hardwick and Adams.[5]

For robustness checks, we divide our sample period into two subperiods, 1994–2001 and 2002–2008. The unreported results generally paint a consistent picture, suggesting that our findings are robust. This also implies that the factors influencing the decision to use derivatives appear not to change from one period to another. We also use logit regression models to conduct the empirical analysis. The parameter estimates in the unreported results vary somewhat from those in the results we report here. However, the main tenor of the statistical test results remains unchanged.

Conclusion

This study examines the factors associated with the decision to employ derivatives in 329 U.K. life insurers. Using a sample of 3,252 firm-year observations for the period 1994–2008, we find that there is a steady trend towards using derivatives for risk management purposes in the U.K. life insurance industry. We also analyse the determinants of derivative participation. We find that the propensity to engage in derivative markets is positively related to solvency, asset structure (cash, bond, equity holdings), product mix (life insurance and pension reserves) and foreign exchange risk, whereas negatively related to insurer size. These results support the bankruptcy costs theory. Our findings suggest that greater currency exposure increases the need for derivative hedging. We also find considerable support for the notion that the insurer's asset structure and product mix have effects on the derivative participation decision. In addition, we find some support for the income volatility reduction argument that insurers facing convex tax schedules have incentives to hedge using derivatives.

Owing to data limitation, this paper identifies determinants of the decision to use derivatives rather than factors affecting the within-year derivative transactions or year-end derivative positions. The FSA statutory returns do not provide data on within-year derivative transactions. The year-end amounts reported are not a good measure of actual use of derivatives because year-end positions exclude derivatives positions taken and then closed out for window-dressing, regulatory or tax reasons.[23] Presumably, the amounts of derivative transactions during the year are much larger than those of transactions open at the end of the year. An interesting issue left for future work is thus what factors influence a life insurer's within-year derivative transactions. In addition, the future work may also seek to differentiate motivations for using derivatives by underlying asset (e.g., interest rate and currency derivatives).

Acknowledgement

I am grateful to the editor and an anonymous referee for helpful suggestions and comments.

References

Adams, M., Hardwick, P. and Zou, H. (2008) 'Reinsurance and corporate taxation in the United Kingdom life insurance industry', *Journal of Banking and Finance* 32(1): 101–115.
Adkins, L.C., Carter, D.A. and Simpson, W.G. (2007) 'Managerial incentives and the use of foreign-exchange derivatives by banks', *Journal of Financial Research* 30(3): 399–413.
Bartram, S.M., Brown, G.W. and Fehle, F.R. (2009) 'International evidence on financial derivatives usage', *Financial Management* 38(1): 185–206.
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. (1998) '1998 Wharton survey of financial risk management by US non-financial firms', *Financial Management* 27(4): 70–91.
Campbell, C.J., Goldberg, L. and Rai, A. (2003) 'The impact of the European Union insurance directives on insurance company stocks', *Journal of Risk and Insurance* 70(1): 125–167.

[23] Shiu and Moles (2010).

Carson, J.M. and Hoyt, R.E. (1995) 'Life insurer financial distress: Classification models and empirical evidence', *Journal of Risk and Insurance* 62(4): 764–775.
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(4): 649–671.
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(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(1): 51–91.
De Ceuster, M., Flanagan, L., Hodgson, A. and Tahir, M.I. (2003) 'Determinants of derivative usage in the life and general insurance industry: The Australian evidence', *Review of Pacific Basin Financial Markets* 6(4): 405–431.
Géczy, C., Minton, B.A. and Schrand, C. (1997) 'Why firms use currency derivatives', *Journal of Finance* 52(4): 1323–1354.
Hardwick, P. and Adams, M. (1999) 'The determinants of financial derivatives use in the United Kingdom life insurance industry', *Abacus* 35(2): 163–184.
Hoyt, R.E. (1989) 'Use of financial futures by life insurers', *Journal of Risk and Insurance* 56: 740–748.
Nance, D.R., Smith, C.W. and Smithson, C.W. (1993) 'On the determinants of corporate hedging', *Journal of Finance* 48(1): 267–284.
Philpott, J. (2009) *FSA Insurance Returns*, Edition 3.3, Ernst and Young LLP.
Shiu, Y.-M. and Moles, P. (2010) 'What motivates banks to use derivatives: Evidence from Taiwan', *Journal of Derivatives* 17(4): 67–78.
Sinkey, J.F. and Carter, D.A. (2000) 'Evidence on the financial characteristics of banks that do and do not use derivatives', *The Quarterly Review of Economics and Finance* 40(4): 431–449.
Smith, C.W. and Stulz, R.M. (1985) 'The determinants of firms' hedging policies', *Journal of Financial and Quantitative Analysis* 20(4): 391–405.
Studenmund, A.H. (2001) *Using Econometrics: A Practical Guide*, 4th Edition. New York: Addison Wesley Longman.
Swiss Reinsurance Company (2009) 'World insurance in 2008', *Sigma* 3: 1–45.
Wang, W.H. (2002) *Reinsurance Regulation: A Contemporary and Comparative Study*, 1st Edition. London: Kluwer Law International.
Warner, J.B. (1977) 'Bankruptcy costs: Some evidence', *Journal of Finance* 32(2): 337–347.
Whidbee, D.A. and Wohar, M. (1999) 'Derivative activities and managerial incentives in the banking industry', *Journal of Corporate Finance* 5(3): 251–276.
Wu, D. (1973) 'Alternative tests of independence between stochastic regressors and disturbances', *Econometrica* 41: 733–750.

About the Author

Yung-Ming Shiu teaches risk management and insurance in the Department of Risk Management and Insurance at National Chengchi University. Dr Shiu's research focuses on the areas of corporate hedging, risk management and isurance. His research has appeared in a number of scholarly and trade journals such as the *Journal of Risk and Insurance*, the *Journal of Futures Markets*, the *Annals of Actuarial Science*, and the *British Actuarial Journal*.