THE DETERMINANTS OF CORPORATE HEDGING*

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ABSTRACT

This study examined the determinants of corporate hedging based on samples taken from non-financial firms on the United Kingdom's Financial Times Stock Exchange FTSE 250. In this study, derivative usage is used as the proxy for risk management. The research model was estimated using the univariate binomial probit model and the Heckman two-stage regression model. The result indicates that executives with options on company's shares prefer risk-taking and choose not to hedge. The study also found that corporate hedging is positively related to (1) level of firms' leverage and (2) proportion of total turnover spent for interest payment. These results suggest that firms that face higher probability of financial distress are using derivatives as risk management tool to stabilised firms' cash flows. Finally, this study also found that large firms are more likely to use derivatives due to the benefits of economies of scale.

Keywords: corporate hedging, derivative, risk management, financial distress

INTRODUCTION

Berle and Means (1932) were amongst the first to suggest the notion of corporate ownership-control separation, which is typically found in today's corporations. Executives and managers (hereafter called 'agents') are hired to undertake almost all the management decisions on behalf of the shareholders (hereafter called 'principals') in return for monetary rewards. This relationship is known as an agency relationship and it is usually governed by an agency contract, which stipulates the conditions of the agency relationship.

For principals, an ideal contract (referred to as *first-best-efficient contract*) would be one that causes the agents to take most efficient actions and accept threshold wages. According to Besanko *et al*. (2000), this is difficult to achieve as it is subject to (1) information symmetry between the principals and the agents, (2) agents' effort is fully

observable, (3) the outcomes are fully detectable and quantifiable, and (4) the agents are at little risk. As a result, the agents would not always do what the principals desire and this conflict is discussed in agency theory (Fama, 1980; Fama and Jensen, 1983; Jensen and Meckling, 1976).

Agents may differ greatly from principals in their attitudes toward risks and such differentiation can lead to problems over the control of managerial risk-taking behaviour which differs from that of principal's wealth maximisation (Coffee, 1988; Gray and Cannella, 1997). Agents tend to be more risk-averse than principals and therefore, will invest in less risky projects. Some of the possible reasons are: (1) the principals are better diversified than the agents (Kilstrom and Laffont, 1979; Marcus, 1982; Clark and Varma, 1999); (2) agents avoid being fired (Amihud and Lev, 1981); and (3) agents act in self-interest behaviours (Boumal, 1959; Marris, 1963; Finkelstein and Hambrick, 1988). Cyert and March (1963) even suggested that the agents, instead of accepting risks, are working hard to avoid them.

Jensen and Meckling (1976) and Fama and Jensen (1983), among others, posit that agency problems resulting from risk-preference differentiation could be reduced if agents are given the right remuneration incentives. A well and appropriately designed remuneration system should be sufficiently attractive for agents to engage in highest possible net present value (NPV) projects at risks acceptable to the principals. Levinthal (1988) and Gibbons and Murphy (1990) argue that such remuneration contract should be contingent on the need to balance the agents' efforts and risk aversion and attractive to agents to take the effort to align their interests with those of the principals' without shifting too much risks and remuneration variability onto the agents. By linking remuneration package to firm performance, the principals are actually taking a compromise position by trading-off some potential returns for higher agents' efforts, hoping to achieve a win-win position for both parties. By offering profit-sharing schemes such as bonuses, share issues, and share options, agents will be enticed to exert productive effort by implementing and investing in more valuable projects as well as to induce them to assume more "good" risks.

The results of this study provided some support by linking agents' remuneration package to firm performance to reduce agency problems. Agents who have large amount of options on company's shares prefer risks and therefore, prefer less hedging. Firms at which these agents serve demonstrate a low level of corporate hedging; suggesting that they prefer volatility rather than stability. This finding is consistent with the remuneration theory. Share options – one of the components of agents' remuneration package – is designed to encourage agents to take more risks. Share options awarded to agents are in fact call options on firm shares. These options give agents the right to buy firm shares at predetermined prices and at predetermined future dates. Options are exercised only if they provide positive returns to owners. Since the value of call options are positively correlated to volatility, assuming more risks would mean agents have more opportunity to exercise their share options.

This study also provides two significant results based on the derivative theory. High-levered firms are found to use more derivatives. Due to their large debt repayment, these firms face higher expected costs of financial distress. To reduce the distress, they choose to hedge because hedging reduces the variability of cash flows and earnings and therefore, reduces the likelihood of incurring bankruptcy costs. Another significant result shows that larger firms prefer to hedge more. Compared to their smaller counterparts, large firms have more resources in setting up hedging unit and have the tendency to trade in higher volumes, therefore driving down transaction costs. In other words, larger firms hedge more because they enjoy cost advantage.

DATA AND METHODOLOGY

The sample is based on non-financial firms on the United Kingdom's FTSE 250. Sources of data included annual reports (2000), Datastream and FAME CD-ROM. New rules of the Financial Reporting Standard (FRS) 13 regulations in 1999 has made this study possible as all UK-listed firms are required to disclose their use of financial instruments. FRS 13–"Derivatives and other Financial Instrument: Disclosures"– published by the Accounting Standard Board on 24 September 1998, requires all companies that are listed in the UK to explain in their financial statements the role that financial instruments play in their funding. This includes describing any risks involved. The Turnbull Report (1999) provides a conceptual framework for such disclosure. Furthermore, in compliance with the Combined Code and as suggested by the Cadbury Report 1992, UK firms also enclose information on (1) establishment, membership and status of remuneration committees, (2) the determinants of remuneration policy for executive directors and other senior managers, and (3) the disclosure and approval of the details of the remuneration policy. Information pertaining to derivative usage and executive remuneration is published as part of the firm's annual report.

Dependent Variables

Mainly as income earner, an agent has more personal wealth invested in the firm than a principal. For most agents, working in the firm is their livelihoods that provide them with earnings. Their human capital (skills, knowledge and talents) is usually firm-specific and therefore, less diversified than the principals. According to the agency theory, rational agents would, therefore, put their interests on top of the principals', which is to secure their job position instead of striving for profit maximisation. One means of achieving this is through risk-management policies. According to Smith and Stulz (1985) and Campbell and Kracaw (1987), risk-management such as hedging activities can reduce undiversified risks borne by the agents. Hedging stabilises firms' cash flows and earnings, which reduces financial distress. Agents benefitted, as their job positions would be more secured.

Consistent with Smith and Stulz (1985), risk-management activities in this study will be measured by corporate hedging activities. Two variables are used to capture corporate use of derivatives. DERUSER, is a dichotomous variable, used to determine whether a firm hedges or otherwise. A hedger is coded as "1" and non-hedger as "0". DERLEVEL is used to capture the level of hedging which is measured by the fair values of the derivatives outstanding at the end of an accounting year, scaled by the market value of the firm's equity.

Independents Variables

Managerial Motives

Two major components of remuneration package, namely, ownership of shares and share options are used to examine whether remuneration components affect risk-management policies. In this study, the ownership by Chairman or CEO and executive directors would be treated separately. Therefore, four variables related to remuneration packages are examined.

CEOSHARE and EXESHARE are shareholdings for Chairman or CEO and executive director respectively. Based on the agency and derivative theories, agents who have more shares in firms in which they serve tend to be risk-averse and therefore, prefer to manage more risks. Hence, the first hypothesis is that both CEOSHARE and EXESHARE are positively related to corporate hedging.

The second pair of variables – CEOPTION and EXEOPT – represent the number of share options owned by Chairman or CEO and executive directors respectively. According to Smith and Stulz (1985), if the level of agents' share option is high, their income is a convex function of the firm's value. Share options awarded to agents is a performance-related component and can be thought of as call options on the value of the firm. As the owners of call options, agents benefit from price increases, but do not lose from price decreases. Agents could be better off if the firm does not hedge because the value of options would increase. Based on this, the more the option-like features are in the remuneration plans, the less the firm is exposed to hedging. Corporate hedging is therefore expected to be negatively correlated with CEOPTION and EXEOPT.

Tax-based Incentives

Smith and Stulz (1985) developed and formalised the tax-based incentive argument for corporate hedging. Under the tax-based incentive argument, they suggest that greater convexity of the tax schedule should lead to more hedging activity. Corporate hedging is also expected to show positive relationship with respect to the tax-preference items such

as tax loss carry forward (TLCF), tax shields, and tax credits. Graham and Smith (1999), Mayers and Smith (1982) and Smith and Stulz (1985) argue that convexity of corporate tax functions can serve as incentives for hedging because it can reduce the expected tax liability. Convexity of tax functions can be attributed by statutory progressivity, and other tax preference items such as tax loss carry forward and investment tax credit in the form of tax shields (Zimmerman, 1988). The convexity of tax function is positively correlated to the reduction in expected taxes (Nance *et al*., 1993). According to Mian (1996), if firms do not hedge their cash flows, the utilisation of the tax shields may be postponed to a later date, thereby reducing their present values. Thus, hedging increases the present values of tax shields by smoothing out corporate earnings.

This study uses two variables to capture the firm's tax-based incentives to hedging. First is a binary variable indicating whether a firm has tax loss carry forward. Firms with TLCF are coded as "1"; otherwise, coded as "0". Another variable measuring tax-based incentives for hedging is the percentage of tax payable to the total revenue (TAXREV). Tax payable refers to the total tax liability for the accounting year while total revenue is the sum of all revenues. This study hypothesises that both TLCF and TAXREV would be positively related to risk-management activities such as hedging.

Expected Costs of Financial Distress

Smith and Stulz (1985) argue that by reducing the probability of financial distress, hedging can increase the expected value of firm. Their model suggests that the level of hedging is positively correlated with the expected costs of financial distress. Hence, a firm that faces a high level of financial distress is expected to have more hedging, and vice-versa. When a firm hedges, it is reducing the variability of its value and therefore, reduces the likelihood of incurring bankruptcy costs. The decrease in expected bankruptcy costs benefits claimholders because the transaction costs of bankruptcy is deducted from total firm value in the event of bankruptcy. Firms with a lower level of bankruptcy costs usually enjoy cheaper and higher capacity of external financing (either equity or debt).

Three metrical variables are employed to examine whether the costs of financial distress affect hedging activities. The first is current ratio (CURRATIO), which is the ratio of total current assets to total current liabilities. Based on the derivative theory, the level of liquidity is negatively correlated to hedging activities. The first hypothesis under the expected costs of financial distress argument predicts that hedging activities are negatively correlated with CURRATIO.

The second variable used to investigate the relationship between hedging activities and firm's expected costs of financial distress is leverage (LEVERAGE). LEVERAGE is the percentage of book value of total debt over the market value of the firm's equity. It is expected that high-leveraged firm tend to face higher risks of insolvency than low-

leveraged firm. When leverage is high, each unit of the firm's equity is worth less because creditors have larger proportion of claim to the firm's asset. Investors and lenders would demand higher return or interest for investing or lending because they are facing higher risks. This exerts more pressure for the firm to perform and therefore, resulting in higher financial distress. When a firm hedges, it is reducing the variability of its cash flows and earnings and therefore, reduces the likelihood of incurring bankruptcy costs. The decrease in expected bankruptcy costs benefits claimholders. Based on the argument, this study predicts a positive relationship between derivative usage and leverage.

The third variable used to measure the magnitude of a firm's expected costs of financial distress is the percentage of interest payment over a firm's total revenue (INTREV). INTREV gives an approximation of the safety margin a firm has in meeting its fixed obligations to its short- and long-term debts. Firms with low INTREV values are expected to have less financial distress and therefore, are less likely to use hedging instruments. This is because firms with low INTREV are expected to be in a stronger position to meet debt repayment and lenders are less likely to take legal actions that could lead to bankruptcy. So, the final hypothesis using the financial distress argument predicts that corporate hedging is positively related to INTREV.

Expected Cost of External Financing and Economies of Scale

The size of a firm (FIRMSIZE) is used to examine the influence of the expected costs of external financing and scale economies on corporate hedging. More specifically, this study is interested to find out which one of the two factors is more influential on hedging policy. FIRMSIZE is hereby defined as the logarithm of the sum of market value of a firm's equity, book value of debt, and book value of preference shares.

Froot *et al*. (1993) argues that the expected cost of external financing could provide incentive for firm to hedge. They argue that transaction costs due to information asymmetries are higher for small firms. Small firms would avoid having to seek costly external financing. Alternatively, they prefer alternative means of financing such as hedging to finance some of its activities, particularly related to risk. On the other hand, Froot *et al*. (1993) posit that large firms have cheaper sources of external funds and therefore, are less likely to hedge. These firms prefer external financing because their shares are actively traded and they regularly engage in borrowing activities. Information on large firms is widely disseminated across the capital markets, resulting in less problems associated with information asymmetry. And since investors and lenders have better knowledge about the prospects and risk positions of large firms, they would demand appropriate level of return or interest.

Contrary to Froot *et al*. (1993), literatures based on economies of scale posit large firms are more likely to hedge than small firms. Large firms have more resources in

setting up hedging unit and have the tendency to transact in large volumes, thus driving down the average costs. Few authors, including Mian (1996) and Nance *et al.* (1993), have presented evidence supporting the notion that economies of scale affect hedging policy. Since there are two conflicting expectations for FIRMSIZE, the study is unable to predict an appropriate sign. If economies of scale were more influential in corporate hedging, the estimated coefficient would have a positive value. However, if the cost of raising external capital was more dominant, then the estimated coefficient would be negative. For reference, Table 1 provides a summary of all the hypotheses to be tested in the study.

Table 1 Hypothesised relations between selected variables and corporate hedging

Hypothesis	Variable	Predicted Relationship	Variable Description
MANAGERIAL MOTIVES	CEOSHARE	Positive	Number of shares owned
	EXESHARE	Positive	by agents.
	CEOPTION	Negative	Number of share options
	EXEOPT	Negative	owned by agents.
TAX-BASED MOTIVES	TLCF	Positive	Binary variable used to distinguish firm that has TLCF or otherwise.
	TAXREV	Positive	Percentage of tax payable to total revenue.
FINANCIAL DISTRESS	CURRATIO	Negative	Percentage of current assets to current liabilities. It measures firm liquidity.
	LEVERAGE	Positive	Total debt scaled by firm size. The ratio is converted to percentage.
	INTREV	Positive	Percentage of total interest payment to total revenue.
COST OF EXTERNAL FINANCING/ SCALE ECONOMIES	FIRMSIZE	Indetermined	Logarithm of sum of market value of equity, book value of debt and book value of preference shares.

Testing Model

Regression model of the following formulation is employed in this study.

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \lambda$$

Where Y = Dependent variable
X_n = Independent variable
α = Constant (Intercept)
β_n = Regression coefficient
λ = Residual

In order to determine the significance of the regression model, this study test the null hypothesis (H_0):

$$H_0: \beta_1 = \beta_2 = \ldots = \beta_n = 0$$

Versus alternative hypothesis (H_1):

H_1: Not all the regression coefficients are simultaneously zero.

Not all firms in the sample (as well as the actual populations) however, use derivatives. The sample population is divided into two groups. First is the hedger (DERUSER = 1), in which information on the regressors (independent variables) as well as the regressand (level of hedging) is available. The other group is non-hedger (DERUSER = 0), in which only information on the regressors is available. If this study is estimated using the probit model alone, it is testing only on the subset of the samples. In this case, only DERUSER = 1 is observed. Information on non-hedgers will not be observed. The consequences can be very serious because the OLS estimates of the parameters obtained from the subset (hedgers) observations will be biased and inconsistent.

To minimise the aforesaid problem, this study uses the Heckman two-step selection regression model. It is an extension of the probit model. The first stage of the Heckman process estimates the expected value of the error term based on the whole population of the sample. DERUSER is treated as the regressand and the explanatory variables as regressors. The second stage reruns the regression with the estimated expected error term (from the first stage) as an extra explanatory variable. In the second stage, the regressand is DERLEVEL.

The first stage of the study model can be expressed as:

$$\text{DERUSER} = \alpha_0 + \alpha_1 \text{TLCF} + \alpha_2 \text{TAXREV} + \alpha_3 \text{FIRMSIZE} + \alpha_4 \text{CURRATIO} + \alpha_5 \text{INTREV} + \alpha_6 \text{LEVERAGE} + \alpha_7 \text{CEOSHARE} + \alpha_8 \text{CEOPTION} + \alpha_9 \text{EXESHARE} + \alpha_{10} \text{EXEOPT} + \varepsilon$$

Where, α_0, α_1, … α_{10} are the parameters to be estimated and ε is a disturbance term assumed to be normally distributed with zero mean and a constant equal to one.

In the second stage of the regression, the expression is:

$$\text{DERLEVEL} = \beta_0 + \beta_1\text{TLCF} + \beta_2\text{TAXREV} + \beta_3\text{FIRMSIZE} + \beta_4\text{CURRATIO} + \beta_5\text{INTREV} + \beta_6\text{LEVERAGE} + \beta_7\text{CEOSHARE} + \beta_8\text{CEOPTION} + \beta_9\text{EXESHARE} + \beta_{10}\text{EXEOPT} + \beta_{11}\text{IMR} + \mu$$

Where, IMR is the inverse Mills ratio derived from the first-stage expression. The error term μ is assumed to have an expected value of zero and a constant variance. β_0, β_1 … β_{11} are parameters to be estimated.

RESULTS AND DISCUSSIONS

Table 2 shows a Pearson correlation matrix for all variables. It can be seen from the table that DERUSER is positively correlated with FIRMSIZE (significant at the 0.05 level) and CEOSHARE (significant at the 0.10 level). DERUSER is negatively correlated with CURRATIO (significant at 0.05 level), CEOPTION (significant at 0.10 the level) and EXEOPT (significant at the 0.10 level). These preliminary results are consistent with research predictions. An interesting finding from the bivariate analysis is the significant and positive correlation between DERUSER and FIRMSIZE. This seems to suggest that scale-economies are more influential in hedging policies compared to costs of external financing. The correlations of tax-based variables with DERUSER signal-mixed results. As expected, there was positive correlation (insignificant) between DERUSER and TLCF. Although this study also predicts positive correlation between DERUSER and TAXREV, the result shows otherwise. The bivariate coefficients between DERUSER and proxies of financial distress also show mixed results.

Table 2 Pearson correlation coefficients

	DERUSER	DERLEVEL	TLCF	TAXREV	FIRMSIZE	CURRATIO	INTREV	LEVERAGE	CEOSHARE	CEOPTION	EXESHARE
TLCF	0.129	−0.045	1								
TAXREV	−0.23	−0.25	**−0.255**	1							
FIRMSIZE	**0.173**	0.071	0.056	0.073	1						
CURRATIO	**−0.257**	−0.142	0.05	0.029	−0.131	1					
INTREV	−0.027	0.221	**0.202***	0.117	−0.001	−0.106	1				
LEVERAGE	0.034	**0.232***	0.087	**−0.246**	−0.154	**−0.338***	0.174	1			
CEOSHARE	**0.176***	**0.212***	−0.061	0.063	−0.231	0.097	−0.192	−0.017	1		
CEOPTION	**−0.186***	−0.072	0.126	0.001	**−0.336***	0.045	0.051	−0.062	**−0.478***	1	
EXESHARE	0.053	−0.18	−0.094	0.138	0.007	0.184	−0.164	−0.234	**0.516***	**−0.308**	1
EXEOPT	**−0.186***	**−0.041***	−0.009	0.025	0.208	−0.168	−0.054	−0.004	**−0.254**	**0.535**	**−0.44***

** = Significant at 0.05 level (two-tailed test), * = Significant at 0.10 level (two-tailed test)

Also provided in Table 2 are correlations between explanatory variables and DERLEVEL. Surprisingly, both of the tax-based variables show unexpected signs. They are negatively (although insignificant) correlated with DERLEVEL. FIRMSIZE is positively correlated (insignificant) with DERLEVEL. All the variables used to capture the level of financial distress have expected sign but only one is significant, namely, LEVERAGE (at the 0.10 level). Both of the variables measuring share options ownership, CEOPTION (insignificant) and EXEOPT (significant at 0.10 level), are negatively correlated to DERLEVEL. Interestingly, the correlations between the proxies of executive shares ownership (CEOSHARE and EXESHARE) and DERLEVEL are mixed. One must be reminded that although some results in Table 2 show the dependent variables are significantly correlated to certain independent variables, these relationships are based on bivariate basis and thus it is too early to draw any conclusions.

Table 3 R-squared and variance inflation factors

Independent Variable	R^2	VIFs
TLCF	0.187	1.23
TAXREV	0.208	1.26
FIRMSIZE	0.204	1.26
CURRATIO	0.215	1.27
INTREV	0.187	1.23
LEVERAGE	0.291	1.41
CEOSHARE	0.441	1.79
CEOPTION	0.481	1.93
EXESHARE	0.459	1.85
EXEOPT	0.443	1.80

In order to confirm that the research model is free from multicollinearity problem, each independent variable is regressed in turn against all other independent variables. Using the R^2 value of each regression, the variance-inflation-factors (VIFs) are computed using the formula $1/(1 - R^2)$. The results of the computation are provided in Table 3. It can be seen from the table that all VIFs are below the value of 2.0, thus confirming that the research model is free from multicollinearity problem.[1]

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[1] This method of detecting multicollinearity was recommended by Belsley *et al*. (1980) and well-documented in econometric text [e.g., Greene (1997) and Kennedy (1998)]. As a rule of thumb, for standardised data, a VIF > 10 indicates harmful collinearity (Kennedy, 1998).

Regression Results

Before the regression results are presented, one must exercise caution in interpreting the results for several reasons. First, there may be problem related to endogeneity. As hedging can be part of financing policy, the hedging decision may be determined simultaneously with other financing policy such as debt and equity structure. Second, the sample population is relatively small and third, there is uneven distribution of users and non-users of derivatives. With this caveat, the remaining section reports the result of the regression model.

Table 4 Univariate binomial probit model regression results

Test statistics:		$X^2 = 19.02$	F statistic = 0.0372	
		Pseudo-R^2 = 0.61		
Variable	**Parameters**	**Coefficient**	**T-Ratio**	**P-Value**
Intercept	α_0	**−24.32***	−1.65	**0.0891**
TLCF	α_1	0.608	0.82	0.4123
TAXREV	α_2	−0.06	−0.901	0.3677
FIRMSIZE	α_3	**2.23****	1.841	**0.041**
CURRATIO	α_4	−0.005	−1.376	0.169
INTREV	α_5	−0.067	−0.795	0.427
LEVERAGE	α_6	−0.003	−0.251	0.802
CEOSHARE	α_7	−0.003	−0.142	0.887
CEOPTION	α_8	−0.008	−0.431	0.666
EXESHARE	α_9	−0.021	−1.217	0.224
EXEOPT	α_{10}	0.011	0.431	0.666

** = Significant different from zero at 0.05 level (one-tailed test)
* = Significant different from zero at 0.10 level (one-tailed test)

The regression results are divided into two main parts. The first part will discuss results generated by the univariate binomial probit model, in which all the independent variables are regressed against DERUSER. The parameter estimates from the first stage probit model are provided in Table 4. Overall, the regression model is significant at the 0.05 level, with p-value (F statistic) of 0.0372. The significance is confirmed by the χ^2 statistics. The critical value of χ^2 statistics with degree of freedom of 10 at the 0.05 level (one-tailed test) is 18.31. The estimated χ^2 value of the model is 19.02. It lies outside the critical limits. The values of F statistic and χ^2 statistics provide confirmation that the data used in this model do not support the H_0. With the rejection of H_0, it is hereby concluded that at least of one the estimated parameters of the univariate binomial probit model is not a zero.

It can be seen from Table 4 that not all of the correlation coefficients carry expected signs. In fact, only three of the estimated coefficients have expected signs. They are α_1 (the coefficient of TLCF), α_4 (the coefficient of CURRATIO), and α_8 (the coefficient of CEOPTION). Two estimates are significant. They are α_0 (the intercept) and α_3 (the coefficient of FIRMSIZE) at 0.10 level and 0.05 level respectively.

Table 5 illustrates a cross-tabulation of the actual and predicted outcomes of the binary independent variable. Overall, 93.75 per cent of the observations are predicted correctly. The model correctly predicts 96 out of the 112 sampled populations. Of the user of derivatives, 96 out of 99 (96.97 per cent) are correctly predicted while for non-user of derivatives, 9 out of 13 (69.23 per cent) are correctly predicted.[2]

Table 5 Cross-tabulation of the actual and predicted outcomes

Actual	Predicted		Total
	Non-user	User	
Non-user	9	4	13
User	3	96	99
Totals	12	100	112

The results of the second stage of the Heckman regression are provided in Table 6. The overall model is significant at the 0.05 level (reflected by F statistic of 0.0379). Less than 25 per cent of the variation in DERLEVEL is explained by the independent variables (reflected in an R^2 of 0.2341). The level of multicollinearity is acceptable as only 23.41 per cent of the variance of DERLEVEL is captured by other independent variables (tolerance level of 0.7659) and the VIF confirms it.[3] Four estimates are significant at least at the 0.10 level. They are β_3 (the coefficient of FIRMSIZE at 0.05 level), β_6 (the coefficient of LEVERAGE at 0.01 level), β_8 (the coefficient of CEOPTION at 0.05 level), and β_{10} (the coefficient of EXEOPT at 0.10 level). The remaining coefficients do not provide significant relationship with the dependent variable DERLEVEL.

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[2] However, it is sensible to treat these outcome-based measures with caution as they are typically unreliable in practical situations where one of the two states of the world are sparsely represented in the data.

[3] Computation of VIF and tolerance:
$$VIF = (1/(1 - R^2)$$
$$= 1/(1 - 0.2341)$$
$$= 1.31$$

$$Tolerance = 1/VIF$$
$$= 1/1.31$$
$$= 0.7659$$

Implications of Regression Results

Results from the probit model do not provide support for the managerial motives hypothesis. The Heckman regression model, however, shows evidence to support that those agents who have share options prefer to take risks rather than to hedge. This finding is consistent with Petersen and Thiagarajan's (2000) and Tufano's (1996), suggesting that the agents' motives do affect corporate hedging. However, it is inconsistent with Berkman and Bradbury's (1996) results for New Zealand, Jalilvand's (1999) results for Canada, and Howton and Perfect's (1998) and Mian's (1996) results for the US. Nevertheless, some differences between this study and earlier ones are worth mentioning. The differences lie in the aspect of sampled populations. Tufano (1996) used sample population exclusively from the gold mining firms. His evidence, therefore, herald one empirical question: Can it be extended to other sectors of an economy? This study [and those conducted by Berkman and Bradbury (1996), Jalilvand (1999), Howton and Perfect (1998), and Mian (1996)] is based on samples across the industries, except (at least in this study) firms in the financial sector. Petersen and Thiagarajan's (2000) results are based only on two firms, one each for non-user and user of derivatives. Their results therefore, encounter the risks of "overfitting" (too specific to the sample and lack of generalability).

Table 6 Heckman two-stage model regression results

	Test statistics:	Mean = 0.89 (DERLEVEL)	R^2 = 0.2341	
		Std. Dev. = 1.73 (DERLEVEL)	F statistic = .0379	

Variable	Parameters	Coefficient	T-Ratio	P-Value
Intercept	β_0	−0.906	−0.11	0.9121
TLCF	β_1	−0.56	−1.051	0.2932
TAXREV	β_2	−0.025	−0.344	0.7306
FIRMSIZE	β_3	**0.165****	0.193	**0.0473**
CURRATIO	β_4	0.004	0.922	0.3566
INTREV	β_5	0.067	1.603	0.109
LEVERAGE	β_6	**0.116*****	2.386	**0.0072**
CEOSHARE	β_7	−0.012	−1.018	0.3089
CEOPTION	β_8	**−0.029****	−1.816	**0.0361**
EXESHARE	β_9	0.002	0.126	0.9001
EXEOPT	β_{10}	**−0.084***	0.311	**0.0583**
IMR	β_{11}	−1.318	−0.699	0.4845

*** = Significant different from zero at 0.01 level (one-tailed test)
** = Significant different from zero at 0.05 level (one-tailed test)
* = Significant different from zero at 0.10 level (one-tailed test)

Both results from the univariate probit model and the Heckman regression model provide no support for the importance of tax-based incentives on corporate hedging policies, suggesting that corporate hedging policies in the UK are not influenced by tax-based incentives. This finding is inconsistent with derivatives theory and evidence provided by Nance *et al*.'s (1993) results for the US and Berkman and Bradbury's (1996) results for New Zealand. The finding of this study however, is consistent with Jalilvand (1999) and Mian (1996).

The univariate probit model does not provide supporting evidence to link corporate hedging and the firms' level of financial distress. All three estimated coefficients are not significantly related to DERUSER, meaning that financial distress variables provide no explanation whether a firm is user or non-user of derivatives.

In the Heckman regression model, two out of the three estimated coefficients have predicted sign, namely β_5 (the coefficient of INTREV) and β_6 (the coefficients of LEVERAGE). Meanwhile, the estimated coefficient of CURRATIO, β_4, is a positive, which is contrary to prediction. The coefficient of LEVERAGE, β_6, is significant at the 0.01 level (one-tailed test, with p-value of 0.0072 and t-ratio of 2.386). The coefficient of INTREV, β_4, is fairly significant at the 0.10 level (p-value of 0.109 and t-ratio of 1.603, one-tailed test). The results suggest that high-levered firms in the UK hedge more than low-levered firms. Also to certain extent, firms that spend larger portion of total revenue for interest payments tend to hedge more than firms that are otherwise.

Although not robust, this finding provides some support to the derivatives model developed by Mayers and Smith (1982) and Smith and Stulz (1985). It is also consistent with evidence provided by Berkman and Bradbury (1996) and Nance *et al*. (1993). It is however, inconsistent with Jalilvand (1999) and Mian (1996) who found no evidence to relate corporate hedging and expected costs of financial distress.

It can be seen from the results of probit model in Table 4 that α_3 (coefficient of FIRMSIZE) has a positive value of 2.23. It is significant at the 0.05 level (one-tailed test), with t-ratio and p-value of 1.841 and 0.041 respectively. This result indicates that large firms are likely to use derivatives, therefore suggesting that economies of scale has more influence on corporate hedging decisions. Results from the Heckman regression in Table 6 shows that larger firms are engaging in more hedging activities than their smaller counterparts. The coefficient of FIRMSIZE, β_3 has a positive value of 0.165 and it is significant at the 0.05 level (t-ratio = 0.193; p-value = 0.0473). It suggests that cost advantage plays an important role in corporate hedging policies.

CONCLUSIONS

Agents are duty-bound and supposed to find and invest in highest available NPV projects. However, given their effort-averse and risk-averse nature, agents may act otherwise.

This can be due to the fact that finding and implementing investments in truly valuable projects is of high effort, with high-pressure activities and usually involve higher risks. Their inclination to engage on actions not preferred by the principals may be reinforced if the agents are paid fixed salary. If the agents have no share in the upside of risky projects, then safe ones, from their point of view, are better. Given the positive relationship between risks and returns, safe investments are not always in the best interest of the principals.

This study provides supporting evidence that incentive remuneration package, to a certain extent, can align the interests of the principals and the agents. The role of such contract is to make the agents to have financial interest to improve firm performance for short and long terms. By including bonuses, shares, and share options in the remuneration package, the agents may become less risk-averse and induced to implement more truly valuable investment projects. It should be reminded that designing an appropriate remuneration package is not easy. When the agents are rewarded when returns exceed target, but they are not penalised for investment failures, they would put forward dubious projects with no real value potential. Notwithstanding, discussion on remuneration design is beyond the scope of this study.

As for firm size, the result is consistent with the economies of scale arguments. Large firms not only prefer hedging, they also tend to hedge more. Other than reasons linked to cost advantages, large firms prefer hedging because they usually have higher exposure to risks. They would seek for more sophisticated risk management tools such as derivatives. As hedging is dynamic and complicated in nature, large firms can afford to spend more resources to set up a proper hedging unit. Few authors, including Mian (1996) and Nance *et al*. (1993), have presented evidence supporting this strand of arguments.

Finally, there is evidence to link corporate hedging with the level of financial distress facing firms. High-levered firms turn to hedging because it would remove some uncertainties in cash flows. Stability brought by hedging not only provides some relief to the management, but would please some creditors. Instead of spending more time to worry about instability in cash flows, the management could utilise this valuable time to seek more "good-risk" investments.

Although the study reveals some interesting results, it is by no means a definitive text. Any conclusions drawn from the sample are very tentative and they need to be confirmed by a more comprehensive study. One must exercise care while interpreting the results because this study is constrained by limitations. Data limitation had been identified as one because UK firms were only required to reveal information on derivative usage in 1999. As we move further into the future, more data of its kind will be available and future researchers in this area may use larger data size to provide more robust evidence. Another possible limitation is in choosing the optimum number and mix of explanatory variables because the determinants of corporate use of derivatives are still unclear. Moreover, too many variables are not viable because of potential collinearity and endogeneity problems.

Having made the assertions with regards to limitations and further research, it is the opinion of the authors that this topic remains an important area both for academicians and corporate professionals. It would be interesting to observe should further studies emerge in the near future.

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