Why Firms in the UK Use Interest Rate Derivatives

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Abstract

Evidence reported by Geczy, Minton and Schrand (1997) showed that foreign exchange risk had a significant influence on the use of currency derivatives but that interest cover and financial leverage did not. In this study, we suggest that the reason why foreign exchange risk was significant but interest cover and financial leverage were not significant in the evidence was because currency derivatives were used to measure the dependent variable. We verify the validity of this suggestion by testing the influence of interest cover and financial leverage on the use of interest rate derivatives. Our sample comprises 140 firms in the UK, 48 of which use interest rate derivatives. Evidence observed shows that interest cover and financial leverage have a significant influence on the use of interest rate derivatives and that foreign exchange risk does not.

We also compare the previous evidence referred to above with our results to determine whether there is a difference between the factors that motivate firms to use currency derivatives or interest rate derivatives. The result of the comparison indicates that dependence on overseas product and capital markets, tax, institutional shareholding and economies of scale are the factors that motivate firms to use currency derivatives. The result also indicates that high interest cover (i.e. interest/profit before interest and tax) or total debt ratio, economies of scale and directors' shareholding are the factors that motivate firms to use interest rate derivatives.

Keywords: Expected cost of financial distress; the risk of financial distress; hedging; interest rate derivatives.

I. Introduction

This study tests the influence of interest cover (interest/profit before interest and tax) and financial leverage (total debt/total assets) on the use of interest rate derivatives by firms in the UK. The objective of the study is to assess the validity of the theoretical suggestion that firms use derivatives because they want to reduce their expected costs of financial distress and enhance their market values (Smith and Stulz, 1985, SS). Previous studies suggest that risk of financial distress is the main driver of expected cost of financial distress (Haugen and Senbet, 1978 and Altman, 1984). Therefore, if the suggestion that firms use derivatives because they want to reduce their expected costs of financial distress is valid, there should be an empirical relationship between the use of interest rate derivatives and the proxies for the risk of financial distress, such as interest cover and financial leverage.

The reason for focusing on interest rate derivatives is that they are the appropriate instruments for testing the prediction that the risk of financial distress is a determinant of the use of derivatives. Although, in principle, firms can use other types of derivatives to

hedge the risk of financial distress (e.g. equity derivatives), the report of a previous study by Grant and Marshall (1997, GM) leads us to believe that this is not common. GM remarked that -

> 'The vast majority of UK companies use derivatives to manage the traditional financial price risks of foreign exchange and interest rate risk, ... Relatively few respondents use either equity derivatives to manage the risks arising from their capital structure, or commodity derivatives to manage their commercial exposures.'
>
> (Grant and Marshall, 1997, p. 195).

However, GM did not state the types of derivatives that the companies used to hedge foreign exchange and interest rate risks, and they did not test the influence of the risk of financial distress on the use of interest rate derivatives. One of the purposes of this study is to bridge these gaps.

Another purpose of the study is to identify the factors that motivate firms to use interest rate derivatives and compare the factors with those that motivate them to use currency derivatives. Previous evidence reported by Geczy, Minton and Schrand (1997, GEMS) indicates that exposure to foreign exchange risk (represented by proxies for dependence on overseas product and capital markets) was one of the factors that motivated firms to use currency derivatives and that interest cover and financial leverage did not have a significant influence on the use of the instruments. While the evidence is useful for identifying the factors that motivate firms to use currency derivatives, it is of little use for identifying the factors that motivate firms to use interest rate derivatives. We are of the view that interest cover and financial leverage were not significant in the previous evidence because currency derivatives were used to measure the dependent variable employed in the study. The result of a test of the influence of interest cover and financial leverage on the use of interest rate derivatives will be more appropriate than the previous evidence for assessing the effect of the variables on the use of derivatives. The result of the test will also be useful for determining whether the factors which motivate firms to use currency derivatives are different from those which motivate them to use interest rate derivatives.

Our results give overwhelming support to the hypothesis that the risk of financial distress has a positive influence on the use of interest rate derivatives. We found that firms which had relatively high values of interest cover or financial leverage were more likely to use interest rate derivatives. The results also indicate that economies of scale have a positive influence, and that managerial risk aversion has a negative influence, on the use of interest rate derivatives. It also appears from the results that foreign exchange risk, dividend payout ratio, liquidity, institutional share ownership, expected growth, tax rate, industry classification and the existence of hybrid securities, such as preference shares and convertible loans, do not have a significant influence on the use of the instruments.

In comparison with the previous evidence relating to the use of currency derivatives, the results of this study suggest that there is a difference between the factors that motivate firms to use currency derivatives or interest rate derivatives. It appears that the factors that motivate firms to use currency derivatives are foreign exchange risk arising from dependence on overseas product or capital markets, tax, institutional shareholding and economies of scale. Whereas, the factors that motivate firms to use interest rate de-

rivatives seem to be high interest cover or total debt ratio, economies of scale and directors' shareholding.

The remainder of this article is organised as follows. In section II, we present a brief discussion of the previous studies. This is followed in section III by data description and definition of variables. The results of the study are presented in section IV, followed by a comparison of the factors that influence the use of currency and interest rate derivatives in section V. The study is concluded in section VI.

II. Previous Studies

SS suggest that firms can use derivatives to reduce expected tax payments and the risk of financial distress. This suggestion implies that derivatives can be used to enhance firm value. The suggestion also implies that expected tax payments and the risk of financial distress should have a positive influence on the use of derivatives. Froot, Scharfstein and Stein (1993, FSS) suggest that derivatives can be used to reduce the underinvestment problem identified by Myers (1977). Contrary to the suggestion of Myers (1977) that firms should not use growth opportunities to support debt, FSS suggest that firms can use debt to finance growth opportunities, realise the tax advantage of debt and use derivatives to reduce the risk of financial distress and the agency problem that may arise from the use of debt.

In addition to the variables that derivatives can be used to control, such as expected tax payments, the risk of financial distress and the underinvestment problem, previous studies have also identified variables that may have an influence on the use of derivatives. Booth, Smith and Stolz (1984) and Block and Gallagher (1986), among others, suggest that size has a positive influence on the use of derivatives because there are economies of scale in the use of the instruments. SS imply that the proportion of the shares of a firm owned by its managers or directors may have a positive influence on the use of derivatives because share ownership may give managers/directors the incentive to take risks and hedge the risks with derivatives. SS further imply that managers have a vested interest in corporate risk management because they cannot diversify their claims on the assets of the firm in the same way as shareholders. It is argued that even though managers can use derivatives on their own account to hedge the risk of their claims on the assets of the firm, this will be seen as a second best strategy because the financial cost of such a strategy will be borne directly by them. Whereas, the financial costs of derivatives used by firms will be borne mainly by shareholders.

Nance, Smith and Smithson (1993, NSS) as well as Berkman and Bradbury (1996, BB) suggest that the use of convertible loans and preference shares will reduce the need to use derivatives because convertible loans and preference shares do not generate the underinvestment problem associated with the use of straight debt. NSS and BB also suggest that dividend payout will have a positive influence on the use of derivatives because of the reluctance to cut dividends and the implication of dividend payments for debt financing. They imply that the degree of liquidity of the assets of a firm will affect its extent of use of derivatives because there is an inverse relationship between liquidity and risk. It is also implied that the nature of the operations of a firm (e.g. its industry) and the degree of exposure of the firm to foreign exchange risk will affect its overall risk profile and have an influence on its degree of use of derivatives. DeMarzo and Duffie (1991) predict that information asymmetry has a positive influence on the use of derivatives because hedg-

ing can benefit shareholders if managers have private information about unobservable risks of the cash flows of the firm.

The results of the previous tests of the suggestions stated above are contradictory. NSS found that while tax losses and growth opportunities had a significant influence on the use of derivatives in the US, interest cover and financial leverage did not. Therefore, their evidence is not consistent with the suggestion that derivatives are used to reduce expected cost of financial distress, although the evidence is consistent with the notion that derivatives are used to reduce expected tax payments and the underinvestment problem.

However, unlike NSS, Tufano (1996, PT) found evidence that derivatives were used to reduce the expected cost of financial distress. The evidence also indicates that expected tax payments did not have a significant influence on the use of derivatives (see Tufano, 1996, Table V, p. 1116). Similarly, GEMS found that while growth opportunities had a significant influence on the use of currency derivatives in the US, tax losses, interest cover and financial leverage did not[1]. They also found that currency risk (represented by the ratio of overseas sales to total sales and/or the use of foreign loans) had a significant influence on the use of currency derivatives in the US.

As in some other areas of financial research, few previous studies have tested the suggestions stated above on data of firms outside the US. Indeed, we are aware of only one such study. The study, reported by BB, used data of firms in New Zealand. BB found that tax losses, interest cover and financial leverage were significant[2], but that currency risk was not. However, the measure of currency risk used by BB was different from the one used by GEMS. BB represented currency risk by the ratio of overseas assets to total assets.

As regards the variables that can influence the use of derivatives, previous studies in general found that size had a positive influence, and that liquidity had a negative influence, on the use of derivatives. The studies also found that the influence of dividend payout, information asymmetry and managerial risk aversion on the use of derivatives was mixed, and that the influence of alternative financing instruments and industry classification was not significant.

The contradictions in the previous evidence cast doubt on the empirical validity of the theoretical explanations for the use of derivatives. However, it appears that a large part of the contradictions arise from differences in the sampling method and the dependent variables used. GEMS observed that all the previous US studies used either 'broad but unrestricted samples' (e.g. NSS) or 'industry-specific samples' (e.g. PT) - see Geczy, Minton and Schrand, 1997, p. 1325. The problem with a broad but unrestricted sample is that it may be too noisy and therefore be biased against the hypothesis being tested. Similarly, the problem with an industry-specific sample is that it may not have sufficient variation for an adequate test of the influence of firm characteristics on the use of derivatives. Therefore, these defects could have accounted for part of the contradictions in the previous evidence. Apart from sampling inadequacies, we think that the dependent variables used in some of the previous studies did not have a clear focus, and that this too could have caused some contradictions in their evidence.

For instance, none of the evidence reported by the previous studies is suitable for assessing the empirical validity of the theoretical suggestion that the risk of financial dis-

tress has a positive influence on the use of derivatives. To illustrate, the dependent variable used by NSS was a dummy variable which was assigned a value of 1, if a firm used any type of derivatives, or a value of 0 otherwise. This variable is not suitable for the test of the hypothesis stated above because it is too broad. The value of the variable would be 1 not only for firms which used derivatives to hedge the risk of financial distress but also for firms which used other types of derivatives to hedge other types of risks (such as currency derivatives to hedge foreign exchange risk, etc).

The same criticism applies to the dependent variable used by BB, which was measured by the ratio of the aggregate notional principal of *all* outstanding derivatives to firm value. In the case of the study by GEMS, the dependent variable was a dummy variable which represented use or non-use of currency derivatives. Therefore, it is not surprising that interest cover and financial leverage did not have a significant influence on the variable[3].

The UK institutional context

A number of recent studies have reported interesting evidence about the use of derivatives by firms in the UK, e.g. see Glaum and Belk (1992), Grant and Marshall (1997), Joseph and Hewins (1997), Joseph (2000), Marshall (2000), Mallin, Ow-Yong and Reynolds (2001) and Christie and Marshall (2001). However, the aim of most of them was to report the surveys that they conducted about the types of derivatives used by the firms, and the reasons given for using them, among other things (Grant and Marshall, 1997; Marshall, 2000; Mallin, Ow-Yong and Reynolds, 2001 and Christie and Marshall, 2001). Since it was not the objective of these studies, or that of Glaum and Belk (1992), to test the theories described above, their results are not directly relevant for determining whether the theories apply to the firms or not. Although Joseph and Hewins (1997) and Joseph (2000) performed some tests to determine whether the theories explain the use of derivatives by firms in the UK, the definition of derivatives that they used was too broad. As explained earlier, the use of a broad definition of derivatives can cause a mismatch between the risk(s) that firms are exposed to and the type(s) of derivatives that they have used to hedge the risk(s). Consequently, it can produce misleading results.

Also, some of the observations stated above for the US and New Zealand may not apply to the UK because of the different institutional context. At the time of this study i.e. October 1996, if a company which did not have taxable profit paid cash dividends, it would be liable to pay advance corporation tax (ACT)[4]. While such a company was able to claim an allowance for this tax under the imputation tax system, there were restrictions on the amount of allowance that could be claimed[5]. Consequently, it was possible for the corporation tax liability of a firm to be driven wholly by its dividend payments, or partly by its dividend payments and partly by its taxable profit. For this reason, a firm may find it unnecessary to use derivatives to reduce its expected tax payments.

There was a general feeling in the UK that the imputation tax system that existed in October 1996 when this study was conducted encouraged firms to pay dividends[6]. As a result, the system was reviewed in July 1997 in order to remove the aspects of it that encouraged firms to pay dividends. Despite this change, we do not expect tax to be a determinant of the use of derivatives in our results because we do not expect the corporation tax of most of the firms in our sample to be driven mainly by their profits[7]. The reason for

this is that the aspects of the tax system which encouraged firms to pay dividends were in existence during our study period.

Similarly, we do not expect foreign exchange risk to have a significant influence on the use of interest rate derivatives because there are more appropriate instruments to use to hedge foreign exchange risk, e.g. currency derivatives. Further, alternative financing instruments are not expected to have a significant influence on the use of interest rate derivatives, because the variable was generally not significant in the previous evidence. However, we expect the rest of the predictions of the theory to apply.

III. Data and Variable Definition

The data for the study were obtained partly from Datastream and partly from a survey. The survey questionnaire covered four pages and included questions concerning the types of contracts used, the notional principal of all outstanding contracts, the underlying assets/liabilities of the contracts, the benefits derived from using the contracts and financial reporting practice. The questionnaire was mailed to 982 firms in the FT-All Share Index on 30th September to 2nd October, 1996. Attention was focussed on large firms because previous evidence indicated that they were more likely to use derivatives than small firms.

A total of 234 responses were received within six weeks. Forty-two of them were not completed. The firms concerned stated that they did not take part in surveys as a matter of policy. Therefore, the total number of usable responses was 192, which gave a response rate of about 20%. Only firms which had all the other data needed for the study in Datastream were included in the sample for the study. Application of this criterion gave a final sample of 140 observations, comprising 52 non-users and 88 users of different types of derivatives.

Our sample size is comparable with those of similar previous studies. For instance, NSS's sample consisted of 169 observations (104 users and 65 non-users) obtained from a postal survey of 535 firms in the Fortune 500 and the S&P 400. The response rate to their questionnaire was 31.58%[8]. BB and GEMS did not conduct a survey. BB's sample consisted of 116 firms (55 users and 61 non-users) in New Zealand and GEMS sample consisted of 372 firms (154 users and 218 non-users of currency derivatives) in the US which disclosed the relevant information in the annual report. Joseph's (2000, p. 164) sample consisted of 75 firms that gave satisfactory responses to a questionnaire survey conducted in 1994.

The variables that we use are measured as follows: We use two proxies for the risk of financial distress, namely, interest cover and financial leverage. As indicated earlier, interest cover (I/PBIT) is represented by the ratio of interest to profit before interest and tax. Normally, interest cover should be measured by the ratio of profit before interest and tax to interest. The measure is inverted in order to reduce the scale problem. Financial leverage (LEV) is measured by the ratio of the book value of total debt (i.e. long term debt and current liabilities) to firm value. Firm value is represented by the market value of equity plus the book values of preference shares and total debt. These variables were used in the previous studies by NSS, BB and GEMS. NSS and GEMS found that the variables were not significant in the US, but BB reported that they were significant in New Zealand.

We use three variables to represent hedging substitutes. They are alternative financing instruments to straight debt (ALTFIN), dividend payout ratio (DIV) and liquidity (LIQ). Variable ALTFIN is measured by the sum of the book values of preference shares and convertible loans divided by firm value. Dividend payout ratio (DIV) is measured by the ratio of dividends per share to earnings per share and liquidity (LIQ) is represented by the quick ratio, which is measured by current assets *less* inventories divided by current liabilities. Similar variables were used in the previous studies by NSS, BB and GEMS. NSS, BB and GEMS found that the influence of alternative financing instruments was not significant, but that the influence of dividend payout and liquidity was generally significant.

Economies of scale are represented by two variables, size (SIZE) and the existence of other types of derivatives (OTHERDER). Size (SIZE) is represented by the log of firm value, measured in £ millions. The existence of other types of derivatives (OTHERDER) is represented by a dummy variable which is assigned a value of 1, if a firm has any other derivatives than the interest rate type, or a value of 0 otherwise. All the previous studies referred to earlier used the size variable (SIZE) and found it to be positive and significant, except PT who found that the variable was not significant. GEMS were the only authors who have used variable OTHERDER before this study. They used the variable as an additional proxy for economies of scale in the use of derivatives. They expected the variable to have a positive influence on the use of derivatives because a firm which uses one type of derivative is likely to have greater expertise and less transaction costs in using other types of derivatives. Their results supported this expectation.

Managerial risk aversion (MANSH) is represented by the proportion of the ordinary shares of a firm owned by its directors. BB and GEMS used this variable but neither of them found it to be significant. We also test the influence of information asymmetry on the use of interest rate derivatives. Like PT and GEMS, we represent information asymmetry (INSTSH) by the proportion of the ordinary shares of a firm owned by institutional investors, such as pension funds, insurance companies, unit trusts and investment trusts. GEMS suggested that institutional investors usually invest in firms that provide a lot of information to the market. Expecting firms which provide a lot of information to the market to have less variation in their market prices, GEMS predicted a negative relationship between institutional share ownership and the use of derivatives. PT found that institutional share ownership had a negative influence, but GEMS observed that the variable had a positive influence, on the use of derivatives (see Tufano, 1996, Table V, p. 1116; Geczy, Minton and Schrand, 1997, p. 1330 and Table III, p. 1336).

We represent agency factor/growth opportunities (E-P) by the inverse of the PE ratio. The inverse of the ratio is used in order to reduce the scale problem. BB used this variable and found that it was not significant. NSS and GEMS represented agency factor/growth opportunities by the book-to-market-value ratio. They also found that the variable was not significant. Tax rate (TLOS) is represented by a dummy variable which is assigned a value of 1, if a firm has irrecoverable advance corporation tax (ACT)[9], or a value of 0 otherwise. Many previous studies used a variable similar to this. For instance, NSS, BB, PT and GEMS represented tax rate by the ratio of tax losses carried forward to total assets. There are contradictions in the previous evidence about the significance of the variable. While NSS and BB reported that the variable was significant in the US and New Zealand respectively, PT and GEMS reported that it was not significant in the US.

We measure foreign exchange risk (FXRISK) by the ratio of overseas sales to total sales. GEMS used this variable and found it to be positive and significant. We use the London Stock Exchange industry classification codes in Datastream (IND) to represent industry influence. GEMS used a similar variable to assess industry influence on the use of currency derivatives in the US. They found that the variable was generally not significant.

Finally, our dependent variable is a dummy variable which measures use or non-use of interest rate derivatives. The value of the variable is based on the response that we got to one of the questions in our questionnaire. In the question, we asked respondents to state the benefits they got from using derivatives. If a respondent stated that his/her firm used derivatives to hedge interest rate risk, we assume that the firm used interest rate derivatives and assign a value of 1 to the dummy variable. Otherwise, a value of 0 is assigned to the variable. The dummy variable is used because we do not have the data of the notional principal of the interest rate derivatives of our respondents. We could not use the data of the aggregate notional principal of *all* derivatives that we obtained from the survey for this study because we do not know the percentage of it that relates to interest rate derivatives. A summary of the descriptions of all the variables that we use and their predicted effects is stated in Appendix A, which also contains the observed effects of the variables in the previous studies.

IV. Analyses and Results

The firms in our sample are from a broad range of industries: Twelve are from the Consumer Goods industry, 5 are from the Extracting industry, 24 are from the Finance industry, 41 are from the Manufacturing industry, 54 are from the Service industry and the remaining 4 are from the Utilities industry. Forty eight of the firms use interest rate derivatives. Some of the 48 firms use other types of derivatives and some of the firms that do not use interest rate derivatives use other types of derivatives. In total, 49 firms use other types of derivatives. For these firms the value of the independent variable which represents the use of non-interest rate derivatives (OTHERDER) is 1. The value of the variable is 0 for all other firms in the sample. The main types of instruments used by the respondents are swaps, forward contracts, option contracts, forward rate agreements (FRAs) and interest rate caps. A few firms used commodity futures, average rate options and equity index futures.

We check for sampling bias by using the t-test technique and the Mann-Whitney non-parametric test technique to compare the means and distributions of interest cover (I/PBIT), financial leverage (LEV) and foreign exchange risk (FXRISK) of the 140 firms in our sample with the corresponding values obtained from a random sample of 140 non-respondents. In general, the results obtained indicate that there is no significant difference between the financial leverage (LEV) of the respondents and those of the non-respondents. However, the results also indicate that the values of interest cover and foreign exchange risk of the non-respondents are significantly less than the corresponding values for the respondents, and that the non-respondents are generally larger than the respondents. We interpret the lower values of interest cover and foreign exchange risk of the non-respondents as an indication that they are less exposed to interest rate and foreign exchange risks than the respondents. On the basis of this interpretation, we conclude that the non-respondents have less risk of financial distress than the respondents and that our

sample is not biased because the non-respondents appear to be non-users who have little or no interest in the subject of our research.

Bivariate test

The summary statistics of the study sample are in Table 1. The sample consists of only the respondents. The means and the medians of the independent variables for users and non-users of interest rate derivatives in the sample are stated in Table 2. We use the Mann-Whitney non-parametric test technique to compare the distribution of each variable for users and non-users. The result of the test is also stated in Table 2. The result indicates that the medians of interest cover (I/PBIT) and financial leverage (LEV) of users are significantly greater than the corresponding values for non-users. These indications are consistent with the prediction that the risk of financial distress has a positive influence on the use of interest rate derivatives.

Table 1: Sample Summary Statistics

Factor/Variable Name	*Mean*	*Std.Dev.*	*Median*	*Minimum*	*Maximum*
Risk of financial distress					
I/PBIT	0.116	0.140	0.067	0.000	0.810
LEV	0.338	0.202	0.302	0.014	0.956
Hedging substitutes					
ALTFIN	0.008	0.027	0.000	0.000	0.252
DIV	0.564	0.396	0.524	0.000	2.907
LIQ	1.216	1.285	0.979	0.000	10.216
Economies of scale					
SIZE	5.767	1.558	5.412	2.490	12.185
OTHERDER	0.421	0.496	0.000	0.000	1.000
Managerial risk aversion					
MANSH	0.089	0.146	0.020	0.000	0.642
Information asymmetry					
INSTSH	0.310	0.190	0.283	0.000	0.805
Agency factor					
E-P	0.060	0.031	0.060	0.000	0.182
Tax rate					
TLOS	0.243	0.430	0.000	0.000	1.000
Nature of assets/operations					
FXRISK	0.287	0.292	0.265	0.000	0.930

Table 2 also indicates that there is a significant difference between the distributions of the liquidity (LIQ), size (SIZE) and directors' shareholding (MANSH) variables in the sub-samples of users and non-users. The pattern of the differences between these variables in the two sub-samples implies that liquidity (LIQ) has the predicted negative influence, size (SIZE) has the predicted positive influence, but instead of the predicted positive influence, directors' shareholding (MANSH) has a negative influence, on the use of interest rate derivatives. None of the other variables has a significant influence on the use of the instruments.

Table 2: Non-parametric Test Results

Factor/Variable Name	*Predicted influence*	**Users** *Mean*	**Users** *Median*	**Nonusers** *Mean*	**Nonusers** *Median*	*Z-score*	*Prob.*
Risk of financial distress							
I/PBIT	+	0.176	0.153	0.078	0.054	3.270	0.001
LEV	+	0.442	0.393	0.292	0.260	3.591	0.001
Hedging substitutes							
ALTFIN	-	0.010	0.000	0.006	0.000	1.250	0.211
DIV	+	0.622	0.573	0.513	0.536	0.819	0.413
LIQ	-	1.223	0.898	1.227	1.073	-2.188	0.029
Economies of scale							
SIZE	+	6.602	6.311	5.686	5.385	2.625	0.009
Managerial risk aversion							
MANSH	+	0.048	0.012	0.103	0.031	-2.353	0.019
Information asymmetry							
INSTSH	-	0.305	0.268	0.308	0.312	-0.391	0.696
Agency factor							
E-P	-	0.061	0.060	0.063	0.062	-0.373	0.708
Tax rate							
TLOS	-	0.306	0.000	0.282	0.000	0.245	0.807
Nature of assets/operations							
FXRISK	+	0.295	0.287	0.369	0.330	-1.434	0.152

Multivariate tests

We also conduct multivariate tests. Before the tests, we use Pearson's correlation technique to check the correlation of the independent variables, excluding industry dummy variables. The results obtained are summarised in Table 3. Applying a criterion that was used in the previous studies (e.g. BB), we find that only two correlation coefficients have absolute values that are greater than 0.3. One of the large values is the coefficient of the correlation between financial leverage (LEV) and interest cover (I/PBIT), which is -0.474. The other large value is the coefficient of the correlation between size (SIZE) and financial leverage (LEV), which is 0.344. NSS had seven, BB had five and GEMS had over twelve such large correlation values in their data (see Nance, Smith and Smithson, 1993, Table III, p. 278; Berkman and Bradbury, 1996, Table 4, p. 11; and Geczy, Minton and Schrand, 1997, Table V, p. 1341). Therefore, our data are not less suitable for the application of a multivariate test technique than the data used in the previous studies."

There is a danger that the correlation between interest cover (I/PBIT) and financial leverage (LEV) may bias the results of the multivariate tests if the two variables are used together in the same model. In order to avoid this problem, we create two models and call them Models I and II. We use interest cover (I/PBIT) to represent the risk of financial distress in Model I and financial leverage (LEV) to represent the same factor in Model II. We then use the logit regression technique to assess the influence of interest cover (I/PBIT), financial leverage (LEV) and the other independent variables described earlier on the use of interest rate derivatives. The results obtained are summarised in Table 4 (a).

Table 3: Pearson's Correlation Coefficients

Var. name	*I/PBIT*	*LEV*	*ALTFIN*	*DIV*	*LIQ*	*SIZE*	*OTHERDER*	*MANSH*	*INSTSH*	*E-P*	*TLOS*
LEV	-0.474*										
ALTFIN	0.164	0.214									
DIV	-0.019	0.084	0.207								
LIQ	0.005	-0.180	-0.082	-0.136							
SIZE	0.020	0.344*	0.063	0.050	-0.117						
OTHERDER	0.094	0.177	-0.064	0.033	-0.054	0.230*					
MANSH	-0.062	-0.014	0.024	-0.006	0.092	-0.190	-0.140				
INSTSH	0.067	0.028	0.062	-0.083	0.017	-0.147	-0.018	-0.216			
E-P	-0.107	0.210	-0.035	0.071	-0.193	0.179	0.200	-0.096	-0.024		
TLOS	0.015	-0.012	0.008	0.106	0.025	0.188	0.158	-0.112	-0.005	0.096	
FXRISK	-0.078	-0.126	-0.098	-0.014	0.076	0.088	0.163	-0.149	0.025	0.140	0.224*

Note: * = correlation coefficient is significant at the 5% or higher level

Table 4(a): Logit Regression Results

		Model I			Model II		
Factor/ Variable name	*Predicted influence*	*Coefficient*	*t-value*	*Prob.*	*Coefficient*	*t-value*	*Prob.*
Constant	NA	-5.471	-3.158	0.002	-5.198	-3.151	0.002
Risk of financial distress							
I/PBIT	+	6.266	3.358	0.001	4.969	3.583	0.001
LEV	+						
Hedging substitutes							
ALTFIN	-	-5.237	-0.546	0.585	-6.864	-0.784	0.433
DIV	+	0.709	0.953	0.341	0.649	0.936	0.349
LIQ	-	0.165	0.749	0.454	0.230	1.196	0.232
Economies of scale							
SIZE	+	0.612	3.442	0.001	0.554	3.025	0.003
OTHERDER	+	0.622	1.224	0.221	0.475	0.921	0.357
Managerial risk aversion							
MANSH	+	-4.065	-1.878	0.060	-5.944	-2.488	0.013
Information asymmetry							
INSTSH	-	-0.075	-0.063	0.950	-0.274	-0.227	0.821
Agency factor							
E-P	-	-6.805	-0.851	0.395	-14.596	-1.739	0.082
Tax rate							
TLOS	+	-0.084	-0.153	0.878	0.089	0.158	0.874
Nature of assets/operations							
FXRISK	+	-0.560	-0.599	0.549	-0.710	-0.759	0.448
IND.INFLUENCE							
EXTRACT	+/-	-0.616	-0.427	0.669	-0.185	-0.128	0.898
FINANCE	+/-	0.940	0.830	0.406	-0.197	-0.174	0.862
MANUFAC.	+/-	0.917	0.882	0.378	0.886	0.867	0.386
UTILITIES	+/-	1.858	1.228	0.219	1.848	1.109	0.267
SERVICE	+/-	-0.007	-0.007	0.994	0.054	0.053	0.958

Table 4(b): Summary Statistics of the Logit Regression Results

No. of observations	**Model I**		**Model II**	
	Predicted dep. variable		**Predicted dep. variable**	
	0	**1**	**0**	**1**
Actual dep. variable				
0 (firm does not use interest rate derivatives)	79	12	81	10
1 (firm uses interest rate derivatives)	19	30	18	31
Total =	98	30	99	41
Overall prediction accuracy	77.86%		80.00%	
Restricted log likelihood	-95.009		-95.009	
Log likelihood at convergence	-64.645		-64.240	
-2*Log likelihood ratio	60.728		61.538	
Degrees of freedom	16		16	
Probability	0.001		0.001	
Note: NA = not applicable				

The results support the indication of the evidence in Table 2 that both interest cover (I/PBIT) and financial leverage (LEV) have the predicted positive influence on the use of interest rate derivatives. The results also support the indications of Table 2 that size (SIZE) has the predicted positive influence, and that directors' shareholding (MANSH) has a negative, rather than the predicted positive, influence on the use of derivatives. Apart from these, no other independent variable is significant. Further evidence reported in Table 4(b) indicates that the estimates in Table 4(a) achieve up to 80% prediction accuracy and that the estimates are significant at the 1% level. These indications affirm the overall adequacy of the models reported in the Table. The difference between the significance of liquidity (LIQ) in Tables 2 and 4 seems to be a reflection of the weakness of the Mann-Whitney non-parametric test technique.

It is possible that some of the variables that we have classified as independent and exogenous are endogenous (e.g. interest cover and financial leverage), or that the capital structure decision and the decision to use interest rate derivatives are made simultaneously rather than separately. We do not investigate the effects of these 'possibilities' on the results reported above because GEMS did and found that neither of the 'possibilities' had a significant effect on their results (see Geczy, Minton and Schrand, 1997, pp. 1342-3).

V. A Comparison of the Factors that Influence the Use of Currency and Interest Rate Derivatives

Next, we compare the evidence reported by GEMS about the factors that influence the use of currency derivatives with the evidence observed in this study about the factors that influence the use of interest rate derivatives. The reason for the comparison is to determine whether there is a difference between the factors that motivate firms to use currency derivatives and the factors that motivate them to use interest rate derivatives. The comparison is based on the evidence reported in GEMS' Tables III and IV (see Geczy, Minton and Schrand, 1997, pp. 1336-9) and the results of this study summarised in Table 4. The result of the comparison is summarised in Table 5.

Table 5 shows that the factors that influenced firms to use currency derivatives were foreign exchange risk, tax rate, institutional shareholding and economies of scale. The Table also shows that the factors that influenced firms to use interest rate derivatives were the risk of financial distress (i.e. high interest cover or total debt ratio), economies of scale and directors' shareholding. Therefore, the evidence in the Table suggests that there is a difference between the factors that motivate firms to engage in foreign exchange risk management and the factors that motivate them to engage in interest rate risk management[10].

VI. Conclusions

We conclude that risk of financial distress and economies of scale have a positive influence, and that directors' shareholding has a negative influence, on the use of interest rate derivatives by firms in the UK. It appears from our results that only these factors have a significant influence on the use of interest rate derivatives by the firms. When compared with the previous evidence reported by GEMS, the result obtained implies that there is a difference between the factors that motivate firms to engage in foreign exchange risk management and the factors that motivate them to engage in interest rate risk manage-

Table 5: A Comparison of the Factors that Influenced the Use of Currency and Interest Rate Derivatives

Factor/Variable Name	*Predicted influence*	**GEMS** (Dependent variable = currency derivatives)	**AB** (Dependent variable = interest rate derivatives)
Constant	NA	-	-
Risk of financial distress			
I/PBIT	+	0[a]	+
LEV	+	0	+
Hedging substitutes			
ALTFIN	-	0[a]	0
DIV	+	0[a]	0
LIQ	-	0	0
Economies of scale			
SIZE	+	+	+
OTHERDER	+	+	0
Managerial risk aversion			
MANSH	+	0	-
Information asymmetry			
INSTSH	-	+	0
Agency factor			
E-P	-	0	0
Tax rate			
TLOS	+	+	0
Nature of assets/operations			
FXRISK	+	+	0
IND. INFLUENCE	+/-	0	0
Prediction Accuracy		75%-78%	78%-80%

Notes: +/-/0 = positive, negative and not significant respectively. GEMS = Geczy, Minton and Schrand (1997). AB = Adedeji and Baker (2002), i.e. this study. Some of the indications stated in this Table are based on the evidence reported in Table III of GEMS' paper while others are based on the evidence reported in Table IV of the paper. Table III contains the results of univariate analyses while Table IV contains the results of multivariate tests conducted with the logit regression technique. Where a variable is reported in both Tables III and IV, only the result in Table IV is indicated in the Table above. However, where a variable is reported only in Table III, then the indication in the Table above is based on the evidence obtained from Table III in GEMS' paper. a = indication that is based on the evidence obtained from Table III. There are some differences between the definition of variables used by GEMS and the definition used in this study. GEMS defined LEV as long term debt/firm value. This definition is not used because long term debt is not a suitable measure of debt in the UK. Unlike in the US, long term debt is a small fraction of the total debt used by firms in the UK. Instead of INSTSH, GEMS used the number of analysts following a firm. This variable is not used in this study because of data problem. GEMS also used book-to-market-value ratio instead of E-P. Our results are similar to theirs as far as the influence of the factor represented by these variables is concerned.

ment. The result suggests that dependence on overseas product and capital markets, tax, institutional shareholding and economies of scale are the factors that motivate firms to use currency derivatives, and that high interest cover or total debt ratio, economies of scale and directors' shareholding are the factors that motivate firms to use interest rate derivatives.

Our evidence is consistent with the theoretical suggestion that firms use derivatives in order to reduce their expected costs of financial distress and enhance their market values. Therefore, the evidence suggests that the use of derivatives by firms is in the shareholders' interest. This suggestion is important because reports of huge losses suffered from the use of derivatives by some firms have generated adverse publicity for the instruments in recent times[11].

An important issue for further research is the nature of the relationship between directors'/managers' attitude to risk and shareholding. While extant theory predicts that managerial risk aversion has a positive influence on the use of derivatives, available evidence gives conflicting indications about the effect of directors'/managers' share ownership on the use of derivatives. Tufano (1996, Table V, p. 1116) observed that the effect was positive, Berkman and Bradbury (1996, Table 3, p. 10) and Geczy, Minton and Schrand (1997, Table IV, p. 1338) observed that the effect was not significant and we find that the effect is negative (see our Table 4).

It is possible that some of the contradictions referred to above arise because directors'/managers' shareholding is not an appropriate proxy for managerial risk aversion. For instance, directors'/managers' shareholding will not be an appropriate proxy for managerial risk aversion if there is no relationship between the two. It is also possible that the suggestion that managers take more risk when they have more ownership is not correct. May be managers take more risk when they have less ownership. Further research is therefore necessary to determine the nature of the relationship between directors'/managers' attitude to risk, share ownership and the use of derivatives.

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Endnotes

1. GEMS used two proxies for the risk of financial distress. They were interest cover, measured by the ratio of profit before interest and tax to interest, and financial leverage, measured by the ratio of the book value of long term debt to the market value of the firm.

2. Like GEMS, BB used two proxies for the risk of financial distress. One of them was interest cover, measured by the log of profit before interest and tax divided by interest. The other was financial leverage, measured by the ratio of debt to the market value of equity. However, it is not clear whether the debt used was the long term debt or total debt.

3. Further evidence on the use of derivatives was reported by Booth, Smith and Stolz (1984), Block and Gallagher (1986), Houston and Mueller (1988), Wall and Pringle (1989), Mayers and Smith (1990), Bodnar, Hayt, Marston and Smithson (1995), and Grant and Marshall (1997), among others. These studies are not discussed in this paper because they are not directly relevant to the test of the theories being considered.

4. There were two corporate tax rates in the UK at the time of the survey (i.e. early October 1996). One was called the small companies rate and the other was called the full rate. The small companies rate was 25% and the full rate was 33%. The small companies rate applied to companies which had chargeable profits of not more than £300,000 and the full rate applied to companies which had chargeable profits of at least £1,500,000. Firms which had chargeable profits between £300,000 and £1,500,000 were taxed at progressive rates which varied between 25% and 33% according to their level of profits. There was also a system of allowances for operating expenses, capital expenditures, expenditures on R&D, Advance Corporation Tax (ACT) paid on dividends, etc. This system of allowances made the effective tax rate in the UK progressive and, therefore, consistent with the theory.

5. Lasfer (1997) stated that there were two main restrictions on the amount of ACT that could be recovered. One of them was that the amount must not exceed a firm's liability to UK tax. This restriction made it impossible to recover ACT on dividends paid from earnings realised abroad. The other main restriction was that gross dividends (i.e. cash dividends plus ACT) should be less than taxable profits (see Lasfer, 1997, p. 242).

6. Support for this view was expressed by the Chancellor of the Exchequer when he stated that: 'The present system of tax credits encourages companies to pay out dividends rather than reinvest their profits...' (see Financial Times, 3rd July, 1997, p. 6)

7. In fact, 25% of our sample (i.e. 35 out of 140) have irrecoverable ACT - a situation which arises when a company has paid 'too much dividend' relative to what the system allows. The tax payments of companies with irrecoverable ACT is driven mainly by their dividends rather than by their profits. Therefore, such companies do not need to use interest rate derivatives to reduce tax.

8. The survey of NSS had the privilege of institutional support. One of the authors, C. W. Smithson, was a member of staff of Chase Manhattan Bank in the US at the time of the survey.

9. The term irrecoverable ACT (i.e. Advance Corporation Tax) refers to ACT that is unlikely to be recovered in the next accounting period. Although, in principle, any unused

ACT arising in an accounting period can be set against the corporation tax liabilities of the preceding six periods, and any surplus ACT remaining after that can be carried forward indefinitely, in practice any surplus ACT that a company is not reasonably certain of using in the next accounting period is usually referred to as irrecoverable ACT - see Lasfer (1997) for further discussions of this.

10. In this comparison, we equated the use of currency derivatives to foreign exchange risk management and equated the use of interest rate derivatives to interest rate risk management. We are aware that these equations may not be entirely correct because there are other strategies that can be used to manage currency and interest rate risks and because currency and interest rate derivatives may be used for non-hedging purposes, such as trading or speculation. However, we believe that the equations are reasonable in the context of this study because the focus of the study and the previous study by GEMS is on the use of interest rate and currency derivatives for hedging. Therefore, it is correct to assume that a firm which uses currency derivatives is engaged in foreign exchange risk management and that a firm which uses interest rate derivatives is engaged in interest rate risk management.

11. The Economist Supplement of 10th February, 1996 and Grant and Marshall (1997, p.192) provided a good catalogue of some of the companies that have suffered losses through the use of derivatives. These publications emphasised the point that derivatives can increase the risk profile of a company in the same way that they can reduce it. This point was also emphasised by the Accounting Standards Board (ASB) in its Financial Reporting Standard 13 (FRS 13) which contains the rules for the disclosure of derivatives. The same point was stressed in a recent article by Derek Ross (1997). These publications also contain some other questions that have been asked about the use of derivatives.

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Appendix A: Variables and Their Effects

				Observed Influence			
Factor	*Represented by*	*Variable Name*	*Predicted Influence*	*NSS (1993)*	*PT (1996)*	*BB (1996)*	*GEMS (1997)*
Risk of financial distress	Interest cover - measured by the ratio of interest to profit before interest and tax.	I/PBIT	+	0	NA	+	0
	Financial leverage - measured by the ratio of the book value of total debt (i.e. long term debt and current liabilities) to firm value (i.e. market value of equity plus the book values of preference shares and total debt).	LEV	+	0	+	+	0
Hedging substitutes	Alternative financing instruments - measured by the sum of the book values of preference shares and convertible loans divided by firm value.	ALTFIN	-	0	0	0	0
	Dividend payout ratio - measured by the ratio of dividends per share to earnings per share.	DIV	+	+	NA	+	0
	Liquidity - measured by the quick ratio i.e. (current assets - inventories) divided by current liabilities.	LIQ	-	-	-	0	-
Economies of scale	Size - represented by the log of firm value, measured in £ millions.	SIZE	+	+	0	+	+
	Use of other types of derivatives - represented by a dummy variable which is assigned a value of 1, if a firm uses other types of derivatives than interest derivatives, or a value of 0 otherwise.	OTHERDER	+	NA	NA	NA	+
Managerial risk aversion	Managerial share ownership - measured by the proportion of the ordinary shares of a firm owned by its directors.	MANSH	+	NA	+	0	0

Appendix A: Variables and Their Effects (continued)

				Observed Influence			
Factor	*Represented by*	*Variable Name*	*Predicted Influence*	*NSS (1993)*	*PT (1996)*	*BB (1996)*	*GEMS (1997)*
Information asymmetry	Institutional share ownership - measured by the proportion of the ordinary shares of a firm owned by institutional shareholders, such as insurance companies, pension funds, unit trusts and investment trusts.	INSTSH	-	NA	-	NA	+
Agency factor/growth opportunities	Expected growth - represented by the inverse of the PE ratio.	E-P	-	NA[b]	NA	0	NA[b]
Tax rate	Tax losses - represented by a dummy variable which is assigned a value of 1, if a firm has tax losses, or a value of 0 otherwise.	TLOS	+	+	0	+	0
Nature of assets/operations	Exposure to foreign exchange risk - represented by the ratio of overseas sales to total sales.	FXRISK	+	NA	NA	0[a]	+
	Industry/business risk - represented by the London Stock Exchange industry classification codes in Datastream.	IND	+/-	NA	NA	NA	0

Notes: NSS represents Nance, D.R., Smith, C.W. and Smithson, C.W. (1993) 'On the determinants of corporate hedging', *Journal of Finance*, 48, pp.267-284. PT represents Tufano, P. (1996) 'Who manages risk? An empirical examination of risk management practices in the gold mining industry', *Journal of Finance*, 32, pp.337-348. BB represents Berkman, H. and Bradbury, M.E. (1996) 'Empirical evidence on the corporate use of derivatives', *Financial Management*, 25, pp.5-13. GEMS represents Geczy, C., Minton, B.A., and Schrand, C. (1997) 'Why firms use currency derivatives', *Journal of Finance*, 52, pp.1323-1354.

a = BB used another proxy for exposure to foreign exchange risk, namely, the ratio of the value of assets abroad to firm value. They found that this proxy did not have a significant influence on the use of derivatives in New Zealand.

b = However, these studies used either the inverse of price-to-book-value ratio or the ratio of R&D expenditures to sales to represent expected growth. They found that these variables had a significant positive influence on the use of derivatives.