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The Association between Accounting and Market-Based Risk Measures

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This paper is circulated for discussion purposes only and its contents should be considered preliminary.

Abstract

The paper derives operating and financial measures of leverage and tests their association with market based measures of equity risk. It is the first such study to use purely accounting-based data to derive the leverage measures. In line with previous literature it conducts a new test on the relative importance of operating and financial leverage. The results suggest that operating costs have a greater impact.

Keywords: Systematic risk, Operating Leverage, Financial Leverage, Beta, Risk Premium, United Kingdom

The Association between Accounting and Market-Based Risk Measures

1. INTRODUCTION

The paper examines the proposition that the underlying cost structure of the firm explains the systematic risk of its cash flow and the consequent behaviour of the firm's stock price. Whilst the intuition of this relationship may seem self-evident, it has been the subject of relatively little empirical research. Systematic risk arises because the firm is the subject of fixed claims but faces variable revenues (Huffman, 1983). The fixed claims associated with debt finance have attracted the attention of the majority of research into the nature of leverage based adjustments of systematic risk. For Modigliani and Miller, (1963) and Miller, (1977) the underlying asset beta or risk class of the all equity firm is specified in advance. In the standard corporate finance text, the asset beta is computed from the market-based equity beta adjusting for leverage effects (Watson and Head, 1998). A likely much larger class of fixed claims however arises from the general operating costs of the business and this has attracted relatively little attention (an exception is Rosett, 2003). A possible important reason for these biases in the research agenda is the dominance of finance over accounting based perspectives in the analysis of systematic risk. Theoretical analyses use financial market data in conjunction with accounting data to develop operating leverage variables (Gahlon and Gentry, 1982, Huffman, 1983). Similarly empirical studies using operating leverage have unanimously incorporated market numbers in their measures of operating leverage (for example, Hamada, 1972, Mandelker and Rhee, 1984, Huffman, 1989, Rosett, 2003). Instead, this paper uses exclusively accounting data, using company accounts and national income statistics.

It then presents an empirical test examining the relative impact on market based systematic risk of operating and financial leverage variables derived using comparable profit and loss account data. An important empirical question is the relative impact of different cost categories on total systematic risk. If, by extension of Modigliani and Miller (1958), variance in total cash flow is a function of the presence of not just interest based, but *all* fixed charges, it would seem logical to expect operating leverage to account the more strongly for the firm's systematic risk. Of the small number of studies that have examined the joint and complementary effects of operating and financial leverage, few have examined the quantitative impacts of differing categories of fixed costs on a systematic basis. An exception is Lord (1996) whose empirical study focuses on three sectors and ends with a call for further research in wider contexts. Moreover, in the international context, including the focus of this study, the United Kingdom, recent evidence is particularly limited.

The examination of operating leverage in the UK and international context is particularly interesting for a number of reasons. First, it provides a mechanism for linking the stock price return to the underlying short-run cost structure of the firm. The presence of certain costs, such as knowledge-based labour, research or capital intensive activities, and scale based production, which have been linked to competitive advantage (Grant, 1996, Lazonick, 1991) may also lead to the creation of fixed cost structures that promote shareholder risk. A further rationale has emerged from recent changes in corporate behaviour, associated with the rise of the notions of the flexible firm and flexible labour markets and their impact on underlying cost behaviour (Armstrong, 2002), which may be expected to attenuate stock market risk. All previous studies predate the major impacts of these changes in the 1990s and the final reason is therefore that earlier empirical findings might be open to question. This is particularly the case in the United Kingdom, where the impact of these ideas has been at least as great if not greater than in the United States. Further work is of particular value given the major direction of institutional reforms in the UK recently with the objectives of de-regulation and the creation of more flexible markets. Consequently a related reason is that theories of competitive advantage suggest a degree of managerial discretion in asset acquisition and that operating leverage does not merely reflect industry membership (Brigham and Gapenski, 1994). A third reason is that where managers are committed to high fixed cost investment, they might exercise greater caution in the borrowing decision. Interactions between operating and financial leverage are therefore potentially important.

To examine these issues in more detail, the remainder of the paper is organised as follows. The next section introduces an alternative perspective on accounting based risk measurement and then reviews the prior literature, particularly concentrating on previous empirical analyses of operating leverage. Subsequent sections describe the hypotheses, data, and results. A final section draws conclusions.

2. ACCOUNTING NUMBERS AND MARKETS RISK: THEORETICAL AND EMPIRICAL APPROACHES

Accounting based measures of financial risk

Because the variability of the firm's profits is a function of the firm's underlying cost structure, systematic shareholder risk depends on the ratio of fixed to total cost. At the aggregate this relationship is captured through gearing or leverage. It has two major components, the degree of financial leverage (DFL) and the degree of operating leverage (DOL). DFL depends on the degree of fixed interest charges that must be paid irrespective of the level of profit. For the purposes of this analysis, it is defined as the rate of change in profit after interest divided by the rate of change in profit before interest. DOL is defined as the rate of change in profits before interest divided by the rate of change in sales. DOL can be used to compute an 'operating' or 'asset' beta by relating the proportion of fixed cost to total cost for one particular firm to the proportion of fixed cost to total cost for all firms.

The intuition of this approach is exactly the same as the adjustment of the cost of capital for the presence of fixed interest charges (Modigliani and Miller (1958, Hamada, 1972). Further analytical models (Lev, 1974, Gahlon and Gentry, 1982, Huffman, 1983 and Mandelker and Rhee, 1984) extend this relationship to include risk measures that depend jointly on underlying accounting and market numbers. In one view financial managers facing high DOL risk can deliberately adopt financial plans that involve low DFL to achieve an appropriate level of total stock risk. The hypothesis implies that changes in DOL and DFL are independent of each other and that total leverage is a product of DOL and DFL. The DOL and DFL non-interaction view is criticised by Huffman (1983), emphasising the endogenous nature of the capacity decision of the firm. Using an option pricing approach, she assumed that the commitment to fixed capacity investment depends on the ex ante debt level. Therefore the capacity decision attenuates the increase in equity risk caused by an increase in business risk but that the attenuating ability decreases as either revenue declines or the level of outstanding debt increases. Also the capacity decision partially offsets the effect of a debt increase on stock risk insofar as the debt is below a critical level. Huffman's approach seems correct as far as total risk is concerned and is confirmed by empirical tests (Li and Henderson, 1991), but less appealing as far as systematic risk is concerned. Debt increases themselves appear exogeneous in Huffman's formulation, but are more likely in reality to be associated with decisions to increase capacity. Moreover, capacity alterations, where endogenous, are the subject of intermittent decisions difficult to observe by market analysts, and are more likely to be attributable to unsystematic changes. On the other hand variables that are more likely to be systematically endogeneous include structural supply and labour market conditions, which can be fixed or varied in response to the ex ante debt level.

The accounting Beta (β_{ac}) as derived from global OG decomposes into specific betas by Cost (C) type $C_{1...n}$ and a Sales Beta (β_s):

$$\beta_{ac} = \beta_{c1} * \beta_{c2} * \beta_s \quad (1)$$

Interest costs arising from financial gearing comprise one of these cost categories. The formulation in (1) is similar to the reconciliation of real asset risk and market risk by Gahlon and Gentry (1982, p.17):

$$CV(\pi) = DOL * DFL * CV(REV) \quad (2)$$

Where $CV(\pi)$ and $CV(REV)$ are respectively the co-efficients of variation of profit and revenue. Equations (1) and (2) are consistent because the classes of beta in (1) are defined as $DOL(C)_i/DOL(C)_m$, (etc) where i = the firm and m = all firms.[1]

In contrast to prior literature, the argument in the present paper is that equation (1) wholly and exclusively accounts for ex post systematic risk. Ex ante systematic risk depends on the forecast expectations of relative rates of change in cost and revenue categories by firm insiders and market participants. Where firms use rational planning such expectations will be built into budget forecasts.

The relationship between global systematic risk and individual cost categories suggests that the weight of each category relative to total cost will have a proportionate impact on the overall beta. The empirical section of the paper tests this intuition by examining the relative aggregate impact of interest based and other fixed costs. Using data obtained from the National Accounts (UKNA, 2005, 3.1.1 and 3.1.3, pp.121-22) suggests of total costs of £1003bn deducted from total resources to arrive at operating surplus for non-financial corporations, the estimated proportionate fixed cost in 2002 is £158bn (16%).[2] Interest charges for 2002 were £37bn. In short, it is possible that non-interest related fixed costs are approximately four times the level of interest based fixed costs. Such an estimate may seem reasonable if it is borne in mind that other fixed costs include for example wages and salaries, which are often both material and fixed in contractual terms at least in the relatively short run and are more often based on time rates than piece rates. Nonetheless the relative impact of these categories is a currently unanswered empirical question and is addressed below in the review of prior empirical literature and in the subsequent tests.

Prior empirical literature

Prior empirical studies have concentrated mainly on financial leverage. In the minority of empirical studies that have considered both operating and financial leverage elements, it has been assumed and to some extent proven that they have equal or complementary effect on total risk. The evidence, albeit limited, shows that where their effects are compared, operating leverage has equal or greater importance compared to financial leverage (Lev, 1974, Mandelker and Rhee, 1984, Li and Henderson (1991). Evidence from these studies is based on a wide variety of methods for estimating operating and financial leverage and predates many structural changes affecting the US, UK and other economies.

There is limited and contradictory empirical evidence on the relationship between financial leverage and beta. Hamada (1972) found that approximately a quarter of the observed cross-sectional variation in a stock's beta could be explained by the DFL of the underlying firm. Further empirical evidence of the association between the DFL and beta was also reported by several other studies that applied and extended the risk-decomposition method (Hill and Stone 1980; Chance, 1982, and Mohr, 1985). However, a few researchers have failed to detect a significant positive effect of DFL on beta (Thompson, 1976; Chung, 1989). These equivocal results may be the result of the relatively small proportion of fixed costs accounted for by interest charges or the variation in methods used to estimate financial leverage.

Early studies examining the role of accounting beta found considerable support for a positive relationship between operating leverage and systematic risk (Beaver, Kettler and Scholes, 1970, Beaver and Manegold, 1975, Gonedes 1973, 1975

Hill and Stone, 1980). Lev (1974) also found empirical support for his model from a sample of firms in electric utility, steel, and oil industries. As noted by Chung (1989), there are limitations in Lev's approach and conclusion because the method of cost decomposition employed may suffer serious measurement problems. Moreover, Lev (1974) included interest expenses in his definition of fixed costs, which made it difficult to separate the pure effect of the DOL. More recently, Rosett (2003) found only a weak relationship between total market risk and operating leverage, finding instead that labour cost leverage was a more important variable. Although these results are interesting, and form the basis for further research using decompositions of operating leverage, the purpose of the present paper is to examine the impact purely the accounting derived measures of operating and financial leverage on systematic market risk.

In other studies, variation in the operating risk component has been typically explained in terms of the diversification of business activities across segments which themselves have differing levels of industry risk. Underlying asset betas are estimated with reference to stock market returns for the appropriate industry segment (Rubinstein, 1973, Fuller and Kerr, 1981), which are then adjusted or not to take account of the impact of firm specific debt (Butler et al, 1991). A problem with this approach is that underlying operating risk is derived from observable market risk. Where betas are particularly useful to corporate managers, for example in evaluating divisional investment opportunities, it is intuitively more appealing to begin with an analysis of the underlying cost structure and its variation.

Several other studies have examined the joint impact of the operating leverage ratio on aggregate beta, usually in conjunction with the financial leverage ratio (Gahlon and Gentry, 1982, Mandelker and Rhee, 1984, Huffman, 1989, Darrat and Mukherjee 1995, Li and Henderson 1991, Lord, 1996). These studies have confirmed the importance of operating leverage relative to financial leverage. At the same time their empirical focus is quite narrow (US-based, industry and time specific) and is suggestive of the value of new studies in the wider international and UK context.

Also the interpretation of their results has been problematic. In their empirical test of the explanatory power of the DOL and DFL, Mandelker and Rhee (1984) found the two variables explained a considerable proportion of the variation in beta at portfolio level. Especially when instrumental variables were used for portfolio grouping, DOL and DFL accounted for 38 to 48% of cross-sectional variation of betas. Further, there was significant correlation between DOL and DFL, suggesting that firms trade-off between DOL and DFL. Although the hypothesised positive relationships between DOL and DFL and stock risk are theoretically sound more recent evidence questions the robustness of these relationships. Huffman (1989) discovered negative relationship between systematic risk and DOL (the opposite of Mandelker and Rhee's findings). Also, he found no support for the negative correlation between DOL and DFL observed by Mandelker and Rhee (1984). Li and Henderson (1991) found that while DOL was significant, only a weak positive beta-DFL relationship was detected. An interaction term between the two leverage measures, included to test Huffman's (1983) hypothesis, was found to be significantly related to total risk at the 90% confidence level, but not to beta. Darrat and Mukherjee (1995), employing a causality approach that differs from the common correlation technique, also found support for Huffman's (1983) model. By contrast, Lord's (1996) study did not confirm the impact of an interrelationship between DOL and DFL on total, unsystematic and systematic risk, as implied by Huffman (1983). Lord (1996) also reported significant positive correlation between DOL and the three risk measures. DFL, however, was significantly related to total and unsystematic risk, but not systematic risk.

One important reason for the inconsistency in empirical evidence of the relationship between DOL and DFL and stock risk may be the problem in finding the correct measurements of the two types of leverage. The most commonly used proxy for DOL is the ratio of the percentage change in earning before interest and tax (EBIT) to the percentage change in sales, estimated by regressing EBIT on sales through time. However where sales are growing, simple time-series regression techniques capture growth rather than leverage (O'Brien and Vanderheiden, 1987). As an alternative, they suggest a two-stage time-series regression technique to eliminate the pattern in the growth of sales. The regression techniques require lengthy estimation periods for reliability and at the same time must assume that underlying assumption is nonetheless that DOL and DFL stay unchanged during the estimation period.[3] Furthermore, as Dugan et al. (1994) observed, the assumption of constant leverage causes the test of the DOL-DFL trade-off hypothesis to be inconsistent in itself because this hypothesis implies that the two measures can change as corporate managers attempt to create a balanced total risk.

To avoid these problems, the current paper uses the point-to-point estimates of DOL and DFL averaged out over the same period as the beta estimation period. Lord (1996) is one of a few authors who employed the point-to-point estimate approach but he did not state whether or not the estimates are averaged out over the same period for beta estimation. However, like other estimate techniques, the point to point approach still has possible problems arising from price effects (i.e. using sales rather than output figures) and discrepancies in accounting methods as suggested by Huffman (1989). However the major advantage as far as the current study is concerned is that it can be applied consistently with the cost category decomposition approach discussed above. Such an approach is also consistent with equation (2) above, so that DOL is based on changes in EBIT and sales and DFL is based on changes in Earnings before tax (EBT) and EBIT. Total leverage is therefore change in EBT divided by change in sales.

Overall the literature suggests that theoretically, DOL and DFL are strongly related to beta and total risk but empirically the leverage-risk relationship is not so strong. The difficulty in identifying the true measures of DOL and DFL is probably one important reason for such inconsistency. The theoretical review has stressed the possibility of using purely accounting data to gain further insight into the nature of systematic risk. The expectation is that DOL will be of greater relative importance to DFL as a determinant of beta. Consistent use of accounting data also helps to overcome inconsistencies in the empirical literature, which have not used precise accounting based point to point estimates. In addition the different UK context has the potential to provide further insight into the leverage-risk relationship.

3. HYPOTHESES AND DATA

3.1 Model and variable definition

In this section the models to be tested are introduced based on the discussion above. The general model follows from equation (2) above with the addition of appropriate control variables:

$$\beta = a_0 + a_1 OLBETA + a_2 FLBETA + a_3 SBETA + a_4 G + a_5 S + a_{6,1} D_1 + a_{6,2} D_2 + \ldots + a_{6,n-1} D_{n-1} + e \quad (4)$$

Where β is the 2003 firm beta factor obtained from *Datastream. OLBETA* is the operating leverage beta, defined as $DOL(C)_i/DOL(C)_m$, where i = the firm and m = all firms, and where $DOL = \%\Delta X / \%\Delta S$ and $\%\Delta X$ and $\%\Delta S$ are the percentage changes in earnings before interest and tax and in sales respectively, both of which are obtained from *Datastream*. The percentage changes are computed using data from 1997 to 2003 inclusive to compute ratios for 1998 to 2003 and then averaged. *FLBETA* is calculated in a comparable fashion and derived from *DFL*, *where* $DFL = \%\Delta Y/\%\Delta X$ and Y is the earnings after interest and before tax and X is EBIT. Using this method the impact of fixed cost characteristics in the firm's interest charges is more easily isolated. Such charges are directly comparable with similar charges deducted in arriving at EBIT and therefore included in the DOL measure. In other words DOL and DFL represent directly comparable fixed cost estimators using profit and loss account data.

Sales beta, growth rates, size, and industry membership ($SBETA$, G, S, $D_{1..n}$) are control variables. *SBETA* is the rate of change in the firm's sales turnover relative to the rate of change in sales turnover for all firms. Data for the latter were obtained from the UKNA (2005, 3.1.1 and 3.1.3, pp.121-22). The computation method is the same as *OLBETA*. Growth rates (G) refer to equity growth and are calculated as $G = E_t / E_{t-1}$ where G is the growth rate and E is the equity capital (balance sheet called up share capital plus total reserves). According to the predictions of the standard CAPM and dividend growth model formulations, growth is an important determinant of equity beta.[4] Size (S) is measured by market capitalisation, which is the product of the market price and the total number of shares outstanding. All the above measures are simple five-year averages for the years 1999-2003 inclusive. There are significant effects of industry group on beta even after controlling for the underlying firm's balance sheet characteristics (Rosenberg and Guy, 1976), and some sectors are more or less insulated from general economic events (Rosenberg and Rudd, 1982). To capture these effects, the sample was grouped into industry sectors most likely to pick up these effects, for example cyclical and non-cyclical (*CYC* and *NCYC*), basic, utilities and resources (*BASIC*, *UTIL*, *RESOR*) and information technology (*ITECH*). Taken together the control variables coupled with *FLBETA* provide a parallel test of the conventional view of the CAPM determinants of beta.

The interpretation of the *OLBETA* and *FLBETA* co-efficients is a test of the principal proposition of the paper; that *DOL* will have greater positive impact on beta relative to *DFL*. In terms of formal hypotheses:

HI: The degree of operating leverage is positively related to beta ($a_1 > 0$)
HII: The degree of financial leverage is positively related to beta ($a_2 > 0$)
HIII: The degree of operating leverage has a greater impact on beta relative to the degree of financial leverage ($a_1 > a_2$)

3.2. Sample and data

To be included in the initial sample, a company was required to satisfy several selection criteria. It must be in the FTSE all share index throughout the period of study. It must have data for beta, industry code, market value, sales, EBIT, profit after interest before tax, and equity,[5] available for the entire period from 1998 – 2003 so that *DOL*, *DFL*, growth and size can be computed. Firms with negative *DOL* and *DFL* values were excluded from the sample. Table 1 summarises the sampling process.

Table 1 about here

Once the initial sample was obtained for the firms satisfying the above criteria, each variable was examined for normality. All variables except beta and industry dummies were log transformed to achieve closer proximity to normality. The sample accommodated some firms with negative growth rates by indexing growth to 1, but in a minority of cases where growth rates were greater than minus 100% they were necessarily excluded from the log transformed variable. Descriptive statistics for the sample firms are shown in table 2.

Table 2 about here

As table 2 panel A shows, the distribution of most of the variables remained problematic, even once these transformations were accommodated. Non-normality of individual variables is not necessarily problematic for the ordinary least-squares (OLS) model, provided the residuals are normal. Shapiro-Wilk tests were conducted on the residuals of all relevant models and in general these showed approximation to normality (table 3). All OLS regression models incorporated White's (1980) heteroscedasticity consistent matrix for standard errors and all models were re-tested using non-parametric quantile regressions. The final model tested, taking into account the log (LN) transformations was:

$$\beta = a_0 + a_1 OLBETA + a_2 FLBETA + a_3 SBETA + a_4 LNG + a_5 LNS + a_{6,1} D_1 + a_{6,2} D_2 + \ldots + a_{6,n-1} D_{n-1} + e \qquad (4)$$

Table 2 panel B shows significant cross correlations between a minority of variables, most notably between the cyclical and other industry groupings. To deal with the effects of potential multi-collinearity the *CYC* variable was dropped from the model and the remaining co-efficients analysed in its absence. A similar procedure was adopted to assess the impact of interactions between *LNOLBETA*, *LNG* and *LNS*. Mean VIFs for all models tested were <1.5.

Finally, to test the possible interrelationship between the two types of leverage, an interaction term (*LNOLBETA*LNFLBETA)* was added to the model. This method has been used by Li and Henderson (1991) and Lord (1996) and provides a supplementary test of Huffman's (1983) interaction hypothesis.

Table 3 about here

4. DISCUSSION

The results of the regressions are reported in table 3. These show the full model set out in equation (4) above and variations in models A-D illustrating the specific impacts of variables important to the above hypothesis. As a robustness check, models E and F report the impact of these key variables using a non-parametric quantile regression specification.

Overall the models explained between 35% and 40% of cross sectional variation in beta, which is consistent with previous similar studies (Mandelker and Rhee, 1984). The *LNOLBETA* variable was significant in all models tested, whereas *LNFLBETA* is not. The evidence therefore supports hypotheses I and III but not hypothesis II. The significance of *LNOLBETA* was robust when non-parametric model specification was used in models (e) and (f). *LNOLBETA* was significant at only the 5% level in the absence of the *SBETA* variable. In contrast, *LNFLBETA* had a negative sign and was insignificant regardless of model specification. The interaction term (*LNOLBETA**LNFLBETA*) was also insignificant and with a negative sign, confirming the results of prior studies. However, if this variable is treated as a direct test of Huffman's (1983) negative interaction hypothesis, it is supported at the 5% significance level.

To examine the reasons for the apparent insignificance of *LNFLBETA*, further sensitivity tests were conducted. A possibility, again suggested by Huffman (1983) and Li and Henderson (1991) is that financial leverage is only important if debt exceeds a certain critical level. To test this hypothesis the sample was split at the median point and the models re-tested on a sub-sample of firms with above average financial leverage (n=78). The notable differences in these tests were that *LNFLBETA* was positive and significant at the 5% level in a simple regression model. It was also significant at that level when *SBETA* and *LNS* were added to the model. In the presence of *LNOLBETA**LNFLBETA* significance reduced to 10% and disappeared altogether when industry dummies were added. Overall, the evidence therefore constitutes only very weak support for hypothesis II, suggesting that financial leverage only affects beta in very specific circumstances.

SBETA was significant in all models tested, and in general added to the significance of the *LNOLBETA* variable when used in conjunction. So although the conjunction of fixed costs and sales revenue variation are important, they need to be flexed to account for the variation in revenue relative to changes in aggregate demand. Of the other control variables, growth was insignificant in all the models tested, whereas size was always strongly and positively significant. Of the industry variables, only *ITECH*, *NCYC* and *UTIL* were consistently influential. *ITECH* was positive and significant suggesting this sector of relatively new firms had higher betas, but also cross sectional variation in the sector is also important regardless of industry norms. This would also seem to be the case for *NCYC* and *UTIL*, although in these cases betas are significantly below average.

5. CONCLUSIONS

The results confirm the importance of operating leverage in the determination of systematic risk. In this respect the analysis confirms the consensus from similar previous empirical studies (Mandelker and Rhee, 1984, Huffman, 1989, Darrat and Mukherjee 1995, Li and Henderson 1991, Lord, 1996). Financial leverage was not important although there is some evidence in support of the notion of capacity trade off and, in very specific circumstances, critical levels of financial leverage (Huffman, 1983). So whereas operating fixed costs have the bigger impact on systematic risk, interest costs arising from financial leverage contribute towards the mitigation of managerial commitment to those fixed costs.

The role of operating leverage in the theoretical and empirical analysis has important implications for risk management and asset allocation within the firm and for the pricing of risk financial markets. The suggestion arising from the alternative approach in this paper is that the 'conventional' method, which identifies a quoted company already engaged in the proposed line of business and adjusts its beta by ungearing and regearing (Watson and Head, p.254), is the wrong approach. There are well known several problems such as the reliance on historical share price variation (usually over a five year period), the empirical question marks over the performance of stock market beta in explaining returns (Fama and French, 1992,1996). Empirical research shows that equity beta does not substantially explain the cross section of stock market returns, whereas these alternative factors might. Moreover, one might question the logic of management accounting, which in using market-based betas in cost of capital calculations, ignores the beta values implied by its own budgeting assumptions.

The linear relationship between operating cost and stock market beta suggest there is a security market line equivalent representing the underlying fixed costs of the business. Corporate managers committing their firms to high fixed cost investment, therefore face a higher cost of capital. Insofar as competitive advantage depends on making such investments, there is a clear trade-off in terms of higher expected returns and the alternative strategy of flexibility.

Table 1. Sample selection process

Number of firms in the FTSE ALL SHARE Index	685
Number of firms without beta data	(30)
Number of firms without complete data for sales, EBIT, after-tax profit, employment costs and equity available for the entire period 1998-2003	(285)
Number of firms with negative or error DOL and DFL values	(178)
Initial sample	192
Outliers and large negative growth firms	(36)
Final sample	156

Table 2: Descriptive statistics

Panel A: Variable descriptors

Variable	**Mean**	**Std Dev**	**Skew**	**Kurtosis**	**swilk Prob>z**
BETA	0.915	0.355	0.190	2.938	0.396
LNOLBETA	0.975	1.371	0.179	3.066	0.052
LNFLBETA	0.063	0.389	-1.335	6.793	0.000
SBETA	4.200	6.616	2.905	16.215	0.000
LNG	0.156	0.206	0.936	5.725	0.000
LNS	6.054	1.331	0.596	2.693	0.000
CYCL	0.500				
GENIN	0.096				
ITECH	0.045				
NCYC	0.109				
RESOR	0.026				
UTIL	0.032				

Panel B: Correlation matrix

	BETA	LNOLBETA	LNFLBETA	SBETA	LNS	LNG	*CYCL*	GENIN	ITECH	NCYC	RESOR	UTIL
BETA	1						0.051	0.076	0.197**	-0.266***	0.045	-0.274***
LNOLBETA	0.139	1					-0.117	0.050	0.093	0.061	0.082	0.006
LNFLBETA	-0.004	-0.037	1				0.128	-0.080	-0.032	-0.071	-0.099	-0.030
SBETA	0.126	-0.255***	-0.007	1			-0.023	0.053	0.072	-0.127	0.102	-0.036
LNS	0.187**	0.017	-0.059	-0.04	1		-0.163**	-0.051	-0.118	0.1788**	0.054	0.220***
LNG	0.107	-0.256***	0.042	0.444***	-0.097	1	0.133	0.001	0.124	-0.059	-0.071	-0.114
CYCL							1	-0.326**	-0.216***	-0.347***	-0.162**	-0.182**
GENIN								1	-0.070	-0.114	-0.052	-0.059
ITECH									1	-0.075	-0.035	-0.039
NCYC										1	-0.056	-0.063
RESOR											1	-0.029
UTIL												1

*** indicates significance P < 0.01
** indicates significance P < 0.05

Pearson correlation co-efficients are shown in the left half of the matrix and Spearman co-efficients for non-continuous variables are shown in the right half.

Table 2: Determinants of equity beta

Dependent variable = beta

	Model					
	(A)	*(B)*	*(C)*	*(D)*	*(E)*	*(F)*
Independent variable						
LNOLBETA	0.044***	0.043***	0.046***	0.036**	0.049**	0.040**
	(2.396)	(2.468)	(2.704)	(1.730)	(1.780)	(1.920)
LNFLBETA	-0.052					
	(0.756)					
LNOLBETA*			-0.094**			
LNFLBETA			(1.788)			
SBETA	0.007**	0.007***	0.008***			
	(1.806)	(2.587)	(2.669)			
LNG	0.130					
	(0.170)					
LNS	0.109***	0.107***	0.110***			
	(5.450)	(5.507)	(5.703)			
CYCL	0.006					
	(0.13)					
GENIN	0.071					
	(0.840)					
ITECH	0.357***	0.350***	0.353***			0.424***
	(3.510)	(3.670)	(3.962)			(3.040)
NCYC	-0.406***	-0.409***	-0.424***			-0.350***
	(3.990)	(4.217)	(4.909)			(3.820)
RESOR	-0.110					
	(1.54)					
UTIL	-0.854***	-0.846***	-0.932***			-0.771***
	(6.730)	(7.644)	(6.405)			(5.190)
CONS	0.221	0.246	0.233	0.880***	0.854***	0.889***
	(1.680)	(2.052)***	(1.988)***	(25.320)	(18.300)	(23.730)
N	156	156	156	156	156	156
F	11.700	22.140	18.850	4.720		
R-squared[I]	0.396	0.387	0.409	0.029	0.018	0.139
Ramsey RESET[ii]	0.244	0.472	0.339	0.572		
S-Wilk[iii]	0.090	0.084	0.219	0.614		

Notes: [i] Adjusted r-square in models *(A)-(D)*, which are specified as ordinary least squares, and psuedo in *(E) –(F)* which use median regression.
[ii] P-Value
[iii] P-value of the Shapiro-Wilk test of normality on regression residuals.

Bracketed figures are t-values, and in models *(A)-(D)* are based on White's (1980) heteroscedasticity-consistent variance matrix. They are based two tailed tests for dichotomous industry variables and on one-tailed tests for the continuous and interaction variables.

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[1] Because the denominator is the same for all firms $DOL(C)_i$ and β_{ci} can be used inter-changeably in cross sectional analysis.

[2] These figures imply leverage from operating fixed costs of 1.60, computed as the ratio of change in profit to change in sales. Variable cost (VC) = Sales – (DOL x ∏). Fixed cost = total cost – VC.

[3] This period may also differ from or be constrained by the estimation period for financial betas. DataStream's and LBS's betas are estimated over a 5-year period.

[4] $\beta = DY + G/(Rm - Rf)$ where DY is dividend yield.

[5] In Datastream, items Earned for ordinary (625) and Total share capital and reserves (307) are used as measures for profits after tax and equity respectively.