THE SIGNIFICANCE OF CORPORATION TAX AS A DETERMINANT OF SYSTEMATIC RISK: EVIDENCE USING UNITED KINGDOM (UK) DATA.

Imanueli D. Mnzava[1]
Insitute of Finance Management
Dar es Salaam, Tanzania

Abstract
This study uses the UK data and corporation tax changes of 1984 in the UK to test the significance of corporation tax as one of the factors influencing systematic risk. The extension to the theoretical relationship model between beta of levered equity and leverage is made to incorporate corporation tax and establish the testable relationship. Using both time series and cross sectional models involving fundamental determinants of systematic risk, the study provides an empirical evidence that corporation tax is one of the significant determinants of systematic risk and that systematic risk is positively related to leverage, effective corporate tax rate, return on assets, financial risk, growth in earnings and the risk of real asset., This study concludes that corporation tax changes of 1984 in the UK led to a significant decrease in firms' equity betas.

Keywords: *Corporate tax; Systematic Risk; Debt-Equity Ratio*

INTRODUCTION

The concept of risk-return trade off states that, in equilibrium, higher returns should be associated with high risk. The concept establishes that by investors trading in efficient capital markets, they should realize returns reflecting the systematic risk they assume. One of the models that establish the risk-return relationship by focusing on systematic risk is Capital Assets Pricing Model (CAPM), which uses equity beta as a measure of risk and suggests a positive linear relationship between return and risk. According to standard CAPM:

$$E(R_j) = R_f + \beta_J [E(R_m) - R_f] \qquad (1)$$

Where $E(R_j)$ is expected return on security *j*, R_f is risk free rate, $E(R_m)$ is expected return on market and β_j is the systematic risk (or *beta*) of security *j*.

Thus, the change in systematic risk (*beta*) is positively related to change in the required rate of return (cost of equity capital). Using the above relationship, one can argue that the factors that affect the systematic risk of a firm may have some effects on the cost of equity capital of the firm, and consequently on the value of the firm. Under the corporate tax structure followed in most countries, different sources of capital employed by a firm may results to different tax cash flows and consequently to different firm values. This suggests that corporation tax influences rate of return and value of the firm. It is from this understanding that I consider corporation tax to be one of the determinants of systematic risk and wish to test its significance in determining the systematic risk. The literature considers corporation tax as affecting the firm through financial leverage (Auerbach, 1985; Devereux, Bond and Denny,

[1] Dr. Imanueli Mnzava is a Lecturer of Finance at the Institute of Finance Management, Department of Collaborative Programs, in Dar es Salaam, Tanzania

1993; Dammon and Senbet, 1988; Fama and French, 1998; Lasfer, 1995; Mayer, 1986; Shum, 1996).

The relationship between corporation tax, financial leverage and value of a company as suggested by Miller and Modigliani (1958, 1963) is given by the following equation:

$$r_e = r_A + \frac{D}{E}(1-T)(r_A - r_d) \tag{2}$$

Where, r_e is return on equity, r_A is return on assets, r_d is return on debt, T is corporation tax rate, D and E are market value of debt and equity respectively. The relationship shows that there is a negative relationship between corporation tax rate and equity return and consequently systematic risk (*beta*). The relationship suggests that a company financed entirely by equity has a return on equity r_e equal to r_A, and that the term $\frac{D}{E}(1-T)(r_A - r_d)$ reflects the compensation for taking financial risk. If r_e is determined by the market, then compensation for financial risk reflects a level of systematic risk arising from using debt in firms' capital structures. In exploring a way in which corporate tax influence systematic risk, it should be noted that the theory of corporate financial policy predicts a positive relationship between corporation tax rate and *D/E* ratio (Dammon and Senbet, 1988; DeAngelo and Masulis, 1980; Givoly, Hahn, Ofer and Sariq, 1992; Miller and Modigliani, 1963). To establish a negative relationship between corporation tax (T) and return on equity capital (r_e), I re-write equation (2) by showing how *D/E* is related to other variables.[2]

$$D/E = \frac{r_e - r_A}{(1-T)(r_A - r_d)} \tag{3}$$

Given that r_A and r_d are constants, it is clear from equation (3) that for a debt-equity ratio, *D/E*, to remain unchanged, an increase (or decrease) in corporation tax rate, T, must cause a corresponding decrease (or increase) in return on equity, r_e. Thus, the negative relationship between corporation tax rate and return on equity (and consequently systematic risk), *ceteris paribus*, implies that the negative impact of corporation tax on return on equity more than offsets its positive impact on return on equity induced by a change in debt-equity.

This study empirically investigated the impact of corporation tax on systematic risk by using UK data and the corporation tax changes of 1984. Using both time series and cross sectional regression analysis the results show that corporation tax is one of the determinants of systematic risk. In this context the results of my study imply that the impact of corporation tax on systematic risk does not necessarily manifest itself only through other factors like leverage. The results showed that whether or not firms adjusted their capital structure immediately to

[2] This re-arrangement assume an equilibrium condition and consequently in equilibrium (according to that model) debt-equity ratio can be expressed in terms of return on equity, return on assets, return on debt and corporation tax rate.

reflect a change in corporation tax structure, effective corporation tax rate remained a relevant determinant of systematic risk.[3] The study also found out that the impact of a change in corporation tax on systematic risk was inversely related to return on assets.

The study also tested the relationship between equity *beta* and its fundamental determinants as documented in the literature. Study findings support the view that, over time, systematic risk is positively related to leverage, effective corporate tax rate, return on assets, financial risk, growth in earnings and the risk of real assets. In general, this study provided empirical evidence to show that corporation tax is a fundamental determinant of systematic risk and that the corporation tax changes of 1984 in the UK led to a significant decrease in firms' equity *betas*.

LITERATURE REVIEW

Both theoretical and empirical studies have analysed the relationship between systematic risk (*beta*) and financial leverage (Hamada, 1972; Ramchand and Sethipakdi, 2000). Hamada (1972) used Miller and Modigliani's (1963) proposition to establish a relationship between systematic risk of a levered firm and that of an equivalent but unlevered firm. The study does not analyse the relationship between corporation tax and leverage but it provides the evidence that approximately 24 percent of the variations in systematic risk are explained by variations in the debt-equity ratio. Their findings suggested that factor(s) that affect debt-equity ratio might affect the systematic risk. The study by Korajczyk and Sadka (2008) for example, has shown that liquidity which is argued to influence debt-equity ratio, is part of systematic risk as used in CAPM. Corporation tax, by affecting cash outflow of the company affects its liquidity and marketability of its stocks in the financial market and is potentially related to systematic risk.

Ramchand and Sethipakdi (2000) used a more general form of the relationship between *beta* of levered equity and that of unlevered equity and show a linear relationship between beta of levered common stock (β_e) and debt-equity ratio. They establish the following relationship:

$$\beta_e = \beta_a + (\beta_a - \beta_d) D/E \tag{4a}$$

Where β_e is *beta* of levered equity, β_a is *beta* of assets (a weighted average of *betas* of equity and debt), β_d is *beta* of debt and D/E is debt-equity ratio. Using (4a) and assuming that $\beta_d = 0$ and that β_a is unaffected by capital structure decision (Miller and Modigliani, 1958), a change in equity *beta* is positively related to a change in debt-equity ratio. More specifically, the change in levered equity *beta* is given as:

$$\Delta\beta_e = \beta_a \Delta(D/E) \tag{4b}$$

[3] It should be noted that corporation tax influence *beta* via debt-equity ratio. Since there are other factors which influence debt-equity ratio, it is expedient to ascertain the change in *beta* induced by the impact of change in corporation tax on debt-equity ratios. A partial derivation of *beta* with respect to corporation tax shows that *beta* is positively affected by change in corporation tax.

Using a sample of 147 equity issues between 1986 and 1993, the paper finds that US firms which issued equity (that is, decreased their debt-equity ratios) experienced a decline in price volatility and systematic risk. It further showed that a decrease in systematic risk is sensitive to whether the equity issue was global (that is, issued in foreign market) or domestic with a larger decline observed for firms which issued equity globally. As in Hamada (1972), Ramchand and Sethipakdi (2000)'s study also ignores factors influencing change in *D/E* ratio and the fact that there are other determinants of beta and debt-equity ratio which might be in operation at the same time. There is a need of controlling for the effects of other determinants in investigating the relationship between *beta* and *D/E* ratio.

Badhani (1997) uses the covariance structure of both levered and unlevered equity returns with the market return to show the relationship between levered and unlevered equity betas. The study shows the following relationship between *beta* of levered equity, β_L and *beta* of unlevered equity, β_U:

$$\beta_L = \frac{1}{1-L}\beta_U \tag{5}$$

Where L is a ratio of debt to capital employed, β_L is *beta* of levered equity and β_U stands for *beta* of unlevered equity.

It is clear from (5) that for $0 \le L < 1$, there is a positive relationship between L and β_L i.e. an increase (or decrease) in L leads to an increase (or decrease) in β_L, holding β_U constant. Badhani (1997) considers the potential change in β_L caused by changes in L, but it does not explore the factor(s) influencing the change in L. In this paper, I include corporation tax as one of the fundamental factors influencing L and asses its impact on systematic risk.

The study by Anderson, Hamid and Prakash (1994) analyses the relationship between systematic risk and growth in earnings. They use non-constant growth, Gordon's valuation model and the security market line to determine the covariance between the return on a security and its *beta*. They show that:

$$Cov(R_{it}, \beta_{it}) = \left(1 + \frac{D_{it-1}}{P_{it-1}}\right) Cov(g_{it}, \beta_{it}) \tag{6}$$

Where,

$$R_{it} = \frac{P_{it-1}(1+g_{it}) + D_{it-1}(1+g_{it})}{P_{it-1}}$$

g_{it} = Growth in earnings, prices and dividends in period t

D_{it} = Dividend in period t

P_{it} = Price in period t

The paper concludes that systematic risk is positively correlated with growth in earnings.

Chung (1989) shows that systematic risk of common stock is a function of net income to net equity ratio, degree of financial leverage (*DFL*), degree of operating leverage (*DOL*) and firm's intrinsic business risk as measured by firm's demand *beta* (B^D). Using a logarithmic transformation of the variables and linear cross sectional regression model, the study provides evidence that, *DFL*, *DOL* and B^D have a positive effect on systematic risk as hypothesised although only coefficients of *DOL* and B^D were found to be statistically significant at the 5 percent level.

Most empirical studies that have focused on the relationship between systematic risk and leverage report a positive relationship between change in leverage and change in systematic risk (Chung, 1989; Hamada, 1972; and Ramchand and Sethipakdi, 2000). Specifically, these studies found that an increase in leverage led to an increase in systematic risk and vice versa. However, Shah (1994) using a more focused capital structure change approach, provided results that suggested that leverage increases and decreases convey qualitatively different information. Using exchange offers, Shah (1994) showed that leverage increasing exchange offers lower the investors' assessment of risk (*beta*) but leaves the cash flows statistically unchanged while leverage decreasing exchange offers have no effect on systematic risk but lead to a significant decrease in the expected cash flows. The findings of Shah (1994) suggested that a leverage decreasing decision might not lead to a corresponding decrease in systematic risk. If his findings hold, then a decrease in leverage following the 1984 corporation tax changes might not lead to an expected decline in systematic risk.

Campbell and Mei (1993) decomposed *beta* into three components using unexpected excess return on stock. They argued that unexpected excess return is a function of revisions in future dividends, news about future real rate of interest and news about future excess return on stock. They showed that:

$$\beta_{i,m} = \beta_{di,m} - \beta_{r,m} - \beta_{ei,m} \tag{7}$$

where $\beta_{i,m}$ is market *beta* (defined using unexpected excess returns)

$\beta_{di,m}$ is market beta of news about future cash flows of assets *i*.

$\beta_{r,m}$ is market *beta* of news about future real interest rates.

$\beta_{ei,m}$ is market *beta* of news about future excess return on asset *i*.

The results showed that cash flow *beta* varies inversely with firm size. This implied that factors such as corporation tax and leverage, which affect cash flows, will be related to firm size. For example, since leverage affects cash flows *beta* positively, then the changes in *beta* following the corporate tax change of 1984 in the UK (the change is considered to have a negative impact on leverage), is expected to be inversely related to firm size.

In summary, most of the reviewed literature suggests determinants of systematic risk and how they are likely to influence systematic risk (as measured by equity *beta*). The variables that influence systematic risk as presented in this section form a basic set of relevant determinants of equity *beta* to be included in a model to be used in assessing the impact of corporation tax changes of 1984 on systematic risk.

Analysis of the Impact of Corporation Tax Changes on Systematic Risk

The main objective of this study was to investigate the impact of the corporation tax changes of 1984 on the systematic risk; and consequently to provide evidence on the significance of corporation tax as a significant determinant of systematic risk. The UK's corporation tax changes of 1984 (see IFS ,2002) involved the reduction of the corporation tax rate from 52 percent in 1983 to 35 percent in 1987 and eliminated initial (or first year) capital allowances (see Appendix A). The changes were progressive and affected all companies operating in the UK. The changes were also significant and it is considered to be important event to test the tax based corporate finance theory. The theory predicts that corporation tax is related to return on equity and consequently it implies that is related to equity *beta*. The changes in corporation tax in the UK, as given in Appendix A, are significant and provide a relevant event to test tax-related theories. The recent study by Ang, Hodrick, Xing and Zhang (2006) shows that time varying volatility induces changes in investment opportunity by changing the risk- return trade off. Thus, understanding of the impact of corporation tax changes on volatility (or systematic risk) and therefore return on equity is of relevance to policy makers as it will influence the change in tax policy.

On the basis of the risk-return trade off and on the assumption that financial markets reward investors for taking on systematic risk, *ceteris paribus*, levered equity *betas* should relate negatively to the corporation tax rate. A re-arrangement of the valuation model by Miller and Modigliani (1963) and using a relationship between *beta* of levered equity and that of an unlevered firm as shown by Hamada (1972), the following testable relationship between *beta* of levered equity and corporation tax rate exists:

$$\beta_L = \beta_U \left[1 + (1 - T)\frac{D}{S_L} \right] \tag{8}$$

From the equation 8 above, *ceteris paribus*, a negative relationship between *beta* of levered equity and corporation tax rate is expected.

It can be shown (see Appendix B), by extending the model by Badhani (1997) that:

$$\beta_L = \frac{1 - T}{1 - L}\beta_U \tag{9a}$$

Where T stands for corporation tax rate.

This extension was important to the study in two ways. Firstly, it reflected the real world situation because most firms operate in economies in which corporate profits are taxable. Thus, analysing the effect of leverage (which to some extent is influenced by the corporation tax) on *beta* without corporation tax, was equivalent to missing an important bit of a real world phenomenon. Secondly, the study focused on the impact of corporation tax reform on systematic risk, therefore, to have a tax variable in the model is necessary.

Lasfer (1995) argued that a change in corporation tax has no immediate effect on leverage. Based on his argument, the study analysed the effect of T on β_L using Equation 9a by assuming that both L and β_U are constants. In such a situation there was a negative relationship between T and β_L so long as L lies between 0 and 1. More specifically differentiating β_L with respect to T is less than zero. That is:

$$\frac{\partial \beta_L}{\partial T} = \frac{-\beta_U}{1-L} < 0 \quad for\, 0 \le L < 1 \tag{9b}$$

This showed for example that, an increase corporation tax (which is advantage since the value of tax shield will increase) led to a decline in systematic risk if that increase in tax had no impact on leverage.

However, on the other hand, a significant number of both theoretical and empirical studies show that corporation tax is one of the major determinants of capital structure and thus, has a profound impact on the debt-equity ratio. Thus, by using equation (8) and expressing L as a function of T, the relationship between β_L and T is given as follows:

$$\beta_L = \frac{(1-T)(r_e - i + iT)}{r_A - i - r_A T + iT}\beta_U \tag{10a}$$

Where r_e is return on levered equity, i is interest (borrowing) rate, r_A is return on assets and T is corporation tax rate. From equation (10a), a change in T is positively related to a change in beta of equity of a levered common stock. More specifically, a change in β_L with respect to T is shown as:

$$\frac{\partial \beta_L}{\partial T} = \frac{i}{r_A - i}\beta_U \tag{10b}$$

Therefore, so long as the rate of return on assets is greater than the borrowing rate (and this is almost always the case, otherwise it is irrational to borrow and invest in risky assets) and they are both positive, a change in systematic risk β_L caused by a change in corporation tax rate T is always positive. (A formal derivation of Equation 10b is shown on Appendix B

RESEARCH METHODOLOGY AND DATA ANALYSIS

Data and Research Methodology

The main objective of the study covered in this paper is to investigate the impact of corporation tax on systematic risk by using the corporation tax changes of 1984 as an event. The hypothesized relationship is that the change in corporation tax affected systematic risk negatively. It should be noted that the change in corporation tax affects all corporations simultaneously, but the response depends mainly on the corporate tax position of each individual company. For each relevant variable used in this study, annual data are drawn from Datastream for the period from 1974 to 2005 inclusive. The number of firms used to study the impact of tax changes on systematic risk is 197. In order to assess a change in systematic risk following the corporation tax changes in the UK, I estimate the equity *beta* using a market model. The estimated OLS slope coefficient (a measure of systematic risk) is then used as the dependent variable in regression analyses (time series and cross sectional) involving tax related variables and a set of fundamental determinants of *beta* as control variables.

Description and Estimation of Variables Used in the Analysis

Estimation of systematic risk variables: Two models were used to test the significance of tax as a determinant of systematic risk; time series and cross sectional regression model. The equity beta (a measure of systematic risk) was estimated using market model given in equation (11) below:

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \varepsilon_{jt} \tag{11}$$

Where, $R_{jt} = \log_e\left(\frac{RI_{j_t}}{RI_{j_{t-1}}}\right)$ is annual return on company *j* at period *t*, and $R_{mt} = \log_e\left(\frac{RI_{mt}}{RI_{mt-1}}\right)$ is annual return on market portfolio represented by FT All Shares Index. Item RI is annual total return index drawn from Datastream. The symbol ε stands for error term, whereas parameters α_j, β_j represent an intercept term and the *beta* of company j respectively.

The systematic risk (*beta*) of each company was estimated using annual data for each of the 29 years (1977-2005) and two *beta* variables (periodic *beta* and *csbeta,*) were estimated. The variable 'periodic *beta*' is the *beta* calculated using market model for each year from 1977 – 2005 inclusive. The variable '*csbeta*' is cross-sectional *beta* calculated for each company as the arithmetic mean of annual *betas* over 29 years (1977-2005). Note that the 'periodic *beta'* for 1977 was estimated using data points for 1974 to 1977and that a number of data points (observations) used to estimate *betas* for other years increases over time. For time series model we used data for 1974 to 2005 to estimate time series variables for 1977 to 2005. For cross sectional model, the changes in variable around the tax change period were determined by subtracting average value of variable for 1981-1983 from the average value of the same variable in 1988-1990.

Estimation of explanatory variables: Corporate finance theory suggests a number of factors that may influence the systematic risk (*beta*) of a company's equity. Some of the factors have been empirically tested to determine their statistical significance as determinants of systematic risk. In this sub section a total of seven factors are analysed and their theoretical relationship with *beta* be explained.

Effective Tax Rate, ETR: This is the variable included to test the hypothesized relationship between corporation tax change and systematic risk. It is calculated as a ratio of sum of taxation paid (Datastream item 433) and deferred corporation taxes (Datastream item 161) to the adjusted total operating profit (Datastream item 137). The relationship between effective tax rate and systematic risk in this study depend, among other things, on how quick firms adjusted their debt-equity ratios in response to the 1984 tax changes. If firms do not respond to the news about changes in corporation tax immediately by changing their debt-equity ratio, the corporation tax rate is expected to be negatively related to returns and consequently negative related to systematic risk (see Equation 1). On the other hand, if firms respond immediately to the changes in corporation tax rate by adjusting their leverage ratios, a positive relationship between corporation tax rate and systematic risk may be observed. Given the differences in tax positions of firms and extent of distortions brought by the pre-1984 tax changes in corporation tax system to each firm, the relationship between ETR and equity beta is not obvious. Some firms were likely to have increased their borrowing (and hence their debt-equity ratios) during the transition period in order to take advantage of capital allowances. For some firms however, there was no incentive to borrow and they might have reduced their debt-equity ratios to reflect unattractiveness of debt induced by the tax changes. The overall effect depends, among other things, on which group of firm was dominant. To assess the impact of tax changes on beta by employing a time series model, I need to introduce a multiplicative dummy variable, $RPt \times ETRpt$ where $RPt = 1$ during the tax changes period and zero elsewhere. The coefficient of $RPt \times ETRpt$ shows the change in coefficient of ETR induced by tax change and is expected to be significantly negative if the corporation tax reform led to a decrease in systematic risk. The same negative relationship between beta and ETR is expected when changes in the value of the variables around the reform period (rather than value at a particular date) are used in cross sectional regression.

Leverage ratio, (LEV): Leverage ratio is estimated as a ratio of total loan capital (Datastream item 321) to market value of equity (Datastream item MV). The relationship to be tested in this study emanates from the fact that asset betas are determined as the weighted averages of betas of debt and equity betas. Accordingly, the relationship between equity beta and debt-equity ratio (Ramchand and Sethipakdi, 2000) is positive as given by equation (4a). The use of debt financing firm's activities increases the variability of earnings available to equity holders and hence systematic risk. Thus, ceteris paribus, a positive relationship between beta and LEV is expected.

Return on Assets, (ROA): Return on assets is estimated as a ratio of adjusted total operating profit (Datastream item 137) to total assets (Datastream item 392 or TA). The relationship between return on assets and systematic risk tested in this study was derived from extension to the model Badhani (1997) model (equation 5) to include corporation tax. The relationship is derived in section 3 above. Theoretically, a positive coefficient of *ROA* (or r_A) in regression analysis is supported in the literature.

Previous studies show that *ROA*, at any time *t*, is positively related to leverage ratio; and since leverage is positively related to *beta*, the same relationship is implied between *ROA* and *beta*. However, using equation (10b) above and assuming that the change in *beta* around reform period is caused by the change in corporation tax, the coefficient of *ROA* in cross sectional regression involving the changes in variables around the tax reform period is likely to be negative.

Market value of equity, (MV): Market value is estimated as the natural logarithm of market value of equity (Datastream item MV). The relationship between MV and systematic risk (beta) is adopted from a non-stationarity model of beta by Brenner and Smidt (1977). According to their study, beta at time t is inversely related to market value, MV at time t-1. The relationship suggests that small firms' returns are more volatile relative to market returns due to their inability to absorb economic shocks. The opposite is true for large firms, which tend to have more stable return. Thus, a negative relationship between size and equity beta is expected.

Risk of real assets (RRISK): In this study, the risk of real assets is defined as the standard deviation of return on net tangible assets. Return on net tangible assets is defined as the ratio of adjusted total operating profits (Datastream item 137) to net tangible assets (Datastream item NTA). The implication according Brenner and Smidt (1977) is that factors which affect market value have no impact on risk of real assets. However, if risk of real assets is defined as given above, factors that cause changes in MV may have an effect on the risk of real assets. Consequently, the effect of a particular factor on market value will have an impact on return on real assets as well. Given that systematic risk is a component of total risk, a change in the risk of real assets would be positively related to a change in systematic risk. Thus, a positive relationship between RRISK and beta is expected.

Financial Risk (FR): Financial risk is defined as the variations in earnings available to shareholders (Datastream item 625) which are not explained by variations in net operating income (Datastream item 154). It is given as one minus the ratio of standard deviation of earnings available to shareholders to standard deviation of net operating income. Thus, FR is defined, symbolically as follows:

$$FR = 1 - \frac{\sigma_{EAS}}{\sigma_{NOI}} \tag{12}$$

Where *EAS* is earnings available to shareholders and *NOI* is net operating income. The symbol σ stands for standard deviation.

The relationship between *FR* and *beta* is adopted from a study by Kale, Noe and Ramirez (1991), which provides evidence of a non-linear relationship between business risk and optimal debt. Since debt is positively related to *beta*, it can be argued that a similar relationship exists between business risk and systematic risk (*beta*). Most studies assume that the nature of business operations for most firms remains unchanged, that is, the volatility of net income (or equivalently the financial risk) is attributable to other financing related sources. Financial risk is positively related to *beta* and if there is a non-linear relationship between financial risk and systematic risk, the coefficient of financial risk squared, *FRSQ* is expected to be negative.

Growth in earnings, GR: The variable GR is the growth variable estimated as the natural logarithm of the ratio of earnings available to shareholders (Datastream item 625) at time t to the same variable at *t-1*. The relationship between growth in earnings and beta as tested in this study was drawn from Hamid *et al*., (1994) which used a market model and Gordon's valuation model to show that the covariance of earnings' growth rate with beta is positive (see Equation 6). Their conclusion implies that any decision which leads to an increase in the growth of earnings will lead to an increase in systematic risk and vice versa. More specifically, this implies that the change in corporation tax in 1984, which aimed at reducing the tax burden to corporations, will lead to an increase in after-tax earnings and this will have a positive effect on systematic risk. Other things remaining constant, this implies that systematic risk is positively related to GR.

EMPIRICAL RESULTS

In analysing the impact of corporation tax changes on equity *beta* it is important to control for the potential effects other variables might have on *beta*. Thus, in order to justify the assertion that the corporation tax is one of the determinants of systematic risk and that corporation tax changes of 1984 led to a decline in *beta*, a formal analysis of the relationship between *beta* and its theoretical determinants is conducted. The significance of tax as a determinant of systematic risk (*beta*) is tested using both time series and cross sectional analyses.

Empirical Test and Results: A Time Series Analysis

In order to test the relationship between beta and the variables described in section 4.2 above, the following time series linear regression model is estimated by using annual data for a portfolio of 197 UK companies over the period of 29 years, 1977- 2005 inclusive.

$$\beta_{pt} = b_0 + b_1 ETR_{pt} + b_2 RP_t \times ETR_{pt} + b_3 LEV_{pt} + b_4 ROA_{pt} + b_5 MV_{pt-1} + b_6 FR_{pt} + b_7 FRSQ_{pt} + b_8 GR_{pt} + b_9 RRISK_{pt} + \varepsilon_{pt} \quad (13)$$

Where the *b*'s are parameters to be estimated, variables are as defined in section 4.2 and ε_{pt} is the error term (residual systematic risk of a portfolio) at *t*. The estimated coefficients and test statistics used to test statistical significance of each coefficient are presented on Table 1 (Appendix A).

Table 1 shows that the estimated coefficient of *ETR* (0.138) is significantly positive at 5 percent (p-value is 0.022). This result shows that even after controlling for other determinants of systematic risk, *ETR* continues to influence systematic risk. The results also support the view that corporation tax is positively related to debt-equity ratio and consequently is positively related to *beta*. It also implies that firms adjusted their debt-equity ratios rather immediately to reflect a change in corporation tax structure. The results show further that the estimated value of b_2 is significantly negative as expected. The estimated coefficient (–0.433) is statistically significant at any level of significance (p-value is virtually zero). This provides evidence that the corporation tax change led to a decline in systematic risk. The finding is consistent with Vassalou and Xing (2004)'s study which showed that default risk (which is a function of debt-equity ratio) is systematic risk and therefore reducing borrowing should also reduce default risk and consequently the systematic risk. The estimated coefficient of *LEV* is positive as expected (0.198) but is statistically insignificant at conventional levels of significance. One possible explanation of insignificance of estimated coefficient of *LEV* is that most of the effects of *LEV* on *beta* suggested in the literature emanate from corporation tax. Since the coefficient of *ETR* is positive and significant, the insignificance of *LEV* is not a surprise. The estimated coefficient of *ROA* is positive and statistically significant at 5 percent (p-value is 0.017). This supports a view that firms continue to borrow (hence higher leverage ratio over time) so long as *ROA* is greater than borrowing rate (see Equation 10b). Given the positive relationship between leverage and *beta*, the same relationship between *ROA* and *beta* should exist. The estimated coefficient of *MV* is negative as expected although it is statistically insignificant (the estimated coefficient is –0.0057 with a p-value of 0.300). The possible explanation of the weak negative relationship between *MV* and *beta* is that most of factors that determine *MV* also determine *beta* and therefore the effect of *MV* on *beta* may have been manifested through other variables like *LEV* and *ETR*. The negative relationship between *beta* and value is supported by both a traditional and a bankruptcy costs argument of capital structure.

The study also tested whether the relationship between *beta* and financial risk is linear or non-linear. As such two variables, *FR* and *FRSQ* were introduced to test a non-linear relationship between *beta* and business risk proposed by Kale *et al*., (1991). Results show that the estimated coefficients of *FR* and *FRSQ* are both positive but they are statistically insignificant. These results support the view that financial risk is positively related to *beta* and imply that borrowing increases financial risk by increasing the volatility of return on equity hence increased systematic risk.

The estimated coefficient of *GR* is positive as expected. This indicates that growth in earnings is positively related to *beta*. The estimated coefficient, however, is statistically insignificant (the estimated coefficient is 0.008 with a p-value of 0.408).

The estimated coefficient of *RRISK* is positive and highly significant (the estimated coefficient is 0.0139 with p-value of 0.006). This result implies that risk of real assets is positively related to systematic risk. This implies that most firms do diversify their portfolios in the sense that a large proportion of their total real asset risk is actually a market risk. The changes in total risk in such a situation should be positively related to changes in systematic risk.

In summary, the findings show that *ETR* is a significant determinant of systematic risk and that changes in corporation tax led to a significant decline in systematic risk. This result supports empirical evidence provided by Okzan (2001). Out of seven variables used as determinants of systematic risk, only the coefficients of effective tax rate, return on assets and risk of real assets are statistically significant. The signs of estimated coefficients of all other variables are as expected although the coefficients are statistically insignificant.

Empirical Results: A Cross Sectional Analysis

The changes in seven variables explained before were used in a cross sectional regression analysis to test whether a cross sectional change in corporation tax explains a cross sectional change in systematic risk. The 'changes' in variables determined by subtracting the values of variables before the tax changes (1981-1983) from their respective values after the changes (1988-1990).

The impact of tax changes on systematic risk is assessed through the coefficient of two variables, *ETR* and *ROA.* The estimated coefficients of both *ETR* and *ROA* are expected to be significantly negative if the hypothesis that corporation tax changes influenced equity *beta* negatively holds. The negative coefficient of *ETR* is expected due to the fact that the effective corporation tax rate is inversely related to return and consequently negatively related to systematic risk. On the other hand a negative coefficient of *ROA* is derived from equation 10b. The model and results for the cross sectional regression is presented on Table 2 (Appendix A).

The estimated coefficient of ΔETR is negative (-0.257) as expected and significant at 5 percent (p-value = 0.012). This supports the argument that *ETR* is one of the determinants of *beta* and that corporation tax changes led to a decline in systematic risk. Given the argument by Miao and Wang (2007) an increase (or decrease) in effective tax rate by influencing systematic risk it discourage (or encourage) investment. This argument implies that before implementing the change in tax policy, policy makers should consider the possible impact on level of investments. The estimated coefficient of ΔROA is also negative (-1.304) as expected and statistically significant at 5 percent (p-value = 0.010). This implies that a change in *beta* around the corporation tax changes period is negatively related to *ROA* as provided theoretically in equation (10b).

The results shown on Table 2 further show that, the signs of the estimated coefficients of *LEV*, *FR*, and *RRISK* are positive as expected. This indicates that the variables influence systematic risk positively although only a coefficient of RRISK is statistically significant at 5 percent. The sign of estimated coefficients of *MV* and *GR* are inconsistent with the hypothesised relationships and are all statistically insignificant. The results on *MV* suggest that a change in market value in a particular direction also lead to a change in systematic risk in the same direction. On the other hand, a negative coefficient of *GR* rejects the assertion made by Hamid *et al*., (1994) and suggests that companies that experienced decreases in growth rate of earnings experienced increases in systematic risk and vice versa.

Thus, although the results do not provide empirical evidence to support the relationship between systematic risk and all variables as hypothesised in the literature, it is evident that corporation tax influences systematic risk and that the corporation tax change of 1984 led to a decrease in systematic risk.

LIMITATIONS

Although the key relationship between corporation tax and systematic risk applies in any economy but the estimation of systematic risk assumes that the capital markets are efficient and competitive. If the estimation is done in imperfect market it is likely that the estimated beta will not be efficient and its use as a measure of systematic risk may produce unreliable results. Furthermore, this been an event study its main findings reflect the fact the study was conducted at the period around which there is a significant change in corporation tax. A similar study conducted during the period without significant change in tax may not produce similar results.

SUMMARY AND CONCLUSION

The objective of this study was to test the significance of corporation tax as a determinant of systematic risk by using the corporation tax changes of 1984 in the UK. The study utilised both time series and cross sectional analyses to provide empirical evidence that the corporation tax is in fact one of the factors influencing systematic risk and that changes in corporation tax led to a significant decline in systematic risk. The study also provided evidence to support the view that systematic risk is positively related to leverage, return on assets, financial risk, earnings growth and the risk of real assets. The findings also show that UK firms adjusted rather quickly their capital structure in response to changes in their effective corporation tax rates. This is consistent with the findings by Okzan (2001) who found that UK firms have target capital structures and that they adjust rather quickly towards their optimal capital structures.

REFERENCES

Ang, A., Hodrick, R.J., Xing, Y., Zhang, X. (2006). The Cross Section of Volatility and Expected Returns. ***The Journal of Finance***, 61, 1: 259-299.

Auerbach, A. (1985). Real determinants of corporate leverage. In B. Friedman (Ed), ***Capital Structures in the US***. Chicago: University of Chicago Press.

Badhani, K. N. (1997). Effects of financial leverage on systematic risk, cost and value of equity under capital assets pricing model. ***Finance India***, 11: 343-352.

Brenner, M., and Smidt, S. (1977). A simple model of non-stationarity of systematic risk. ***The Journal of Finance***, 32: 1081-1092.

Campbell, J. Y., and Mei, J. (1993). Where do betas come from? Asset price dynamics and the sources of systematic risk. ***Review of Financial Studies***, 6: 567-592.

Chung, K. H. (1989). The impact of the demand volatility and leverage on systematic risk of common stocks. ***Journal of Business Finance and Accounting***, 16: 343-360.

Dammon, R. M., and Senbet, L.W. (1988). The Effects of Taxes and Depreciation on Corporate Investment and Financial leverage. ***The Journal of Finance***, 43: 357-373.

DeAngelo, H. and Masulis, R.W. (1980). Optimal capital structure under corporate and personal taxation. ***Journal of Financial Economics***, 8: 3-29.

Devereux, M., Bond, S., and Denny, K. (1993). Capital Allowances and the impact of corporate tax on Investments in the UK. ***Fiscal Studies***, 14, 2: 1-14.

Fama, E. F., and French, K. R. (1998). Taxes, financing decisions and firm value. ***The Journal of Finance***, 53: 819-843.

Givoly, D., Hahn, C., Ofer, A., and Sariq, O. (1992). Taxes and capital structure: Evidence from firms’ response to tax reform choice of 1986. ***Review of Financial Studies***, 5: 331-355.

Hamada, R. S. (1972). The effect of firm's capital structure on the systematic risk of common stocks. ***The Journal of Finance***, 27: 435-452.

Hamid, S., Prakash, A. J. and Anderson, G.A. (1994). A note on the relationship between systematic risk and growth in earnings. ***Journal of Business Finance and Accounting***, 21: 231-242.

Kale, J. R, Noe, T.H. and Ramirez, G. G. (1991). The Effect of Business risk on corporate capital structure: Theory and Evidence. ***The Journal of Finance***, 46: 1693-1715.

Korajczyk, R. A. and Sadka, R. (2008). Pricing Commonality across different measures of liquidity. ***Journal of Financial Economics***, 87 45 -72.

Lasfer, M. A. (1995). Agency Costs, Taxes and Debt: The UK Evidence. ***European Financial Management***, 1, 3: 265-285.

Mayer, C. (1986). Corporation Tax, Finance and the Cost of Capital. ***Review of Economic Studies***, 53: 93-112.

Miao, J. and Wang, N. (2007). Investments, Consumption and Hedging under incomplete markets. ***Journal of Financial Economics***, 86: 608 – 642.

Miller, M. H. and Modigliani, F. F. (1958). The cost of capital, Corporation Finance, and the Theory of Investment. ***American Economic Review***, 48: 261-297.

Miller, M. H. and Modigliani, F. F. (1963). Corporation Income Tax and the Cost of Capital: A correction. ***American Economic Review***, 53: 433-443.

Ozkan, A. (2001). Determinants of Capital Structure and Adjustment to Long Run Target: Evidence from UK Company Panel Data. ***Journal of Business Finance & Accounting***, 28, 1&2: 175-198.

Ramchand, L., and Sethipakdi, P. (2000). Changes in systematic risk following global equity issuance. ***Journal of Banking and Finance***, 24: 1491-1514.

Shah, K. (1994). The nature of Information Conveyed by Pure Capital Structure Changes. ***Journal of Financial Economics***, 36: 89-126.

Shum, P. M. (1996). Taxes and Corporate Debt Policy in Canada: An Empirical Investigation. ***Canadian Journal of Economics***, 29: 556-572.

Vassalou, M. and Xing, Y. (2004). Default Risk in Equity Returns. ***The Journal of Finance***, 59, 2: 831-868.

APPENDIX A: (Tables)

EXHIBIT 1

The UK Corporation Tax Rates, 1982 - 1988

Year	Full Rate (%)	*Rate of Capital Allowance (%)*				Advance Corporation Tax (ACT) %
		Plant and Machinery		Industrial Buildings		
		First Year	*Writing down*	*Initial*	*Writing down*	
1982-83	52	100	25	75	4	30
1983-84	50	100	25	75	4	30
1984-85	45	75	25	50	4	30
1985-86	40	50	25	25	4	30
1986-87	35	0	25	0	4	29
1987-88	35	0	25	0	4	27

Source: The Institute of Fiscal Studies (IFS), Fiscal Facts, 2002 on www.ifs.org/taxsystem/corp1time.shtml

TABLE 1: The Estimated Coefficients for the variables hypothesised to influence Systematic Risk (beta) of a company: A Time Series Model's Results

Variable	Coefficient	Standard error	T-value	P-value
Intercept	0.913	0.067	13.65	0.000
ETR	0.138	0.052	2.64	0.022
$D_t \times$ETR	-0.433	0.071	-6.12	0.000
LEV	0.198	0.124	1.60	0.136
ROA	0.866	0.313	2.77	0.017
MV	-0.006	0.005	-1.08	0.300
FR	0.008	0.006	1.42	0.182
FRSQ	2.87 E–6	4.17 E–6	0.69	0.504
GR	0.008	0.009	0.86	0.408
RRISK	0.014	0.004	3.33	0.006
R-Squared	88.1%			

TABLE 2: Cross sectional estimates of coefficients estimated to test the impact of corporation tax reform on systematic risk.

Variable	Coefficient	Standard error	T-value	P-value
Intercept	0.024	0.038	0.63	0.527
ΔETR	-0.257	0.102	-2.52	0.012
ΔLEV	0.042	0.050	0.84	0.402
ΔROA	-1.304	0.501	-2.60	0.010
ΔMV	0.037	0.025	1.47	0.143
ΔFR	0.00043	0.00106	0.40	0.686
ΔGR	-0.008	0.007	-1.07	0.284
ΔRRISK	0.189	0.091	2.08	0.039
R-Squared		10.1%		

APPENDIX B:

Deriving the relationship between *beta* of asset and *beta* of levered equity under corporation tax.

Description of the variables

C = total capital employed
D = debt capital
i = rate of interest (borrowing rate)
T = corporation tax rate
r_A = return on assets
r_e = return on levered equity
r_m = return on market
β_L = *beta* of levered equity
β_U = *beta* of unlevered equity or beta of assets

$$r_e = \frac{(r_A C - iD)(1-T)}{C-D} \quad \text{(i)}$$

By removing brackets and dividing through out by C we get:

$$r_e = \frac{r_A(1-T) - i\,{}^{D}\!/_{C}(1-T)}{1 - {}^{D}\!/_{C}} \quad \text{(ii)}$$

Letting L = D/C, we can write the formula for *beta* of levered equity as follows:

$$\beta_L = \frac{Cov(r_e, r_m)}{Var(r_m)} = \frac{Cov\left[\left(\frac{r_A(1-T)}{1-L} - \frac{iL(1-T)}{1-L}\right), r_m\right]}{Var(r_m)} \quad \text{(iii)}$$

Assuming that i is independent of r_m we have:

$$\beta_L = \frac{Cov\left(\frac{r_A(1-T)}{1-L}, r_m\right)}{Var(r_m)} \quad \text{(iv)}$$

$$\beta_L = \frac{(1-T)}{(1-L)}\beta_U \text{ where } \beta_U = \frac{Cov(r_A, r_m)}{Var(r_m)} \tag{v}$$

Using equation (ii) and substituting *L* for *D/C* we can write *L* in terms of other variables as follow:

$$L = \frac{r_e - r_A(1-T)}{r_e - i(1-T)} \tag{vi}$$

Substituting the value of *L* from (vi) into (v) and removing the brackets we arrive at the following expression:

$$\beta_L = \frac{r_e - i + 2iT - r_e T - iT^2}{r_A - i + iT - r_A T}\beta_U \tag{vii}$$

By using quotient rule, the partial derivative of β_L with respect to *T* is given as follow:

$$\frac{\partial \beta_L}{\partial T} = \frac{i}{r_A - i}\beta_U \tag{viii}$$