THE USE OF STRUCTURAL EQUATION MODELLING (SEM) IN CAPITAL STRUCTURE EMPIRICAL ANALYSIS

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Abstract

This study synthesizes the capital structure determinants theory and empirically examines both the determinants and the suggested firm behaviour patterns in relation to financing decisions of 651 UK companies between 1985 to 2000. Such analysis is carried out by using a relatively new and innovative factor-analytic structural equation modelling (SEM) methodology. The SEM Methodology allows the use of more than one indicator for a latent variable. It also estimates the latent variables and accommodates reciprocal causation and interdependences among variables. Methodologically, all previous UK capital structure studies used conventional regression estimates. Given the differences in tax regimes, and similarities in economic systems, it is important to find out whether the results will be different from those of the US study, (Titman and Wessels, 1988), and the Australian study, Chiarella et al. (1992), that used SEM methodology. Consistent with the dominant theory, the findings of this study are that non-debt tax shields, business risk and probability of bankruptcy are negatively related to gearing, while tangibility, firm size and current profitability are positively related to gearing. The study does not provide support for any negative impact on debt arising from past profitability and tangibility.

JEL classification codes: G32.

Key words: *Capital Structure, Structural Equation Modelling, SEPath, United Kingdom*.

INTRODUCTION

Evidence exists in literature that empirical work in the area of determinants of capital structure has lagged behind the theoretical research. Not only has the empirical work on determinants of capital structure lagged behind the theoretical research, but comparatively, in the UK there have been less such studies than in the U.S. While the U.S. boasts of scores of such studies starting since late sixties, in the UK only a few studies exist. This was the case in 1980s (see Marsh, 1982: 121); It continued to be the case in 1990s (see Varela and Limmack, 1998: 2); It is still the case to date (see Ozkan, 2001).

One of the earliest UK studies was Marsh (1982), who gave a summary of a number of prior cross-sectional studies on determinants of capital structure, and postulated that during the time of his publication there was support that *business risk*, *firm size*, and *asset composition* exerted the hypothesized influence on gearing decisions. Marsh also suggested that the documented significant industry effect in gearing by Schwartz and Aronson (1967) among others, might simply be a mere reflection of systematic industry differences in asset composition, risk, and other variables.

A subsequent UK study by Bennett and Donnelly (1993) found that asset structure, and firm size, do affect capital structure in the manner suggested by the ‘balancing’ theory of capital structure. They also documented that *non-debt tax shields*, and *past profitability* were both negatively related to gearing, though their

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results did not provide significant evidence for growth as a determinant of capital structure. They also reported that industrial classification explains a significant cross-sectional variation in capital structure of UK firms. However, their findings that earnings volatility is positively related to gearing was both counter intuitive and inconsistent with the theory which says that risky firms are more likely to avoid the use of higher levels of debt. Neither did their analysis go further to investigate whether the cross-sectional variation in debt ratios among different industries was due to business risk or due to asset structure as postulated by the theory (see for example Marsh [1982] and Kale *et al.*, [1991]). Their study provided more significant results for market rather than book value gearing ratios.

In an international study by Rajan and Zingales (1995), UK was included only as a component. Apart from investigating the levels and determinants of capital structure in the G-7 countries, the study also examined institutional differences among these countries. Their cross-sectional evidence suggested that *growth prospects* (proxied by market-to-book ratio), and profitability are negatively related to gearing while company size, and tangibility were found to be positively related to gearing in the UK.

Bevan and Danbolt (2002) replicated the Rajan and Zingales (1995) and found almost the same results, except that the tests for tangibility had conflicting results depending on the definition of gearing used. Total debt to total assets ratio generated positive relationship with gearing while the ratio of non-equity liabilities to total assets yielded a significant negative relationship. More recently, Ozkan (2001) has also contributed to this body of research. He found that growth opportunities, non-debt tax shields, *current profitability,* and *liquidity* exert a negative influence on gearing.

A careful survey of prior research and empirical investigation reveals that inconsistencies in the results are contributed by not only choice of gearing measures, how gearing is calculated and choice of proxies for independent variable. These differences and perverseness are also contributed by inappropriate methodology. This study therefore uses a more innovative methodology in the UK environment.

LITERATURE

Findings from previous UK studies on determinants of capital structure, in the light of the underlying theory and findings of similar empirical studies done elsewhere, can therefore be summarized as hereunder. First, there exists persuasive evidence that size exerts a positive influence on gearing. Secondly, there exists some evidence, albeit weak in some cases, that tangibility is positively related to gearing. Thirdly, there is still inconclusive evidence whether business (operating) risk is negatively related to gearing as the dominant theory predicts. This is the case because most UK studies have avoided testing this attribute. Bennett and Donnelly (1993) who tests it find a counter intuitive result of a positive relation between earnings volatility and gearing.

When it comes to growth opportunities, negative relationship between growth and gearing outweighs evidence to the contrary. Fifthly, between the two studies that tested for industry classification one-study documents a significant industry effect, while the other report rather weak evidence. Profitability, the sixth determinant tested in UK studies, shows some confusion just like studies conducted elsewhere. The two studies, that did not report the segregation between past and current profitability, report a negative relation consistent with the dominant theory. The other two studies, that attempted to segregate past from current profitability, also have interesting results; one reported a negative relation between past profitability and gearing. The other reports a negative relationship between current profitability and gearing but a positive relationship between past profitability and gearing. These findings are actually the opposite of what the expectations should be given the theory. It has also been found that liquidity is negatively related to gearing. Contradictions in these previous UK studies are worth examining.

The factors, that have been examined by UK studies, are therefore limited to the seven factors that is. tangibility, business risk, size, growth opportunities, industry influence, profitability, and liquidity, as discussed and summarised in the immediately preceding paragraphs. Among the factors tested elsewhere, both *uniqueness*, and *cash holdings,* have not been tested in previous studies, which have used UK companies' data. In addition to the confirmation of the factors discussed above, this paper reports results following tests of these two determinants probably for the first time in the UK.

Although there have been numerous references and echoes in the literature about *free cash flow* and *probability of bankruptcy,* the literature does not provide evidence of any rigorous empirical analysis regarding these hypothesised determinants. This study carries out empirical tests on these two determinants by introducing a new proxy for probability of bankruptcy in capital structure research, and by conducting rigorous tests on free cash flow hypothesis as well in order to validate the respective theories.

Methodologically, most previous UK studies used conventional regression estimates in their analysis of determinants of capital structure. Conventional regression analysis has been criticised for failing to recognise and mitigate measurement errors and other econometric problems that arise in studies involving estimation of latent variables. Such problems include ignoring measurement errors in exogenous variables; failing to accommodate models that include *latent variables, reciprocal causation* among variables, and *interdependence* among variables, and failing to include more than one indicators for a latent variable (Titman and Wessels, 1988).

The relatively lack of empirical work on determinants and on dynamics of capital structure in the UK could be attributable to a number of reasons. First, as Titman and Wessels (1988) puts it, the relevant attributes theorised to affect capital structure are usually expressed in fairly abstract concepts not directly observable. Secondly, there seems to exist complacency by some researchers that UK and U. S. exhibits more or less the same economic and financial environment. That being the case, they argue, findings in the U.S could also apply to the U.K.

This study therefore synthesizes the theory regarding capital structure determinants and takes the theory further by empirically examining both the determinants and the newly suggested firm behaviour patterns in relation to financing decisions. Such analysis is carried out, by using a relatively new and innovative factor-analytic structural equation modelling (SEM) methodology. One of the goals of this study is to test a larger number of determinants of capital structure by examining their impact on multiple gearing measures. Consequently, the number of *indicators* is also likely to rise. The resulting increase in the number of variables creates two possibilities. One is that some variables are likely to be highly correlated, with the result that they will not represent different concepts and/or there are going to be several proxies (indicators) representing one attribute of interest. This being the case, it is crucial that the interrelatedness between or among variables be identified so that the results are interpreted correctly. It is here where SEM becomes useful.

The use of SEM has been prompted by the two previous empirical capital structure determinants studies, which have so far used it. In a U.S. study, Titman and Wessels (1988), the pioneers of this technique in capital structure empirical studies, and subsequently in Chiarella *et al.* (1992), an Australian study. These studies have claimed that SEM estimation technique has a number of advantages over the conventional (standard) or traditional regression models, including its ability to recognise and mitigate measurement and specification errors, which have plagued previous similar studies.

Despite these theoretical justifications, the results of these two empirical studies generate more contradicting (even between the studies themselves), insignificant, and perverse results than most other similar studies, which have used several variants of the conventional regression estimation models. Before we can judge the practical superiority (or rather inferiority) of the SEM model, we need to use it on an independent sample in a different environment. Besides, prior literature does not provide any evidence of the use of SEM by previous UK capital structure empirical studies. The use of multiple measures of gearing also serves to capture the different forces that govern the choices of long-term debt, and short-term debt, or book value measures and market value measures, and thereby provide explanation for theories predicting different relationship between attributes and different types of debt.

Briefly, the findings of this study are that growth and past profitability are negatively related to gearing, while size is positively related to gearing. Some weak evidence is also discerned that non-debt tax shields, and probability of bankruptcy are negatively related to gearing. The study does not provide support for any impact on debt arising from future profitability, and tangibility.

Approaches to empirical research on determinants of capital structure:

Some researchers have recently been involved in testing the relative strength (validity) of the competing optimal capital structure theoretical models like ‘trade off’ theory, pecking order theory, etc. See for example, Bradley *et al.* (1984), Jung *et al*. (1996), Shyam-Sunder and Myers (1999), and Fama and French (2002).

Another school of thought has taken the view that there appears to be many factors, which affect capital structure choice such that it is difficult to arrive at a simple model of determining capital structure. This group therefore seeks to identify and test various factors theorised to affect capital structure in order to find evidence of either positive or negative relationship between leverage and these factors. These studies include Ferri and Jones (1979), Marsh (1982), Titman and Wessels (1988), Rajan and Zingale (1995) and Bevan and Danbolt (2002).

Hypotheses

This study tests the following hypotheses:

1. H_1 : Asset structure or tangibility is positively related to gearing.

2. H_2: Non-debt tax shields are negatively related to gearing.

3. H_3: Growth potential/investment opportunities are negatively related to gearing.

4. H_4: The size of a firm is positively related to gearing.

5. H_5: Volatility of returns (risk) is negatively related to gearing.

6. H_6: The level of past profitability is negatively related to gearing

7. H_7: The level of current profitability is positively related to gearing

8. H_8: Probability of bankruptcy is negatively related to leverage.

RESEARCH METHODOLOGY

Data

The data were taken from DataStream. The database contains accounting data and market value data relating to 1277 UK industrial (non-financial) companies collected. The data relate to the 16-years from 1985 to 2000. The variables were analysed over the 16 years period (1985 through 2000). The required variables for non-regulated, non-financial, companies in the U.K were computed as far as the data permitted.

The sample selection went as follows; from the original sample of 1277 companies collected, some companies could not meet the criteria set. Firms were selected using the following criteria: Regulated firms like utilities, railway companies, electricity, gas and telephone providers were excluded. Regulation limits managerial discretion by transferring much of the investment and financing decisions to regulatory authorities. Such managerial restrictions together with a stable cash flow stream brought about by the regulatory process, implies that regulated firms should be expected to have higher leverage and pay high dividends than unregulated firms (Barclay *et al.*, 1999: 225-226).

It has been argued that regulation ‘protect’ firms (or industries) from failure and therefore could lead to higher gearing (Bowen, *et al.*, 1982: 13). One of the outcomes of regulation is that financing decisions of these firms are unlikely to convey new information to the market (Pinegar and Wibrich, 1989: 84).

Empirically, Bradley *et al.* (1984) provided evidence that out of 54 percent capital structure variation explained by industry classification, 29 percent was due to regulation effect. Financials like banks and insurance companies were also excluded because their capital structures are not normally a result of pure financing decisions but also reflect regulations such as minimum capital requirements, and insurance scheme such as deposit insurance (Rajan and Zingales, 1995: 1424). Only firms with at least 11 years of data (out of 16 years) were included. These selection criteria reduced the number of firms to the final sample of 651 firms.

Methodology

In capital structure theories in particular, a number of factors (attributes) have been theorised to influence capital structure. Size, business risk, profitability, growth, uniqueness are but a few examples. Although these attributes exist, a good number of them are not readily visible and sometimes difficult to quantify. Consequently researchers have to come up with some indicators (proxies) for the attributes of interest. In capital structure determinants research, these indicators are included in regression equation as explanatory variables. Some practical problems usually crop up at this stage. First, not only there may be more than one proxies contributing towards one attribute, the relationships which may not be captured by conventional regression estimates without a considerable degree of collinearity problems.

Alternatively the researcher may be biased towards working with fewer proxies by selecting those which are statistically convenient (that is. have higher explanatory power in terms of higher R-sq, etc.) even if some indicators are ignored or even if the relationship between variables is mechanistic or spurious (See Titman and Wesses, 1988; Bevan and Danbolt, 2002; and Welch, 2002). As Titman and Wessels (1988) puts it '…measurement in the proxy variables may be correlated with measurement error in the dependent variables, creating spurious correlations even when the unobserved attribute being measured is unrelated to the dependent variable' p. 1. Chiarella *et al.* (1992) conclude that where variables are generated from unobservable attributes, conventional regression is found wanting.

Structural equation modelling

For a long time Ordinary least squares (OLS) analysis has dominated research related to controlled experiments, group comparisons, and prediction studies. These regression models have been used in many fields including physical science for curve-fitting problems and even in financial economics where an empirical relationship between an observed dependent variable and a manipulated (varying) independent variable must be estimated. One key feature of regression models is that only the dependent variable is assumed to be subject to measurement errors or other random variation. The independent variable (or treatment level, as it is referred to in some non-parametric tests) is assumed to be fixed by the researcher at known values. There is a problem with this assumption because in most such experiments, the measurements of independent variables are also subject to errors.

In addition to ignoring measurement errors in exogenous variables, traditional regression models are not designed to accommodate models that include *latent variables*, *reciprocal causation* among variables, and *interdependence* among variables. In most previous similar studies, proxies for latent variables have been used in place of the latent variables. The use of proxies creates an additional problem to regression models not only because there is a possibility that there may be no one unique proxy for a latent variable being examined, but also a proxy may be correlated with other variables in the model. It is therefore obvious that these conventional regression models would not be appropriate and any results from an attempt to use them in such cases would be misleading.

In many fields of scientific inquiry (financial economics included) sometimes a mere empirical prediction is not an objective of the study. In these cases the essential problem of data analysis is the estimation of *structural* relationships between quantitative observed variables. When the mathematical model that represents these relationships is linear, a *linear structural relationship* emerges. The various aspects of formulating, fitting, and testing such relationships are referred to as *structural equation modelling (SEM).*

SEM software packages like *SEPATH*, Linear structural relationship (*LISREL*), *AMOS*, or EQS are descendants of *factor analysis*. Factor analysis is a generic name given to a class of multivariate statistical methods whose primary purpose is to define the underlying structure in a data matrix. Factor analysis is a statistical approach that can be used to analyse interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (factors). It is a statistical approach involving finding a way of condensing the information contained in a number of original variables into smaller set of dimensions (factors) with a minimum loss of information.

Unlike conventional regression, which is a dependence (or a prediction) technique, factor analysis is an interdependence technique in which all variables are simultaneously considered, and although still employing the concept of the variate and linearity, each variable is related to all others. Factor analytic techniques can either be used as exploratory tool or as confirmatory tool.

The earliest and most common form of factor analysis is exploratory factor analysis (EFA), also known as correspondence analysis, is a descriptive technique useful in studies seeking to uncover the underlying structure of relatively large set of variables or as a data reduction method, in cases where the researcher has no pre established theory and his a priori assumption is that any indicator may be associated with any factor. The researcher has a 'take what the data give' attitude. The exploratory factor analysis enables the researcher to see the relationships among variables that are not at all obvious in the original data or even in the correlations among variables. The factor loadings in this case are used to gain insights into the factor structure of the data.

Confirmatory factor analysis (CFA) on the other hand, refers to cases where the researcher has preconceived ideas about the actual structure of the data, may be from the underlying theory or prior research. The researcher therefore wishes to test some hypothesis about the data structure. In the language of factor analysis, the researcher wishes to determine if the number of factors and the loadings of measured (indicator) variables on them conform to the underlying theory. In this approach, indicator variables are selected on the basis of this underlying theory and factor analysis is used to confirm if they load as predicted on the expected number of factors. The structural equation modelling (SEM) approach is typically used to model causal relationships among unobservable variables (factors). Confirmatory factor analysis through Structural equation modelling (SEM CFA) requires a software package such as SEPATH whose model specification is discussed in detail in the next section.

In capital structure empirical research, a factor-analytic technique, SEM, has been used in the US by Titman and Wessels (1988), who were the pioneers of its use, and in an Australian study, Chiarella *et al.* (1992). Both studies have claimed that its use improves the estimation procedure and mitigates measurement and specification errors inherent in other previous studies that have not used this methodology.

Having identified more appropriate proxies for the theoretical attributes, this independent testing of this new methodology by using different data is vital for a number of reasons. First, both studies that have used the new technique contend that the technique has relative merits over traditional approaches used so far. Titman and Wessels (1988) argue that because there is no single unique proxy for a theoretical (unobservable) attribute, researchers may select a statistically convenient variable with a resulting consequence of a bias in interpretation. They suggest further that the interrelation among variables of interest implies that a selected variable for one attribute may actually be measuring the effects of other variables as well. Finally they claim that the correlation between measurement errors in proxy variables with similar errors in gearing measures are likely to cause spurious results whether or not the unobservable attribute is related to the measure of gearing. Both Titman and Wessels (1988) and Chiarella *et al.* (1992) maintain that LISREL explicitly recognises and mitigates these measurement and specification problems.

LISREL related methodology has also been used in other fronts of financial research. Titman and Wessels (1988) say that the methodology is very similar to the return generating process used by Roll and Ross (1980) to test the Arbitrage Pricing Theory (APT) formulated by Ross (1976). In that empirical investigation Roll and Ross use similar technique and conclude that APT performs well under empirical scrutiny and they recommend that APT should be considered a reasonable model form explaining cross-sectional variation in average returns (Roll and Ross, 1980: 1076).

Despite elaborate theoretical justification for SEM provided by Titman and Wessels (1988) and Chiarella *et al.* (1992), these empirical studies provide more contradicting as well as perverse results than other studies. Their results were consistent in that both found no significant support for tangibility and growth opportunities as determinants of capital structure. However, despite the use of the same technique the studies had some contradicting results in that while the former did not provide significant evidence that non-debt tax shield has any effect on gearing and also found that size is negatively related to gearing, the latter study found strong evidence in support of non-debt tax shield as an inverse determinant of gearing, and that size is positively related to gearing. Titman and Wessels (1988) also fails to provide support for volatility as a determinant of gearing and as a result wonder whether their model captured the relevant aspects of the attributed as per theory prescriptions.

Generally, either the model does not perform well for both studies or their data is not representative of a cross-section of Australian or US firms. Titman and Wessels (1988) uses data relating to 469 firms while Chiarella *et al.* (1992) uses 226 firms (See table 1). Their results are actually more perverse than most other studies that have used traditional OLS regression. For example Titman and Wessels (1988) does not provide evidence to support the theoretical predictions regarding the impact of growth opportunities, non-debt tax shields, volatility, or collateralizable assets.

Most other studies using traditional methods (OLS-regressions, GMM etc.) have generally agreed on the direction of influence these attributes have on gearing (See for example Rajan and Zingales, 1995; Bennett and Donnelly, 1993; Ozkan , 2001; and Bevan and Danbolt, 2002, among others). With hindsight it seems like the two studies that used SEM also used some inappropriate proxies, the problem which is also dealt with in this study.

Differences in results between these two studies, and between these two on one hand and the rest of other studies call for the an independent testing of the technique by using the data taken from a different environment (something which has not been done before), in order to explore whether the new methodology has any potential, whether it is just another method, or indeed whether it is inferior to the traditional methods. A relatively larger sample is used, a longer period is covered and a larger number of attributes are tested in an attempt to both avoid econometric problems and extend empirical research to untested theoretical attributes. The result from the use of this methodology will help us judge the practical superiority (or rather inferiority) of the SEM model.

The SE Path Model specification

The application of this model in this study flows from the discussion of factor analysis discussed above and relies on statistical software *SEPath*. From the preceding discussion and the hypotheses developed earlier in this chapter, it has become evident that this study has a number of *a priori* assumptions about the relationships among different variables used. This assumption has to be tested in order to confirm a number of theoretical predictions in capital structure theory. It has also been stated that the use of a factor-analytic technique in this context is known as *confirmatory factor analysis (CFA)*. In factor analytic terms the study seeks to test specific hypotheses about the factor structure for a set of variables in a given sample. Such application of factor analysis requires the use of a structural equation modelling (SEM).

This study therefore fits into *structural equation modelling-confirmatory factor analysis (SEM CFA)*. A particular software package used for this kind of study is known as *SEPath*. The package is a simpler automated approach to Structural modelling than the well-known *Linear Structural Relationships (LISREL)* which was developed by Joreskog and Sorbom (See Joreskog, 1977; and Joreskog and Sorbom, 1981).

Because in this study factor analysis takes a confirmatory (CFA) approach, which implies that the researcher hypothesize beforehand about the number and the factor structure for a set of variables, it is necessary that a brief summary of the variables be presented at this point. The variables are divided into two; (i) 18 indicators (proxies) which represent ten attributes, and (ii) eight gearing ratios. The use of SEM CFA, and *SEPath* allows more than one indicator for each attribute, which is why the number of indicators exceeds the number of attributes. In addition an indicator variable can contribute to more than one attribute although in the model used here there was no such relationship. Some attributes have four, three or two indicators, others have only one depending on theoretical predictions and/or existence of sufficient correlation among them. Some of these indicators have been used following previous research. Others however, are new to capital structure research, and have been used because it is considered that they have stronger linkages with the relevant attributes.

In its most general form, *SEPath* consists of a set of equations. Variables in the equation system may be either directly observable variables, or latent variables. In the model, the linear structural relationship and the factor structure are combined into one comprehensive model applicable to observational studies in many fields. It is assumed in the model that there is a causal structure among a set of latent variables, and that the observed variables are indicators of the latent variables. The model consists of two parts, the measurement model and the structural equation model.

The Measurement Model. The measurement model in *SEPath* specifies how hypothetical constructs (latent variables), are indicated by the indicators (observed variables). In this way it describes the measurement properties (reliabilities and validities) of the indicators. The measurement model is expressed as in the following equation:

$$x = \Lambda\xi + \delta \text{ ,} \tag{1}$$

where x is a ($q \times 1$) vector of indicators (proxies),

ξ is a ($m \times 1$) vector of latent (unobservable) attributes,

Λ is a ($q \times m$) matrix of factor loadings (a matrix of regression coefficients of x on ξ), and

δ is a vector of measurement errors in the measurement model.

The measurement model functions like a process of forming a portfolio of several proxies for each latent variable, the ‘portfolio weights’ being the factor loadings. It is the factor loadings, that are then related to measures of gearing in the structural model. Both these processes are however, taking place simultaneously in the *SEPath* model. This study has eight (unobservable) attributes, which are potential determinants of gearing and 18 indicators whose proxies have been calculated. Hence x is 18x1 and the dimensions of lambda (Λ) are 18×8. Because there may exist more than one proxy for the latent attributes specified by capital structure theory as determinants of capital structure, equation 1 implies that these proxies (measured by accounting or market value data), can be expressed as linear function of one or more latent attributes plus a random measurement error.

The Structural Equation Model. The structural equation model specifies the causal relationships among the latent variables, describes the causal effects, and assigns the explained and unexplained variance. By so doing the model estimates the impact of each of the latent variables on each of the gearing ratios used in this study. The structural equation model is specified as:

$$y = \Gamma\xi + \varepsilon \tag{2}$$

where y is px1 vector of gearing ratios,

Γ is a $p \times m$ matrix of factor loadings,

ξ is an $m \times 1$ vector of latent attributes (as defined in the measurement model),

ε is a vector of $p \times 1$ vector of random errors (random disturbance) in the structural relationship.

The SEM technique estimates the unknown coefficients of the set of linear structural equations. It is particularly designed not only to accommodate models that include latent variables, but also those with measurement errors in both endogenous and exogenous variables, reciprocal causation, simultaneity, and interdependence. The random components in each equation are assumed to be uncorrelated with the variables in that equation, and with other random variables in other equations. That is in the case of the two equations specified above:

δ is not correlated with ξ
ε is not correlated with ξ and,
δ is not correlated with ε, or any other random component.

The version of the model employed in this study is a constrained factor-analytic technique in which additional restrictions are imposed on the parameters of the measurement model. Figure 1 (see appendix) shows that a total of 126 (that is,144-18) restrictions are imposed on matrix Λ of factor loadings. These restrictions are specified to equal zero. The restrictions are not arbitrary as they are guided by theory predictions. For example since FA/TA is not theorised to be an indicator of growth opportunities, its factor loading on growth attribute is set to zero. Unlike the parameters of the measurement model, those of the structural equation do not contain any restriction. The structural model in which the calculated gearing ratios are expressed as functions of the attributes specified in the measurement model, and an 8×1 vector of debt ratios is specified.

Mitigation of measurement problems found in conventional regression

A number of advantages have been associated with *SEPath* or LISREL technique. Firstly, the estimation models that is. the measurement model and the structural model, are actually two parts of one model because they are estimated simultaneously. Secondly, unlike in conventional regression, more indicators are used per latent variable, which is likely to provide better results because the researcher can attempt to use all indicators, which adequately reflect the nature of the attribute suggested by the theory. For example it is possible to include both depreciation and investment tax credit as indicators of non-debt tax shields in the model.

Thirdly, again unlike conventional regression, the model allows for indicators to load (contribute) to more than one latent attribute. An example here could be that research and development expenditure (R&D) be used as an indicator for growth opportunities as well as for non-debt tax shield, with different factor loadings. Finally, as Titman and Wessels (1988) and Chiarella *et al*. (1992) put it, the technique explicitly specify the relation between the unobservable attribute and the observable (measurable) indicators.

Dependent variable

The endogenous variable is gearing (or leverage as it is called in the US) for which a total of eight different measures are used in this study. Finance theory does not restrict us to a single ratio, as a measure of gearing, neither does the theory straightjacket researchers as to how gearing should be computed. Measures of gearing are tools in assessing the probability that the firm will meet both interest and principal payments on debt as they fall due. Debt ratios also highlight protection of investors from insolvency and the ability of companies to obtain financing for potentially profitable investment opportunities. Financial analysts assert that "however leverage measures may be calculated they should be computed consistently both over time and when making comparisons between companies" (Samuels *et al.*, 1995, p.18).

Measures of gearing:

Some previous similar studies used one (Bradley *et al.*, 1984, and Givoly *et al.*, 1992) or two (Bowen *et al.*, 1982) measures of gearing and regressed them against the independent attributes; and). Bradley *et al.* (1984) estimated gearing as the ratio of the mean level of long-term debt (book value) for the sampling period to the mean level of long-term debt plus market value of equity over the same time period. Givoly *et al.* (1992) defined leverage as the ratio of 'the value of debt to the sum of the value of debt and equity'.

However as Timan and Wessels (1988) and Chiarella *et al.* (1992) argue, a single measure of gearing may not be appropriate because some theories of capital structure have different implications for the different types of debt. These theories predict different relationships between firm attributes and measures of gearing. For example Myers (1977) predict that short-term debt ratios might be positively related to growth opportunities if growth firms pursue a policy of rolling over short maturity debt claims because short-term debt does not induce sub optimal investment decisions. Jensen and Meckling (1976) and Warner (1979) among others, argues that issuing convertible debt may reduce the agency costs of debt. Titman and Wessels (1988) also finds that that smaller firm size and short-term financing are positively related and interprets such findings to be due to high transaction costs that small firms face when they opt for long-term debt or equity.

To capture different implications from these theories Titman and Wessels (1988) used six measures of financial leverage, the long-term, short-term, and convertible debt divided by market and by book values of equity. Because of unavailability of convertible debt data in Australia, Chiarella *et al.* (1992) used only long-term and short-term debt divided by market and book values of equity in replication of Titman and Wessels work.

Rajan and Zingales (1995) also points out that, "…the extent of leverage and the most relevant measure depends on the objective of analysis…"p.1427. They further argue that for agency problems of debt, which relate to how the firm has been financed in the past and thus on the relative claims held by equity and debt, the relevant measure is the stock of debt relative to firm value. However, when focussing on gearing as a potential for the transfer of control form equity holders to debt holders in an economically distressed firm, income gearing the kind of interest coverage ratio is relevant.

With these in mind this study is going to uses a total of eight different measures of gearing. These measures of gearing have been selected because of a number of reasons. First, it has already been possible to use them in the UK and elsewhere e.g in the US and Australia. One would also be expected to compare the results of this study with previous U.K. studies (that is. Bennett and Donnelly (1993), Rajan and Zingales (1995), Varela and Limmack (1998), Bevan and Jo Danbolt (2000), and Ozkan (2001). These previous studies used some of these gearing measures. Secondly, the measures are appropriate as regards to U.K. financial statements disclosure as corroborated by data stream definitions. In all market value (MV) ratios except the debt to equity, the market value gearing is calculated by adjusting total assets value, by subtracting the book value of equity and adding the market value of equity.

1. The ratio of total liabilities to total assets (in book values) $\frac{TL_P}{TA}$

2. Debt to total assets; where debt includes both short and long term debt (in book values)

$$\frac{D_P}{TA}$$

3. The ratio of total debt to total equity (in book values) $\frac{D_p}{E}$

4. Debt to capital; where capital (CAP) is defined as total debt plus the market value of equity

$$\frac{D_P}{CAP}$$

5. The ratio of long-term debt to total assets (in book values) $\frac{LTD_P}{TA}$.

6. The ratio of short-term debt to total assets (in book values) $\frac{STD}{TA}$

7. The ratio of current liabilities to total assets (in book values) $\frac{CL}{TA}$

8. EBITDA/I = (Profit Before Interest, Tax and Depreciation)/Interest charge.

A number of other gearing measures were computed for use in this study. However, correlation among these measurers reduced them to these eight shown here. These eight measures have at least one book value measure and one income gearing measure. The subscript '$_p$' indicates that preference shares are included as part of 'debt'.

Independent variables

Asset structure/Tangibility. This study uses the ratio of inventory, gross plant and equipment to total net assets (IGP/TA); the ratio of net fixed assets to book value of total net assets (FA/TA), and the log of (inverse) ratio of intangible assets to total net assets (LnInvInt) to proxy for tangibility characteristics. Net assets exclude all depreciation and intangibles.

Non-debt Tax shields. Firms with non-debt tax shields may be proxied by the ratio of depreciation over total assets (D/TA); and by investment tax credits over total assets

(ITC/TA). Bradley *et al.*, (1984) measure the non-debt tax shield as the sum of annual depreciation charges and investment tax credits divided by the sum of annual earnings before depreciation, interest and taxes. Because of its availability of this data in the US, a number of other studies use investment tax credit (ITC), as a proxy for non-debt tax shields. ITC however, are not used in the UK, the fact that is reflected in our data source. Lack of data for investment tax credit in the UK prevents this study to come up with similar measure. Instead, this study uses two measures of non-debt tax shield.

Following Titman and Wessels (1988) and Chiarella *et al.*, (1992) a direct measure of non-debt tax shields, called *OIiT,* is derived using corporate tax payments (T), operating income (OI), interest payments (i), and the corporate tax rate applicable during the period (τ_c) using the following equation:

$$NDT = OI - i - T / \tau_C \tag{3}$$

Equation 3 simply states that corporate tax payments are equal to corporate tax rate multiplied by whatever remains after interest payments and non-debt tax shields have been taken out of the operating income.

that is., $T = \tau_c(OI - i - NDT)$[2]

However, it is important to note that equation 3 used here differs from the one used by both Titman and Wessels (1988) and Chiarella *et al.*, (1992) in that while they used one average rate for the whole period covered by their respective data, here our equation captures τ_c for each of the 16 years covered. Both *OIiT*, and another proxy, depreciation over total assets (D/TA) are used.

Growth/Investment opportunities. Firms with higher growth prospects/investment opportunities may be proxied by the ratio of capital expenditure to total assets (CE/TA); and by the percentage of changes in total assets (GTA) Titman and Wessels (1988). It can also be proxied by the ratio of research and development expenditure to sales (RD/S). Numerous empirical studies have used the ratio of the aggregate market value to the aggregate book value of assets (market-to-book ratio), or Tobin's Q to proxy for efficient management (or for existence of real growth opportunities). See for example Rajan and Zingales (1995), Bevan and Jo DanBolt (2000). Four indicators are used; the MTB ratio, the TQ ratio, and the ratio of capital expenditure to total assets (CE/TA).

Which is the same as, $T = \tau_c(OI) - \tau_c i - \tau_c(NDT)$. And also the same as

$$\tau_c(NDT) = \tau_c(OI) - \tau_c i - T$$

Dividing throughout by τ_c gives,

$$NDT = OI - i - T / \tau_C .$$

Firm Size. Firm size may be proxied by the natural logarithm of sales (LnSales), the natural logarithm of total assets (LnTA), the number of employees, or quit ratio (QR) (Titman and Wessels (1988)). The very high correlation between LnSales and LnTA (0.95) meant that only one of them could be used. Because of lack of data relating to QR, in this study we use only LnTA as an indicator (or exogenous) variable for firm size. Other recent studies such as Fan, *et al.* (2003) have also used LnTA as a proxy for firm size.

Volatility of earnings/returns .The volatility of a firm's earnings may be proxied by the standard deviation of the percentage of change in operating income (SIGOI)(Titman and Wessels, 1988), or by the standard deviation of the first difference in annual earnings, scaled by the average value of the firm's total assets over the period (Bradley *et al.*, 1984).Other studies have also used the coefficient of variation of earnings before interest tax and depreciation (CVEBITDA) and the standard deviation of share price, SIGP.

Titman and Wessels (1988) uses only one measure, fearing that other indicators of risk like stock beta or total volatility may bring about spurious correlation because they are partially determined by the firm's debt ratio. These precautions are taken on board and it is found that the standard deviation of share price is not a potential source of spurious correlation with the market value gearing ratios. The correlations between SIGP and measures of market value gearing are 0.025 (D/CAP), 0.007 (Dp/E), 0.072 (Dp/TA), and –0.208 (TLp/TA). These are not sufficiently large to cause colinearity problems in the regression model. In this study four proxies are used that is. SIGOI, the standard deviation of the percentage of change in operating income divided by total sales (SIGOIS), CVEBITDA, and SIGP.

Profitability. The dichotomy inherent in theoretical predictions regarding profitability requires that two proxies be estimated. Following from this dichotomy, a meaningful empirical test should therefore come up with a means of differentiating between a proxy for past profitability and that of future profitability. *Past profitability* is readily observable and is proxied by the ratio of retained earnings to total book value of assets (RE/TA), which is used in both models.

Another ratio, the ratio of retained earnings to total sales (RE/S) could also be used. However, the very high correlation between total assets and sales resulted in a very high correlation between RE/TA and RE/S. RE/S was therefore discarded and RE/TA is used in as an indicator of past profitability. In addition the sum of cash and cash equivalents scaled by current and long-term debt, CACLLL was found to be negatively correlated to gearing, and highly correlated with measures of past profitability. CACLLL is therefore added as one of the indicators of past profitability.

Current Profitability; The challenge is how to measure *future profitabilit*y or what is referred to as 'quality' by Barclay *et al.* (1999). Because it is not observable, we have to come up with a good proxy for future profitability. Assuming that the best known predictor of a company's next year's profitability is current year's earnings, (See Barclay *et al.* (1999), this study uses the ratio of operating income to total sales (net of discounts and rebates)(OI/S), to proxy for future profitability in the OLS regression estimation. In the SEM model, both OI/S and the ratio of earnings before interest, tax, and provisions, divided by Total assets (EBITDA/T), are used.

Probability of bankruptcy. Theory has suggested that bankruptcy costs influence leverage (Ross, 1977). Haugen and Senbet (1978), Altman (1984), and Andrade and Kaplan (1998) among others have argued that it is the expected (present) value of bankruptcy costs at the time of making a financing decision, which matters. In the simulation of their theoretical model Bradley *et al.*, (1984) find that firm leverage is inversely related to the expected costs of financial distress. Rajan and Zingales (1995) suggest that size may be a proxy for the (inverse) probability of bankruptcy.

For a cross-sectional study like this one, which deals with healthy companies, the variable of importance is the one, which assesses how likely a firm, is to experience financial distress, and then relate this to measures of gearing. It is in this way we can investigate the potential impact of the probability of bankruptcy on capital structure decisions. Instead of inferring the probability of bankruptcy using firm size (as suggested by Rajan and Zingales (1995), the probability of bankruptcy of the sample companies is estimated using Altman's Z-Score. Altman (1968) developed a Multiple Discriminant Analysis (MDA) and used it to predict firms' bankruptcy with 94 per cent accuracy on a sample of 66 firms comprising of healthy and bankrupt firms.

If Altman's Z-score had a higher degree of success in predicting company failure, and its variants are continuing to be used by consulting firms in credit rating, and if the threat of bankruptcy is able to deter managers from using debt, then Z-score should also be able to find out if the firms with lower Z-score actually avoid the use of debt. To be able to use this model properly the ratios comprising the MDA model for all companies in our sample are calculated, then those observations whose Z-score falls within the grey area (between 1.81 and 2.99) are removed because they may have a neutral impact on gearing and thereby distort the influence of probability of bankruptcy on gearing. . Firms with a score below this range are considered good candidates for bankruptcy and should are expected to use less debt, while those whose score is above this range are not likely to be bankruptcy and may use higher levels of debt. The major aim is to find out whether those firms that are predicted to have a higher probability of bankruptcy (that is. lower Z-score) actually avoid debt and vice versa.

It should be noted that in this study, it is the positive relationship between Z-score and gearing which will confirm whether debt is inversely related to probability of bankruptcy. This is because the higher the Z-score, the lower the probability of bankruptcy and hence the higher the likelihood of using debt. Alternatively, the lower the Z-score, the higher the probability of bankruptcy, and hence the higher the likelihood of avoiding the use of debt.

Cash holdings .Cash holdings are a measure of internal funds available for financing investments by a firm. The pecking order theory by Myers (1984) and Myers and Majluf (1984) predict that financing follows a pecking order that is. first with internal funds (retained earnings), then with external least risk debt. Equity is seen as a last resort. The correlation between past profitability (RE/TA) and free cash flow (CACLL) is (that is. 0.266). This significant positive correlation between past profitability and cash flow indicates that a substantial part of cash flow for these companies was generated from past profitability. This therefore suggests that CACLL may as well serve as another proxy for past profitability. It is therefore predicted that leverage is inversely related to cash holdings.

RESULTS

As table 1 (see appendix) shows the findings of previous studies are somehow mixed. Some findings contradict; some are inconsistent with the theory. In many cases (especially for Titman and Wessels, 1988), although the sign is in the hypothesized direction, the results fall short of being significant. In relation to the previous studies, this study's results are better because there are less perverse results than both of the previous studies, which used structural equation modelling (SEM). Titman and Wessels (1988) had perverse results relating to growth, tangibility, and firm size. Chiarella *et al.*, (1992) also had perverse results for both growth and asset structure.

Table 2 (see appendix) presents the estimates of the parameters of the measurement model. The magnitude and the statistical significance of the estimates indicate that the manifest variables measure the underlying attributes well. However, the direction of effect for some of the factor loadings (e.g. *Ndts* and Growth), are exceptions. Each group of indicators is designed to capture the constructs of the attributes we wish to consider as determinants of capital structure. As the table shows this study uses between one and four manifest variables (or indicators) to represent one attribute. This is in recognition of the fact that there may be many possible proxies for one attribute of interest. In total, 18 indicators are used, in different groupings, for eight attributes. Having got the factor loadings reported in table 2, the model then generates the measures of the impact the groups of indicator variables have on each measure of gearing employed in table 3 discussed in the following paragraphs.

Before a closer look at the coefficients of table 3 (see appendix) it is appropriate to explain how the *SEPath* model works and also how to interpret the summary box below that table. Structural equation modelling generally must obtain their parameter estimates by using iterative techniques. These techniques are special cases of nonlinear optimization procedures for minimizing a function of 'n' unknowns. When iteration begins each parameter in the model is given an initial value, or start value. These values are 'plugged in' to the model equations and used to generate an estimated covariance matrix, which is compared to the actual sample covariance matrix, and the value of the discrepancy function. The programme alters the parameter values to improve the discrepancy function (that is. make it smaller). If the discrepancy function has improved sufficiently, the programme goes on to the next iteration. If the programme is anywhere near the correct solution, the process will continue smoothly until it reaches the minimum, usually in 20 iterations or less.

Table 3 presents the estimates of the structural coefficients. The coefficients estimates, along with their corresponding t-statistics, specify the relationship between unobservable factors hypothesised to determine capital structure and the computed gearing measures. In general, the direction of the relationship between hypothesised determinants and measures of gearing is consistent with the theory. The only exception is growth. Four out of eight coefficients of tangibility are positive and significant at 1 percent. This indicates that firms with more fixed assets are likely to access debt financing because they have readily available collateral. All coefficients for non-debt tax shields except for short term debt are negative; most of the significance levels are at 1 percent. All eight coefficients for Business risk are also negative with five of them significant, two at 1percent, the remaining two at 5 percent, and 10 percent levels respectively. As for size coefficients, consistent with the theory, all coefficients are positive, seven of them being significant at 1percent level, even the magnitude of the remaining one point towards a positive relationship wit gearing.

Past profitability has six out of eight, negative coefficients that are significant at 1 percent level. The remaining two coefficients are positive but not significant. In support of the expected results specified in this study, five gearing measures are significantly positively related to current profitability (which is used as a proxy for future profitability). However, the market value measure of gearing is significantly negatively related to current profitability.

Six out of eight coefficients for probability of bankruptcy are positive. It should be noted that in this study, it is the positive relationship between Z-score and gearing which will confirm whether debt is inversely related to probability of bankruptcy. This is because the higher the Z-score, the lower the probability of bankruptcy and hence the higher the likelihood of using debt, and vice versa. The being the case, the results in table 3 shows that firms with a higher probability of bankruptcy are likely to avoid the use of debt.

SUMMARY AND CONCLUSION

This study was an attempt to use a new and relatively innovative technique (Structural Equation Modelling-SEM) in capital structure empirical research on UK company data. The Pioneer of the methodology used it in the U.S. in 1988. In 1992 a group of scholars replicated it in Australia. The results of these two studies had some inconsistent results. As table 4 (see appendix) and table 1 show, the findings of previous Structural Equation Modelling (SEM) studies are mixed. Some findings are contradictory; while others are inconsistent with theoretical predictions. In many cases (especially for Titman and Wessels, 1988), while the sign is in the hypothesized direction, the results fall short of being significant. It is due to these pervasive results that is why it was important for this rigorous study to be conducted by using data from a similarly developed economy so as to iron-out inconsistencies and also to test a new methodology in the area of capital structure research.

In summary, the use of structural equation model (SEM), and particularly the statistical software *SEPath*, has given the following results. Consistent with theory and a consensus of previous research, strong concrete evidence has been found in support of a positive relationship between tangibility, firm size, future profitability and gearing, and a negative relationship between gearing and both non-debt tax shields, past-profitability, Business risk and probability of bankruptcy.

In relation to the previous studies, the results presented in this study are more supportive of the dominant capital structure theories. Titman and Wessels (1988) had perverse results relating to growth, tangibility, and firm size, and had insignificant results regarding business while Chiarella *et al.*, (1992) had perverse results for both growth and asset structure. The limitations of this model however, is that it has not been able to confirm the hypothesized negative relationship between gearing and growth prospects/investment opportunities.

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APPENDIX A

TABLE 1: Results of previous SEM studies in comparison with this study

Determinants	TITMAN AND WESSELS (1988)		CHIARELLA *et al.* (1992)		HYPOTHESISED RELATION WITH GEARING	This Study JAIRO (2008)	
	RELATION	SIGNIF.	RELATION	SIGNIF.		RELATION	SIGNIF.
1.Tangibility	+, -	NS	-	NS	+	+	S
2.Ndts	-	NS	-	S	-	-	S
3.Growth	+	S	+	S	-	+	S
4.Size	-	S	+	S	+	+	S
5.Volatility	-	NS	N/A	N/A	-	-	S
6.Pprofit	N/A	N/A	N/A	N/A	-	+	S
7.Cprofit	-	S	+, -	S	+	+, -	S
8. PrBankr	N/A	N/A	N/A	N/A	-	-	S
9. Cash holding	N/A	N/A	+	S	+, -	-	S

'Ndts' refers to Non-debt tax shields
'Pprofit' refers to past profitability
'Cprofit' refers to current profitability
'PrBankr' refers to Probability of Bankruptcy
'+ ' Means a positive relationship between a determinant and gearing
'- 'Means a negative relationship between a determinant and gearing
'SIGNIF' columns indicate the level of significance of the corresponding relationships
S, and **NS**, or under SIGNIF means Significant and Not significant respectively
N/A (Not Applicable) indicates that that particular determinant was not tested by the study

APPENDIX B

TABLE 2: The Measurement model: Factor Loadings for Manifest variables

Manifest Variables	*ATTRIBUTES*							
	ξ_1 Tang	ξ_2 Ndts	ξ_3 Grow	ξ_4 Size	ξ_5 Brisk	ξ_6 PProfit	ξ_7 Cprofit	ξ_8 PrBankr
FAn/TAn	-0.03 (-3.1)***							
LnInvInt	12.1 (6.3)***							
D/TA		-0.4 (-0.4)						
OIiT		3.5 (2.0)**						
MTB			10.6 (15.6)***					
TQ			29.9 (36.0)***					
CE/TA			-1.2 (-1.6)					
LnTA				0.9 (8.9)***				
SIGOI					-3.9 (-3.2)***			
SIGOIS					0.4 ((5.8)***			
CVEBIT DA					27.9 (36.0)***			
SIGP					3.8 (3.2)***			
RE/TA						7.9 (8.3)***		
RE/S						34.1 (11.1)***		
CACL						3.0 (2.6)***		
OI/S							16.6 (13.9)***	
EBITD/TA							23.1 (19.3)***	
Zscore								-3.3 (-3.1)***

Explanation: Coefficients that are significantly different from zero at 1percent, 5percent and 10percent are marked with ***, **, and * respectively. The numbers in the parentheses are corresponding t-statistics

APPENDIX C

TABLE 3: The SEM Estimates of the Structural Coefficients

GEARING MEASURES	*ATTRIBUTES/FACTORS*							
	ξ_1 **Tang**	ξ_2 **Ndts**	ξ_3 **Grow**	ξ_4 **Size**	ξ_5 **Brisk**	ξ_6 **PProfit**	ξ_7 **Cprofit**	ξ_8 **PrBankr**
PANEL A: BOOK VALUE GEARING MEASURES								
TLp/TA (BV)	15.4 (11.1)***	-7.3 (-3.1)***	3.4 (4.9)***	3.7 (2.7)***	-3.2 (-4.7)***	2.02 (2.5)***	4.3 (5.9)***	-2.1 (-0.7)
Dp/TA (BV)	7.0 (3.3)***	-8.6 (-3.1)***	1.9 (2.1)**	10.6 (6.4)***	-0.7 (-0.8)	1.8 (1.6)	1.9 (2.1)**	8.9 (3.3)***
Dp/E (BV)	2.4 (1.3)	-9.5 (-5.7)***	3.9 (4.8)***	7.8 (5.6)***	-1.4 (-1.7)*	5.5 (5.3)***	2.1 (2.4)**	5.0 (1.85)*
LTD/TA (BV)	3.3 (1.2)	-11.9 (-3.7)***	0.23 (0.2)	11.6 (5.6)***	-1.3 (-1.2)	7.4 (5.1)***	-0.32 (-0.3)	10.9 (3.1)***
STD/TA (BV)	17.7 (6.0)***	15.1 (3.1)***	2.8 (2.4)**	11.8 (4.9)***	-2.5 (-2.1)*	-1.1 (-0.8)	3.2 (2.6)***	15.7 (3.3)***
CL/TA (BV)	8.5 (6.1)***	-2.8 (-1.6)	3.6 (3.3)***	1.9 (1.2)	-3.5 (-3.2)***	7.8 (5.6)***	1.6 (1.4)	-2.6 (-1.3)
EBITD/I (BV)	-3.3 (-1.5)	-3.9 (-1.4)	0.9 (0.6)	-17.1 (-10.9)***	1.9 (1.7)*	-4.5 (-3.2)***	14.5 (10.5)***	8.5 (3.6)***
PANEL B: MARKET VALUE GEARING MEASURE								
Dp/CAP-MV	-3.5 (-1.7)*	-4.3 (-1.5)	3.9 (3.3)***	11.0 (6.0)***	-0.83 (-0.7)	8.4 (5.6)***	-3.4 (-2.8)***	9.7 (4.6)***

Explanation: Coefficients that are significantly different from zero at 1percent, 5 percent and 10 percent are marked with ***, '**', and '*' respectively. The numbers in the parentheses are corresponding t-statistics

APPENDIX D

TABLE 4: Comparison between this study and previous SEM studies' results

Factors/ Determinants	*Relationship between hypothesized determinants and measures of gearing*		
	This Study (Jairo, 2008)	**Titman & Wessels (1988)**	**Chiarella et al. (1992)**
Tang	6+, 5 (S) 2-, 1(S), 1 (NS)	2+, (NS) 4-, (NS)	1+, (NS) 3-, (NS)
Ndts	7-, 5(S) 2-, (NS)	0+ 6-, (NS)	0+ 4-, 3 (S)
Growth	8+, 6 (S) 0-	3+ (BV), 1 (S) 3- (MV), (NS)	3+, 1 (S) 1-, (NS)
Size	7+, 6(S) 0-	2+, (NS) 4-, 3 (S)	4+, 1 (S) 0-
Brisk	7-, 4 (S) 1+ (S)	0+ 6-, (NS)	N/A
PProfit	6+, 5 (S) 2-	N/A	N/A
Cprofit	6+, 5 (S) 2-, 1 (S)	0+ 6-, 3 (S)	1+, (S) 3-, (S)
PrBankr	6+, 6 (S) 2-, N(S)	N/A	N/A

Key:
S = significant relationship
NS = Not Significant relationship
N/A = Not Applicable
BV = Book Value
MV = Market Value

APPENDIX E

FIGURE 1: The Matrices of the Measurement Model

$$
\begin{bmatrix} FA/TA \\ LnInvInt \\ D/TA \\ OIiT \\ MTB \\ TQ \\ CE/TA \\ LnTA \\ SIGOI \\ SIGOIS \\ CVEB/TA \\ SIGP \\ RE/TA \\ RE/S \\ CACL \\ OI/S \\ EBITD/TA \\ Zscore \end{bmatrix}
=
\begin{bmatrix}
\lambda_{1,1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\lambda_{2,1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & \lambda_{3,2} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & \lambda_{4,2} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \lambda_{5,3} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \lambda_{6,3} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \lambda_{7,3} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \lambda_{8,4} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \lambda_{9,5} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \lambda_{10,5} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \lambda_{11,5} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \lambda_{12,5} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \lambda_{13,6} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \lambda_{14,6} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \lambda_{15,6} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \lambda_{16,7} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \lambda_{17,7} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & \lambda_{18,8}
\end{bmatrix}
*
\begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \\ \xi_5 \\ \xi_6 \\ \xi_7 \\ \xi_8 \end{bmatrix}
+
\begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \\ \delta_6 \\ \delta_7 \\ \delta_8 \\ \delta_9 \\ \delta_{10} \\ \delta_{11} \\ \delta_{12} \\ \delta_{13} \\ \delta_{14} \\ \delta_{15} \\ \delta_{16} \\ \delta_{17} \\ \delta_{18} \end{bmatrix}
$$