Determinants of Capital Structure Choice: A Structural Equation Modeling Approach

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Abstract

In their seminal research on the determinants of capital structure choice using structural equation modeling (SEM), Titman and Wessels (1988) obtained weak results and hence called for further investigation. We apply a multiple-indicators-multiple-causes (MIMIC) model with refined indicators to cross-sectional and pooled samples for the period 1988-2003 and find more convincing results than those obtained by Titman and Wessels. With the capital structure measured simultaneously by the ratios of long-term debt, short-term debt, and convertible debt to the market value of equity, our results show that growth is the most important determinant of capital structure choice, followed in order by profitability, collateral value, volatility, non-debt tax shields, and uniqueness. Moreover, we find that long-term debt is the most important proxy of capital structure, followed by short-term debt and then convertible debt.

I. Introduction

The investigation of the determinants of capital structure has been an interesting subject in finance literature. The theoretical determinants of capital structure in corporate finance can be attributed to unobservable constructs that are usually measured by a variety of observable indicators or proxies in empirical studies. These observable indicators or proxies can then be viewed as measures of latent variables with measurement errors. Traditionally, researchers use either one or more observable variables to form a proxy to measure a single latent theoretical variable. However, the use of these indicators as theoretical explanatory variables in both cases may cause errors-in-variables problems (Maddala and Nimalendran (1996)).

Ordinary least squares method, which is often used in capital structure research, defines leverage in a variety of proxies as the dependent variable. For example, Barclay and Smith (1995), Chaplinsky and Niehaus (1993), Friend and Lang (1988), and Rajan and Zingales (1995) use the total debt (the long-term debt plus the debt in current liability), the long-term debt divided by firm value, the debt to assets (book value) ratio, and total liabilities to total assets as leverage, respectively. Bradley, Jarrell, and Kim (1984) even define the leverage as the ratio of the mean level of long-term debt during 1962-1981 to that of long-term debt plus market value of equity over the same time period. In these studies, the measures of capital structure cause errors-in-variables problems. Moreover, the application of ordinary least squares method to these studies faces other problems, such as multicollinearity problem in the independent variables and the violation of assumptions in disturbance term.

By using a structural equation modeling approach in our research, we overcome the problems mentioned above. For instance, the regression analysis doesn't control measurement errors and can only deal with one dependent variable at a time. But, the structural equation modeling not only controls the measurement errors but is also able to handle several dependent variables. Furthermore, as for independent variables, it regards several observable variables as indicators of the theoretical constructs without causing multicollinearity problems, which is a common issue of regression analysis in financial studies. In addition, regression deals with observable variables but not latent constructs. It assumes the observable proxies as the exact measures of the theoretical constructs, though this may not be true due to measurement errors. In empirical research, the assumptions of regression analysis can easily be violated, while the normality distribution required by maximum likelihood estimation method in structural equation modeling can be met by a normal score transformation.

Titman and Wessels (1988) point out some problems associated with estimating parameters with proxies for unobservable theoretical attributes in regression analysis. First, the lack of unique representation of the attributes may lead researchers to select variables based on the statistical goodness-of-fit criteria and bias economic interpretation. Second, the lack of unique representation of proxy variables for theoretical attributes means that a proxy may be measuring the effects of several different attributes. Third, the regression analysis introduces an errors-in-variables problem due to the imperfect representation of proxy variables for interested attributes.

Considering the drawbacks of regression analysis, Titman and Wessels (1988; TW, hereafter) initially apply the structure equation modeling approach to investigate the determinants of capital structure. They estimate parameters in a model with eight latent constructs measured by 21 observable variables. Based on the financial theory of the determinants of capital structure, they employ structural equation modeling to test the effect of eight latent constructs on the latent leverage construct with six observable debt ratios simultaneously. Since the model is fairly complex, they constrain 105 coefficient entries as zero in order to have the model identified. Though they propose eight latent variables as attributes that determine the capital structure, their results lend no support for the causal relation in four out of the eight attributes to capital structure, while the other four also have only poor correlation. Thus, they suggest further study to find more representative indicators of latent variables to improve the results.

Maddala and Nimalendran (1996) indicate that the problematic model specification causes the poor results in TW's research. They call for further investigation by using a Multiple Indicators and Multiple Causes (MIMIC)[1] model to improve the results. However, the poor results from TW's research have discouraged further application of structural equation modeling in corporate finance for the past decade. TW's innovative approach has therefore not been appreciated in the academic community. In this study, we re-examine the issue by using structure equation modeling approach as

[1] MIMIC model will be described in Section IV.

TW did and believe our results will bring renewed interest to research in this field.

The structural equation modeling programs (e.g., LISREL, EQS, AMOS, etc.[2]) have popularized the application of causal models in psychology, sociology, education, and marketing but not in finance. Titman and Wessels (1988) and Maddala and Nimalendran (1995) are notable exceptions to apply structural equation modeling in corporate finance. The former employ it to study the determinants of capital structure, while the latter to examine the effect of earnings surprises on stock prices.

The advantage of structural equation modeling over traditional regression analysis is that it explicitly models measurement errors and can estimate parameters with full information maximum likelihood (FIML), which provides consistent and asymptotically efficient estimates. On the other hand, using structural equation modeling has some limitations of which we should be aware. As stated by Maddala and Nimalendran (1996), employing too many latent variables and indicators in a model may cause problems because using proxies as instrumental variables in the equations may result in poor instruments. The problem of poor instruments apparently exists in the TW model. Moreover, the TW model uses 15 indicators associated with eight latent variables and set 105 restrictions on the coefficient matrix. Thus, their study needs to be further investigated on both the selection of indicators and the model specification.

As mentioned above, Titman and Wessels (1988, p. 17) find no support for four out of the eight

[2] LISREL, EQS, and AMOS are programs for structural equation modeling method and are distributed by Scientific Software International, Multivariate Software, and SPSS, respectively.

propositions on the determinants of capital structure. Specifically, their result shows that capital structure is not significantly related to non-debt tax shields, volatility of earnings, collateral value of assets, and future growth. However, they also question the appropriateness of the measurement model of these theoretical attributes (i.e., latent variables). One possibility of their poor results is that the predicted effects are not uncovered because the indicators used in the study do not adequately reflect the nature of the attributes suggested by financial theories.

At the conclusion of their paper, Titman and Wessels (1988, p. 17) suggest that

> "If stronger linkages between observable indicator variables and the relevant attributes can be developed, then the methods suggested in this paper can be used to test more precisely the extant theories of optimal capital structure."

They believe their results can be improved by finding indicators with stronger linkage to corresponding latent variables. Moreover, Maddala and Nimalendran (1996) further state that it is an unsolved issue to detect weak indicators in the presence of several instruments. They urge further examination on the selection of indicators in structural equation models.

In addition to the issue of indicator selection, the model specification is also essential in structural equation modeling. Maddala and Nimalendran (1996) suggest using Multiple Indicators and Multiple Causes (MIMIC) model to analyze the effect of observable variables on the latent construct while examining the determinants of capital structure. By applying MIMIC, the number of latent variables in the model can be reduced to one from eight. Thus, our study refines both the indicators and the model specification to obtain an acceptable model based on the model goodness-of-fit criteria.

First, we re-advocate the use of structure equation modeling in corporate finance, following Titman and Wessels' (1988) seminal work on determinants of capital structure over a decade ago. Second, we unravel the relative impact of determinants of capital structure in a cause-effect simultaneous framework. To achieve the first goal, we specify an acceptable model based on the overall model fit evaluation and re-establish structure equation modeling in corporate finance. And then, with capital structure measured with long-term, short-term, and convertible debt, we rank the relative impact of determinants of capital structure choice in terms of firm characteristics as follows: growth, profitability, collateral value, volatility, non-debt tax shields, and uniqueness. The capital structure is strongly indicated by long-term debt, followed by short-term, and then convertible debt.

The paper is organizes as follows. Section II discusses the measures and determinants of capital structure. Section III describes the sample. Section IV states the methodology of structure equation modeling and MIMIC model. Section V presents the empirical results. Section VI concludes the study.

II. Measures and Determinants of Capital Structure

In essence, the capital structure and its determinants constitute a cause-and-effect relationship. Since the capital structure is the effect caused by its determinants, their relationship can be formulated as a causal model such as the structural equation model in a comprehensive framework that encompasses two components, the construct of capital structure and the group of constructs representing the determinants. The structural equation model consists of two parts, the measurement and the structural sub-models. The measurement sub-model presents possible measurable surrogates for each of the constructs. It specifies the presumed relations between the theoretical constructs and their measurable indicators. The structural sub-model specifies the causal relation among unobservable constructs.

In the investigation of the causal relation between the capital structure and its determinants, the determinants of capital structure are hypothesized to affect the capital structure choice. Indicators of capital structure might be a company's long-term debt, short-term debt, and convertible debt deflated by the market value of equity or the book value of equity. The determinants of capital structure are firm characteristics such as growth, firm size, collateral value of assets, profitability, volatility, non-debt tax shields, uniqueness, industry, etc.. Each determinant of capital structure may have several indicators. For instance, the ratio of R&D to total assets, the ratio of market-to-book assets, and the percentage change of total assets may serve as indicators of growth. Each observable indicator is assumed to have measurement error associated with it.

We use three measures of capital structure, including long-term debt, short-term debt, and convertible debt deflated by the market value of equity and denote as LT/MVE, ST/MVE, and C/MVE, respectively. These measures of capital structure have been characterized by Myers (1977).[3]

[3] Myers (1977) characterized both book value and market value as denominators of debt ratio. Based on the goodness-of-fit criterion, debts deflated by book value of equity as indicators of leverage are excluded.

The financial theories of capital structure suggest eight attributes that may affect the choice of a firm's capital structure. These eight latent attributes are derived from a variety of theories, as summarized in TW (1988), and they are assets collateral value, non-debt tax shields, growth, uniqueness, industry classification, size, earnings volatility, and profitability. This section briefly reviews how these latent attributes may affect the choice of capital structure and the adoption of indicators for each attribute, as discussed in TW and other literature.

A. Growth

Toy, Stonehill, Remmers, Wright, and Beekhuisen (1974) use a multivariate linear regression model and find that growth in assets and profitability are determinants of capital structure. Their study focuses on manufacturing sector across five industrialized countries. In four of the five countries, with France being the exception, the overall results are significant.

Toy et al. (1974) find that with respect to the attribute of collateral value of assets, equity-controlled firms tend to invest sub-optimally to expropriate bondholders' wealth. This agency cost can be higher for growing firms since they have flexibility of choice to future investments. As a result, the expected future growth should be negatively related to long-term debt levels.

On the other hand, Myers (1977) notes that this agency problem can be lessened if the firm issues short-term rather than long-term debt. This view suggests that short-term debt ratios might be positively related to growth rates if growing firms substitute short-term financing for long-term financing. He also contends that market-to-book ratio indicates the growth opportunities, which can be thought as real options. Jensen and Meckling (1976) also argue that the agency costs will be reduced if firms issue convertible debt. Thus convertible debt ratios should be positively related to growth opportunities too.

However, as noted by TW (1988), though growth opportunities are capital assets that may add value to a firm, they can neither collateralize nor generate current taxable income. Thus, negative relation is expected to exist between debt and growth opportunities.

Five indicators of growth attribute to be considered are capital expenditures over total assets (CE/TA), the percentage change in total assets (GTA), research and development over sales (RD/S), research and development over total assets (RD/TA), the ratio of market value to the book value of assets (MBA), and the ratio of market value to the book value of equity (MBE).

B. Uniqueness

Titman (1984) argues that a firm's liquidation decision is causally related to its bankruptcy status. Hence the liquidation costs that a firm may impose on its customers, workers, and suppliers are relevant to the firm’s capital structure. If the firm’s products have s “high” level of uniqueness, its customers, workers, and suppliers find it difficult to find alternative products, jobs, and buyers when the firm liquidates. Hence, uniqueness is negatively related to debt ratios.

Following Berger, Ofek, and Yermack (1997) and TW (1988), we use the ratio of the expenditures on the research and development to the total sales (RD/S) as the indicator of uniqueness. It is postulated to be negatively related to uniqueness because the firms that manufacture close substitutes are less likely to do research and development due to the ease of duplication.

C. Non-Debt Tax Shields

DeAngelo and Masulis (1980) construct a model to demonstrate the effect of non-debt tax shields on optimal debt level. They argue that the existence of non-debt tax shields (e.g., depreciation expenses, depletion allowances, and investment tax credits) lowers a firm's capacity of debt tax benefit. Therefore, non-debt tax shields negatively affect a firm's optimal debt level. The firms with large non-debt tax shields tend to have relatively less debt in their capital structure. One important implication of this model is that the different levels of non-debt tax shield found in different industries can explain the observed differences in financial leverage across industries.

In the study of cross-industry differences in financial leverage, Bowen, Daley, and Huber (1982) found that non-debt tax shields significantly affect the capital structure at the industry level. Their findings are consistent with the assertions of DeAngelo and Masulis (1980).

Boquist and Moore (1984) perform another test on the hypothesis of DeAngelo and Masulis (1980) in a study similar to that of Bowen et al. (1982). However, their findings are opposite to the conclusions of Bowen et al. The authors claim the differences caused by the different methodologies. The Boquist and Moore study excludes spontaneous liabilities, such as accounts payable, accrued wages, and tax payables, in the computation of leverage ratio. In this study, operating income instead of revenues is used for its measure of standardized non-debt tax shields. Furthermore, Boquist and

Moore perform the test using data at the firm level instead of industry level. The results of this new methodology reject the DeAngelo and Masulis hypothesis.

Fama and French (2000) regard depreciation as a proxy for non-debt tax shields, while Berger et al. (1997) use investment tax credits for non-debt tax shields. Both measures are scaled by total assets. The indicators of non-debt tax shields in this study include investment tax credits (ITC/TA), depreciation (DEP/TA), and non-debt tax shields (NDT/TA), which are respectively divided by total assets.

D. Collateral Value of Assets

The type of the assets owned by a firm may affect its capital structure choice. In one way, selling secured debt is beneficial to a firm because issuing secured debt can avoid the costs of securities issuing, as stated in Myers and Majluf (1984). They argue that the firms with more collateral value of assets tend to issue more debt to take the advantage of low cost. The firms with more collateral value of assets are more capable of issuing secured debt and revealing less information about future profits. Therefore, the collateral value of assets can be a proxy for agency and financial distress costs. In addition, Jensen and Meckling (1976) and Myers (1977) indicate that stockholders of the leveraged firms tend to invest sub-optimally to expropriate wealth from the firm's bondholders and thus a positive relation between debt ratios and the collateral value of assets exists.

On the other hand, some researchers argue the opposite relationship between debt ratios and the collateral value of assets exists. Grossman and Hart (1982) argue that managers in firms with higher level of debt tend to consume less perquisites because of the increased threat of bankruptcy and the bondholders' closely monitoring on the firms. The monitoring cost is higher for the firms with less collateral value of assets. Hence, the firms with less collateral value of assets tend to issue more debt to limit manager's consumption on perquisites.

Following Berger et al. (1997) and TW (1988), our study uses the ratio of the inventory with gross plant and equipment to total assets (IGP/TA) as the indicator for the collateral value of assets.

E. Profitability

Myers (1984) argues that a firm's preference on raising capital is retained earnings, debt, and then new equity. Issuing new equity is the last choice because of its high cost. The cost may arise from asymmetric information or transaction charge. In either case, the realized profitability and the available amount of earnings to be retained should be important determinants of current capital structure.

Garvey and Hanka (1999) state that the negative relation between leverage and profitability is well known. Booth, Aivazian, Demirguc-Kunt, and Maksimovic (2001) further contend that profitable firms might be able to finance their growth by using retained earnings and maintain a constant debt ratio. In contrast, less profitable firms are forced to resort to debt financing. Booth et al. use ROA as profitability measure and find that high profitability is consistent in 10 developing countries associated with low debt. Berger et al. (1997), Booth et al., and Rajan and Zingales (1995) use the return on assets as proxy for profitability, though they use different measure for earnings.

Our two indicators for the profitability are the ratios of the operating income to the total sales (OI/S) and to the total assets (OI/TA).

F. Volatility

Some studies suggest that a firm's optimal debt level is inversely related to the volatility of earnings. However, the relationship between earnings variability and financial leverage is found ot be inconsistent in studies such as Bradley, Jarrell, and Kim (1984). Thies and Klock (1992) examine the inconsistencies regarding the determinants of capital structure and find the existence of the cross-sectional relationship between earnings variability and capital structure.

In our study, the indicators for volatility are the standard deviation of the percentage change in operating income (STDGOI), the coefficient of variation of ROA (CV(ROA)), the coefficient of variation of ROE (CV(ROE)), and the coefficient of variation of OI divided by total assets (CV(OITA)).

G. Industry Classification

Scott (1972) is one of the earliest empirical studies to that find optimal financial structures exist not only in theory but also in practice. His study confirms the traditional theory that the objective of minimizing the cost of capital leads to an optimal level of financial structure. The results indicate that different industries develop different financial structures due to the different levels of business risk for each industry.

Bowen, Daley, and Huber (1982) test the empirical evidence of cross-industry differences in financial leverage. They perform both the cross-sectional studies among different industries and the inter-temporal studies within each industry. Their study indicates consistent significant differences in the level of financial leverage among industries. They find that the ranking of industry leverage remains consistent over the time period of study and that the leverage level adopted by the individual firm within each industry tends to revert back to the industry average over the same time period.

Titman (1984) suggests that the firms that produce manufacturing equipment require specialized servicing and spare parts and have high cost of liquidation, as a result these firms are less likely to be financed with debt. To measure this industry effect found in TW, we include a dummy variable equal to one for the firms producing machines and equipment (with SIC codes between 3400 and 4000) and equal to zero for all other firms in the model.

III. Sample

To investigate the determinants of capital structure of choice, we collect 16 cross-sectional samples and one pooled sample for all the firms in the Annual *Compustat* Industrial Files with complete data for variables discussed in previous section during 1988-2003. During 1988-2003, the sample size of cross-sectional data ranges from 538 to 1,202 firm-year observations, while the pooled sample has a total of 13,887 firm-year observations in 16 years. During 1988-1996, the numbers of sample observation are 725, 761, 788, 773, 631, 581, 538, and 648, respectively. During

1997-2003, the sample sizes are 1069, 1105, 1202, 1157, 1083, 1181, and 924, respectively. These samples cover a wide variety of industries. The sample of pooled data consists of 351 industries based on four-digit SIC code.

Table 1 presents the descriptive statistics for the pooled data during 1988-2003.[4] Most variables in the samples are not normally distributed except for the ratio of investment tax credit to total assets (ITC/TA), the ratio of depreciation to total assets (DEP/TA), and the ratio of the sum of inventory and gross plant and equipment to total assets (IGP/TA).

<INSERT TABLE 1 ABOUT HERE>

We apply maximum likelihood method that assumes normality to estimate parameters. The non-normality of the sample distribution violates the assumption of maximum likelihood estimation applied in structure equation modeling. Thus, we normalize the variables before analysis by transforming the data into normal scores so that the maximum likelihood method can be applied. Based on the normal scores, the covariance matrix is then calculated for each of the 15 samples. The covariance matrix instead of correlation matrix is used as an input to estimate the parameters in LISREL since the analysis of correlation matrix is problematic in several ways (Cudeck (1989)). Such an analysis may (1) modify the specified model, (2) produce incorrect goodness-of-fit measures, and (3) provide incorrect standard errors. However, the correlation matrix of the pooled

[4] The other 14 cross-sectional sample distributions are not presented here.

sample[5] is presented in Table 2 as it would be more meaningful to readers than covariance matrix.

<INSERT TABLE 2 ABOUT HERE>

IV. Methodology

As shown in Table 3[6], TW (1988) propose eight attributes as the determinants in their framework of structural equation model of capital structure choice. However, they find poor correlations in that only four out of eight constructs are statistically significantly different from zero. We suggest that the results may be primarily due to model misspecification since they impose too strict assumptions on the model in which 105 parameters are constrained as zero.

<INSERT TABLE 3 ABOUT HERE>

This study tries to improve the TW (1988) study in several ways. As suggested by Maddala and Nimalendran (1996), some indicators are removed while others are newly added. Most importantly, a Multiple Indicators and Multiple Causes Model (MIMIC) is proposed to examine the determinants capital structure choice. The model selection is based on the overall model fit evaluation results. The evaluation of the model fit evaluation assures that the model-implied covariance is within an acceptable range of the population covariance such that the interpretation of parameter estimates can

[5] The other 14 cross-sectional correlation matrices are not presented here.
[6] As a complement to Table 3, Appendix A shows the path diagram implied in Titman and Wessels (1988) model.

be more informative about the population.

A. MIMIC Model

This study uses a MIMIC model of structure equation modeling to examine the determinants of capital structure choice. Jöreskog and Goldberger (1975) prove the estimation of parameters with maximum likelihood method in MIMIC model with a single latent variable. Stapleton (1978) further developments MIMIC with more latent variables.

Figure 1 shows the path diagram that depicts a simplified MIMIC model in which variables in rectangular box denote observable variables while variables in oval box are latent constructs. In this diagram, observable variables X_1, X_2, and X_3 are causes of the latent variable η, while Y_1, Y_2, and Y_3 are indicators of η. In our study, X's are determinants of capital structure (η) which are then measured by Y's.

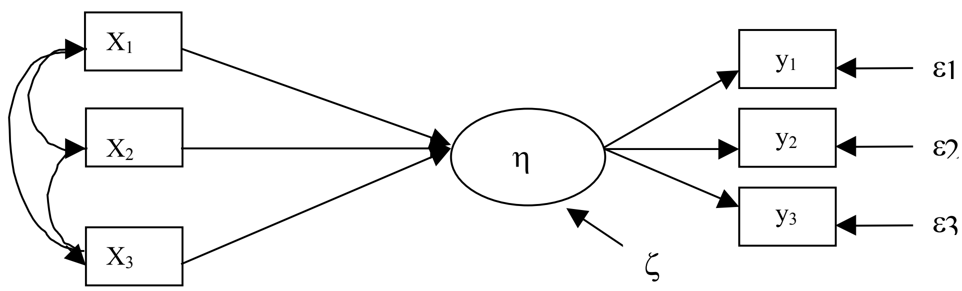

Figure 1. Path Diagram of a Simplified MIMIC

In general, as stated in Joreskog and Sorbom (1989), a structural equation model is composed of two sub-models - structural sub-model as presented in equation (1) and measurement sub-model in equation (2). The following presents the full structural equation model:

(1) $$\eta = B\,\eta + \Gamma\,\xi + \zeta$$

$$Y = \Lambda_y\,\eta + \varepsilon$$

(2) $$X = \Lambda_x\,\xi + \delta,$$

where

B and Γ are (m x m) and (m x n) matrices of structural coefficients (path coefficients), respectively;

Y is a (p x 1) vector of indicators linked to endogenous latent variables η's;

X is a (q x 1) vector of indicators linked to exogenous latent variables ξ's;

Λ_y is a (p x m) matrix of the loadings of the Y's on the η's;

Λ_x is a (q x n) matrix of the loadings of the X's on the ξ's;

ε is a (p x 1) vector of error variables of indicators linked to endogenous latent variables η's;

δ is a (q x 1) vector of error variables of indicators linked to exogenous latent variables ξ's.

The full structural equation model can be restricted to be a MIMIC model. Let B=0, $X \equiv \xi$, Λ_x=I, and δ=0, the full structural equation model becomes a MIMIC model

$$\eta = \Gamma\,X + \zeta$$

$$Y = \Lambda_y\,\eta + \varepsilon,$$

where

η is a (m x 1) vector of endogenous variables with zeros on the diagonal;

ξ is a (n x 1) vector of exogenous variables;

ζ is a (m x 1) vector of errors in equation.

The latent variable η is linearly determined by a set of observable exogenous causes, $X = (X_1, X_2, \ldots, X_q)'$, and a disturbance ζ.

In matrix form

$$\eta = \Gamma X + \zeta$$

or in equation form

$$\eta = \gamma' X + \zeta = \gamma_1 X_1 + \gamma_2 X_2 + \ldots + \gamma_q X_q + \zeta.$$

The latent variable, in turn, linearly determines a set of observable endogenous indicators, $Y = (Y_1, Y_2, \ldots, Y_p)'$ and a corresponding set of disturbance, $\varepsilon = (\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_p)'$.

In matrix form

$$Y = \Lambda_y \eta + \varepsilon.$$

In equation form

$$Y_1 = \lambda_1 \eta + \varepsilon_1$$

$$Y_2 = \lambda_2 \eta + \varepsilon_2$$

$$\ldots$$

$$Y_p = \lambda_p \eta + \varepsilon_p.$$

The disturbances are mutually independent due to the fact that correlations of Y's are already accounted for by their common factor or so-called latent variable, η. For convenience, all variables are taken to have expectation zero. That is, the mean value of each variable is subtracted from each variable value. Thus,

$$E(\zeta\ \varepsilon') = 0',\ E(\varepsilon^2) = \psi,\ E(\varepsilon\varepsilon') = \Theta_\varepsilon,$$

where

Θ is a (p x p) diagonal matrix with the vector of variances of the ε's, θ, displayed on the diagonal.

The equations can be combined to yield a reduced form

$$Y = \Lambda_y\ \eta + \varepsilon = \Lambda_y\ (\gamma' X + \zeta) + \varepsilon$$

$$= (\Lambda_y\ \gamma')\ X + \Lambda_y\ \zeta + \varepsilon = \Pi'\ X + (\Lambda_y\ \zeta + \varepsilon)$$

$$= \Pi'\ X + z,$$

where

$\Pi = \Lambda_y\ \gamma'$ is the reduced form coefficient matrix;

$z = \Lambda_y\ \zeta + \varepsilon$ is the reduced form disturbance vector.

The disturbance vector has covariance matrix

$$Cov(z) = \Omega = E(zz') = E[(\Lambda_y\ \zeta + \varepsilon)(\Lambda_y\ \zeta + \varepsilon)'] = \Lambda_y\ \Lambda_y'\ \psi + \Theta_\varepsilon$$

where

$\psi = Var(\zeta)$ and Θ_ε is diagonal covariance matrix of ε.

Since the scale of the latent variable is unknown, the factor indeterminacy is a common problem in MIMIC model as in other structure equation models. The values of reduced-formed parameters keep unchanged when Λ_y is multiplied by a constant and γ'and $\psi^{1/2}$ are divided by the same constant. That is, by arbitrarily changing the scale of the latent variables we can obtain infinite parameter estimates from the reduced form.

By fixing the scales of latent variables, one can solve the indeterminacy problem. Two methods are usually adopted to fix the scale of latent variables. One is the normalization in which a unit variance is assigned to each latent variable, while the other is to fix a nonzero coefficient at unity for each latent variable. This study adopts the normalization method to deal with the factor indeterminacy problem.

B. Estimation Criterion

This study uses maximum likelihood estimation method in structural equation modeling to estimate parameters. The maximum likelihood estimates for the parameters of the model are obtained at the minimization of the fit function as follows:

$$F = \log \|\Sigma\| + tr(S\Sigma^{-1}) - \log\|S\| - (p + q),$$

where

Σ is the population covariance matrix;

S is the model-implied covariance matrix;

p is the number of exogenous observable variables;

q is the number of endogenous observable variables.

C. Model Fit Evaluation

MacCallum, Browne, and Sugawara (1996) argue that a major aspect of the application of structural equation modeling (SEM) for a hypothesized model in empirical research is the assessment of model's goodness-of-fit to the sample data. The overall model fit evaluation should be done before interpreting the parameter estimation results.

Structural equation modeling estimates parameters by minimizing the discrepancy between population covariance matrix and model-implied covariance matrix. Any conclusions from the model estimations without evaluating the model fit would lead to misleading results. However, what is the acceptable discrepancy to interpret estimate coefficients?

Over the past few decades, researchers have developed more than 30 fit indices in the area of structural equation modeling. Recent focus in this area has been on closeness fit tests such as RMSEA instead of the traditional exact-fit χ^2 test. Since the application of the latter may discard many good models, this is perhaps why some articles do not report model fit. This section reviews the model fit indices.

Structural equation modeling can estimate parameters for eight matrices simultaneously. Since there are usually a large number of parameters involved in the model, the application of structural equation modeling is consists of the following six steps performed sequentially: model specification, model identification, estimation, model evaluation, model re-specification, and interpretation. As such, a researcher forms a model in a path diagram and then transforms it to equation or matrix form.

A model can be under-identified, exact-identified, or over-identified. An under-identified model is an unfeasible model. An exact-identified model is of no interest to researchers due to the impossibility for model evaluation. An over-identified model is testable and hence interesting to researchers. A model being able to measure its goodness of fit should be over-identified. Model evaluation is based on χ^2-related statistics that requires non-zero degrees of freedom to perform the overall fit test. One problem that may be encountered in estimation procedure is the non-positive definite issue.[7] After obtaining the estimate coefficients, the model evaluation is performed based on some fit indices. In case the overall model fit is not acceptable, the model is re-specified again and again until an acceptable model results for interpret ation of the findings.

Over the past few decades, there has not been much economics, finance, or accounting research using structural equation modeling. Some structural equation modeling studies report the overall model fit, while some do not. Lambert and Larcker (1987), Reiter and Ziebart (1991), Rodgers (1991), Ziebart (1987), and Wang (1991) are among the studies that have report overall model fit, while the latter including Frey and Weck-Hanneman (1984), Hopwood and Schaefer (1988), and TW (1988) do not report model fit. However, three out of six studies reporting overall model fit have unacceptable fit indices. In all, only three out of the nine studies present acceptable overall model fit. Unacceptable model fit, as stated above, may be result from the use of inappropriate fit indices. For example, the exact-fit χ^2-statistic is sensitive to large sample sizes, and using a model with large

[7] Wothke (1993) is a seminal article on non-positive definite problem.

sample size with the exact-fit χ^2-statistic would result in an inappropriate model evaluation.

As MacCallum et al. (1996) argue, empirical applications of SEM typically evaluate overall model fit using two approaches: (a) the traditional likelihood ratio χ^2 test, which hypothesizes that the specified model holds exactly in the population and (b) using other descriptive measures of model fit to the sample data. As is the convention, researchers applying structure equation modeling mainly rely on the exact-fit χ^2-statistic to test goodness-of-fit for the overall model. However, the use of the exact-fit χ^2-statistic test has two drawbacks. First with the χ^2-statistic tests for exact fit, a minor discrepancy between the model-implied covariance matrix and the population covariance matrix may cause the model to be rejected, thus easily discarding a good model. Second, the exact-fit χ^2-statistic test is very sensitive to sample size because it is an increasing function of sample size. Models with large sample size result in a much higher probability of rejection than those with small ones. Furthermore, exact-fit χ^2-statistic test is based on asymptotic theory, which requires large sample sizes to be valid. Thus, the evaluation function of exact-fit χ^2-statistic test is contradictory to its theoretical rationale. In previous research applying structure equation modeling, the exact-fit χ^2-statistic is widely used as a primary model fit test statistic to evaluate a model. The application of χ^2 test either results in many good studies unacceptable for publication or published studies that don't report model fit. Recently, the drawbacks of exact-fit test have been identified and alternative closeness fit indices such as RMSEA thus are proposed (Browne and Cudeck (1993); Steiger (1990); MacCallum et al. (1996); Hu and Bentler (1998); Hu and Bentler (1999)).

V. Empirical Results

In empirical research, theoretical attributes or constructs may be measured with several proxies. The flexibility in the measure of constructs results in arbitrary measurement. It causes measurement error problem and hence leads to inconsistent research results. Traditional ordinary least squares (OLS) method is incapable of dealing with either cause-effect relationships or multiple dependent variables. The TW (1988) study is the pioneer in applying structural equation modeling to corporate finance and investigates the determinants of capital structure choice. However, they obtain poor results and call for further investigation on this issue.

In order to improve on the mode of the determinants of capital structure under the structural equation modeling approach, we adopt a Multiple Indicators and Multiple Causes Model (MIMIC), which is comprised of two sub-models -- a structural sub-model and measurement sub-model. As shown in Table 4, the structural sub-model includes the hypothesized determinants of capital structure, which are growth, uniqueness, non-debt tax shields, collateral value of assets, profitability, volatility, and industry classification. These constructs/attributes are then measured by several indicators.

<INSERT TABLE 4 ABOUT HERE>

Growth is measured with the following 6 indicators: the ratio of R&D to sales (RD/S), the ratio of capital expenditure to total assets (CE/TA), the percentage change in total assets (GTA), the ratio of market-to-book assets (MBA), the ratio of market-to-book equity (MBE), and the ratio of R&D to total assets (RD/TA). Uniqueness is measured with the ratio of R&D to sales (RD/S), and non-debt tax shields are measured with the following 3 indicators: the ratio of non-debt tax shields to total assets (NDT/TA), the ratio of investment tax credit to total assets (ITC/TA), and the ratio of depreciation to total assets (DEP/TA). Collateral value of assets has only one indicator, which is the ratio of the sum of inventory and gross plant and equipment to total assets (IGP/TA). Profitability is measured with the ratio of operating income to total assets (OI/TA) and the ratio of operating income to sales (OI/S). Volatility is measured with the standard deviation of the percentage change in operating income (STDGOI), the coefficient of variation of ROA (CV(ROA)), the coefficient of variation of ROE (CV(ROE)), and the coefficient of variation of operating income divided by total assets (CV(OITA)). Industry is measured with the dichotomous industry classification (IND).

In this structural sub-model, a firm's characteristics are modeled as implicit constructs that are not shown in the model but only implicitly represented by cause variables. The measurement sub-model, as presented in Table 5, has three measures of capital structure construct. They are long-term (LT/MVE), short-term (ST/MVE), and convertible (C/MVE) debt divided by market value of equity. The full MIMIC model combines the structural sub-model and the measurement sub-model together.

As mentioned in previous section, the model selection in our study is based on the overall model fit evaluation. The evaluation of the model fit assures that the model-implied covariance is within an acceptable range to the population covariance, such that the interpretation of parameter estimates can be reliable and valid. There are two types of goodness-of-fit indices: absolute fit indices and incremental fit indices. The absolute fit indices include Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR), while incremental fit indices include Non-Normed Fit Index (NNFI), Comparative Fit Index (CFI), and Incremental Fit Index (IFI). Nowadays, RMSEA is strongly recommended by scholars such as Browne and Cudeck (1993), Hu and Bentler (1999), MacCallum et al. (1996), and Steiger (1990); while SRMR is recommended by Hu and Bentler (1999). NNFI and CFI are recommended by Hu and Bentler (1999) and Marsh, Balla, and Hau (1996), and IFI is recommended by Hu and Bentler (1999). NNFI is also called Tucker-Lewis Index (TLI).

The above five goodness-of-fit indices are widely accepted. The cutoff criteria follow conventional rules of thumb: RMSEA<.05, SRMR<.05, NNFI>.90, CFI>.90, and IFI>.90. Table 5 shows each of the seventeen MIMIC models of either cross-sectional or panel data samples has met all five goodness-of-fit criteria. With the support of acceptable goodness-of-fit measures, we have great confidence in the interpretation of resultant parameter estimates.

<INSERT TABLE 5 ABOUT HERE>

Structural equation modeling has two kinds of standardized parameter estimates. They are (1) a standardized solution, in which the latent constructs are scaled to have variances equal to one and the observed variables are still in the original metric; and (2) a completely standardized solution, in which both observed and latent constructs are standardized. For a comparison of the relative impact of indicators and determinants of capital structure, we compute a completely standardized solution, which is presented in Table 6. We obtain consistent result that the strongest indicator of capital structure is long-term debt, followed by short-term debt, and then convertible debt. For example, in the pooled (1988-2003) sample, the completely standardized loadings of long-term, short-term, and convertible debt are 0.87, 0.64 and 0.31, respectively. The relative impact of the determinants of capital structure over time period of 1988-2003 can be interpreted in terms of the determinants' significance, signs, and magnitude. The significance of determinants in terms of completely standardized solution cannot be tested. Instead, the significance of unstandardized total effects of the determinants can be tested based on t-statistics, which is shown in Table 7. Table 7 shows -GTA, MBA, MBE, IGP/TA, OI/TA, OI/S, CV(ROA), and CV(OITA) are significant at α=.05 in at least 10 out of 16 years. For example, the loadings of market-to-book equity ratio (MBE) are significant in 14 out of 16 cross-sectional samples.

<INSERT TABLE 6 ABOUT HERE>

<INSERT TABLE 7 ABOUT HERE>

Table 8 shows the resultant signs of completely standardized loadings of each determinant of capital structure are consistent over the cross-sectional and the pooled samples. For each determinant, the mode of signs over 16 cross-sectional samples is the same as that of the pooled sample. Among these 17 determinants of capital structure, seven determinants have consistent signs over all 16 cross-sectional and the pooled samples, including RD/TA (growth), NDT/TA (non-debt tax shields), IGP/TA (collateral values of assets), OI/TA (profitability), OI/S (profitability), CV(ROA) (volatility), and CV(OITA) (volatility). Four determinants have consistent signs over 14 cross-sectional and the pooled sample of 16 sample years. These determinants are CE/TA (growth), MBA (growth), GTA (growth), and MBE (growth). In sum, growth, profitability, collateral values of assets, volatility, and non-debt tax shields have very consistent signs in terms of their individual total effect on capital structure choice.

<INSERT TABLE 8 ABOUT HERE>

Further, we turn the completely standardized loadings of determinants into relative impact scores with which we rank the average score of absolute loadings of 16 cross-sectional total effects and that in the pooled sample for each determinant of capital structure. Figure 2 depicts the relative impact of the determinants in the following order: MBA (growth), MBE (growth), OI/TA (profitability), OI/S (profitability), IGP/TA (collateral values of assets), CV(ROA) (volatility), CV(OITA) (volatility), RD/TA (growth), GTA (growth), NDT/TA (non-debt tax shields), RD/S (uniqueness), STDGOI (volatility), CE/TA (growth), IND (industry), DEP/TA (non-debt tax shields), CV(ROE) (volatility), ITC/TA (non-debt tax shields).

<INSERT FIGURE 2 ABOUT HERE>

The direct relative impact of the determinants of capital structure can be measured in terms of completely standardized loadings[8], as shown in Figure 2. In structural equation modeling, the portion of variation of endogenous constructs or indicators explained by exogenous constructs are measured with squared multiple correlations (SMC), which are analogous to R^2 in linear regression analysis. The squared multiple correlations (SMC) are presented in Table 9. More than half of the SMC of leverage is larger than 40%. Among the indicators of capital structure, long-term debt (LT/MVE) has the largest SMC over all years and across samples, followed by short-term debt (ST/MVE) and then

[8] Alternatively, the relative impact of the determinants of capital structure can also be measured in terms of the total effect of each determinant, which is calculated as the sum of the direct and indirect effects. In the MIMIC model, the relative impact of the determinants of capital structure in terms of total effect is shown in Appendix B.

convertible debt (C/MVE). This fact coincides with the relative impact of the indicators of capital structure analyzed previously.

In an attempt to improve the application of structure equation modeling to corporate finance and specifically to the determinants of capital structure choice, this study obtains consistent results across cross-sectional and pooled samples over 16 years during 1988-2003. A comparison of the results from TW (1988) and our findings is shown in Table 10. This study excludes size attribute from the model based on goodness-of-fit measures. Except for industry attribute, the other six determinants of capital structure are all significant in our model, while only four determinants are marginally significant in the TW model.

<INSERT TABLE 9 ABOUT HERE>

<INSERT TABLE 10 ABOUT HERE>

IV. Conclusion

The purpose of this study is two-fold. We attempt to re-advocate the use of structure equation modeling in corporate finance, following Titman and Wessels' (1988) seminal work on determinants of capital structure over a decade ago. In addition, this study tries to unravel the relative impact of determinants of capital structure in a cause-effect simultaneous framework. In keeping with our first purpose, we successfully specify an acceptable model based on the overall model fit evaluation and re-establish the potential of applying structure equation modeling in corporate finance. As for the second purpose, with capital structure measured with long-term, short-term, and convertible debt, we rank the relative impact of determinants of capital structure choice in terms of firm characteristics as follows: growth, profitability, collateral value, volatility, non-debt tax shields, and uniqueness. The capital structure is strongly indicated by long-term debt, followed by short-term and then convertible debt.

Harris and Raviv (1991, p. 336) summarize the results from several studies[9] on the determinants of capital structure choice and find that in general "leverage increases with fixed assets, non-debt tax shields, growth opportunities, and firm size and decreases with volatility, advertising expenditures, research and development expenditures, bankruptcy probability, profitability and uniqueness of the product." We examine seven firm factors previously mentioned above and one industry factor of effect as follows: profitability, collateral value of assets (fixed assets), growth opportunities, non-debt tax shields, uniqueness, volatility, and industry. When we take logarithm of total sales as a proxy for firm size, the indices of goodness-of-fit for the MIMIC model do not meet model acceptance criteria, and therefore the firm size attribute is excluded from the model. The R&D expenditure is divided by total sales in our study as a proxy of uniqueness attribute. Other attributes are not considered in this study for their inclusion largely reduces the sample size.

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[9] These studies include Bradley, Jarrell, and Kim (1984); Baskin (1985); Kester (1986); Long and Malitz (1985); Marsh (1982); and Titman and Wessels (1988).

We find a consistent result for our cross-sectional and pooled samples over the 16 years during 1988-2003. In terms of relative impact on capital structure, growth is the most influential determinants on capital structure when we measure the growth either as market-to-book assets ratio or as market-to-book equity ratio. The second influential determinant on capital structure is the profitability measured with operating income divided either by total assets or by total sales. However, different measures result in different signs of the loadings of growth and profitability. The growth has negative effect on leverage when we measure it with market-to-book assets (MBA) ratio while positive if it's measured with market-to-equity (MBE) ratio. Similar situation happens to measures of profitability. In all the cross-sectional and pooled samples, when the profitability is measured as operating income divided by total assets, it has negative effect on leverage, but it has positive effect on leverage if it is measured as operation income divided by total sales. The former is consistent with many previous studies such as Booth et al. (2001) in which the profitability being measured as the rate of return (ROA) has negative effect on capital structure. The fact that different measures for the same determinant of capital structure result in different effects may explain the contradictory findings in capital structure models. For example, the pecking-order hypothesis indicates the more profitable the firm the lower the debt ratio while the static trade-off model expects profitable firms would use more debt to lower tax bill. The contradictory conclusions in the literature resulted from different measures are avoided in our studies by presenting a variety of measures for each determinants of capital structure in MIMIC model.

Our results also consistently support the opposite relationship between collateral value of assets and debt ratios across 17 samples over 16 years. The role of collateral value of assets is ranked as important factor, only secondary to profitability, in the financing decision. This result is consistent with Harris and Raviv (1991), Booth et al. (2001), and Garvey and Hanka (1999).

As TW (1988) notes, since growth opportunities are capital assets that add value to a firm but cannot be collateralized and do not generate current taxable income, negative relation is expected to exist between debt and growth opportunities. When the growth is measured as market-to-book assets (MBA) ratio, our study supports their argument and is also consistent with Booth et al. (2001) that growth is found negatively correlated with leverage. When growth is measured with R&D, Harris and Raviv (1991) find the same result as ours. However, as growth being measured with market-to-book equity (MBE) ratio, we find negative effect of growth on capital structure.

Consistent with Harris and Raviv (1991), we find uniqueness and volatility is negatively correlated with leverage. However, Booth et al. (2001) and Rajan and Zingales (1995) have similar findings about the mixed effect of business risk on leverage.

In general, under a simultaneous cause-effect framework, the sign and relative impact of certain important determinants of capital structure choice are consistent over pooled and cross-sectional samples for our 16 sample periods, 1988 to 2003. However, the unresolved issue of different indicators for the same construct may have different signs still persists.

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Table 1
Descriptive Statistics for the Pooled Sample during 1988-2003

RD/S is the ratio of R&D to sales. CE/TA is the ratio of capital expenditure to total assets. GTA is the percentage change in total assets. MBA is the ratio of market-to-book assets. MBE is the ratio of market-to-book equity. RD/TA is the ratio of R&D to total assets. RD/S is the ratio of R&D to sales.NDT/TA is the ratio of non-debt tax shields to total assets. ITC/TA is the ratio of investment tax credit to total assets. DEP/TA is the ratio of depreciation to total assets. IGP/TA is the ratio of the sum of inventory and gross plant and equipment to total assets. OI/TA is the ratio of operating income to total assets. OI/S is the ratio of operating income to sales. STDGOI is the standard deviation of the percentage change in operating income. CV(ROA) is the coefficient of variation of ROA. CV(ROE) is the coefficient of variation of ROE. CV(OITA) is the coefficient of variation of operating income divided by total assets. IND is the

Variable	N	Minimum	Lower Quartile	Mean	Median	Upper Quartile	Std Dev	Maximum
LT/MVE	13,887	0.00	0.00	0.44	0.08	0.35	1.94	84.99
ST/MVE	13,887	0.00	0.00	0.19	0.02	0.08	1.38	69.18
C/MVE	13,887	0.00	0.00	0.05	0.00	0.00	0.40	33.61
RD/S	13,887	0.00	0.00	0.16	0.02	0.08	1.38	54.79
CE/TA	13,887	0.00	0.02	0.06	0.04	0.07	0.06	1.32
GTA	13,887	-0.94	-0.04	0.15	0.06	0.19	0.71	32.45
MBA	13,887	0.08	1.03	1.92	1.37	2.10	1.97	43.19
MBE	13,887	0.01	1.07	3.03	1.81	3.19	5.02	98.68
RD/TA	13,887	0.00	0.00	0.06	0.02	0.08	0.10	3.69
NDT/TA	13,887	0.00	0.04	0.41	0.06	0.13	2.02	70.13
ITC/TA	13,887	0.00	0.00	0.00	0.00	0.00	0.06	6.40
DEP/TA	13,887	0.00	0.03	0.05	0.04	0.06	0.04	1.61
IGP/TA	13,887	0.00	0.25	0.43	0.44	0.60	0.24	1.00
OI/TA	13,887	-4.21	0.02	0.04	0.08	0.14	0.22	1.40
OI/S	13,887	-81.64	0.01	-0.18	0.07	0.12	2.55	9.12
STDGOI	13,887	0.00	0.20	2.07	0.52	1.53	6.18	93.21
CV(ROA)	13,887	0.00	0.19	1.73	0.49	1.29	5.46	98.05
CV(ROE)	13,887	0.00	0.19	1.72	0.51	1.42	5.07	97.28
CV(OITA)	13,887	0.00	0.14	1.19	0.32	0.79	4.19	92.43
IND	13,887	0.00	0.00	0.01	0.00	0.00	0.11	1.00

Table 2

Pearson Correlation Coefficients for the Pooled Sample during 1988-2003, N = 13,387

	LT/MVE	ST/MVE	C/MVE	RD/S	CE/TA	GTA	MBA	MBE	RD/TA	NDT/TA	ITC/TA	DEP/TA	IGP/TA	OI/TA	OI/S	CV(ROA)	CV(ROE)	CV(OITA)	STDGOI
LT/MVE	1	0.158	0.160	-0.020	-0.033	-0.028	-0.099	-0.066	-0.091	-0.022	-0.004	-0.026	0.036	-0.002	0.022	-0.002	0.038	0.034	-0.005
		<.0001	<.0001	0.0165	0.0001	0.0011	<.0001	<.0001	<.0001	0.0102	0.6501	0.0021	<.0001	0.8181	0.0089	0.7878	<.000	<.0001	0.5487
ST/MVE		1	0.390	-0.012	-0.035	-0.020	-0.062	-0.041	-0.044	0.004	-0.003	-0.016	0.035	-0.036	0.005	0.003	0.016	0.014	0.021
			<.0001	0.1728	<.0001	0.0212	<.0001	<.0001	<.0001	0.6753	0.7389	0.0581	<.0001	<.0001	0.5913	0.7248	0.0541	0.1097	0.0126
C/MVE			1	0.001	-0.023	-0.018	-0.047	-0.022	-0.014	0.022	-0.001	0.019	0.024	-0.044	-0.004	0.023	0.009	0.013	0.021
				0.9122	0.0067	0.0329	<.0001	0.0102	0.1016	0.0087	0.8706	0.0268	0.0056	<.0001	0.5976	0.0071	0.3162	0.13	0.0136
RD/S				1	-0.043	0.043	0.124	0.093	0.319	0.152	0.034	0.007	-0.113	-0.236	-0.799	0.000	-0.011	-0.007	-0.004
					<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.3862	<.0001	<.0001	<.0001	0.9927	0.1985	0.3789	0.6216
CE/TA					1	0.027	0.074	0.038	-0.042	-0.056	-0.008	0.277	0.406	0.097	0.030	-0.049	-0.044	-0.052	-0.057
						0.0014	<.0001	<.0001	<.0001	<.0001	0.3758	<.0001	<.0001	<.0001	0.0003	<.0001	<.0001	<.0001	<.0001
GTA						1	0.146	0.090	-0.036	-0.044	-0.002	-0.120	-0.089	0.086	-0.021	0.006	0.000	0.004	0.002
							<.0001	<.0001	<.0001	<.0001	0.8475	<.0001	<.0001	<.0001	0.0125	0.4861	0.9883	0.652	0.7889
MBA							1	0.679	0.258	0.197	0.024	0.023	-0.174	-0.063	-0.138	-0.005	-0.046	-0.037	-0.031
								<.0001	<.0001	<.0001	0.0046	0.0058	<.0001	<.0001	<.0001	0.5571	<.0001	<.0001	0.0002
MBE								1	0.215	0.210	0.008	0.077	-0.116	-0.151	-0.112	0.018	-0.034	-0.021	-0.021
									<.0001	<.0001	0.3268	<.0001	<.0001	<.0001	<.0001	0.0371	<.0001	0.0125	0.0138
RD/TA									1	0.377	0.035	0.242	-0.258	-0.481	-0.212	0.076	0.026	0.031	0.064
										<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.0022	0.3	<.0001
NDT/TA										1	0.036	0.261	-0.131	-0.559	-0.225	0.032	-0.009	0.000	0.006
											<.0001	<.0001	<.0001	<.0001	<.0001	0.0002	0.2664	0.987	0.4947
ITC/TA											1	-0.003	-0.011	-0.025	-0.027	0.001	-0.003	-0.002	-0.002
												0.6927	0.1995	0.0027	0.0015	0.9383	0.7634	0.8167	0.8319
DEP/TA												1	0.172	-0.356	-0.057	0.034	0.012	0.021	0.070
													<.0001	<.0001	<.0001	<.0001	0.1477	0.0148	<.0001
IGP/TA													1	0.147	0.089	-0.086	-0.026	-0.037	-0.049
														<.0001	<.0001	<.0001	0.0023	<.0001	<.0001
OI/TA														1	0.353	-0.101	-0.046	-0.072	-0.086
															<.0001	<.0001	<.0001	<.000	<.0001
OI/S															1	-0.0076	0.00883	-0.00692	-0.0002
																0.3703	0.2983	0.4147	0.9862
CV(ROA)																1	0.07523	0.07477	0.09366
																	<.0001	<.0001	<.0001
CV(ROE)																	1	0.53098	0.18257
																		<.0001	<.0001
CV(OITA)																		1	0.15952
																			<.0001
STDGOI																			1

Table 3
Constructs and Indicators in Titman and Wessels (1988) Model

Six measures used to indicate capital structure in Titman and Wessels (1988) are long-term, short-term, and convertible debt divided by market and book values of equity and denoted as LT/MVE, ST/MVE, C/MVE, LT/BVE, ST/BVE, and C/BVE, respectively. The determinants of capital structure include growth, uniqueness, non-debt tax shield, collateral value, size, profitability, volatility, and industry.

Constructs	Indicators	Definition of Indicators
(A). Capital Structure	(Effects)	
	LT/MVE	Long-Term Debt / Market Value of Equity
	ST/MVE	Short-Term Debt / Market Value of Equity
	C/MVE	Convertible Debt / Market Value of Equity
	LT/BVE	Long-Term Debt / Book Value of Equity
	ST/BVE	Short-Term Debt / Book Value of Equity
	C/BVE	Convertible Debt / Book Value of Equity
(B). Determinants of Capital Structure (Causes)		
Growth	RD/S	Research & Development / Sales
	CE/TA	Capital Expenditure / Total Assets
	GTA	Percentage Change of Total Assets
Uniqueness	RD/S	Research & Development / Sales
	QR	Quit Rates
	SE/S	Selling Expenses / Sales
Non-Debt Tax Shields	NDT/TA	Non-Debt Tax Shields / Total Assets
	ITC/TA	Investment Tax Credit / Total Assets
	D/TA	Depreciation / Total Assets
Collateral Value	INT/TA	Intangible Assets / Total Assets
	IGP/TA	(Inventory + Gross Plant and Equipment) / Total Assets
Size	LnS	ln(Sales)
	QR	Quit Rates
Profitability	OI/TA	Operating Income / Total Assets
	OI/S	Operating Income / Sales
Volatility	SIGOI	Standard Deviation of the Percentage Change in Operating Income
Industry	IDUM	Industrial Classification Dummy Variables

Table 4
Constructs, Causes and Effects in MIMIC Model

In MIMIC model, long-term (LT/MVE), short-term (ST/MVE), and convertible (C/MVE) debt divided by market value of equity are indicators of the latent construct -- capital structure. The determinants of capital structure include ratio of R&D to sales (RD/S), the ratio of capital expenditure to total assets (CE/TA), the percentage change in total assets (GTA), the ratio of market-to-book assets (MBA), the ratio of market-to-book equity (MBE), the ratio of R&D to total assets (RD/TA), the ratio of R&D to sales (RD/S), the ratio of non-debt tax shields to total assets (NDT/TA), the ratio of investment tax credit to total assets (ITC/TA), the ratio of depreciation to total assets (DEP/TA), the ratio of the sum of inventory and gross plant and equipment to total assets (IGP/TA), the ratio of operating income to total assets (OI/TA), the ratio of operating income to sales (OI/S), the standard deviation of the percentage change in operating income (STDGOI), the coefficient of variation of ROA (CV(ROA)), the coefficient of variation of ROE (CV(ROE)), the coefficient of variation of operating income divided by total assets (CV(OITA)), and the dichotomous industry classification (IND). In the model, firm characteristics include growth, uniqueness, non-debt tax shields, collateral value, profitability, and volatility, and they are modeled as implicit constructs that are not shown in the model but only implicitly represented by cause variables.

Constructs	Causes/Effects	Definition of Indicators
A. Capital Structure	(Effects)	
	LT/MVE	Long-Term Debt / Market Value of Equtity
	ST/MVE	Short-Term Debt / Market Value of Equity
	C/MVE	Convertible Debt / Market Value of Equity
B. Implicit Construct	(Causes)*	
Growth	RD/S	Research & Development / Sales
	CE/TA	Capital Expenditure / Total Assets
	GTA	Percentage Change in Total Assets
	MBA	Market-to-Book Assets
	MBE	Market-to-Book Equity
	RD/TA	R&D-to-Assets Ratio
Uniqueness	RD/S	Research & Development / Sales
Non-Debt Tax Shields	NDT/TA	Non-Debt Tax Shields / Total Assets
	ITC/TA	Investment Tax Credit / Total Assets
	DEP/TA	Depreciation / Total Assets
Collateral Value	IGP/TA	(Inventory + Gross Plant and Equipment) / Total Assets
Profitability	OI/TA	Operating Income / Total Assets
	OI/S	Operating Income / Sales
Volatility	STDGOI	Standard Deviation of the Percentage Change in Operating Income
	CV(ROA)	Coefficient of Variation of ROA
	CV(ROE)	Coefficient of Variation of ROE
	CV(OITA)	Coefficient of Variation of OI Divided by Total Assets
Industry	IND	Two-Category Dummy Variable

Table 5
Goodness-of-Fit Measures

Two types of goodness-of-fit indices, absolute fit indices and incremental fit indices, are presented in this table. The former includes RMSEA and SRMR while the latter includesNNFI, CFI, and IFI. RMSEA is recommended by Browne and Cudeck (1993),Hu and Be

	(A) Absolute Fit Indices		(B) Incremental Fit Indices		
Year	RMSEA	SRMR	NNFI	CFI	IFI
1988	0.02	0.04	0.99	0.99	0.99
1989	0.00	0.03	1.00	1.00	1.00
1990	0.00	0.03	1.00	1.00	1.00
1991	0.00	0.03	1.00	1.00	1.00
1992	0.00	0.03	1.00	1.00	1.00
1993	0.00	0.03	1.01	1.00	1.01
1994	0.00	0.03	1.01	1.00	1.01
1995	0.01	0.03	0.99	1.00	1.00
1996	0.00	0.03	1.00	1.00	1.00
1997	0.02	0.04	0.99	0.99	0.99
1998	0.01	0.04	1.00	1.00	1.00
1999	0.01	0.03	1.00	1.00	1.00
2000	0.02	0.04	1.00	1.00	1.00
2001	0.02	0.04	0.99	0.99	0.99
2002	0.01	0.03	1.00	1.00	1.00
2003	0.00	0.03	1.00	1.00	1.00
1988-2003	0.03	0.04	0.99	0.99	0.99

Table 6
Completely Standardized Loadings

A completely standardized solution is computed by standardizing both observed and latent constructs before performing parameters estimation.

	LEVERAGE						
	1988	1989	1990	1991	1992	1993	1994
Panel A: Indicators of Leverage							
LT/MVE	0.97	0.94	0.83	0.86	0.88	0.80	0.90
ST/MVE	0.52	0.58	0.64	0.68	0.63	0.71	0.64
C/MVE	0.37	0.33	0.36	0.36	0.36	0.34	0.39
Panel B: Determinants of Leverage							
RD/S	-0.17	-0.21	-0.12	0.02	-0.02	0.05	0.03
CE/TA	0.04	-0.03	-0.13	-0.10	-0.18	-0.08	-0.19
GTA	0.12	0.09	0.07	-0.04	0.08	0.11	0.18
MBA	-0.76	-0.59	0.38	-0.14	-0.46	-1.01	-0.70
MBE	0.50	0.34	-0.56	-0.12	0.21	0.65	0.46
RD/TA	-0.09	-0.01	-0.05	-0.14	-0.10	-0.14	-0.21
NDT/TA	0.11	0.19	0.17	0.07	0.05	0.03	0.08
ITC/TA	0.03	-0.03	-0.09	-0.06	-0.08	-0.05	0.00
DEP/TA	-0.07	-0.09	-0.04	0.08	0.09	0.04	0.14
IGP/TA	0.14	0.22	0.25	0.32	0.36	0.31	0.26
OI/TA	-0.31	-0.41	-0.41	-0.22	-0.17	-0.07	-0.11
OI/S	0.18	0.31	0.28	0.13	0.16	0.06	0.05
STDGOI	0.00	0.04	-0.01	0.01	-0.08	-0.14	-0.18
CV(ROA)	0.24	0.09	0.38	0.38	0.15	0.15	0.18
CV(ROE)	-0.02	0.08	-0.05	-0.01	0.20	0.09	0.19
CV(OITA)	-0.27	-0.24	-0.29	-0.39	-0.26	-0.07	-0.18
IND	-0.06	0.09	0.05	0.06	0.02	0.04	0.02

Table 6 (cont'd)
Completely Standardized Loadings

A completely standardized solution is computed by standardizing both observed and latent cons before performing parameters estimation.

	LEVERAGE									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	8-2003
Panel A: Indicators of Leverage										
LT/MVE	0.91	0.85	0.84	0.87	0.84	0.83	0.9	0.96	0.87	0.87
ST/MVE	0.62	0.66	0.62	0.59	0.64	0.64	0.58	0.57	0.64	0.64
C/MVE	0.34	0.31	0.27	0.27	0.23	0.29	0.26	0.33	0.29	0.31
Panel B: Determinants of Leverage										
RD/S	-0.1	0.15	0.15	-0.01	-0.18	-0.03	0.17	-0	0.16	-0.07
CE/TA	-0.2	-0.14	-0	-0.1	-0.08	-0.03	-0.1	0.04	-0.08	-0.05
GTA	0.16	0.12	0.15	0.21	0.15	0.01	0.08	-0	0.13	0.1
MBA	-0.3	-0.7	-1.1	-0.97	-0.79	-0.33	-0.8	-0.4	-1.2	-0.7
MBE	0.2	0.45	0.83	0.67	0.41	0.11	0.53	0.24	0.83	0.4
RD/TA	-0.1	-0.37	-0.3	-0.19	-0.02	-0.29	-0.4	-0.3	-0.31	-0.12
NDT/TA	0.02	0.09	0.1	0.08	0.12	0.04	0.07	0.13	0.23	0.08
ITC/TA	-0.1	-0.03	-0	-0.07	-0.02	-0.07	-0	0.01	-0.01	-0.02
DEP/TA	0.12	0.08	-0	0.07	0.01	0.01	0.09	-0	0.05	0.04
IGP/TA	0.36	0.33	0.33	0.25	0.23	0.19	0.15	0.21	0.23	0.28
OI/TA	-0.2	-0.23	-0.3	-0.44	-0.4	-0.45	-0.4	-0.4	-0.32	-0.31
OI/S	0.12	0.25	0.31	0.4	0.36	0.36	0.39	0.44	0.48	0.3
STDGOI	-0	-0.09	-0.1	-0.09	-0.13	-0.1	-0.1	-0.1	-0.08	-0.06
CV(ROA)	0.1	0.29	0.12	0.17	0.25	0.15	0.1	0.22	0.25	0.22
CV(ROE)	0.22	-0.04	0.03	0.05	-0.02	0.12	0.17	-0	-0.1	0.03
CV(OITA)	-0.2	-0.12	-0.1	-0.14	-0.17	-0.19	-0.2	-0.1	-0.19	-0.2
IND	-0.2	0.01	0.11	0.02	0.07	-0.03	-0.1	0.05	0.13	0.05

Table 7
Significance of Unstandardized Total Effect of Determinants of Capital Structure

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	1988-2003	Frequency of paremeters significant at α=.05
RD/S												*		*		*	***	0
CE/TA			***	**	***		***	***	***		***	**				*	***	8
GTA	***	**			*	***	***	***	***	***	***	***		**		***	***	11
MBA	***	***	***		***	***	***	***	***	***	***	***	***	***	***	***	***	15
MBE	***	***	***		**	***	***	***	***	***	***	***		***	**	***	***	14
RD/TA								***	***	***	*		***	***	**	***	***	8
NDT/TA	**	***	***			**			*	***	**	***		*	***	***	***	9
ITC/TA			**		**					*	***		**				**	4
DEP/TA							**	**			*			**			***	3
IGP/TA	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	16
OI/TA	***	***	***	***	***			***	***	***	***	***	***	***	***	***	***	14
OI/S	***	***	***	**	***			**	***	***	***	***	***	***	***	***	***	14
STDGOI						***	***		*		**	***	**	***	*	**	***	7
CV(ROA)	***		***	***					***	*	***	***	**		***	***	***	10
CV(ROE)					**			***					*	***				3
CV(OITA)	***	***	***	***	***		***	***	*	**	***	***	***	***	***	***	***	15
IND		**		*				***		***		**		**		***	***	6

*Significant at .10 level; **significant at .05 level; ***significant at .01 level.

Table 8

Signs of Total Effect of Determinants of Capital Structure

																	Frequency			1988-
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	-	+	Mode	2003
RD/S	-	-	-	+	-	+	+	-	+	+	-	-	-	+	-	+	9	7	-	-
CE/TA	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	14	2	-	-
GTA	+	+	+	-	+	+	+	+	+	+	+	+	+	+	-	+	2	14	+	+
MBA	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	15	1	-	-
MBE	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	2	14	+	+
RD/TA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	0	-	-
NDT/TA	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	0	16	+	+
ITC/TA	+	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	13	3	-	-
DEP/TA	-	-	-	+	+	+	+	+	+	-	+	+	+	+	-	+	5	11	+	+
IGP/TA	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	0	16	+	+
OI/TA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	0	-	-
OI/S	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	0	16	+	+
STDGOI	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	13	3	-	-
CV(ROA)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	0	16	+	+
CV(ROE)	-	+	-	-	+	+	+	+	-	+	+	-	+	+	-	-	7	9	+	+
CV(OITA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	0	-	-
IND	-	+	+	+	+	+	+	-	+	+	+	+	-	-	+	+	4	12	+	+

Table 9
Squared Multiple Correlations

Sample Year(s)	Leverage	Indicators of Leverage		
		LT/MVE	ST/MVE	C/MVE
1988	0.33	0.94	0.27	0.14
1989	0.36	0.87	0.34	0.11
1990	0.38	0.69	0.41	0.13
1991	0.43	0.74	0.46	0.13
1992	0.37	0.78	0.40	0.13
1993	0.48	0.64	0.51	0.11
1994	0.41	0.81	0.41	0.15
1995	0.37	0.83	0.39	0.11
1996	0.53	0.73	0.43	0.10
1997	0.61	0.71	0.38	0.07
1998	0.49	0.75	0.35	0.07
1999	0.48	0.71	0.41	0.05
2000	0.40	0.70	0.41	0.08
2001	0.37	0.81	0.34	0.07
2002	0.26	0.93	0.32	0.11
2003	0.58	0.75	0.41	0.08
1988-2003	0.40	0.76	0.41	0.10

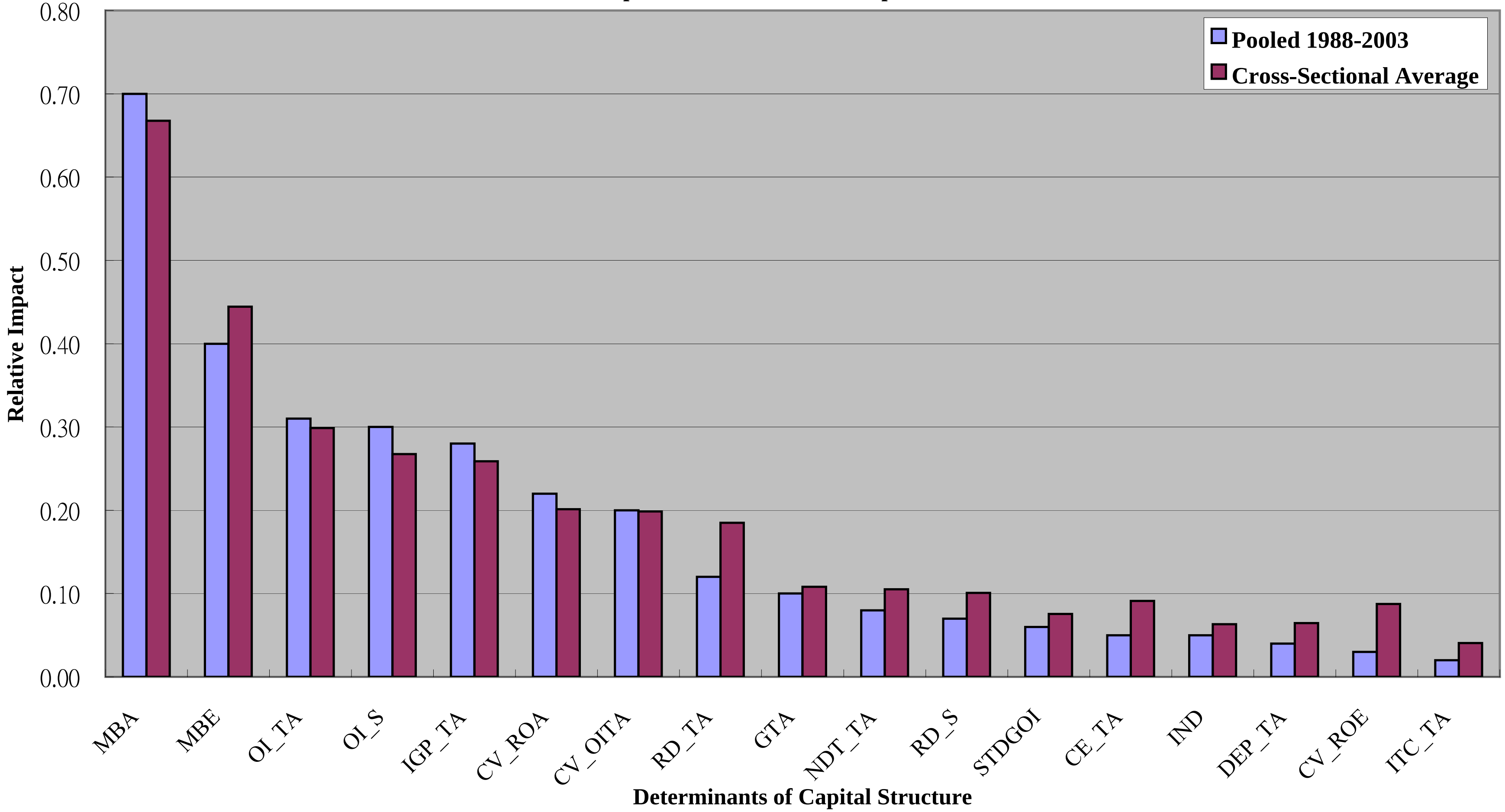
Table 10
Comparison of the Empirical Results

The asterisks indicate the empirical results which are consistent with finance theory. This study employs MIMIC model to investigate the determinants of capital structure and obtains the results more consistent with finance theory than Titman and Wessels (1988). This study excludes size attribute based on goodness-of-fit model selection criteria. Except for industry construct, the other 6 determinants of capital structure are all significant in our model

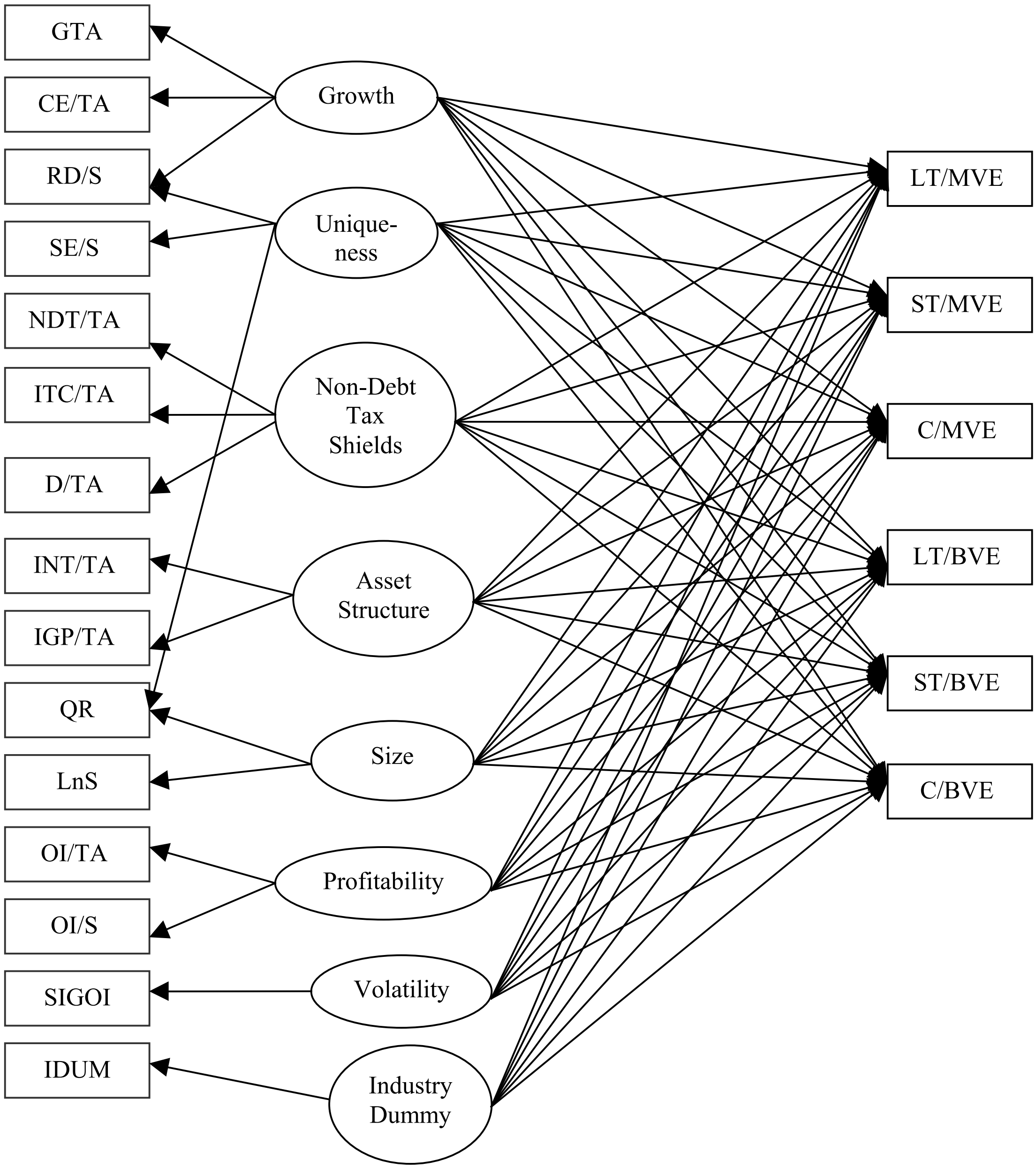
	Growth	Unique-Ness	Non-Debt Tax Shields	Collateral Values	Size	Profitability	Volatility	IND
Panel A: MIMIC Model								
LT/MVE	*	*	*	*	(excluded)	*	*	
ST/MVE	*	*	*	*	(excluded)	*	*	
C/MVE	*	*	*	*	(excluded)	*	*	
Panel B: Titman and Wessels (1988)								
LT/MVE		*				*		*
ST/MVE		*			*	*		
C/MVE								

Figure 2

Relative Impact of Determinants of Capital Structure



Appendix A. Path Diagram Implied in Titman and Wessels (1988) Model



Path Diagram Implied in Titman and Wessels (1988) Model

Appendix B: Completely Standardized Total Effect of Determinants of Capital Structure

Completely Standardized Total Effect of Determinants of Capital Structure

Determinants of Leverage	1988 LT/MVE	1988 ST/MVE	1988 C/MVE	1989 LT/MVE	1989 ST/MVE	1989 C/MVE	1990 LT/MVE	1990 ST/MVE	1990 C/MVE
RD/S	-0.16	-0.09	-0.06	-0.20	-0.12	-0.07	-0.10	-0.08	-0.05
CE/TA	0.04	0.02	0.01	-0.03	-0.02	-0.01	-0.11	-0.09	-0.05
GTA	0.11	0.06	0.04	0.09	0.05	0.03	0.06	0.05	0.03
MBA	-0.74	-0.40	-0.28	-0.55	-0.34	-0.20	0.32	0.24	0.14
MBE	0.48	0.26	0.18	0.32	0.20	0.11	-0.47	-0.36	-0.20
RD/TA	-0.08	-0.05	-0.03	-0.01	-0.01	0.00	-0.04	-0.03	-0.02
NDT/TA	0.11	0.06	0.04	0.18	0.11	0.06	0.14	0.11	0.06
ITC/TA	0.02	0.01	0.01	-0.03	-0.02	-0.01	-0.07	-0.06	-0.03
DEP/TA	-0.07	-0.04	-0.03	-0.09	-0.05	-0.03	-0.03	-0.02	-0.01
IGP/TA	0.13	0.07	0.05	0.21	0.13	0.07	0.21	0.16	0.09
OI/TA	-0.30	-0.16	-0.12	-0.38	-0.24	-0.14	-0.34	-0.26	-0.15
OI/S	0.17	0.09	0.07	0.29	0.18	0.10	0.23	0.18	0.10
STDGOI	0.00	0.00	0.00	0.04	0.02	0.01	-0.01	-0.01	-0.01
CV(ROA)	0.24	0.13	0.09	0.08	0.05	0.03	0.32	0.24	0.14
CV(ROE)	-0.02	-0.01	-0.01	0.08	0.05	0.03	-0.04	-0.03	-0.02
CV(OITA)	-0.26	-0.14	-0.10	-0.22	-0.14	-0.08	-0.24	-0.18	-0.10
IND	-0.06	-0.03	-0.02	0.08	0.05	0.03	0.04	0.03	0.02

Completely Standardized Total Effect of Determinants of Capital Structure

Determinants of Leverage	1991 LT/MVE	1991 ST/MVE	1991 C/MVE	1992 LT/MVE	1992 ST/MVE	1992 C/MVE	1993 LT/MVE	1993 ST/MVE	1993 C/MVE
RD/S	0.02	0.01	0.01	-0.01	-0.01	-0.01	0.04	0.03	0.02
CE/TA	-0.08	-0.07	-0.03	-0.16	-0.11	-0.06	-0.06	-0.06	-0.03
GTA	-0.03	-0.03	-0.01	0.07	0.05	0.03	0.09	0.08	0.04
MBA	-0.12	-0.09	-0.05	-0.40	-0.29	-0.16	-0.80	-0.72	-0.34
MBE	-0.10	-0.08	-0.04	0.18	0.13	0.07	0.52	0.46	0.22
RD/TA	-0.12	-0.10	-0.05	-0.09	-0.06	-0.04	-0.11	-0.10	-0.05
NDT/TA	0.06	0.05	0.03	0.05	0.03	0.02	0.11	0.10	0.05
ITC/TA	-0.05	-0.04	-0.02	-0.07	-0.05	-0.03	-0.04	-0.04	-0.02
DEP/TA	0.07	0.06	0.03	0.08	0.05	0.03	0.04	0.03	0.01
IGP/TA	0.28	0.22	0.12	0.32	0.23	0.13	0.25	0.22	0.10
OI/TA	-0.18	-0.15	-0.08	-0.15	-0.11	-0.06	-0.06	-0.05	-0.02
OI/S	0.11	0.09	0.05	0.14	0.10	0.06	0.05	0.04	0.02
STDGOI	0.01	0.01	0.01	-0.07	-0.05	-0.03	-0.11	-0.10	-0.05
CV(ROA)	0.33	0.26	0.14	0.13	0.09	0.05	0.12	0.11	0.05
CV(ROE)	-0.01	-0.01	0.00	0.18	0.13	0.07	0.07	0.07	0.03
CV(OITA)	-0.33	-0.26	-0.14	-0.23	-0.17	-0.09	-0.06	-0.05	-0.03
IND	0.05	0.04	0.02	0.02	0.01	0.01	0.03	0.03	0.01

Completely Standardized Total Effect of Determinants of Capital Structure

Determinants of Leverage	1994 LT/MVE	1994 ST/MVE	1994 C/MVE	1995 LT/MVE	1995 ST/MVE	1995 C/MVE	1996 LT/MVE	1996 ST/MVE	1996 C/MVE
RD/S	0.02	0.02	0.01	-0.12	-0.08	-0.05	0.13	0.10	0.05
CE/TA	-0.18	-0.12	-0.08	-0.15	-0.11	-0.06	-0.12	-0.09	-0.04
GTA	0.16	0.12	0.07	0.14	0.10	0.05	0.10	0.08	0.04
MBA	-0.63	-0.45	-0.27	-0.31	-0.21	-0.12	-0.60	-0.46	-0.22
MBE	0.41	0.29	0.18	0.18	0.12	0.07	0.39	0.30	0.14
RD/TA	-0.19	-0.14	-0.08	-0.08	-0.05	-0.03	-0.31	-0.24	-0.11
NDT/TA	0.07	0.05	0.03	0.02	0.01	0.01	0.08	0.06	0.03
ITC/TA	0.00	0.00	0.00	-0.04	-0.03	-0.02	-0.02	-0.02	-0.01
DEP/TA	0.12	0.09	0.05	0.11	0.08	0.04	0.07	0.05	0.03
IGP/TA	0.23	0.17	0.07	0.33	0.23	0.12	0.28	0.22	0.10
OI/TA	-0.10	-0.07	-0.05	-0.19	-0.13	-0.07	-0.20	-0.15	-0.07
OI/S	0.04	0.03	0.02	0.11	0.08	0.04	0.21	0.16	0.08
STDGOI	-0.16	-0.11	-0.07	-0.02	-0.01	-0.01	-0.07	-0.06	-0.03
CV(ROA)	0.17	0.12	0.07	0.09	0.06	0.03	0.25	0.19	0.05
CV(ROE)	0.17	0.12	0.07	0.20	0.14	0.08	-0.04	-0.03	-0.01
CV(OITA)	-0.17	-0.12	-0.07	-0.19	-0.13	-0.07	-0.10	-0.08	-0.04
IND	0.02	0.01	0.01	-0.15	-0.10	-0.06	0.01	0.01	0.00

Completely Standardized Total Effect of Determinants of Capital Structure

Determinants of Leverage	1997 LT/MVE	1997 ST/MVE	1997 C/MVE	1998 LT/MVE	1998 ST/MVE	1998 C/MVE	1999 LT/MVE	1999 ST/MVE	1999 C/MVE
RD/S	0.12	0.09	0.04	-0.01	-0.01	0.00	-0.15	-0.12	-0.04
CE/TA	-0.02	-0.01	-0.01	-0.08	-0.06	-0.03	-0.07	-0.05	-0.02
GTA	0.13	0.09	0.04	0.18	0.12	0.06	0.12	0.09	0.03
MBA	-0.96	-0.70	-0.30	-0.84	-0.57	-0.26	-0.66	-0.51	-0.18
MBE	0.70	0.51	0.22	0.58	0.40	0.18	0.35	0.27	0.10
RD/TA	-0.23	-0.17	-0.07	-0.16	-0.11	-0.05	-0.02	-0.01	0.00
NDT/TA	0.08	0.06	0.03	0.07	0.05	0.02	0.10	0.08	0.03
ITC/TA	-0.03	-0.02	-0.01	-0.06	-0.04	-0.02	-0.02	-0.02	-0.01
DEP/TA	-0.01	-0.01	0.00	0.06	0.04	0.02	0.01	0.01	0.00
IGP/TA	0.28	0.21	0.09	0.22	0.15	0.07	0.19	0.15	0.05
OI/TA	-0.26	-0.19	-0.08	-0.39	-0.26	-0.12	-0.34	-0.26	-0.09
OI/S	0.26	0.19	0.08	0.35	0.24	0.11	0.31	0.23	0.08
STDGOI	-0.05	-0.04	-0.02	-0.08	-0.05	-0.02	-0.11	-0.08	-0.03
CV(ROA)	0.10	0.08	0.03	0.15	0.10	0.05	0.26	0.16	0.06
CV(ROE)	0.02	0.02	0.01	0.04	0.03	0.01	-0.02	-0.01	-0.01
CV(OITA)	-0.09	-0.06	-0.03	-0.12	-0.08	-0.04	-0.15	-0.11	-0.04
IND	0.09	0.07	0.03	0.02	0.01	0	0.06	0.05	0.02

Completely Standardized Total Effect of Determinants of Capital Structure

Determinants of Leverage	2000 LT/MVE	2000 ST/MVE	2000 C/MVE	2001 LT/MVE	2001 ST/MVE	2001 C/MVE	2002 LT/MVE	2002 ST/MVE	2002 C/MVE
RD/S	-0.03	-0.02	-0.01	0.15	0.10	0.05	-0.01	0.00	0.00
CE/TA	-0.03	-0.02	-0.01	-0.04	-0.03	-0.01	0.04	0.03	0.01
GTA	0.01	0.00	0.00	0.07	0.05	0.02	-0.02	-0.01	-0.01
MBA	-0.28	-0.21	-0.10	-0.68	-0.44	-0.20	-0.41	-0.24	-0.14
MBE	0.09	0.07	0.03	0.48	0.31	0.14	0.23	0.14	0.08
RD/TA	-0.24	-0.18	-0.08	-0.38	-0.25	-0.11	-0.24	-0.14	-0.08
NDT/TA	0.04	0.03	0.01	0.07	0.04	0.02	0.13	0.07	0.04
ITC/TA	-0.06	-0.04	-0.02	-0.01	-0.01	0.00	0.01	0.01	0.00
DEP/TA	0.01	0.01	0.00	0.08	0.05	0.02	-0.04	-0.02	-0.01
IGP/TA	0.16	0.12	0.06	0.13	0.09	0.04	0.20	0.12	0.07
OI/TA	-0.38	-0.29	-0.13	-0.35	-0.23	-0.10	-0.34	-0.20	-0.12
OI/S	0.30	0.23	0.10	0.35	0.23	0.10	0.43	0.25	0.02
STDGOI	-0.08	-0.06	-0.03	-0.09	-0.06	-0.03	-0.08	-0.04	-0.03
CV(ROA)	0.12	0.09	0.04	0.09	0.06	0.03	0.22	0.13	0.07
CV(ROE)	0.10	0.08	0.04	0.15	0.10	0.04	-0.01	-0.01	0.00
CV(OITA)	-0.16	-0.12	-0.06	-0.20	-0.13	-0.06	-0.13	-0.08	-0.05
IND	-0.03	-0.02	-0.01	0.15	0.10	0.05	-0.01	0.00	0.00

Completely Standardized Total Effect of Determinants of Capital Structure

Determinants of Leverage	2003 LT/MVE	2003 ST/MVE	2003 C/MVE	1988-2003 LT/MVE	1988-2003 ST/MVE	1988-2003 C/MVE
RD/S	0.14	0.10	0.05	-0.06	-0.04	-0.02
CE/TA	-0.07	-0.05	-0.02	-0.04	-0.03	-0.01
GTA	0.12	0.09	0.04	0.09	0.06	0.03
MBA	-1.04	-0.77	-0.34	-0.64	-0.45	-0.22
MBE	0.72	0.53	0.24	0.35	0.25	0.12
RD/TA	-0.27	-0.20	-0.09	-0.11	-0.08	-0.04
NDT/TA	0.20	0.15	0.07	0.07	0.05	0.03
ITC/TA	-0.01	-0.01	0.00	-0.02	-0.01	-0.01
DEP/TA	0.04	0.03	0.01	0.03	0.02	0.01
IGP/TA	0.20	0.15	0.07	0.24	0.18	0.09
OI/TA	-0.28	-0.21	-0.09	-0.27	-0.20	-0.10
OI/S	0.41	0.31	0.14	0.26	0.19	0.06
STDGOI	-0.07	-0.05	-0.02	-0.05	0.04	-0.02
CV(ROA)	0.21	0.16	0.07	0.19	0.14	0.07
CV(ROE)	-0.08	-0.06	-0.03	0.02	0.02	0.01
CV(OITA)	-0.16	-0.12	-0.05	-0.17	-0.13	-0.06
IND	0.11	0.08	0.04	0.04	0.03	0.01