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PLSR and MIMIC-PLS Model Approach to Determinants of Capital Structure Choices and Comparative Analysis[1]

Sermaye Yapısı Seçimlerinin Belirleyicilerine PLSR ve MIMIC-PLS Model Yaklaşımı ve Karşılaştırmalı Analizi

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Abstract

In this study, the determinants of capital structure choices, which are very important for companies. For this reason, the data of 167 companies traded in ISE and BIST between 2008 and 2017 were collected. 11 variables as 8 indicators, and 3 causes, which are thought to have an impact on the capital structure, were determined. In the study, 2 analyses were made and the results were compared. In the first analysis, 3 models were established by changing the dependent variable and analysed with the Partial Least Squares Regression (PLSR) method. Afterwards, the MIMIC Model, which can provide a simultaneous solution to these 3 models, is again analysed with Partial Least Squares (PLS). According to the results of the analysis, it has been seen that the most effective indicator variables on the capital structure in all models are profitability and liquidity. Among the reason variables, which are thought to represent the capital structure best in the model, total debt is the variable that best represents the capital structure, which is included as a latent variable. Again, according to the MIMIC model result, it has been seen that the effective theory for the companies traded in the BIST in Turkey is the trade-off theory. Finally, when the PLSR and MIMIC models are compared, it can be said that the MIMIC model is preferable in terms of both examining the relationships in more detail and the compatibility of the results with the theories.

Keywords: Partial least squares regression, MIMIC model, trade-off theory, pecking order theory, capital structure determinants.

Öz

Bu çalışmada, şirketler için önemli olan sermaye yapısı seçimlerinin belirleyicileri incelenmiştir. Bu nedenle 2008-2017 yılları arasında İMKB'de ve BİST'te işlem gören 167 şirketin verileri kullanılmıştır. Sermaye yapısı üzerinde etkisi olduğu düşünülen 8 gösterge ve 3 neden olmak üzere 11 değişken belirlenmiştir. Çalışmada 2 analiz yapılmış ve sonuçları karşılaştırılmıştır. İlk analizde bağımlı değişken değiştirilerek 3 model kurulmuş, Kısmi En Küçük Kareler Regresyonu (PLSR) yöntemi ile tahmin edilmiştir. Sonrasında bu 3 modelin eşanlı çözümünü sağlayabilen MIMIC Model yine Kısmi En Küçük Kareler (PLS) ile analiz edilmiştir. Yapılan analiz sonuçlarına göre tüm modellerde sermaye yapısı üzerinde en etkili gösterge değişkenlerin karlılık ve likidite olduğu görülmüştür. Modelde sermaye yapısını en iyi temsil ettiği düşünülen neden değişkenlerinden toplam borçlar, gizil değişken olarak yer alan sermaye yapısını en iyi temsil eden değişkendir. Yine MIMIC model sonucuna göre Türkiye'de BİST'te işlem gören firmalar için etkin olan teorinin Dengeleme Teorisi olduğu görülmüştür. Son olarak PLSR ve MIMIC model kıyaslandığında hem ilişkileri daha detaylı olarak inceleyebilmesi hem de sonuçların teorilere uygunluğu açısından MIMIC modelin daha tercih edilebilir olduğu söylenebilir.

Anahtar Kelimeler: Kısmi en küçük kareler regresyonu, MIMIC model, dengeleme teorisi, finansal hiyerarşi teorisi, sermaye yapisi belirleyicileri

[1] This paper is resulted from the doctoral (PhD) thesis study of the first author.

Introduction

From a financial management perspective, a firm's primary goal is to maximize its value. The financial manager is the person responsible for realizing this purpose. While creating the capital structure and managing the firm, the financial manager aims to increase the value of the firm while maintaining the current status of the firm and preventing the loss of value (Koller et al., 2005, p. 7). It is the resource structure of the firm, which is expressed by the concept of capital structure. In other words, it is the problem of what the equity and debt structure of the firm will be. If the firm borrows excessively in accordance with its capital structure decisions, its financial structure deteriorates, it cannot fulfil its obligations and it may result in the termination of the legal existence of the firm. On the other hand, capital structure decisions, which will strengthen the financial structure, increase resource alternatives and lead to cheaper solutions, reduce/eliminate the possibility of financial failure (Turaboğlu et al., 2017, p. 248). Due to the changing firm and market conditions, it is not possible to talk about a continuous and unchanging capital structure that maximizes the value of a firm or minimizes the cost of capital (Frank and Goyal, 2007, p. 2). Because the capital structure decisions of the companies constantly change according to the country, sector, time and company, the capital structures are still being tested (Köksal et al., 2013, p. 2). A significant number of theories have been developed regarding the concept of capital structure.

These theories are divided into two; classical and modern. Classical theories of capital are; Net Income Theory, Net Operating Income Theory, Traditional Theory and Modigliani-Miller Theory. Modern capital structure theories based on Modigliani-Miller are Trade-off Theory, Pecking Order Theory, Market Timing Theory, Asymmetric Information Theory and Signaling Theory. In this study, Trade-off Theory and Pecking Order Theory are discussed because they are the most effective theories.

1. Modern Approaches

1.1.Trade-off Theory

Explains moderate and prudent borrowing. It argues that the optimum solution will exist at the point where marginal costs and marginal benefits are balanced. Kraus and Litzenberger (1973) defined the optimum point as reflecting a balance between the tax benefits of debt and the deadweight costs of bankruptcy (p. 912). According to Myers (1984), if the firms follow the trade-off theory, a firm sets a target debt-to-value ratio and then slowly moves towards the target (p. 575). The target is set by balancing debt tax shields against bankruptcy costs. A company that conforms to the trade-off theory should set a debt-to-value ratio and act gradually according to this target ratio (Myers and Majluf, 1984, p. 187).

1.2. Pecking Order Theory

The trade-off theory is said to be a rival theory to the pecking order theory. Contrary to the trade-off theory, it argues that there is no optimal debt level (Drobetz and Gruninger, 2007, p. 294). That is, it argues that the firm follows a sequence to raise funds. The financing need is primarily provided by internal funds, and when internal funds are not sufficient for investment, securities in current assets are used for investment expenditures. Finally, external funds are used for investment financing.

1.3. Signalling Theory

Asymmetric information lies on the basis of the signaling theory, as in the pecking order theory (Ross, 1977, p. 28). According to Signaling Theory, business managers want the market value of the business to increase and the capital owners to benefit from it by sending signals about the course of the business to individuals outside the business (Ceylan and Korkmaz, 2008, p. 259).

1.4. Market Timing Theory

It argues that there is no optimal capital structure and firms support equity market timing. Baker and Wurgler (2002) found out in their study that low leverage firms raise funds when their valuations are high, while high leverage firms raise funds when their valuations are low (p. 1).

2. Factors Affecting Capital Structure

Firm-specific factors consist of many variables under the influence of finance theories. These variables are mainly determined as tangible assets, non-debt tax shields, growth opportunities, liquidity, sector type, business size, earnings instability(volatility) and also profitability (Titman and Wessels, 1988, p. 2-6).

Table 1.
Relationship of variables with theories

Variables	Trade-off Theory	Pecking Order Theory
Tangible Fixed Assets	(+)	(-)
Company Size	(+)	(-)
Non-Debt Tax Shield	(+)	
Growth	(-)	(+)
Uniqueness		
Sector Type		
Income Volatility	(-)	(+)
Probability	(+)	(-)
Liquidity	(+)	(-)

3. Literature

There are various studies related to determinants of capital structure in Turkey using different theories and variables. Durukan (1997) analyzed the data of 68 companies whose stocks were traded in the ISE, covering the years 1990-1995, to determine the factors affecting the capital structure, and concluded that profitability and non-debt tax shield are the most important factors affecting the capital structure of Turkish firms. Acaravcı (2004) analyzed the relationship between growth rate, profitability, inflation and corporate tax variables and the capital structure of enterprises by using the data of 66 manufacturing industry companies traded in the ISE between 1992 and 2002. The results of this study, which used panel data analysis as the analysis method, support the pecking order theory. Demirhan (2009) used panel data analysis methods in his study , which aimed to determine the firm-specific factors affecting the capital structure of service sector firms by using the financial statement data obtained from the ISE . The results of the analysis showed that the most important factors affecting the capital structure are profitability, firm size, firm's liquidity and firm's asset structure, in accordance with the pecking order theory. Güner (2016) aims to examine the compatibility of the trade-off theory and the pecking order theory with the capital structure determinants and to make comparisons between countries (Greece, France, England, China) by revealing the capital structure theories that are compatible with the capital structure determinants. Study results show that while the capital structures of the enterprises in Turkey reveal evidence that is compatible with both the pecking order and the trade-off theory, the determinants of capital structure differ based on countries. Demirci (2017) examined the Capital Structure Theories in the Turkish manufacturing sector and stated that the capital structures of the firms are mostly compatible with the pecking order theory. Özdemir (2019) examined and the changes in the interest rate, inflation rate and exchange of the data of 29 manufacturing industry companies operating in the BIST100 index for the years 2009-2018 with the

panel data analysis method. As a result of the study, he found that inflation has no effect on the capital structure, but the exchange rate and interest rate have a strong effect on the capital structure.
Chang et. al (2009) examined the determinants of capital structure by applying the MIMIC model and partial least squares analysis to the data of 13887 companies registered in the Compstat sectoral database between 1988 and 2003. While 3 different leverages were used as the dependent variables; asset structure, firm size, profitability, growth opportunity, liquidity, uniqueness and income volatility were used as independent variables. According to the results of the study, there are very strong and significant relationships between all independent variables and dependent variables. While there is a strong negative relationship between uniqueness, growth and profitability and leverage, the results for income volatility vary according to their sub-variables (RoA, RoE). Cortez and Susanto (2012) included the capital structure of 21 firms operating in Japan as the total debt/equity ratio in order to determine the capital structures of the firms. According to the findings of the study, a positive and significant relationship was determined between the total debt/equity ratio and the asset structure, and a negative and significant relationship with profitability. The relationship between growth opportunity and debt/equity ratio could not be determined. Gharaibeh and Sarea (2015) aimed to determine the factors affecting the capital structure of 215 companies from 49 different industries operating in Kuwait between 2009 and 2013 in their study where financial leverage represents the capital structure. As a result of the analysis, there is a positive and significant relationship between firm age, growth opportunity, liquidity, firm size, asset structure and financial leverage ratio, but a negative correlation was found with ROE. Arsov and Naumoski (2016) tried to determine the variables affecting capital structures by creating 5 different models. For this reason, panel data analysis was applied to the data of 173 Balkan countries companies of public ownership such as Croatia, Macedonia and Serbia between 2008 and 2013. As a result of the analysis, a positive and significant relationship was determined between the total debt ratio which is one of the dependent variables representing the capital structure. In addition there was a negative and significant relationship between profitability and asset structure and firm size. Matias and Serrasqueiro (2017) examined firms operating in Portugal between 2007 and 2011 in order to determine the factors affecting the capital structures of firms. In the study, the capital structure was represented by the financial leverage ratio and the factors affecting the capital structure are represented by firm size, profitability, asset structure, growth opportunity and firm age. According to the results of the analysis, there was a significant and positive relationship between financial leverage and firm size and asset structure, and a significant and negative relationship between firm age and financial leverage. In addition, no statistically significant relationship was found between growth opportunity and financial leverage.

4. Method

4.1. Partial Least Squares Regression Method (PLSR)

PLS is a model that could find a simple model with few components even if the variables are linearly independent or highly correlated. (De Jong, 1993). It is particularly useful when we need to predict a set of dependent variables from a (very) large set of independent variables. PLS is the tool of choice in the social sciences because it can be used as a multivariate technique for both non-experimental and experimental data (Abdi, 2003, p. 792). The latent variables found by the PLSR model are also called X scores and are denoted by t_a (a=1,2,…,A). X scores are predictors of Y and model X. In the PLS method, t_a , a = 1,2,…,A values can be determined iteratively using the classical NIPALS algorithm. X scores are so few that they can be denoted by A and are perpendicular to each other. These scores are estimated as linear combinations of the original x_k variables and coefficients called weights (a=1,2,...,A) w^*_{ka}. To show in equation format;

$$t_{ia} = \sum_k w^*_{ka}\, x_{ik} \qquad (1.1)$$

X scores' (t_a) properties:

The X scores are multiplied by the p_{ak} loads, which are good summaries of X. Therefore, the error numbers for X, indicated by e_{ik} are small. For multivariate Y (M>1), the Y scores u_a are multiplied by c_{am}. Therefore, the error terms g_{im} for Y are also small.

$$x_{ia} = \sum_{a} t_{ia}\, p_{ak} + e_{ik} \tag{1.2}$$

$$y_{im} = \sum_{a} u_{ia}\, c_{am} + g_{im} \tag{1.3}$$

X scores are good estimators of Y, as shown in 1.4. The residual of Y (f_{im}) represents the deviations between the observed and modeled dependent variables. Y residual matrix forms the elements of F. It can be written Equation 1.4. by using Eq. 1.1. Also It can be written as in Eq. 1.5. to look like a multiple regression model.

$$y_{im} = \sum_{a} c_{ma}\, t_{ia} + f_{im} \tag{1.4}$$

$$y_{im} = \sum_{a} c_{ma} \sum_{k} w^{*}_{ka}\, x_{ik} + f_{im} = \sum_{k} b_{mk}\, x_{ik} + f_{im} \tag{1.5}$$

PLS regression coefficients b_{mk} (B) can be written as in Eq. 1.6.

$$b_{mk} = \sum_{a} c_{ma}\; w^{*}_{ka} \tag{1.6}$$

PLSR achieves MLR (Multiple Linear Regression) solution in one component. Thus, the coefficients of MLR and PLSR are equal to $w_1 c_1'$. Reducing the matrix X after each component (a) by subtracting $t_a p_a'$ allows the PLSR model to be optionally expressed in terms of w_a weights. While doing this, the residual of the previous dimension E_{a-1} is used instead of the X variables. Therefore, Spouse. Instead of Eq. 1.1, Eq. 1.7 can be written;

$$t_{ia} = \sum_{a} w_{ka}\, e_{ik,a-1} \tag{1.7}$$

The Y matrix can also be reduced by subtracting $t_a c_a$. However, this reduction is not necessary. The results are similar regardless of whether Y is reduced or not.

$$e_{ik,a-1} = e_{ik,a-2} - t_{i,a-1} P_{a-1,k} \tag{1.8}$$

$$e_{ik,0} = x_{ik} \tag{1.9}$$

w weights can be converted to weights represented as w^{*}. w^{*} weights directly relate to X, it gives Eq. 1.1 (Polat and Günay, 2009, p. 439-440).

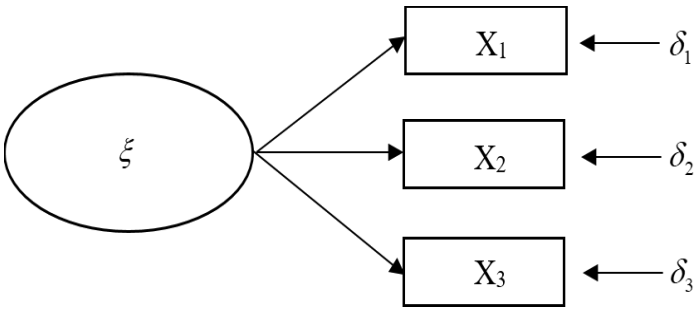
4.2. MIMIC Model

MIMIC (Multiple Indicators and Multiple Causes) model is a special structural equation modeling technique in which latent variables are used. It is also used when the same dependent variable is unknown. The MIMIC model approach is based on the statistical theory of latent variables, which includes many cause and indicator variables.

The MIMIC model contains both formative and reflective relations. Reflective models are classical factor analysis models. All of the observed variables in these models are structured in the understanding that they measure the same latent variable (Chin, 1998, p. 297). When the reflective variables are replaced with another reflective variable, it does not degrade the quality of the structure. The purpose of the formative model is to explain the variance in the latent variable to the maximum extent. For this reason, if formative variables are not included in the model, it causes an incomplete explanation of the structure (Bollen and Lennox, 1991, p. 306) .

Figure 1.1.

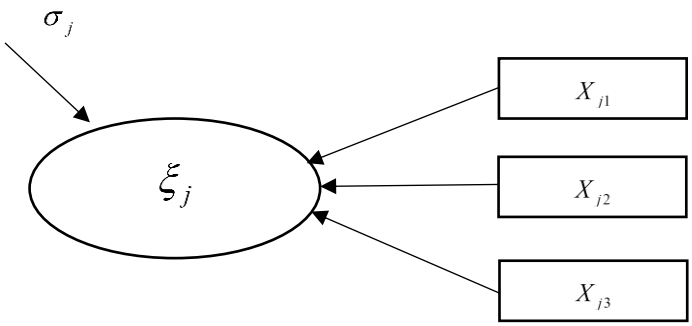
Reflective Structure



(Götz et al., 2010)

Figure 1.2.

Formative Structure



(Götz et al., 2010)

The equation model, known as the structural equation model, can be constrained and converted to a MIMIC model;

$$\eta = \mathrm{B}\eta + \Gamma\xi + \zeta \quad (2.1)$$

$$Y = \Lambda_y \eta + \varepsilon \quad (2.2)$$

$$X = \Lambda_x \xi + \delta \quad (2.3)$$

Here, in the first model $B = 0$, $\mathrm{X} \equiv \xi$, , $\Lambda_x = \mathrm{I}$ and $\delta = 0$ considered, the MIMIC model transforms into equations (2.4) and (2.5.);

$$\eta = \Gamma X + \zeta \quad (2.4)$$

$$Y = \Lambda_y \eta + \varepsilon \quad (2.5)$$

latent variable η, observable exogenous variables determined linearly by a linear sequence ($X = (X_1, X_2, ...X_q)$) determines the error term ζ .

In matrix form,

$$\eta = \Gamma X + \zeta \quad (2.6)$$

In equation form,

$$\eta = \gamma' X + \zeta = \gamma_1 X_1 + \gamma_2 X_2 + ..., \gamma_q X_q + \zeta \quad (2.7)$$

latent variable, in turn , determines $Y = (Y_1, Y_2, ..., Y_q)$ the corresponding set of error terms with the observable endogenous variables $\varepsilon = (\varepsilon_1, \varepsilon_2, ..., \varepsilon_p)$.

In matrix form;

$$Y = \Lambda_y \eta + \varepsilon \quad (2.8)$$

In equation form;

$$Y_1 = \lambda_1 \eta + \varepsilon_1 \quad (2.9)$$

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

…

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

4.3. Partial Least Squares Method in Structural Equation Modeling

This model was developed as an alternative to CB-SEM (Covariance-Based Structural Equation Model - Covariance Based Structural Equation Model) (Noonan and Wold, 1982, p. 75). PLS-SEM shows a strong approach to the normal distribution and large sample size constraints of the data, that is, it allows to obtain effective results in cases where there are small samples and non-normal distribution (Boßow and Albers, 2010, p. 594; Hair et al., 2011, p. 143). The method also allows working with a large number of variables, a dataset with fewer observations than a variable, and more complex models (Chin and Newsted, 1999). It is preferred by researchers especially for new technology research and information systems research because it is model both factors and composites (Henseler et al., 2016, p. 3). PLS is one of the most used methods in information systems research (Marcoulides and Saunders, 2006, p. 3). Also it is generally used in strategic management and marketing studies (Hair et al., 2012, p. 140).

PLS-SEM applies a 2-step method to make predictions. In the first iterative stage, they estimate the loadings and weights in the measurement model by using the relationships of the latent variables with each other and with the measurement variables that depend on them. In the second stage, using the weights found in the first stage, estimates the structural model using the relationships among latent variables (Chin, 1998, p. 298).

5. Scope of the Study, Data Set and Method

The variables of the companies whose stocks were traded in Borsa Istanbul (BIST) and the ISE between 2008 and 2017 were obtained through the Finnet Database in the form of monthly data. SmartPLS 3 program and Excel XLSTAT module were used to analyze this information. In the first stage, regression was applied to these data using the PLS method. In the second stage, the MIMIC model, which is a special type of structural equation modeling, was analyzed using the Partial Least Squares method. Finally, the results of the 2 analysis methods were compared.

5.1. Variables Used in the Study

In this study, the variables of size, sector type, profitability, asset structure, non-debt tax shield, growth, liquidity and income volatility, which are thought to be effective on capital structure in the literature, are modelled and analysed.

There are multiple ratios in the literature for the measurement of these variables. In this study , RoA(net profit-loss/total assets) for **profitability**, quartile and numbered form of the firm's total assets for size, asset structure (stocks+cost of tangible fixed assets purchased, manufactured or constructed)/total assets, debt depreciation expenses/sales income ratio for non-tax shield,the nominal value of sectors with companies operating in BIST for the sector, for liquidity (current assets-stocks)/short-term liabilities, the standard deviation of percentage change in total assets for volatility, for growth opportunities (research-development expenses+marketing, selling and distribution expenses+general administrative expenses)/total assets for short-term liabilities/total assets for short-term debt, long-term liabilities/total assets for long-term debt and finally total debt (short-term liabilities+long-term liabilities)/total assets are used.

There are many different sectors in the main model consisting of 1503 observations. Partial Least Squares Regression has been applied by creating 3 different models in which all sectors are together, and the results are given. These models were created in such a way that the dependent variable was changed and the independent variables remained the same. Afterwards, these three models were solved simultaneously using the MIMIC model and the results are given below.

6. Results

The first analysis of the study consists of the analysis of 3 different models with the PLSR method. The regression result, standardized variable coefficients and goodness-of-fit criteria are available below. First, the model in which the total debt is a dependent variable and its coefficients, the goodness of fit statistics (Table 2) and VIP values (Table 3) are as follows;

$$TD = -0{,}364RoA + 0{,}067size + 0{,}116col + 0{,}08grow + 0{,}037tax - 0{,}008vol - 0{,}387liq + 0{,}109idum$$

Table 2.
Goodness-of-fit criteria

R^2	0,433
Std. Deviation	0,195
MSE	0,038
RMSE	0,195

Table 3.
VIP Values

Variable	VIP
Liquidity- liq	**1,935**
Profitability- RoA	**1,820**
Collateral value- col	0,580
Sector-idum	0,545
Growth- grow	0,399
Size- size	0,337
No-debt tax Shield- tax	0,183
Volatility- vol	0,039

The model's goodness-of-fit criteria are at an acceptable level. While they say that the variables that have importance in the model are liquidity and profitability since their VIP values are above 1, their coefficients also support this situation. In the model where the dependent variable is total debts, it is seen that the variable that affects total debts is liquidity and profitability with values between 0,38 and 0,36.

The second model, in which short-term debt is the dependent variable, and its coefficients goodness of fit statistics (Table 4) and VIP values (Table 5) are as follows:

$$STD = -0{,}245RoA - 0{,}057grow + 0{,}158col + 0{,}148grow - 0{,}037tax + 0{,}002vol + 0{,}32liq + 0{,}027idum$$

Table 4.
Goodness-of-fit criteria

R^2	0,322
Std. Deviation	0,171
MSE	0,029
RMSE	0,171

Table 5.
VIP Values

Variable	VIP
Liquidity- liq	**1,954**
Profitability- RoA	**1,496**
Collateral value- col	**0,965**
Growth- grow	**0,902**
Size- size	0,348
Non-debt Tax Shield- tax	0,227
Sector- idum	0,164
Income Volatility- vol	0,009

According to the VIP values of the model, it is seen that the important variables for the model are liquidity profitability, asset structure and growth, and the mean error squares are close to zero (desired value). It can be said that the most effective variable for short-term debts is liquidity, followed by profitability, asset structure and growth variables. However, the effect levels are not high. As in the first model, it is seen that profitability and liquidity variables have a negative relationship with short-term debts.

Finally, the model with long-term debt as a dependent variable and its coefficients, goodness of fit statistics (Table 6) and VIP values (Table 7) are as follows;

$$LTD = -0{,}469RoA + 0{,}033size - 0{,}056col - 0{,}145grow - 0{,}001tax + 0{,}000vol - 0{,}015liq - 0{,}014idum$$

Table 6.
Goodness-of-fit criteria

R^2	0,279
Std. Deviation	0,126
MSE	0,016
RMSE	0,126

Table 7.
VIP Values

Variable	VIP
Liquidity-liq	**1,229**
Profitability-RoA	**1,747**
Size- size	**1,400**
Sector-idum	**1,012**
Growth-grow	0,607
Collateral Value- col	0,280

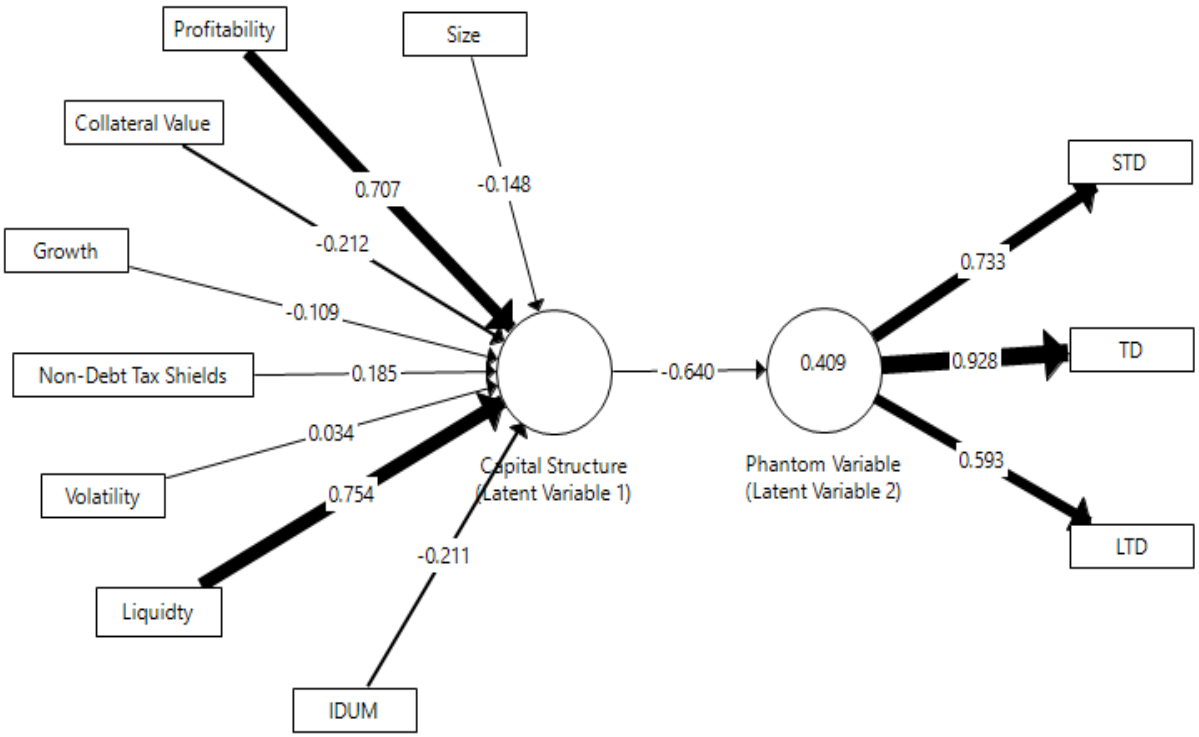
Income Volatility- vol	0,076
Non-debt Tax Shield- tax	0,044

The model's MSE and RMSE have acceptable values. VIP values indicate that the important variables for the model are profitability, size, liquidity and sector. However, the coefficients of the variables are not high. Therefore, this model is the model with the lowest R^2 value. Despite this, the profitability variable is the most effective variable is this model. As a result, it can be said that the most important value is profitability when it comes to short-term debts. As in the previous 2 models, it is seen that the profitability variable has a negative relationship with short-term debts.

The second analysis is the analysis in which the established MIMIC model is analysed with PLS. Here, short-term debts, long-term debts and total debts, which are taken as cause variables in the first analysis, are included in the model together. However, in this model, the aim of the indicator variables is to find out their effects on the capital structure, not their effects on debts. It is also to determine simultaneously with which debt the capital structure is better represented.

Figure 1.3.

MIMIC Model



When the CR is greater than 0.7, Cronbach's Alpha greater than 0,60 and the AVE coefficient greater than 0,5, it is accepted as an indicator of good fit. It is seen that these values have the values of 0,803, 0,621 and 0,583 respectively. The R^2 value has a value of 0,409. This value is considered as moderate intensity, which is not very high. However, since there is only one latent variable in the model and the capital structure is tried to be explained with a single latent variable, this situation is accepted as normal. Finally, in the table showing the validity and reliability of the internal model, the R^2 f^2 SRMR values are 0,409, 0,693 and 0,077.

$$l = -0{,}148size + 0{,}70RoA - 0{,}212col - 0{,}109grow + 0{,}185tax + 0{,}034vol + 0{,}754liq - 0{,}211idum + \zeta$$

$$kvb = 0,507l + \varepsilon_1$$
$$tb = 0,643l + \varepsilon_2$$
$$uvb = 0,41l + \varepsilon_3$$

It is seen that the most effective variable on the capital structure is liquidity with a coefficient of 0,754, followed by profitability with a coefficient of 0,70. According to t values of the variables, it is seen that all variables are significant except for volatility. After significance, for loadings it is seen that the most effective variables on the capital structure among the indicator variables are profitability, liquidity and the sector, respectively, while the least effective variables are growth opportunities, asset structure and non-debt tax shield.

While there is a positive and significant relationship between the capital structure of the most effective variable profitability, liquidity, and non-debt tax shield, but there is a negative relationship between size, asset structure, growth opportunities and the sector. Profitability, liquidity, growth opportunities, non-debt tax shield support the trade-off theory, and the size and asset structure variable support the pecking order theory. It has been seen that the effective theory for the companies traded in the BIST is the trade-off theory since all but not all of the variables mainly support the trade-off theory.

It is thought that short-term debts, total debts and long-term debts, which are among the cause variables, are the 3 variables that best represent the capital structure. Therefore, they are included in the model as a causal variable. According to the results of the analysis, these three variables have a positive and statistically significant relationship with the capital structure. It has been seen that the variable that best represents the capital structure among these three variables is total debts. Short-term debt and long-term debt follow.

The total effect models of the MIMIC model as below;

$$TD = 0,419RoA - 0,087size - 0,125col - 0,064grow + 0,109tax + 0,020vol + 0,447liq - 0,125idum$$

$$STD = 0,331RoA - 0,069size - 0,099col - 0,051grow + 0,086tax + 0,015vol + 0,353liq - 0,098idum$$

$$LTD = 0,268RoA - 0,056size - 0,080col - 0,041grow + 0,070tax + 0,012vol + 0,286liq - 0,080idum$$

When the coefficients of the total effects models showing the relationship between the indicator variables and the cause variables are compared with the PLSR coefficients and R^2 values, it can be seen that the coefficients of the MIMIC model results are more significant and give more effective results on debts. This situation is more in line with financial expectations.

Conclusion

Financial decisions have a vital importance on the financial structure of the firm. A wrong decision regarding the capital structure can lead a business to financial distress or even bankruptcy. Therefore, capital structure decisions have been a very important issue for finance. The total number of observations for the model is 1503, and the majority of this data consists of the manufacturing sector traded in BIST.

According to the results of the model, in which leverage ratios are taken as dependent variables, the most effective variables on debt ratios are profitability and liquidity. It is possible to say that financial leverage does not work because its effects on the model are negative. However, the low R^2 values make it necessary to add more variables to the model.

According to the results of the MIMIC model, which is the second analysis, it can be said that although the size and asset structure variable in the model support the pecking order theory, the other

variables in the model comply with the trade-off theory. Likewise, the liquidity and profitability variables, which are the most effective, have very close coefficients to each other and it is seen that they have a very strong effect on the capital structure. This situation meets expectations. Because for companies, the amount of liquid they hold and the profit they make are the strongest arguments when making investment decisions. However, the fact that other variables have such low coefficients causes difficulties in determining the degree of importance between them.

Simultaneous model analysis of the MIMIC model ensures that it causes less error than modelling separately. In addition, its ease of use and all effects allow a comprehensive and detailed examination. Because of MIMIC model structure, it enables the calculation of the effects on the (latent) capital structure and the coefficients of these effects, which do not have a direct numerical value. In addition to these, it allows reaching the conclusion on which type of debt the capital structure, which is a latent variable, is more effective, that is, which can be represented better. Finally, it gives the relationship between indicator variables and debt variables, which are cause variables in the form of total effects. This is clearly seen by the analysis made.

As a result, the use of relatively new methods, rather than the use of classical regression methods, will provide better and more detailed results when examining the relationships. In addition, this study was carried out using the data of companies registered in BIST. In Turkey, there is a lack of information in terms of capital structure and determinants of companies not registered in BIST, sectoral or company size differences. For this reason, this study can be developed by considering companies that are not registered in Borsa Istanbul and the results can be compared.

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Declaration of Publication and Research Ethics

The authors declares that all ethical principles and rules were followed in data collection, analysis and reporting processes.

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