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Firm valuation: An application on Borsa Istanbul with discounted cash flow and relative valuation approaches*

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ABSTRACT

This study estimates the firm values of BIST cement industry firms between 2011 and 2019 with relative valuation and discounted cash flow (DCF) methods, and compares the valuation methods in terms of their accuracy in predicting firm value by examining the error margins in prediction. The results reveal that the DCF is the best performing valuation method followed by the Price/Earning (P/E) and the Price/Book Value (P/BV) respectively. In addition, the relationship between firm values calculated with the DCF method and firm variables used in valuation are analyzed, and the variables were found to be reliable. We also examined the effect of weighted average cost of capital (WACC) and growth rate on the firm value. The results show that firms are sensitive to the changes in the WACC and growth rate.

Firma değerlemesi: İndirgenmiş nakit akımları ve göreceli değerleme yöntemleri ile Borsa İstanbul üzerinde bir uygulama

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ÖZ

Bu çalışmada, BIST çimento sektörü firmalarının 2011-2019 dönemi arası firma değerleri göreceli değerleme ve indirgenmiş nakit akımları (İNA) yöntemlerine göre tahminlenmiştir. Yöntemler, tahminlemedeki hata payları incelenerek firma değerini tahmin etmedeki doğrulukları açısından kıyaslanmıştır. Bulgular, en iyi tahminleme performansına

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Anahtar Kelimeler: Firma değerlemesi, tahminleme hata payı, indirgenmiş nakit akımları, göreceli değerleme yöntemleri.

sahip olan yönteminin İNA olduğunu, bunu takip eden diğer yöntemlerin ise sırasıyla F/K ve PD/DD yöntemleri olduğunu göstermiştir. Ayrıca, İNA yöntemine göre hesaplanan firma değerleri ile değerlemede kullanılan firma değişkenleri arasındaki ilişki incelenmiş ve kullanılan bu değişkenlere güvenilebileceği belirlenmiştir. Bunun yanında, ağırlıklı ortalama sermaye maliyeti (AOSM) ve büyüme oranının firma değerine etkisi incelenmiştir. Sonuçlar, firmaların AOSM ve büyüme oranındaki değişime karşı hassas olduğunu göstermiştir.

1. Introduction

Firms may have different values due to the economic environment, economic scale, area of economic activity or different perspectives of the firm (Fernandez, 2007, p. 5). So, the price formed under market conditions may not always reflect the correct value of the asset or the firm to be invested.

Every asset has a value; the price of each asset can be known, however, its value cannot be understood easily. Investors do not want to pay more for an asset than its real value. Therefore, the essence of investing in a right asset depends on the correct determination of the value of the asset (Damodaran, 2012, p. 1). That's where the concept of valuation comes into play. When the literature about valuation is examined, it is seen that different valuation models used in the valuation of assets or firms have been developed. These methods determined by these models are also used in practice. Although the application of these methods differs, the purpose is the same for each method: determining the firm value in the most accurate way.

In the field of valuation, there are three basic approaches: asset-based approach, relative valuation (market value) approach, and income approach. Under each approach, there are several common firm valuation methods. (Reilly and Schweihs, 1998, p. 96). For instance, some analysts use the discounted cash flow method[1] under the income approach while others make valuation by using a set of multiples within the scope of the market approach[2] (Damodaran, 2002, p. 6).

When these methods are considered, the question of which method will most accurately determine the firm value becomes important as seen in the studies of researchers such as Bailey et al. (2008), Biddle et al. (1997), Cupertino et al. (2013), Frankel and Lee (1998), Hand et al. (2016), Ismail (2006), Jiang and Lee (2005), Plenborg (2002). Valuation has an active role in the investment decision phase. In portfolio management, active investors in the market make their buying and selling decisions according to the valuation result. Investors who try to reduce the risk by diversifying their portfolio according to the *Traditional Portfolio Theory*, take a position by the over or under valuation of the asset they will invest in the market.

The decisions and behaviors of investors may change according to the real value of the firm. The most important starting point of this study is the investor decisions and behaviors. Investors aim to make the right decision by having information about the real value of the firm they invest. Here, the question of which method or methods in valuation will determine the real value of the firm constitutes the subject of this study. In addition, it is aimed to investigate the effect of firm variables that play an important role in valuation such as growth rate and weighted average cost of capital on firm value calculated with the discounted cash flow method.

[1] The discounted cash flow method refers to the reduction of the firm's future cash flows to the present value as of the valuation date with a certain discount rate. The method is based on accurately determining the firm's future cash flows, estimating an accurate discount rate (weighted average cost of capital) that will reduce cash flows to its present value and long-term growth rate. According to the method, there are two methods to make a valuation. The first one aims at valuing the firm only with its equity (free cash flows to equity); the second one is for valuing the firm as a whole (free cash flows to the firm) (Copeland et al., 2000, pp. 131-132).

[2] In the market approach known as the relative method, the value of a firm is derived from the pricing of comparable firms (Damodaran, 2002, p 18). In the comparison, the firm whose value will be determined is usually valued with the help of various ratios such as the price/earning ratio, price/sales ratio, etc. of similar firms in the sector in which it is included (Feldman, 2005, p. 45).

The study contributes to the literature in revealing the method or methods that will give the most accurate result in determining the share value of firms. Accordingly, it is clear that those who use the correct valuation method may be able to make better investment decisions and create more accurate investment portfolios. For this purpose, in this study, we calculated the values of the cement industry firms trading in Borsa Istanbul between 2011 and 2019 by using 5 different firm valuation methods. Since there are more firms in the cement sector compared to other sectors, we preferred the cement sector, thinking that the analyzes would be carried out more robustly. We examined the relationship between the estimated values and the market values of the firms with micro panel data methods. In addition, we also calculated the prediction error margin for each method and determined as a percentage. The findings show that the method that achieves the most realistic results in firm valuation is the *"Discounted Cash Flow"* method. Thus, we analyzed the relationship between the firm values calculated with this method and firm variables used in calculations and found that firm variables used in determining the firm value are reliable.

In the studies conducted in the literature, it is concluded that income approach methods are generally more consistent than market approach methods because they contain more useful information. In some of these studies (Cupertino et al., 2013; Nel, 2009; Plenborg, 2002), the applicability of the discounted cash flow method has been emphasized while discounted dividends model has been deemed appropriate in some others (Bailey et al., 2008; Francis et al., 2000; McLemore et al., 2015).

In the successful investment and management of every financial or real asset, it is important to determine the real value of the asset and the factors that cause this value (Damadoran, 2002, p. 1). Therefore, in this study, we examined whether the effects of growth rate and WACC, which are two important factors in valuation according to the discounted cash flow method, on firm value differ by low or high rate firms. In this respect, the study differs from other studies in the literature on valuation. For this purpose, 4 separate portfolios have been created from firms with high or low growth rates and WACC. Accordingly, we observed that firms with low growth rates are sensitive to the change in the growth rate, while firms with low WACC are sensitive to the change in WACC. In addition, it is seen that if a firm's growth rate is low or WACC is high, the firm has to focus on growth to increase its value. Moreover, the leverage effect is also included in the models, and the findings are re-tested through a separate panel data. To sum up, we observed that the findings differ by low or high rate firms.

This study proceeds as follow. The following section presents a literature review. The third section explains the process of creating the dataset. The fourth section discusses the methodology used in the study. In the fifth section, we discuss the empirical results. A final section concludes the paper.

2. Literature review

When the literature about firm valuation is examined, it is seen that the subject has been investigated in many studies. Some of these studies aim at investigating financial ratios and policies associated with stock returns or firm value (See Aktaş, 2009; Birgili and Düzer, 2010; Büyükşalvarcı and Uyar, 2012; Masulis, 1983; Naceur and Goaied, 2002). These studies examined whether there is a relationship between the current ratio, liquidity ratio, stock turnover rate, receivable turnover ratio, debt-equity ratio, net profit margin, return on assets, and return on equity with firm value. The results of the studies showed that some of these ratios are positively correlated with firm value, while a negative correlation has existed in others. Küçükkaplan (2013) found that the effects of these variables on the value of firms differ by sectors. A similar finding has been reached in the study of Naceur and Goaied (2002).

Some studies in the literature have been on the application of valuation methods. For example, Frayer and Uludere (2001) have calculated the value of a firm operating in the energy sector with the *Discounted Cash Flow (DCF)* method, considering the dynamic market conditions. A sample application has also been included in the study conducted by Alkan and Demireli (2007), and the firm value has been determined by taking the averages of firm values in different methods. Petersen and Plenbog (2009) have tried to detect the methodological errors of the *DCF* method by creating 5 different models. The results of the study showed that that *DCF* and *Price/Earnings (P/E) ratio* methods generally give more accurate results. Nel (2009) has examined the difference between what is written academically and practiced in the valuation method, and found that the *DCF* method is the most preferred method and that the method is equally popular in terms of academic and practical use.

We see that firm valuation methods attract the attention of researchers. Within this scope, there are also studies investigating the relationship between firm values calculated with different valuation methods and the market value of firms. The studies of Biddle et al. (1997), Cupertino et al. (2013), Frankel and Lee (1998), Hand et al. (2016), Ismail (2006), Jiang and Lee (2005), Ozturk (2010) can be given as example. While panel data analysis methods are generally used in the studies (Biddle et al., 1997; Frankel and Lee, 1998; Ismail, 2006; Öztürk, 2010 etc.), Ordinary Least Squares (OLS) methods have been used in some studies (Cupertino et al., 2013; Hand et al., 2016 etc.). The studies examined the ability of the firm values calculated with the valuation methods to explain the market value. The general opinion emerging as a result of the studies is that *Residual Income (RI)* and *DCF* methods have the best explanatory power and accuracy.

In addition, the performance of the methods used in firm valuation in the literature has been examined. The performance of the methods has been determined by examining the prediction error margin of the methods used. The calculated firm values and actual transaction prices have been compared in the studies of Berkman et al. (2000), Francis et al. (2000), McLemore et al. (2015), Penman and Sougiannis (1998) etc. In the studies of Bailey et al. (2008), Francis et al. (2000), Penman and Sougiannis (1998), the *Dividend Discount Model (DDM)*, *DCF* and *RI* methods have been compared. The results showed that the *RI* and *DCF* methods gives the lowest error margin. According to Berkman et al. (2000), *DCF* and *P/E* methods are the methods resulting in the most accurate predictions. Similarly, Goedhart et al. (2005) has shown that *DCF* is the most accurate valuation method and the method of multiples may be preferred if a careful process is carried out.

Plenborg (2002) has compared *DCF* and *RI* methods under different scenarios. In the study, WACC-Weighted Average Cost of Capital, which is one of the most important assumptions about valuation, and *growth rates* have been prepared in different scenarios. The findings showed that the firm is overvalued if the growth rate is high and undervalued if it is small. It was determined that as the debt ratio increases in the capital structure of the firm, the firm is valued higher, and as it decreases, it is valued less in the *DCF* model, while it is the opposite in the *RI* model. McLemore et al. (2015) have examined the prediction error of the models in the *DDM* method. The findings of the study showed that the prediction error decreases in the valuation considering the short-term dividend payments.

3. Data

This section of the study is related to creating the data set. We will focus on sampling and variable selection issues in the section.

3.1. Sample selection

We include 16 firms trading in the Borsa Istanbul manufacturing industry-cement sector with a continuous record of financial statements and price series about 15 years in our sample. The study covers the period 2011-2019. The firms' past performances need to be analyzed when the firm values to be used in the study were determined according to the *Discounted Cash Flow* method. Within the scope of the study, the valuation is made based on the financial statements of the firms for the past 7 years. This requires firms operating in BIST prior to 2011 to be included in the sample. In order to keep order in the financial statements, the statements after the publication of the Turkey General Communique on Accounting System Applications of 2004 are included. Considering the past financial statement requirement for 7 years as of 2005, the starting year of the sample corresponds to 2011.

Since the number of firms in the sector is adequate and the sector is homogeneous, the cement sector firms are preferred and the sample is created.

Table 1

Firms included in the sample

NAME	CODE	NAME	CODE
ADANA CEMENT	ADANA	CIMBETON CEMENT	CMBTN
AFYON CEMENT	AFYON	CIMENTAS CEMENT	CMENT
AKCANSA CEMENT	AKCNS	CIMSA CEMENT	CIMSA
ASLAN CEMENT	ASLAN	GOLTAS CEMENT	GOLTS
BATISOKE CEMENT	BSOKE	KONYA CEMENT	KONYA
BATICIM CEMENT	BTCIM	MARDIN CEMENT	MRDIN
BOLU CEMENT	BOLUC	NUH CEMENT	NUHCM
BURSA CEMENT	BUCIM	UNYE CEMENT	UNYEC

In valuation of firms, we use the financial statements of the firms and some financial ratios. The appropriate levels of these ratios may vary from sector to sector. In their studies, Küçükkaplan, 2013; Naceur and Goaied, 2002 have found that the effect of these ratios on the value of firms differs by sectors. In order to avoid the possibility of sectoral differences, we include only the cement sector firms in the sample considering the fact that comparing valuation methods for a specific sector may yield better results.

3.2. Variables selection

In this study, we used the firm values of 16 cement industry firms trading in BIST for each year between 2011 and 2019. Accordingly, in the study, we analyzed the relationship between firm valuation methods and market value through 144 observations. Within this scope, we have chosen 5 different valuation methods, considering the approaches used in valuation.

In the asset-based approach, one of these approaches, the value of a firm consists only of its assets and liabilities as seen from the balance sheet. This approach has a static point of view and ignores any information that is not included in the financial statements about the current period or the future. This situation may cause the method to underestimate. For these reasons, the asset-based approach is excluded from the study.

Another approach is the relative valuation approach. Reasons such as being able to make comparisons and using current market information cause these methods to be used frequently by investors (Damodaran, 2001, p. 252). Accordingly, *Price/Earning (P/E), Price/Book Value (P/BV), Price/Sales (P/S), and Price/Cash Flow (P/CF)* methods, which are frequently preferred by investors in the market, are included as the explanatory variables in the study. In addition, within the scope of the income approach, the *DCF (Discounted Cash Flow)* method, which is a method that takes into account the time value of money and reflects the firm's future performance to the firm's value, is included as an explanatory variable.

Market Value (MV) is determined as the dependent variable of the study. The data are created from the year-end stock market closing share price series for the 2011-2019 period for all the firms in the sample. These data are accessed from the "Bloomberg" data terminal.

P/E, P/BV, P/S, P/CF and *DCF* series, the explanatory variables used in the study, are created by determining the values of 16 firms for each year between 2011 and 2019. The firm data used in the calculations are accessed from the financial statements of the firms published on the "Public Disclosure Platform (KAP)", and the stock market data from the "Bloomberg" data terminal. The calculation procedures for valuation methods are different from each other.

In the relative valuation method, the ratios generally used in the valuation are standardized under the titles such as earnings, book value, cash flows and income (Damodaran, 2002, p. 18). In the application of the method, the value of the firm is determined by calculating comparable rates (multiples). One of the multiples is the *Price/Earning (P/E)* ratio. This ratio, which is widely used in valuation, is calculated as seen in Equation (1) (Damodaran, 2012, p. 468);

$$P/E = Market\ price\ per\ share\ /\ Earnings\ per\ share \quad (1)$$

Investors also prefer to value firms with the *Price/Book Value (P/BV)* ratio method. According to this method, the value of a stock is calculated as seen in Equation (2) (Damodaran, 2002, p. 512; Feldman, 2005, p. 45).

$$P/BV = Market\ price\ per\ share\ /\ Book\ value\ of\ equity\ per\ share \quad (2)$$

Here, the *P/BV* method compares the present value of the investments made in the firm with the costs. However, earnings or book value ratios may not produce significant results for start-ups that have negative profits and have difficulties in earning. In such cases, the *Price/Sales (P/S)* method, which is seen in Equation (3), based on the sales of the firms can be used;

$$P/S = Market\ value\ of\ equity\ /\ Revenues \quad (3)$$

The *P/S* ratio is one of the most preferred methods. However, the most important disadvantage of the method is that firms are valued only based on their sales without taking into account their costs, profits or losses (Damodaran, 2012, p. 542). In addition, the difference in the depreciation rates applied by the firms also affects the comparable valuation. In that respect, according to many analysts, cash flow that takes into account depreciation can be more informative when examining a firm's financial performance. Therefore, the *Price/Cash Flow (P/CF)* method can be preferred. According to the method shown in Equation (4), cash flows are calculated simply by taking the sum of net profit and depreciation (Corrado and Jordan, 2002).

$$P/CF = Market\ price\ per\ share\ /\ Cash\ flow\ per\ share \quad (4)$$

Another explanatory variable used in the study is the *DCF*. According to this method, future cash flows have an important role in valuation. Additionally, in order to determine the present value of the cash flows to be obtained in the coming years, it needs to be reduced to its present value with a certain discount rate. The method is based on estimating a growth rate that can accurately determine the firm's future cash flows and an accurate discount rate (Weighted Average Cost of Capital-WACC) that will reduce these cash flows to its present value (Damodaran, 2005, pp. 27-29).

Free cash flow is an important valuation tool for firm managers and shareholders (Kadioglu and Yilmaz, 2017, p. 111). In the study, the "Free Cash Flows to Firm (FCFF)" method is preferred because it includes more information in the determination of cash flows and uses cash flows to both shareholders and lenders of the firm. Before estimating the cash flows, we calculated the WACC rates of the firms in the sample of the study separately for all years between 2011 and 2019 by using Equation (5).

$$WACC = [(k_d\ x\ (1-t))\ x\ W_d] + [k_e\ x\ W_e] \quad (5)$$

The t in the formula shows the tax rate for the relevant year. The financial borrowing interest rate information in $, which is included in the financial statements and footnotes of each firm for the relevant year, is used in order to determine the k_d, which is the cost of the debt. For the k_d of firms with no debt in $, the interest rates of firms with the highest $ borrowing interest rate are taken as a precedent. Thus, firms are prevented from being valued more than they should be. In addition, the weights of equity and debts (W_e and W_d) within the total resources of each firm are also determined. Finally, the Capital Asset Pricing Model (CAPM) is used to calculate the k_e, which represents the cost of equity. Risk-free interest rate data in the CAPM model are accessed from the Bloomberg database. Beta and risk premium data showing the relationship of the shares of the relevant firm with the market are accessed from Damodaran's online page. Here, an additional firm-specific risk premium is added to the equity cost of firms with a high level of borrowing. When KPMG and Deloitte valuation reports are examined, the risk premium of the firms operating in Turkey generally ranges from 3% to 1%. Therefore, in the study, it is deemed appropriate to take the firm-specific risk premium as 2% on average.

In determining the firm value, the present value of cash flows in a certain prediction period and the current value of cash flows after the prediction period, i.e. the terminal value, are added as in Equation (6) (Damodaran, 2012, p. 386).

$$Value\ of\ firm = \sum_{t=1}^{t=n} \frac{FCFF_t}{(1+WACC)^t} + \left[\frac{FCFF_{n+1}}{WACC - g_n}\ x\ \frac{1}{(1+WACC)^n} \right] \tag{6}$$

In order to make the valuation, it is necessary to predict the infinite growth (g_n) ratio in the terminal value prediction. For this purpose, the cement industry is examined in a comprehensive manner and it is seen that the growth rate of the sector is about 3% for the last 7 years. In the KPMG Turkey's 2018 and 2019 reports, the worldwide growth of about 3% in the construction sector is expected to be reflected in the cement sector in Turkey. Thus, an infinite growth (g_n) of 3% is estimated for the cement sector.

We have used the valuation module prepared by Aykan Üreten and Metin Kamil Ercan in determining the values of the firms. Past financial statement data are transferred to the module which is prepared according to the desired format of Capital Markets Board of Turkey and General Communique on Accounting System Applications. 10 years projections are made to calculate future cash flows. Based on the past 7 years financial statement data of the firms, 10 years predictions about their future activities are made. While making predictions, the sectoral trend is considered and the average and standard deviations of the firms for the past 7 years are used. These predictions made in the range of average and standard deviation enable the preparation of projected balance sheets and income statements. After this stage, firms' future net operating profit and cash flows are estimated. Terminal value is calculated over 3% infinite growth rate. These values obtained are reduced to their present values with the calculated WACC rates and the required values of the firms are calculated. This value is divided by the number of shares of the firm and the required value of a stock is determined. These stages are carried out separately for all firms and for all years between 2011 and 2019. We applied all these procedures in each of 5 valuation methods used in the study according to the theoretical methodology of each method as explained. We have determined the firm values in 5 different methods for 144 observations consisting of 16 firms and 9 years. (For all comprehensive details regarding the calculations, see Genç (2020)).

4. Methodology

In this study, we have investigated which valuation method (s) gives the most accurate result. For this purpose, the values of companies trading in Borsa Istanbul cement industry are determined by 5 different valuation methods explained in "Section 3". Here, we analyze the relationship between stock values and market values calculated with those 5 methods and calculate the prediction error margin of the methods.

As a result of the study, we expect that the method (s) that have a statistically significant relationship with the market value and that estimate the value mathematically closest to the market value, i.e. with the lowest margin of error, will be the most preferable method(s) for the cement industry. Among the methods used, the *P/E, P/BV, P/S, P/CF* and *DCF* are determined as explanatory variables while the MV is determined as dependent variable expressing the market value.

According to the analysis preformed with these variables, we tested the validity of the hypotheses, "H_0: $There\ is\ no\ significant\ relationship\ with\ MV.$" and "$H_1$: $There\ is\ a\ significant\ relationship\ with\ MV$" separately for each of the 5 different valuation methods. In the analysis of the data used in the study, we used the panel data analysis technique as in the studies of Biddle et al., 1997; Frankel and Lee, 1998; Ismail, 2006. The use of micro panel, also known as short panel methods, especially in samples with a small time size, makes it possible to reach a larger sample by combining cross-sectional observations with time series. In this study, the cross section units consist of 16 firm data while the time dimension consists of 9 years.

Panel data regression differs from a normal time series or cross-section regression in that it has a double subscript on its variables. A linear panel data regression is as expressed in Equation (7) (Baltagi, 2013, p. 13):

$$Y_{it} = \alpha + \beta X'_{it} + u_{it} \; (i = 1, \dots, N; t = 1, \dots, T) \tag{7}$$

Here i represents the cross-sectional dimension such as individuals, households, firms, countries, etc., while t refers to the time dimension. Y_{it} is the dependent variable and shows the value of the i. observation at t time. X'_{it}, is the matrix that expresses the value of K explanatory variables at t time of the i. observation. Additionally, α represents the constant term, β $Kx1$ is the vector, and u_{it} is the error term of the model. When the model is written as in Equation (8), it is possible to observe the effects of the unit.

$$Y_{it} = (\alpha + \mu_i + \lambda_i) + \beta X'_{it} + u_{it} \; (i = 1, \dots, N; t = 1, \dots, T) \tag{8}$$

In the equation, μ_i shows the unit effect, while λ_i demonstrates the time effect. These effects are individual specific effects that cannot be observed. The μ_i also allows such unobservable unit, industry or country-specific effects to be measured. This effect may change by the unit or time (Baltagi, 2013, p. 13). In order to measure these effects, the *Random Effects Model-REM* model is used when a very large population is studied and only a certain part of the population is available (Baltagi, 2013, p. 20; Hsiao, 2004, p. 34). However, the data set used in this study is created not by random selection from a large population, but by considering firms in a certain sector such as the cement sector. Thus, we preferred the *Fixed Effects Model-FEM* model to test unit or time effects. The model used in FEM method is shown as follows based on linear panel data regression (Asteriou and Hall, 2016, p. 443):

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + u_{it} \; (i = 1, \dots, N; t = 1, \dots, T) \tag{9}$$

In the model, the measurement of the fixed effects is usually applied one-way by placing a dummy variable in the horizontal section. However, it may be possible for firms or countries to change their constant terms in time (Asteriou and Hall, 2016, p. 443). According to the FEM method, prediction can be made by adding a dummy variable to the model to obtain a different constant term specific to each unit. Therefore, this method is called *"Least Squares Dummy Variable-LSDV"* method (Hsiao, 2004, p. 32).

Accordingly, when we consider that a dummy variable is added for each unit or constant, *"one-way FEM"* is as seen in Equation (10);

$$Y_{it} = \alpha_1 + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \cdots + \alpha_k D_{ki} + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + u_{it} \tag{10}$$

Here, dummy variables D in the model provide different constants for each section. D must be added to the model as much as N cross-sections. However, in order not to fall into the trap of dummy variables, it is necessary to add $N - 1$ dummy variables to the model or add N dummy variables and not to include the constant term in the model (Baltagi, 2013, p. 15). In t*wo-way FEM*, a dummy variable must be added to the model for each year of time dimension.

After predicting the models in this way, it is necessary to check whether fixed effects (μ_i or λ_i) are actually included in the model before evaluating the validity of the fixed effects model. The validity of the null hypothesis ($H_0 = \alpha_1 = \alpha_2 = \cdots = \alpha_N$) stating that all constants are the same (assumption of homogeneity) and valid for this method is tested with the F-test statistic (Asteriou and Hall, 2016, p. 444). Accordingly, if H_0 is rejected, the existence of fixed effects is accepted and the fixed effects model is continued.

It should be examined whether there is a multicollinearity problem since it causes deviations in parameter prediction in the analysis. Models with minimal correlation between explanatory variables are statistically more reliable. As a result of the correlation analysis, it is seen that there is a high degree of correlation between *P/BV* and *P/S* variables. Explanatory variables that have high correlation with each other are excluded from the model respectively, which is one of the frequently preferred methods to eliminate this problem.

Model 1:

$$MV_{it} = \alpha + \beta_1(P/E)_{it} + \beta_2(P/BV)_{it} + \beta_4(P/CF)_{it} + \beta_5(DCF)_{it} + \varepsilon_{it} \quad (11)$$

Model 2:

$$MV_{it} = \alpha + \beta_1(P/E)_{it} + \beta_3(P/S)_{it} + \beta_4(P/CF)_{it} + \beta_5(DCF)_{it} + \varepsilon_{it} \quad (12)$$

Model 3:

$$MV_{it} = \alpha + \beta_1(P/E)_{it} + \beta_2(P/BV)_{it} + \beta_3(P/S)_{it} + \beta_4(P/CF)_{it} + \beta_5(DCF)_{it} + \varepsilon_{it} \quad (13)$$

Accordingly, we formed two separate regression models and interpreted the findings. In addition, we also formed a model including all explanatory variables and compared the findings obtained from three different models.

5. Empirical results

In the application part of the study, firstly (Panel 1), we tested the relationship between market value and firm value over 3 different models shown in Equations (11), (12) and (13). Before analyzing, it is investigated whether the assumption of homogeneity is valid on the FEM model to be tested. The test results given in Table 2 show that H_0 is rejected at the 1% significance level in all models for the cross-section effect and there is a cross-section effect by moving to the alternative hypothesis.

Table 2

FEM time effect and cross-section effect test results - Panel 1

	Model 1		**Model 2**		**Model 3**	
	t-stat.	**p-value**	**t-stat.**	**p-value**	**t-stat.**	**p-value**
Cross-Section Effect	142.326	0.000	136.055	0.000	159.962	0.000
Time Effect	0.815	0.590	1.566	0.142	0.970	0.462
	Hypotheses					
Cross-Section Effect	H_0: No cross-section effects. H_1: Has a cross-section effects.					
Time Effect	H_0: No time effects. H_1: Has a time effects.					
LM-p	0.958	0.327	0.617	0.431	1.683	0.194
LM-p*	5.983	0.014	5.057	0.024	7.684	0.005
LM-h	637.390	0.000	626.372	0.000	554.360	0.000

Note: LM-p and LM-p* in the table refer to autocorrelation tests and LM-h represents heteroscedasticity tests.

Time effect results show that H_0 cannot be rejected. In this case, it will be more advantageous to test the *one-way FEM* cross section effect. In addition, autocorrelation and heteroscedasticity problems are observed in all models. Necessary corrections are made and the model is estimated to avoid these problems that may cause biased estimates. The findings obtained as a result of the tests performed within the scope of the models are as shown in Table 3.

Table 3

Panel data regression results - Panel 1

Dependent Variable: MV
Cross-Sections (Number of Firm): 16
Periods: 9 (2011-2019)
Total Number of Observations: 144

	Model 1		**Model 2**		**Model 3**	
Variable	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**
C (α)	7.1661	1.7923 [0.0755]	18.0426	7.0534 [0.0000]	7.2433	2.1337 [0.0349]
P/E (β_1)	0.0142	3.3578 [0.0010]	0.0151	3.5422 [0.0006]	0.0112	3.2183 [0.0016]
P/BV (β_2)	4.8374	2.7677 [0.0065]	-	-	8.7839	4.7404 [0.0000]
P/S (β_3)	-	-	-0.7928	-1.1698 [0.2443]	-2.5635	-3.6495 [0.0004]
P/CF (β_4)	0.0075	0.7050 [0.4821]	0.0087	0.7722 [0.4414]	-0.0001	-0.0120 [0.9904]
DCF (β_5)	0.5569	6.0144 [0.0000]	0.5936	6.3540 [0.0000]	0.4771	6.1617 [0.0000]
	Descriptive Statistics of the Models					
F-stat.	360.477 [0.0000]		334.959 [0.0000]		395.547 [0.0000]	
R^2	0.9822		0.9808		0.9846	
Adj. R^2	0.9794		0.9779		0.9821	
SE of Regress.	9.2955		9.6366		8.6601	

Note: The Coefficient Covariance Method Period Weights (PCSE) method is used for autocorrelation and heteroscedasticity corrections in the models, and the values in brackets in the table show the probability values.

The findings show that H_0 is rejected for *P/E* and *DCF* variables in all models and it is significant at *1%* level. P/CF variable cannot reach a significant result in any of the models. A similar situation exists for the *P/S* variable. While the test results of the *P/S* variable are significant in Model 3, they are not significant in Model 2, established by considering the correlation between variables. These findings show that *P/CF* and *P/S* methods should not be preferred in the valuation of the firms in the cement industry.

A variable with significant test statistics (significant at *1% level*) is the P/BV variable in Model 1 and Model 3. The findings indicate that the variables *P/E, P/BV* and *DCF* explain the market values of the firms in the cement industry. Considering the coefficients of the models, it is seen that especially the *P/BV* variable affects the market value of the firms at a higher rate. Regression results show that firms should focus on making market value higher than book value, as well as increasing their profits and cash flows.

In the next step of the empirical application, we examined the error margin of the basic valuation models used in the valuation of the firms in correctly predicting the market value. Prediction error margins are calculated by the formula $\overline{PE} = (\overline{FV}_t - \bar{P}_t)/\bar{P}_t$ based on the studies of McLemore et al., 2015; Penman and Sougiannis, 1998. Here, $\overline{PE}$ shows mean prediction error, FV is the calculated mean firm value in the period t; $\bar{P}_t$ represents the mean market value of firms in the period t. With this formula, considering the absolute value of the error margin calculated according to 5 different methods, a ranking is made from the method with the lowest error margin to the method with highest (See Table 4).

Table 4

Prediction error margins in valuation models

	Mean Prediction Error ($\overline{HP}$)	High/Low Valuation	Ranking
P/E	-12.38	Low Valuation	2
P/BV	15.96	High Valuation	3
P/S	35.45	High Valuation	5
P/CF	-31.44	Low Valuation	4
DCF	4.02	High Valuation	1

Table 4 shows that the *P/S* method has the highest prediction error margin with a rate of 35.45%, whereas the *DCF* method has the lowest with a rate of 4.02%. The error margins of *P/S* and *P/CF* methods are very close to each other. However, while the *P/CF* method values firms less than their market value, the *P/S* method values them higher. Similarly, the *P/E* method values the firms lower with a rate of 12.38%, while the *P/BV* method values the firms higher with a rate of 15.96%. As a result, while *P/CF* calculates the lowest value compared to the market value of firms, the *P/S* method is the method that calculates the highest value. The *DCF* method also values firms higher and the deviation is much less than other methods.

Findings about both panel data analysis and prediction error margin support each other. It is seen that the method that makes the closest estimate to the market value and should be used in the valuation of companies is the *DCF* method. This finding is also supported by studies demonstrating the superiority of the *DCF* method. For example, Kaplan and Ruback (1995) have provided evidence that the prediction error margin in the *DCF* method is less than 10% and is more preferable in practice than relative methods. According to Berkman et al. (2000), *DCF* and *P/E* methods reach the most accurate predictions. Additionally, Goedhart et al. (2005) assert that *DCF* is the most accurate prediction method. Finally, Nel (2009) has revealed that the *DCF* method is the most popular method both in academia and practice.

In terms of margin of error, the *P/E* method ranks second and the *P/BV* method takes the third place. *P/CF* and *P/S* methods reached larger prediction errors compared to other methods and make predictions that are significantly lower or higher than market value. This finding also supports the findings obtained from panel data analysis. We could not obtain significant findings as a result of panel data regressions for these variables.

Although the *DCF* method brings some difficulties in practice such as accurate prediction of WACC and growth rate, if these predictions are performed correctly, it calculates the value closest to the market value. The most important reason for this is that the method is scientific and reflects the firm's future performance to the firm’s value in the best way. When the *DCF* method evaluates a firm, it values not only based on a certain year, but also based on the past years and future projection. This enables a better determination of the true value of the firm.

As stated by Copeland et al. (2000), the value of a firm primarily depends on its ability to generate a higher return on investment capital than WACC, and its ability to grow. Within this scope, it has been stated that if WACC and growth predictions, which are two important components in the valuation, are made correctly, the *DCF* model will give correct results. However, they have stressed the importance of determining the right capital structure for the right WACC. Considering the importance of these variables in determining firm value, we examined the relationship between firm values calculated with the *DCF* method and firm variables including WACC and growth with the new panel data model (Panel 2). For this purpose, firm value obtained in *DCF* method is determined as dependent variable and firm variables used in valuation as explanatory variable. Table 5 lists the explanatory variables used in Panel 2 with their codes.

Table 5

Firm variables used in valuation

Name of Variable	Code	Name of Variable	Code
Growth in Net Sales	**K1**	Other Current Assets	**K7**
Cost of Sales/Net Sales (Excluding Depreciation)	**K2**	Trade Payables	**K8**
Operating Expenses/Net Sales	**K3**	Other Short-Term Liabilities	**K9**
Cash Need	**K4**	Net Tangible Fixed Assets/Net Sales	**K10**
Trade Receivables	**K5**	Depreciations/Last Year Tangible Fixed Assets	**K11**
Inventories	**K6**	Weighted Average Cost of Capital	**K12**

First, a correlation analysis is performed to see the existence of multicollinearity problem in the model to be established with these variables. There is no correlation finding at a degree that may cause multicollinearity problem in variables other than *K10* and *K11*. For this reason, three different models are established, namely Model 1, where *K10* variable is excluded from the model, Model 2 where *K11* variable is excluded from the model, and Model 3, where all variables are included. In addition, the existence of time effect and cross-section effect is examined in the models to be created (See Table 6).

Table 6

FEM time effect and cross-section effect test results - Panel 2

	Model 1		**Model 2**		**Model 3**	
	t-stat.	**p-value**	**t-stat.**	**p-value**	**t-stat.**	**p-value**
Cross-Section Effect	34.564	0.0000	38.080	0.0000	36.502	0.0000
Time Effect	3.388	0.0016	4.065	0.0002	4.151	0.0002
	Hypotheses					
Cross-Section Effect	H_0: No cross-section effects. H_1: Has a cross-section effects.					
Time Effect	H_0: No time effects. H_1: Has a time effects.					
LM-p	16.514	0.0000	16.527	0.0000	16.572	0.0000
LM-p*	31.355	0.0000	31.374	0.0000	31.437	0.0000
LM-h	326.315	0.0000	318.986	0.0000	320.202	0.0000

Note: LM-p and LM-p* show autocorrelation tests; LM-h indicates heteroscedasticity tests.

Table 6 shows that H_0 is rejected at the *1%* significance level in all models according to cross-sectional effect and time effect results, and both cross-section and time effects are present. In this case, panel data analysis is performed with the *two-way FEM* method. In addition, the autocorrelation and heteroscedasticity problems in the models are corrected for the *Coefficient Covariance Method Period Weights (PCSE)* method. The panel data regression results are presented in Table 7.

Table 7

Panel data regression results - Panel 2

Dependent Variable: DCF						
Cross-Sections (Number of Firm): 16						
Periods: 9 (2011-2019)						
Total Number of Observations: 144						
	Model 1		**Model 2**		**Model 3**	
Variable	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**
C	40.7665	1.9832 [0.0499]	-3.7946	-0.1724 [0.8634]	4.2668	0.1794 [0.8579]
K1	5.2463 (0.0300)	1.0709 [0.2866]	8.0261 (0.0459)	1.8655 [0.0648]	6.4961 (0.0372)	1.3991 [0.1646]
K2	19.7472 (0.6492)	1.2966 [0.1975]	60.4269 (1.9866)	2.6292 [0.0098]	59.4211 (1.9535)	2.6083 [0.0104]
K3	-17.6506 (-0.1024)	-0.2805 [0.7796]	-9.9409 (-0.0576)	-0.1567 [0.8757]	-12.6991 (-0.0736)	-0.2030 [0.8395]
K4	3.0272 (0.0258)	0.7607 [0.4484]	7.5953 (0.0648)	1.8560 [0.0661]	10.3343 (0.0882)	2.1371 [0.0348]
K5	-39.1702 (-0.6162)	-1.9222 [0.0572]	-19.8748 (-0.3126)	-0.9877 [0.3255]	-22.5125 (-0.3541)	-1.1025 [0.2727]
K6	13.6482 (0.1089)	0.3867 [0.6997]	4.0455 (0.0323)	0.1185 [0.9058]	3.6725 (0.0293)	0.1080 [0.9142]
K7	10.1390 (0.0238)	0.4455 [0.6568]	1.4429 (0.0033)	0.0636 [0.9494]	-0.4055 (-0.0009)	-0.0177 [0.9859]
K8	2.2736 (0.0197)	0.0840 [0.9332]	-26.6056 (-0.2315)	-1.1392 [0.2571]	-13.2122 (-0.1149)	-0.4877 [0.6267]
K9	7.9339 (0.0174)	0.1899 [0.8497]	-43.5941 (-0.0960)	-0.9156 [0.3619]	-49.8189 (-0.1097)	-1.0428 [0.2994]
K10	-	-	7.2251 (0.3885)	2.3491 [0.0206]	8.1633 (0.4390)	2.5083 [0.0136]
K11	-12.7771 (-0.0653)	-0.1238 [0.9017]	-	-	-105.2036 (-0.5383)	-0.9893 [0.3247]
K12	-199.0914 (-1.3441)	-1.9916 [0.0489]	-90.9724 (-0.6141)	-0.9023 [0.3689]	-87.5856 (-0.5913)	-0.8797 [0.3810]
	Descriptive Statistics of the Models					
F-stat.	19.178 [0.0000]		20.230 [0.0000]		19.632 [0.0000]	
R^2	0.8567		0.8632		0.8641	
Adj. R^2	0.8121		0.8205		0.8201	
SE of Regress.	10.5062		10.2679		10.2788	

Note: The values in the parentheses in the table show the elasticity coefficients and the values in the square brackets indicate the probability values. The elasticity coefficients are calculated using the elasticity formula $\epsilon = [\Delta Y/\Delta X]x[\bar{X}/\bar{Y}] = \hat{\beta}x[\bar{X}/\bar{Y}]$, while Y is the dependent variable and X is the explanatory variable.

According to Panel 2 (see Table 7), Adj. R^2 shows that the explanatory variables explain the dependent variable over 80%. This finding shows that the WACC and other firm variables used in the valuation strongly explain the firm value calculated in the *DCF* method. In addition, considering the *F* *statistic* and *probability value*, it is seen that the model is statistically significant. Therefore, these variables are found to be reliable in calculating the firm value with the *DCF* method.

Considering the significance of the variables in Table 7, it is noteworthy that especially the variables K1 and K12 are statistically significant. These variables are "growth" and "WACC" variables, which have an important role in the application of *DCF* method. The correct determination of WACC is one of the most important points in the *DCF* method. It is important as it is open to subjective manipulations to evaluate the firm lower or higher. Another important point of the method is to estimate the cash flows and ultimately the value of the firm under the assumption of stable growth. Therefore, it is important to estimate an accurate growth rate while valuing firms under the growth assumption. The statistical significance of the two most important variables used in the application of the method strengthens the findings of the study.

In addition, we calculated elasticity coefficient to measure the change in one variable caused by the change in the other variable. According to the elasticity coefficient showing the sensitivity of one variable to another variable, we found that an increase of 1 unit in the growth rate increases the firm value by 0.0459 units, while a 1 unit increase in WACC decreases 1.3441 units. To sum up, an increase in growth affects firm value positively, whereas an increase in WACC affects it negatively. These findings also coincide with the theory. Apart from these variables, K2, K4, K5 and K10 variables are also statistically significant.

The findings about K1 and K12 variables demonstrate that growth rate and WACC variables affect the firm value. From this point of view, we sought the answer to the question of whether the effects of variables on firm value vary by high or low rate firms. Here, we designed a new panel series (Panel 3) and created portfolios from the firms in the sample to measure the sensitivity of firms with high or low rates. For this purpose, we created two separate portfolios with high and low growth rate and designed two portfolios with high and low WACC (See Table 8).

Table 8

Portfolios Created According to Growth Rate and WACC

Firms with high growth rate		**Firms with low growth rate**		**Firms with high WACC**		**Firms with low WACC**	
Firm	**Mean Growth**	**Firm**	**Mean Growth**	**Firm**	**Mean WACC**	**Firm**	**Mean WACC**
AFYON	0.241	ADANA	0.092	ADANA	0.133	AFYON	0.112
ASLAN	0.124	AKCNS	0.096	AKCNS	0.123	ASLAN	0.115
BSOKE	0.201	CMBTN	0.090	BUCIM	0.126	BSOKE	0.106
BTCIM	0.116	CMENT	0.066	CMBTN	0.139	BTCIM	0.105
BOLUC	0.142	KONYA	0.053	CMENT	0.136	BOLUC	0.119
BUCIM	0.119	MRDIN	-0.012	KONYA	0.141	CIMSA	0.109
CIMSA	0.107	NUHCM	0.058	MRDIN	0.133	GOLTS	0.105
GOLTS	0.114	UNYEC	0.052	UNYEC	0.137	NUHCM	0.117

While creating the portfolios, the mean growth rates and WACCs of 16 firms in the sample between 2011 and 2019 are taken. Thus, the specific mean growth and WACC rates of each firm over the relevant years are reached. In addition, the mean of 144 observations is taken by including the firms and years in the whole sample, and the general means of the growth rate *(mean: 0.104)* and WACC *(mean: 0.122)* are calculated based on the sample. Firms are included in portfolios as shown in Table 8, depending on whether their specific means are above or below the calculated general mean values.

Table 8 shows 4 different portfolios. Firms with a mean growth rate higher than the calculated general mean are divided into two separate portfolios as firms with a high mean growth rate and firms with a low mean growth rate. Calculations for the growth rate are repeated for WACC. Accordingly, portfolios are created as firms with a high WACC and firms with a low WACC.

According to the new datasets consisting of 8 firms included in these portfolios and 9 years of observations between 2011 and 2019, 4 different models are created where *DCF* variable is dependent variable and K1 (growth rate) and K12 (WACC) variables are explanatory variables. First of all, in the models, whether there is a correlation between K1 and K12 variables is examined separately for all models. It is observed that there is no multicollinearity problem in any model. In addition, the existence of the cross-section effect and the time effect in the models is also examined. The statistics and probability values are shown in Table 9.

Table 9

FEM time effect and cross-section effect test results - Panel 3

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Firms with high growth rate		Firms with low growth rate		Firms with high WACC		Firms with low WACC	
	t-stat.	**p-value**	**t-stat.**	**p-value**	**t-stat.**	**p-value**	**t-stat.**	**p-value**
Cross-Section Effect	31.288	0.000	42.447	0.000	39.623	0.000	33.614	0.000
Time Effect	2.371	0.028	1.670	0.127	1.290	0.268	2.952	0.008
	Hypotheses							
Cross-Section Effect	H_0: No cross-section effects. H_1: Has a cross-section effects.							
Time Effect	H_0: No time effects. H_1: Has a time effects.							
LM-p	12.810	0.000	8.777	0.003	8.670	0.003	12.773	0.000
LM-p*	21.909	0.000	16.407	0.000	16.257	0.000	21.861	0.000
LM-h	173.117	0.000	170.372	0.000	168.719	0.000	176.956	0.000

Note: LM-p and LM-p* show autocorrelation tests; LM-h indicates heteroscedasticity tests.

According to the test results in Table 9, *two-way FEM* in Model 1 and Model 4 and *one-way FEM* in Model 2 and Model 3 will be tested. The necessary corrections are made for the heteroscedasticity and autocorrelation problem in the models. The findings of the models established within the scope of all these explanations are as shown in Table 10.

Table 10

Panel data regression results - Panel 3

Dependent Variable: DCF
Cross-Sections (Number of Firm): 8
Periods: 9 (2011-2019)
Total Number of Observations: 72

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Firms with high growth rate		Firms with low growth rate		Firms with high WACC		Firms with low WACC	
Variable	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**
C	29.3193	2.4234 [0.0188]	1.7808	0.1296 [0.8973]	1.6385	0.1177 [0.9067]	39.8448	3.6379 [0.0006]
K1	-2.0683 (-0.0189)	-0.4642 [0.6443]	18.4805 (0.0563)	1.9125 [0.0604]	17.2059 (0.0595)	1.8766 [0.0653]	-1.2006 (-0.0102)	-0.2864 [0.7757]
K12	-117.073 (-0.8258)	-1.1020 [0.2753]	131.3871 (0.8559)	1.2335 [0.2220]	129.1346 (0.8587)	1.2000 [0.2347]	-212.2851 (-1.4599)	-2.1869 [0.0331]
Descriptive Statistics of the Models								
F-stat.	14.845 [0.0000]		35.827 [0.0000]		35.876 [0.0000]		15.951 [0.0000]	
$\mathbf{R^2}$	0.8237		0.8387		0.8389		0.8339	
Adj. $\mathbf{R^2}$	0.7682		0.8153		0.8155		0.7816	
SE of Regress.	9.7493		11.8725		11.9201		9.4051	

Note: The values in the parentheses in the table show the elasticity coefficients and the values in the square brackets indicate the probability values. The elasticity coefficients are calculated using the elasticity formula $\epsilon = [\Delta Y/\Delta X]x[\bar{X}/\bar{Y}] = \hat{\beta}x[\bar{X}/\bar{Y}]$, while Y is the dependent variable and X is the explanatory variable.

The results in Table 10 show that K1 and K12 variables are not significant in the portfolio of firms with a high growth rate compared to Model 1 and these variables do not explain the firm value. However, in the portfolio of firms with a low growth rate in Model 2, it is seen that the K1 variable is significant at the *10%* level. Accordingly, it is determined that in firms with low growth rates, this rate affects the firm value, and an increase of 1 unit in the ratio will increase the firm value by 0.0563 units. From this point of view, it is understood that firms with low growth rates will focus on increasing their growth rates, thus they will increase the firm value as a result of the positive developments that will occur at this rate.

According to Model 3, which consists of firms with a high WACC, it is seen that the K1 variable is significant at the *10%* level. Here, it is observed that an increase of 1 unit that will occur in the growth rate will increase the firm value by 0.0595 unit. The findings show that an increase in the growth rate positively affects the value of the firm. The fact that a firm has a high WACC is a factor that will lead to a low valuation of that firm. For this reason, it is possible to say that firms with high WACC can increase the firm value by focusing on the growth rate.

For the firms with a low WACC in Model 4, the K12 variable is significant at *5%* level. Theoretically, WACC, which is expected to affect firm value negatively, shows a decreasing effect on the firm value as a result of the analysis. The findings show that a 1 unit increase in WACC will cause a decrease in the firm value by approximately 1.46 units. This shows that firms with a low WACC will be sensitive to the change in WACC.

In line with the findings of Panel 3, we also examined whether the findings with the inclusion of the leverage effect in these models change. For this purpose, K8 (trade payables) and K9 (other short-term liabilities) variables related to borrowing are added to Panel 3 series, and than Panel 4 series are created. After this stage, correlation analysis is performed between K1, K8, K9 and K12 variables and it is seen that there is no multicollinearity problem in explanatory variables. In addition, analysis is carried out to test the presence of cross-section effect and time effect in models. The results demonstrate that only the cross-section effect exists in Model 3, while the cross-section and time effects are present in other models. After making the necessary corrections for autocorrelation and heteroscedasticity problems in the models, the stage of testing the models starts.

The findings are given in Table 11. When these findings are compared with the findings of Panel 3 (see Table 10), we see that when the leverage effect is included in the model, K1 variable in Model 2 and Model 3 and K12 variable in Model 4 are statistically significant. However, when the elasticity coefficients of these variables are examined, there is a change in the coefficients.

Table 11

Panel Data Regression Results - Panel 4

Dependent Variable: DCF
Cross-Sections (Number of Firm): 8
Periods: 9 (2011-2019)
Total Number of Observations: 72

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Firms with high growth rate		Firms with low growth rate		Firms with high WACC		Firms with low WACC	
Variable	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**	**coefficient**	**t-stat.**
C	41.8114	3.0125 [0.0040]	35.5575	1.1022 [0.2754]	10.9884	0.5691 [0.5714]	52.0887	4.0268 [0.0002]
K1	-2.0080 (-0.0183)	-0.4561 [0.6502]	31.8362 (0.0970)	3.1497 [0.0027]	13.8297 (0.0478)	2.1776 [0.0334]	-0.8332 (-0.0071)	-0.2018 [0.8408]
K8	-33.2033 (-0.3565)	-2.3530 [0.0224]	71.0760 (0.5050)	1.2787 [0.2067]	-39.7325 (-0.2858)	-0.6847 [0.4962]	-29.1784 (-0.3085)	-2.1713 [0.0345]
K9	-9.4335 (-0.0247)	-0.2614 [0.7948]	100.5882 (0.1885)	1.0522 [0.2975]	115.5060 (0.2042)	1.0498 [0.2980]	-17.6889 (-0.0485)	-0.4996 [0.6194]
K12	-174.522 (-1.2310)	-1.5703 [0.1224]	-236.7837 (-1.5425)	-0.9814 [0.3309]	73.0742 (0.4859)	0.6159 [0.5402]	-271.193 (-1.8650)	-2.6290 [0.0112]
Descriptive Statistics of the Models								
F-stat.	13.919 [0.0000]		19.689 [0.0000]		29.703 [0.0000]		14.849 [0.0000]	
R^2	0.8356		0.8779		0.8448		0.8443	
Adj.R^2	0.7756		0.8333		0.8164		0.7875	
SE of Regress.	9.5926		11.2774		11.8916		9.2780	

Note: The values in the parentheses in the table show the elasticity coefficients and the values in the square brackets indicate the probability values. The elasticity coefficients are calculated using the elasticity formula $\epsilon = [\Delta Y/\Delta X]x[\bar{X}/\bar{Y}] = \hat{\beta}x[\bar{X}/\bar{Y}]$, while Y is the dependent variable and X is the explanatory variable.

Table 11 shows that the positive effect of K1 variable in Model 2 on firm value increases from 0.0563 to 0.097 with the inclusion of the leverage effect. Accordingly, considering the borrowing in low-growth firms, it is found that a change in growth rate will have a higher positive effect on firm value. However, in the model, a significant result cannot be reached for K8 and K9 variables.

The findings in Model 3 shows that the elasticity coefficient in K1 variable decreases from 0.0595 to 0.0478. In this case, when the effect of borrowing is included in the model, a change in the growth rate of firms with a high WACC will affect the firm value less. By looking at the debt-equity structure of these firms, it is seen that the share of borrowing is low. This situation also reduces the tax shield effect and causes WACC to be determined as high. Hence, according to Panel 4 findings, in which the borrowing effect is included in the model, the positive effect of growth on firm value in firms with a high WACC, where the borrowing rate is low, decreases compared to Panel 3 findings, where the borrowing effect is not included.

The findings about the firms with a low WACC in Model 4 show that the negative effect of a change in WACC on firm value increases from approximately 1.46 to 1.865. The share of debt in the debt-equity structure of firms with a low WACC is higher than that of the firms with a high WACC. With the introduction of the tax shield brought about by borrowing, WACC is also lower. The lower rate will make the firm more valuable. However, it should not be forgotten that the sensitivity of such firms to borrowing will also increase. Therefore, the inclusion of the borrowing effect in the model makes the effect of WACC on firm value more pronounced.

Although borrowing has a positive effect on WACC, continuous borrowing will also cause some risks for firms. According to the *"Traditional Approach"*, one of the capital structure theories, it is impossible to think of an increase in the value of the firm in such a situation. When Panel 4, Model 1 and Model 4 findings are examined, we see that the K8 variable is significant at the *5%* level. This finding shows that a 1 unit increase in borrowing in highly valued firms will reduce the firm value by around 0.3085-0.3565.

6. Conclusion

In this study, we examined the prediction performance of the firm valuation methods. We compared the predicted firm values in 5 different methods with market values of the firms. In addition, we also examined the effect of firm variables used in valuation with *DCF* method on firm value. Further, by examining whether the effect of WACC and growth rate, which are two important components in valuation, on the firm value vary by high or low-rate firms, a different contribution is made to the literature. The study is carried out on 4 different panels established in this context.

Our analyses concluded that the *DCF* method yields the most realistic results to assist investors in their investment decisions, according to the cement industry. The method evaluates a firm not only based on a specific year, but also based on the firm's past years' performance and future projection. This situation enables the real value of the firm to be determined more accurately. However, when valuing firms with this method, we must be careful in determining the growth rate and WACC, which are two important variables that may affect the firm value. In order to observe the effect of these variables, we calculated the elasticity coefficients. Accordingly, we determined that a 1-unit increase in the growth rate increases the firm value by approximately 0.0459 units, while a 1-unit increase in WACC decreases the firm value by 1.3441 units. In addition, we see that firms with low growth rates may be sensitive to the change in the growth rate, whereas firms with low WACC may be sensitive to the change in WACC. We also observed that this sensitivity increases when the borrowing effect is included in the model. However, the effect of growth rate on firm value decreases in firms with high WACC.

The results demonstrate that it is possible for firms to increase firm value by focusing on the increase in growth rate and the decrease in WACC. For example, if a firm's growth rate is low or WACC is high, the firm should focus on increasing growth to increase its value. In addition, firms should focus on increasing their profits and cash flows and making their market value higher than their book value. According to the results, the second preferred method for investors is the *P/E* and the third method is the *P/BV*, respectively. However, it should be noted in portfolio management that the *P/E* method is undervaluing due to loss-making firms, while the *P/BV* method is overvaluing due to the fact that the market value of the firms is generally higher than the book value.

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