“Impact of financial ratios on technology and telecommunication stock returns: evidence from an emerging market”

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ARTICLE INFO	Hakki Ozturk and Tolun A. Karabulut (2020). Impact of financial ratios on technology and telecommunication stock returns: evidence from an emerging market. *Investment Management and Financial Innovations*, *17*(2), 76-87. doi:10.21511/imfi.17(2).2020.07
DOI	http://dx.doi.org/10.21511/imfi.17(2).2020.07
RELEASED ON	Monday, 18 May 2020
RECEIVED ON	Friday, 07 February 2020
ACCEPTED ON	Tuesday, 05 May 2020

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JOURNAL	"Investment Management and Financial Innovations"
ISSN PRINT	1810-4967
ISSN ONLINE	1812-9358
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
25	2	15

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BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

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IMPACT OF FINANCIAL RATIOS ON TECHNOLOGY AND TELECOMMUNICATION STOCK RETURNS: EVIDENCE FROM AN EMERGING MARKET

Abstract

This study focuses on the relationship between financial ratios and the technology and telecommunication stock returns listed on the Istanbul Stock Exchange. Since technology and telecommunication sector has become an important part of the Turkish economy and is attractive for investors and shareholders, the results play a critical role for all stakeholders. This academic work aims to determine, through the application of panel data analysis, using both the Parks-Kmenta estimator and the Two-way Mixed Effects Model, whether the Price-to-Sales, Earnings per Share (EPS), Debt-to-Equity, and EBITDA Margin financial ratios affect the returns of technology and telecommunication stock returns listed on the Istanbul Stock Exchange. According to empirical findings, Earnings per Share (EPS), EBITDA Margin, and Price-to-Sales ratios have statistically significant effects on technology and telecommunication companies' stock returns. Higher EPS and EBITDA Margin ratios generate higher returns for the next quarters, and lower Price-to-Sales ratios lead to higher returns for the following periods. Furthermore, the results obtained using the Two-way Mixed Effects Model show that the Debt-to-Equity ratio is negatively related to stock returns.

Keywords Price-to-Sales, EBITDA, Earnings per Share, Debt-to-Equity, stock returns, panel data

JEL Classification C23, G10

Received on: 7th of February, 2020
Accepted on: 5th of May, 2020
Published on: 18th of May, 2020

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Conflict of interest statement:
Author(s) reported no conflict of interest

INTRODUCTION

Technology and telecommunication sector has become an important part of the Turkish economy and has grown up rapidly over recent years. Technology and telecommunication sector demonstrated a 7.7% annual growth on average, while the annual average growth rate of GDP in Turkey was 6.5% between 2012 and 2018. In 2018, the total sector size reached up to TL 131.7 billion (around USD 28 billion), indicating a growth of 15% on the TL basis. It seems that technology and telecommunication industries are expected to grow for the following years because of achieving higher growth rates and increasing market size.

Companies operating in technology and telecommunication sector in Turkey raise funds with equity and debt financing. The companies offer shares to the public and sell some portion of their shares to international private equity funds to provide equity financing. Due to high capital and investment expenditures in the sector, the companies borrow in local and foreign currency to provide debt financing.

Because of the reasons mentioned above, the stock market performance of technology and telecommunication companies plays an important role for investors, creditors, and shareholders.

http://dx.doi.org/10.21511/imfi.17(2).2020.07

This study aims to identify the effects of financial ratios on technology and telecommunication stock returns, which are critical for investors, creditors, and shareholders.

The factors that influence a stock return or price are a controversial issue in the financial literature. Particularly after the 1980s, various researchers studied financial ratios as one of the major determinants of stock price or stock return. However, few studies were conducted on technology and telecommunication stocks in the literature, so this study is also expected to fill this gap.

1. LITERATURE REVIEW

The literature contains many studies investigating the relationship between stock returns and different financial ratios. However, there are few studies about the companies, which are operating in the technology and telecommunication sector.

Over sixty years ago, Kendall and Hill (1953) analyzed whether changes in the price of a stock could be estimated according to past returns, and ultimately showed that stock prices have a random walk over time. Subsequent studies used other predictive determinants – the book-to-market ratio, the earnings-price ratio, the liquidity ratios, interest rates, and dividend yields – as the regressors of empirical tests (e.g., Fama & French, 1992; Campbell & Yogo, 2006; Ferrer & Tang, 2016).

Campbell and Shiller (1998) showed that price-earnings multiple and dividend price ratios had a significant effect on predicting stock returns in the long run. They updated this study in 2001 and confirmed that the ratios were instructive in predicting how stock prices change in the future.

Ferrer and Tang (2016) indicated that some financial ratios, including price-earnings multiple, asset turnover, and dividend payout ratio, have a significant impact on the stock prices of companies traded on the Philippines Stock Exchange.

Aras and Yilmaz (2008) investigated the predictability of stock returns in twelve emerging stock markets by analyzing several financial ratios, including dividend yield, market-to-book ratio, and price-to-earnings ratio, from 1997 to 2003. According to the result of that study, in all countries except South Africa, a relationship between the market index returns and the market-to-book ratio at a 1% level of statistical significance is observed. The dividend yield also plays a prominent role in forecasting the stock returns according to the findings in the study. On the other hand, the study indicated P/E was only statistically significant for Poland, South Africa, Taiwan, and Turkey.

Lewellen (2004) examined whether book-to-market ratio, dividend yield, and earnings-to-price ratio could be handled as the estimators of the stock returns on the NYSE during the period 1946–2000. The research demonstrates significant support for the claim that B/M and E/P can be used as estimators of the stock returns on the NYSE over the period between 1963 and 1994.

Fama and French (1992) pointed out a significant interplay among book-to-market ratios, firm size, and returns of securities belonging to non-financial firms. Moreover, they investigated whether the leverage ratio has a considerable effect on stock returns or not. They defined leverage in two ways. The first one is the ratio of book assets to market equity (market leverage), and the second one is the ratio of book assets to book equity (book leverage). Using the first definition, they found a positive relationship between leverage ratio and stock returns, although they found a negative effect on the same variables when using the second definition. The main conclusion is that for the period between 1963 and 1990, stock returns' cross-sectional variation was related to earnings-to-price ratio, size, and BV/EV (book/market equity).

In another study related to stock portfolios' average returns, Fama and French (2007) concluded that dividends contribute more to average stock returns, with a low value of price-to-book ratios versus stocks with higher PBs, during the period 1964–2006.

Novy-Marx (2013) and Titman and Wei (2004) pointed out the incompleteness of Fama and French's (1992) three-factor model for expected

returns since three factors defined in their study do not capture most of the variation in average returns related to profitability and investment. Fama and French (2015) subsequently developed a five-factor asset pricing model by adding profitability and investment factors to the three-factor model. Their five-factor model explains most of the cross-section variance (between 71% and 94%) of expected returns for size, B/M, operating profit, and investment portfolios.

Petcharabul and Romprasert (2014) studied technology sector stocks in Thailand for 15 years. They used several financial ratios and, as a result, ROE and PE were merely interrelated to stock returns at a 95% significance level.

Campbell and Yogo (2006) used an efficient test after trying a conventional t-test to find evidence for the predictability of stock returns using financial ratios. Their findings represented that the dividend-price ratio predicts stock returns at annual frequencies. Moreover, their test revealed that the earnings-to-price ratio predicts the returns at both monthly and annual frequencies.

Saji and Harikumar (2015) investigated 32 firms from the Information Technology (IT) sector, traded in the Indian Stock Exchange over the period 2000–2010. They used some financial ratios to find out if they are related to stock returns. According to the findings, earnings growth, E/P ratio, and stock returns are positively correlated. They pointed out that having low P/E ratio or high E/P ratio would provide better stock returns in the long term in India.

Since few studies were conducted on technology and telecommunication stocks in the literature, one of the main purposes of this paper is to examine the interplay between financial ratios and technology and telecommunication sector companies' stock returns traded on the Istanbul Stock Exchange, which is an emerging market.

2. DATA AND METHOD

Eleven firms are operating in the technology and telecommunication industry listed on the Istanbul Stock Exchange during the time window of this study. The quarterly data for this study are obtained from Bloomberg Terminal for the period between December 31, 2008 and September 30, 2016. Thirty-two (32) quarters and 11 firms generate 352 observations in balanced panel data analysis. The selection process for the firms is based on the following criteria. Firstly, the firms must have been listed on the ISE before December 31, 2008. Secondly, the stocks of the firms must not have been suspended or off the list during the research period. Eleven (11) stocks out of 18 technology and telecommunication firms on the ISE fulfill the above requirements.

Four market-based financial ratios, Price-to-Sales, Debt-to-Equity, EBITDA Margin, and Earnings per Share (EPS), have been selected to measure the effects on stock returns. The dependent variable, stock return is calculated as "($Price\ of\ stock_t$ – $Price\ of\ stock_{t-1}$/$Price\ of\ stock_{t-1}$)", where t refers to quarter. The data, which were gathered from Bloomberg Terminal, were adjusted for stock splits and dividends. Price-to-Sales ratio, which is computed as price per share divided by sales per share, is generally used as a measure of market value multiple, particularly for technology companies. Though similar to price-earnings ratio, analysts look at Price-to-Sales ratio for companies that have negative earnings because price-earnings ratios are not meaningful in such cases. Another financial ratio selected for the study, Earnings per Share (EPS), is calculated as the difference between net income and preference dividends divided by the weighted average of common shares outstanding. Debt-to-Equity ratio, which shows the financial leverage of a company, is measured by the company's total debt over equity. Lastly, EBITDA Margin, which refers to a company's operating profitability, is measured as EBITDA/Sales. To describe and analyze the data, Stata 11.0 statistical software is used. Table 1 summarizes the descriptive statistics of the selected variables.

Before employing the regression model to analyze the predictive power of independent variables on stock returns, several tests were conducted to determine the right model and to test whether the suitable variables were selected or not. Multicollinearity, which means correlation among independent variables, is one of the undesired problems often found in regression models.

http://dx.doi.org/10.21511/imfi.17(2).2020.07

Table 1. Descriptive statistics of the variables in the sample

Dependent variable	Observation	Mean	Standard deviation	Min	Max
Return	352	0.0867917	0.2546509	–0.419598	1.798611
Independent variables	Observation	Mean	Standard deviation	Min	Max
Price-to-Sales	352	1.218155	1.398234	0.0303206	9.8766532
Debt-to-Equity	352	49.56074	51.94399	0	303.0229
EBITDA Margin	352	14.74126	16.30233	–30.62149	66.70674
EPS	352	0.093209	0.128722	–0.5312	0.725

If there is a high correlation between two or more independent variables, it becomes harder to identify which independent variable actually affects the dependent variable. In Table 2, a correlation matrix is shown to indicate correlation coefficients among variables. In Table 3, the Variance Inflation Factor (VIF) belonging to each independent variable is shown. VIF is a measure of tolerance, which indicates how much the variance of the coefficient estimate is being inflated by multicollinearity. VIFs have been observed for two different scenarios, a model without dummy variables and a model with time and unit dummy variables. A commonly given rule of thumb is that VIFs of 10 and higher or big values of the correlation coefficient, e.g., 0.80 and above, may be the reason for concern of multicollinearity. In the present study, there is no multicollinearity concern, as shown in Tables 2 and 3.

Heterogeneity enables the avoidance of biased results in panel data analysis. For the data, heterogeneity across stocks and quarters is demonstrated in Figure 1 and Figure 2, respectively. The authors have taken the mean of return according to id and time, the dependent variable, and generated graphs, which show how the dependent variable varies across id and time, respectively.

Just like heterogeneity and multicollinearity, the stationarity of variables is also a crucial topic in panel data analysis. Gujarati (2003) states that the terms non-stationary, random walk, and unit root could be treated as synonymous. Stationary matters for any statistical model, such as the present one, because it allows for the preservation of model stability and provides a framework in which averaging (used in autoregressive and moving-average processes) can be properly used to describe the time series behavior. Unit root test has become broadly popular over the past several years to test stationarity, so Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were applied. According to the null hypothesis of both tests, the variable contains the unit root. In Table 4, unit root test results have been shown. As exogenous variables, individual intercepts and individual linear trends are used in the tests. As shown in Table 4, Debt-to-Equity and Price-to-Sales ra-

Table 2. Correlation matrix of variables

	Return	Price-to-Sales	Debt-to-Equity	EBITDA Margin	EPS
Return	1.0000	–	–	–	–
Price-to-Sales	–0.0742	1.0000	–	–	–
Debt-to-Equity	–0.1231	–0.2060	1.0000	–	–
EBITDA Margin	0.0544	0.5840	0.0645	1.0000	–
EPS	0.1054	0.3790	–0.0287	0.4958	1.0000

Table 3. Variation Inflation Factors of the variables

Scenario 1 (Regress without dummy variables)			Scenario 2 (Regress with dummy variables)		
Variable	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**
Price-to-Sales	1.85	0.541104	Price-to-Sales	3.15	0.316996
Debt-to-Equity	1.11	0.904746	Debt-to-Equity	2.75	0.363077
EBITDA Margin	1.85	0.541104	EBITDA Margin	5.45	0.183436
EPS	1.35	0.741218	EPS	2.20	0.455495
Mean VIF	1.50	–	Mean VIF	2.30	–

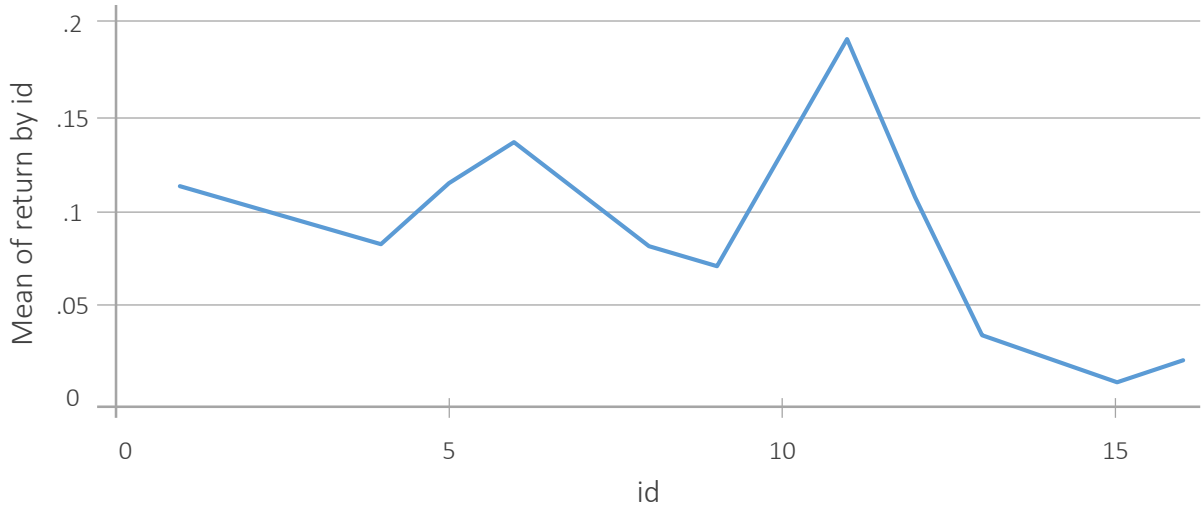

Figure 1. Heterogeneity across units

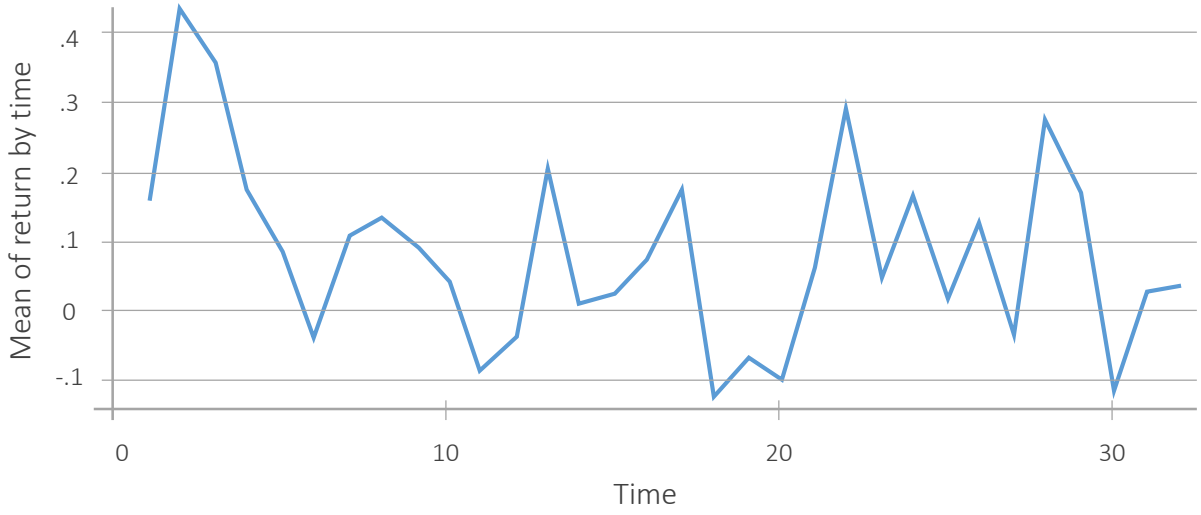

Figure 2. Heterogeneity across periods

tio variables contain unit roots, and all other variables are stationary at a 95% confidence interval. For those variables, the tests were applied by taking the first differences of each variable. As can be seen from Table 5, one can build a stationary model for the differenced data for both variables, so one could state that Debt-to-Equity and Price-to-Sales ratio variables are difference-stationary.

After testing stationarity, multicollinearity, and

Table 4. Stationarity test results for all variables

Variables	Test type							
	Augmented Dickey-Fuller (intercept)		Augmented Dickey-Fuller (intercept, trend)		Phillips-Perron (intercept)		Phillips-Perron (intercept, trend)	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Return	121.257	0.0000	103.204	0.0000	205.312	0.0000	253.251	0.0000
Price-to-Sales	27.2985	0.2001	24.4969	0.3217	27.1445	0.2058	41.4760	0.0072
Debt-to-Equity	26.2056	0.2430	32.0224	0.0770	23.1433	0.3937	27.0390	0.2097
EBITDA Margin	114.127	0.0000	161.508	0.0000	183.862	0.0000	201.236	0.0000
EPS	50.3902	0.0005	62.0784	0.0000	172.666	0.0000	616.567	0.0000

http://dx.doi.org/10.21511/imfi.17(2).2020.07

Table 5. Stationarity test results for first differenced variables

Variables	Test type							
	Augmented Dickey-Fuller (intercept)		Augmented Dickey-Fuller (intercept, trend)		Phillips-Perron (intercept)		Phillips-Perron (intercept, trend)	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Price-to-Sales	142.716	0.0000	108.557	0.0000	215.116	0.0000	–	
Debt-to-Equity	122.883	0.0000	101.661	0.0000	256.352	0.0000	673.987	0.0000

heterogeneity, it was tested whether to add unobservable individual effect and unobservable time effect into the model using the Breusch-Pagan Langrange Multiplier and *F*-Test. Baltagi (2013) recommends the *F*-test, claiming that it gives better results than LR and LM tests for both one-way and two-way models.

According to the null hypothesis of *F*-test, all unit or time-specific effects are equal to zero, and an alternative hypothesis of the test shows that any of individual or time-specific effects is non-zero for the model. As one sets time and the individual variable as the fixed variable, and by applying the *F*-test, it is observed that there should be both individual and time-specific effects in the model. For the data, *F*(10,337) value of 2.84 and *F*(31,316) value of 3.60 is reported for stock-specific effects and time-specific effects, respectively. The *F*-table value of *F*(10,337) is 1.858 and *F*-table value of F(31,316) is 1,4877. According to those results, a two-way fixed effects model could be suitable for the data. The results of the *F*-test are reported in Table 6, where μ_i denotes an individual or stock-specific effect, and λ_t denotes a time-specific effect.

Table 6. *F*-test results for testing individual and time-specific effects

F-test (for fixed effects)	For individual effects (H_0: all $\mu_i = 0$; H_a: any $\mu_i \neq 0$)		For time effects (H_0: all $\lambda_t = 0$; H_a: any $\lambda_t \neq 0$)	
	Stat.	Prob.	Stat.	Prob.
Values	2.84	0.0021	3.60	0.0000
Decision	Reject H_0		Reject H_0	

As shown in Table 6, a two-way fixed effects error component model could be suitable as the regression model. However, what about the individual effects and time effects in the random effects model? Breusch and Pagan (1980) derived the Langrange Multiplier (LM) test to test $H_0 = \sigma_\mu^2 = \sigma_\lambda^2 = 0$. Meanwhile, Breusch and Pagan LM test is employed to test whether there are individual and time effects or not. As reported in Table 7, the Chi-square results obtained for the data are higher than the Chi-square (1) table value, which is 3.84. It can, thus, be stated that one can reject the null hypothesis of this test at a 95% confidence interval, illustrating the presence of individual and time-specific effects for the random effects model.

Table 7. Breusch-Pagan LM test results for random effects

Breusch-Pagan Langrange multiplier test (for random effects)	For individual effects (H_0: var (μ) = 0)		For time effects (H_0: var (λ) = 0)	
	Stat.	Prob.	Stat.	Prob.
Value	6.55	0.0106	58.18	0.0000
Decision	Reject H_0		Reject H_0	

According to the outcomes of both *F*-test and Breusch-Pagan LM test, the existence of individual and time effects for both fixed and random effects is obvious. If the individual effect (μ_i) and time effect (λ_t) are presumed to be fixed parameters to be estimated and the remainder disturbances (v_{it}) are presumed to be stochastic, independently and uniformly distributed with zero mean and constant variance (or standard deviation). Formula (1) represents a two-way fixed effects error component model (Baltagi, 2013).

$$U_{it} = \mu_i + \lambda_t + V_{it} \quad (i = 1,\ldots,N;\ t = 1,\ldots,T). \quad (1)$$

If individual effect (μ_i), time effect (λ_t), and the remainder stochastic disturbance term (V_{it}) are independent of each other and if the independent variables (X_{it}) are independent of μ_i, λ_t and V_{it} for all *i* and *t*, then we could have two-way random effects model (Baltagi, 2013). To determine whether two-way random effects or two-way fixed effects models are the appropriate methods for estimating the model, the Hausman specification test is applied. This analysis tests whether individual ef-

fects or time effects are correlated with explanatory variables or not. The null hypothesis of the test says that there is a correlation between the estimator and individual unit or between the estimator and time variable. If the null hypothesis is accepted according to the test results, both fixed and random effects are consistent, but since random effects model is more effective, it is more convenient to use it as a regression model (Tatoğlu, 2016). The results of Hausman specification test for two-way model are reported in Table 8. The results of Hausman test show a *t*-statistic of 1.34. This does not reject the two-way random effects model estimator. At that point, the correlation between individual effects and regressors and correlation between time effects and regressors are tested one by one. According to the test results, a two-way mixed model with μ_i fixed and λ_t random could be more appropriate for the analysis of the data. Moreover, the use of a two-way fixed effects model is also possible regarding the test results presented in Table 8.

Table 8. Hausman test for two-way model results

Hypothesis	Hausman	Decision
H_0: $E(\lambda_t X_{it}) = E(\mu_i X_{it}) = 0$	1.34	Do not Reject H_0
H_0: $E(\mu_i X_{it}) = 0$	30.89	Reject H_0
H_0: $E(\lambda_t X_{it}) = 0$	4.25	Do not Reject H_0
Table value of Chi-squared (4) = 9.488		

As a result of the tests conducted so far, the two-way panel data regression model should be used for the study, which has the following form:

$$Return_{it} = \beta_0 + \beta_1 \left(\frac{P}{S}\right)_{i,t-1} + \\ + \beta_2 \left(EbitdaMargin\right)_{i,t-1} + \\ + \beta_3 \left(EPS\right)_{i,t-1} + \beta_4 \left(\frac{D}{E}\right)_{i,t-1} + \\ + \mu_i + \lambda_t + U_{it} \qquad (2)$$

$$\left(i = 1,\ldots,11;\ t = 1,\ldots,32\right).$$

In the formula (2), β_0 denotes the constant term, β_i denotes the coefficients of the explanatory variables, which are Price-to-Sales ratio (*P/S*), EBITDA Margin (*EbitdaMargin*), Earnings per Share (*EPS*), and Debt-to-Equity ratio (*D/E*). The other parameters μ_i, λ_t, and U_{it} denote the unobservable stock-specific effect, unobservable time effect, and remainder, respectively. The *i* represents stocks, and the *t* represents quarters. For the two-way mixed effects model with μ_i fixed and λ_t random, λ_t and U_{it} have zero mean and constant variance, and the λ_t is independent of the remainder. The μ_i are assumed to be fixed parameters to be estimated, and it is also independent of the remainder and other regressors. As for the two-way fixed effects model, both the μ_i and λ_t are fixed parameters and are independent of the remainder and other explanatory variables.

Autocorrelation in the data should be tested before the estimation. Autocorrelation, also referred to as serial correlation, is an indicator of the relationship between a variable's current value and its past values. The error component model generalized by Lillard and Willis (1978), with the assumption of first-order autocorrelation for remainder disturbances (V_{it}), is as follows:

$$V_{it} = p \cdot V_{i,t-1} + \varepsilon_{it}, \qquad (3)$$

where $|p| < 1$, and ε_{it} is identically and independently distributed with zero mean and constant variance. As Bertnard, Dulfo, and Mullainathan (2004) also warned, autocorrelation causes the standard errors of the coefficients to be understated. Moreover, autocorrelation leads to an overestimation of the level of significance and *t*-statistics. In this study, the Wooldridge test for autocorrelation is implemented. According to the null hypothesis of the test, no first-order autocorrelation exists. The test results are summarized in Table 9. According to the test results, the null hypothesis is accepted, so it can be inferred that there is no first-order autocorrelation for the model.

Table 9. Wooldridge autocorrelation test results

Wooldridge test	Stat (*F*(1,10))	Prob
Value	2.837	0.1230

Cross-sectional dependence is a problematic issue because it can lead to bias in test results like contemporaneous correlation. Hoechle (2007) suggests performing Pesaran's test for cross-sectional dependence test for panels with *N* and *T* values go to infinity. According to the null hypothesis of the test, the residuals are uncorrelated across the

http://dx.doi.org/10.21511/imfi.17(2).2020.07

stocks or units. Moreover, the Breusch-Pagan LM test could also be used to test the cross-sectional dependency for large T and small N values (Tatoğlu, 2016). The null hypothesis of this test remarks the residuals are independent across the individuals. It can be inferred from the results summarized by both Table 10 and Table 11 that the null hypothesis is rejected. The results of both tests consistently indicated that regression residuals for the data are dependent or correlated across stocks. Moreover, according to Pesaran's result, the absolute correlation between the residuals of two stocks is 0.25.

Table 10. Breusch-Pagan LM test of cross-sectional independence

Breusch-Pagan LM test	Statistic ($\chi^2(55)$)	Probability
Value	143.348	0.0000

Table 11. Pesaran's test of cross-sectional independence

Pesaran's LM test of independence	Statistic	Probability
Value	10.421	0.0000

One of the main assumptions of the standard panel data model is that regression disturbances are homoscedastic across entities and periods (Baltagi, 2013). Homoscedasticity is a restrictive assumption for panels, including different size of individuals, because cross-sectional entities with varying size possibly show different variations. Although an attempt is made to use the data of individuals (stocks) from the same sector for this study, it is difficult to meet this assumption because of the varying company sizes. Under the assumption of homoscedasticity, when heteroscedasticity is present, the estimates of regression coefficients will not be satisfactory. Moreover, the standard errors of those estimations would be biased; therefore, robust standard errors should be computed in the presence of heteroscedasticity (Baltagi, 2013). The Wald test is employed to test for heteroscedasticity in this study. The null hypothesis of the test states that the variance is constant across the individuals or periods. As summarized in Table 12 and Table 13, the test results indicate that the regression disturbances have inconstant variance across time and stocks, which means there is heteroscedasticity in the model.

Table 12. Modified Wald test for heteroscedasticity across stocks

Wald test	Statistic ($\chi^2(11)$)	Probability
Value	920.72	0.0000

Table 13. Modified Wald test for heteroscedasticity across quarters

Wald test	Statistic ($\chi^2(11)$)	Probability
Value	2279.48	0.0000

As a result of all tests before estimating the coefficients of the regressors, one will deal with cross-sectional dependent and heteroskedastic disturbances in the two-way error component regression model. On the other hand, no first-order autocorrelation exists for the model, according to Wooldridge test results. In the next section, the use of robust standard errors will be discussed to correct for the presence of cross-sectional dependence and heteroscedasticity. Also, the regression results will be presented.

3. RESULTS

According to the results of the tests stated in section 2, one should deal with heteroscedasticity and cross-sectional dependency in the model. The literature describes some methodologies that can deal with cross-sectional heteroskedastic disturbances. In this section, regression results using robust estimators will be presented. The regression model used in this study is presented again in Formula(4):

$$\begin{aligned} Return_{it} &= \beta_0 + \beta_1 \left(\frac{P}{S}\right)_{i,t-1} + \\ &+ \beta_2 \left(EbitdaMargin\right)_{i,t-1} + \\ &+ \beta_3 \left(EPS\right)_{i,t-1} + \beta_4 \left(\frac{D}{E}\right)_{i,t-1} + \\ &+ \mu_i + \lambda_t + U_{it} \end{aligned} \tag{4}$$

$$\left(i = 1,\ldots,11;\ t = 1,\ldots,32\right).$$

Table 14. Regression results using Parks-Kmenta estimator

Return	Coefficient	Std. err.	*Z* statistics	Probability
Price-to-Sales	–0.0490327	0.0160176	–3.06	0.002**
Debt-to-Equity	–0.0001995	0.0002403	–0.83	0.406
EBITDA Margin	0.0034327	0.0015587	2.20	0.028**
EPS	0.3047442	0.1274176	2.39	0.017**
Constant	0.199074	0.0593501	3.35	0.001**
Wald $Chi^2(44)$	7568.81			

Note: ** indicates 5% significance level.

Parks (1967) conducted the first study to consider periodical and spatial correlation with heteroscedasticity (Tatoğlu, 2016). Then, Kmenta (1986) described an alternative method based on the feasible generalized least square estimation algorithm to deal with autocorrelated and cross-sectional heteroskedastic disturbances. For the model, there is no autocorrelation, so the data are not transformed for compatibility with AR(1) correlation. Therefore, the Parks-Kmenta method could have been employed. That is, using this method for our model, generalized least square estimation under heteroscedasticity and cross-sectional dependency is applied to predict the effects of regressors on stock returns. The method could be appropriate when *N* is small, and *T* is large. However, and importantly, it is infeasible when *N* is large, and *T* is small (Baltagi, 2013).

First, the Parks-Kmenta estimator was employed for robust estimation. There is no autocorrelation, but there is cross-sectional dependence with heteroscedasticity in the model; therefore, the panels (correlated) and correlation (independent) option were used. Table 14 summarizes the regression results estimated using the Parks-Kmenta methodology. The number of observations is 352, with 11 groups (stocks) and 32 time-periods (quarters). According to the regression results computed using the Parks-Kmenta estimator, Price-to-Sales, EBITDA Margin, and EPS ratios have a statistically significant effect on stock returns. The value of Wald statistics is meaningful in terms of statistical significance.

According to Hausman test results summarized in Table 8, the two-way mixed effects regression model with fixed individual effects and random time effects is one of the efficient models to which one could apply to the data. Moreover, an "i.id" variable was added, which refers to fixed individual effects and "all:R.Time" variable, which refers to random time effects (Tatoğlu, 2016). To maintain the independence of residual errors by allowing heteroscedasticity with respect to individual effects, we added a "residuals (independent, by(id))" option into the command in Stata (Statacorp, 2009). In Table 15, the regression results computed employing two-way mixed effects maximum likelihood regression, are summarized. The values and signs of regressor coefficients obtained by estimating a two-way mixed effects model are similar to the previous results. Due to the existence of heteroscedasticity across individuals, standard deviations of each residual were computed independently using Stata. For the MLE

Table 15. Regression results computed using two-way mixed effects model

Stock return	Coefficient	Std. err.	*Z* statistics	Probability
Price-to-Sales	–0.0742176	0.0173375	–4.28	0.000**
Debt-to-Equity	–0.0004359	0.0002059	–2.12	0.034**
EBITDA Margin	0.0027465	0.0013489	2.04	0.042**
EPS	0.2479863	0.1166029	2.13	0.033**
Constant	0.1626725	0.0651094	2.50	0.012**
Wald $Chi^2(14)$	68.62			

Note: ** represents significance at 5% level.

http://dx.doi.org/10.21511/imfi.17(2).2020.07

(maximum likelihood estimation) of the two-way mixed effects model, there are two different results, which are different from the previous one. Firstly, all of the financial ratios selected for this study have a statically significant effect on stock return, as shown in Table 15. Secondly, the statistical significance of the dummy variables becomes insignificant when keeping them as independent individuals.

The results obtained by different kinds of estimation models indicate that Price-to-Sales, Debt-to-Equity, EBITDA Margin, and EPS ratios have statistically significant effects with different significance levels on stock return. Moreover, according to the MLE estimation of the two-way mixed effects error components model with independent residuals, all financial ratios analyzed for this research have statistically significant effects on a stock return.

4. DISCUSSION

This study examines through application of panel data analysis, whether the Price-to-Sales, EPS, Debt-to-Equity, and EBITDA Margin financial ratios affect the returns of stocks listed on the Istanbul Stock Exchange operating in the technology and telecommunication sector. According to empirical findings, using both the Parks-Kmenta Estimator and the Two-way Mixed Effects Model, the results are similar, and they confirm each other.

According to the regression results computed using the Parks-Kmenta estimator, Price-to-Sales, EBITDA Margin, and EPS ratios have a statistically significant effect on stock returns.

Table 14 indicates that EBITDA Margin and EPS have a positive relationship with stock returns as expected. If a technology anrd telecommunication company increases its EBITDA Margin and EPS, the stock return rises.

EBITDA Margin is calculated as EBITDA/Sales, and EBITDA is found by adding depreciation and amortization (non-cash expenses) to operating profit. EBITDA refers to operating profit of a company, which is generated from its core business. It shows operational cash flow for business by eliminating non-operating factors. As EBITDA grows, the value of a business grows, and it affects the expected rate of return of the shareholders positively.

On the other hand, EPS is measured by dividing net earnings to weighted average of common shares outstanding. A company with a high EPS ratio can generate high profits that can be distributed to shareholders as dividends or reinvested in the company for new investment projects as retained earnings. Therefore, higher EPS results in higher stock returns.

According to findings, the price to sales ratio also has a statistically significant but negative relationship with stock returns. Price-to-Sales ratio is one of the main revenue multiples in relative valuation. It is widely used to value technology companies. It is computed as price per share divided by sales per share or market value of equity (mcap) divided by sales. As with other multiples, other things remaining equal, firms that trade at low Price-to-Sales multiple, are considered as cheap relative to firms that trade at high multiple of Price-to-Sales. If a firm's Price-to-Sales multiple is lower than the average of the similar (comparable) firms in the same industry, this stock is viewed as undervalued and higher Price-to-Sales multiple compared to the average of the similar firms operating in the same industry is interpreted as overvalued. Therefore, lower Price-to-Sales ratios lead to higher returns for the following periods on the Istanbul Stock Exchange operating in the technology and telecommunication sector.

The results obtained by employing a two-way mixed effects model remarks that Debt-to-Equity ratio is negatively related with stock returns (Table 15). Debt-to-Equity ratio is calculated as total liabilities over shareholders' equity, which is used to evaluate a company's financial leverage. It indicates how much debt and how much equity a company uses to finance its assets. High Debt-to-Equity ratio can be interpreted as a measure of high financial risk that a company incurs high interest expense and may have difficulty to repay its financial obligations; therefore, the company may face default or bankruptcy.

CONCLUSION

This paper analyzes the effective and predictive power of four financial ratios, Price-to-Sales, EPS, Debt-to-Equity, and EBITDA Margin, on stock returns on the Istanbul Stock Exchange over a thirty-two-quarter period spanning from 2008 to 2016. The study was conducted for the technology and communication sector using 352 stocks/periods (panel data) observations.

According to the tests, it is clear to use the two-way panel regression to estimate the explanatory power of regressors. Moreover, since there is heteroscedasticity and cross-sectional dependence in the sample, the authors deal with those disturbances by using robust estimators for the wo-way fixed effects model, including the Parks-Kmenta estimator. There was also employed a Two-way Mixed Effects Model by using independent residuals. The results obtained by different estimation methodologies are consistent with each other in terms of the effects of ratios, including Price-to-Sales, EPS, and EBITDA Margin, on the stock returns. The EPS ratio is the most dominant variable, which has significant positive effects on the stock returns of technology and communication companies listed on ISE. As a similar kind of ratio, the Price-to-Sales ratio also has a statistically significant but negative relationship with stock returns. As for the EBITDA Margin ratio, it has a statistically significant and positive effect on the stock returns based on the findings. The Debt-to-Equity ratio has a negative but statistically insignificant effect on the stock returns based on estimation results employed using Parks-Kmenta estimator.

On the other hand, according to the two-way mixed effects estimation using individual residuals, Debt-to-Equity ratio is significant; however, the coefficient is very small. All those findings are supported by the previous studies tailored to different sectors, as given in the literature review.

All those results show that the stocks of technology and telecommunication companies listed on the Istanbul Stock Exchange, having high EPS and EBITDA Margin ratios, tend to carve out higher returns for the following periods. Besides, lower Price-to-Sales ratios lead to higher returns for the following periods on the Istanbul Stock Exchange.

AUTHOR CONTRIBUTIONS

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Investigation: Hakki Ozturk, Tolun A. Karabulut.
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Software: Hakki Ozturk, Tolun A. Karabulut.
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Validation: Hakki Ozturk.
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