NORMALITY OF TURKISH STOCK RETURNS OVER TIME

[Normální rozdělení výnosnosti tureckých akcií v čase]

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Abstract: This paper examines whether Borsa Istanbul (BIST) 100 index returns as well as individual stock returns are normally distributed and whether return distributions approach normal for longer return periods. Data include the daily aggregate market returns, i.e., BIST-100 index returns, and 9 firms' daily returns in 3 sectors, i.e. banking, automotive and holding. Data period is from 2004 to 2018Q1. Three types of normality tests, Shapiro-Wilk, Jarque-Bera and Kolmogorov-Smirnow were applied. The results showed that returns seemed to have leptokurtic distribution instead of normal distribution and as the return period increases, distribution of returns approached normal. This suggests that investors should not rely on the normality of returns assumption while evaluating risk for shorter return periods.

Keywords: Borsa İstanbul, distribution of returns, investments, normality over time.

JEL classification: G2, G11, G32

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Introduction

Most of the models and theories developed in the finance area including CAPM, classical portfolio theory, and Black and Scholes option pricing formula assume that the returns are normally distributed. Empirical studies are conducted regarding the normal distribution of returns. However, it is known for a long time that the asset returns do not follow a normal distribution. Financial data shows large variations that happen with a frequency higher than a normal distribution would allow, i.e., they have fat tails problem.

Mandelbrot (1963) analyzed the stock return distributions and found that the distributions of price changes are more likely to belong to the family of stable Paretian distributions that have heavy tails than to the normal distribution. Mandelbrot tested the theory with the distribution of cotton price changes based on a very long time series. He increased the sample size from 1 to 1300 observations and calculated the variance of the price changes. He found that the sample variance did not converge to a limiting value but continued to change in an unpredictable way, which is parallel with the stable Paretian hypothesis. He argued that the extreme events in financial data series too frequently occur which prevent the normal distribution to hold.

Fama (1965) examined the distribution pattern of the daily price changes, i.e., whether the price changes follow a normal or stable Paretian distribution. Fama empirically tested the Mandelbrot's stable Paretian hypothesis. In most of the studies which have been conducted in the area of finance, logarithmic returns are used since they (1) allow continuous compounding, (2) control the increasing variance with the increasing price problem, and (3) for changes less than 15%, they are very close to the percentage change (Fama 1965). The data in Fama's study consisted of the daily prices of the 30 stocks of the Dow-Jones Industrial

Average over the period 1957 to 1962. To test the hypothesis, Fama calculated the price changes within given standard deviations, constructed a frequency distribution and compared it with that of the normal distribution. According to the empirical frequency distributions results, there was some degree of leptokurtosis for each stock, which means that the distributions are more peaked at the centre and have fatter tails.

Blattberg and Gonedes' (1974) study is mainly about an alternative distribution of the stock returns, t-distribution, which accounts for the fat tails. Both stable and student models can account for fatter tails. They found that the t-distribution has greater descriptive validity than the symmetric stable distributions for the given sample of stock returns. They also found that if the variance of a normal distribution follows an inverted gamma distribution, then the distribution is the t-distribution. Data used in this study includes both daily and weekly observations for each of the 30 stocks in the Dow-Jones Industrials for the period 1957 to 1962. They used a two step-method to discriminate between the stable and the student models. The results show that the characteristic exponents of the distribution of the intertemporal sum for the returns on assets increase with the sum size, which is a sign of instability.

Contrary to the findings of Fama (1965) and Blattberg and Genodes(1974), Press (1967) assumed that stock returns are generated from not a single distribution but a mixture of distributions. The mixture of distributions hypothesis states that price changes are combinations of normal distributions with different variances. Press argued that the return distribution is created by the interaction of two processes: (1) a continuous diffusion part (Brownian motion) and (2) a discontinuous part (Poisson) where the first one captures the changes in the usual day-to-day price changes and the second one captures the large informational shocks. Second process is the one, which changes the form of the distribution. Then, he empirically investigated the distribution of the monthly returns for 10 stocks over the period 1936 to 1960. He found that the observed movements in the returns are explained with a Poisson mixture of normal distributions.

In line with the Press' findings, Kon (1984) argued that the true distribution of stock returns seems to be the discrete mixture of normal distributions and its parameters may shift among a finite set of values. Shifts in the parameters are the main reason for the observed significant fat tails. Kon used 4,639 daily return observations on S&P index, CRSP value weighted and equal-weighted indices for the period July 2, 1962 to December 31, 1980. He grouped the data by (1) year, (2) day of the week to determine cyclical effects, and (3) year & day to detect both effects. 30 stocks from each group are used. All three indices showed excess kurtosis and skewness at 0.01 probability level. Specifically, 26 out of 30 stocks showed positive skewness significantly. He used the logarithmic likelihood maximization procedure to test model specifications. He found that among Dow Jones Industrial Average stocks, 7 can be described as mixtures of four Gaussians, 11 as mixtures of three Gaussians, and the remaining 12 as mixtures of two Gaussians. Moreover, all three indices in the sample can be described by a mixture of three normal distributions. Then he compared the discrete mixture of normal distributions model with the student distribution model and found that the mixture model has more descriptive validity than the student distribution model, which is supported by Blattberg and Gonedes (1974).

Different from other studies conducted by using changes in spot prices, Hall, Brorsen and Irwin (1989) investigated the distribution of futures price changes. They tested the stable Paretian and mixture of normals hypotheses by using the stable distribution's property of stability under addition. Stable Paretian distributions have four parameters namely alpha (α), beta (β), gamma (γ) and delta (δ). Alpha (α), the characteristic exponent, measures the degree of peakedness and the fatness of the tails. It takes a value of one for the Cauchy distribution and a value of two for the normal distribution. Mandelbrot's stable Paretian hypothesis asserts that when $1 < \alpha < 2$, the distributions have means and infinite variances. The data of Hall, Brorsen and Irwin's study (1989) consisted of daily closing future price movements of the 20 commodities obtained from the Dunn & Hargitt Commodity Data bank for the period 1979 to 1984. The sample includes financial, metal, and agricultural futures. According to the analysis, financial, metal, and agricultural futures groups exhibited varying results. For example, within the financial group two interest rate contracts, Treasury bills and bonds, showed increasing alphas across the sums for the whole dataset; however, they did not approach two. On the other hand, currency contracts showed increasing alphas that approach two. Within the metal group, while gold exhibited an increasing alpha that does not reaches two, copper did. Silver showed constant alpha. Within the agricultural group, corn, cocoa, soybeans, wheat, sugar, and cotton exhibited little evidence of increasing alphas for the whole period. However, for subperiods or for other goods such as pork bellies, live cattle, live hogs, and lumber estimates showed increasing alphas. When they evaluated the analysis results, they concluded that the results offer some support for the mixture of normal distributions hypothesis.

By using daily closing values of the S&P composite index for the period 1979 to 1987, Gray and French (1990) examined the distribution of stock returns. They compared normal distribution results with those of three alternative distribution types, namely the scaled t-distribution, the logistic distribution, and the exponential power distribution. Different from other studies, Grey and French used the logistic distribution to analyze the distribution of returns. Logistic distribution shows heavy tails and peakedness, which better fits empirical return distributions. Like logistic distribution, the exponential power distributions show heavy tails and peakedness, although its tail decreases at an exponential rate. Moreover, they used graphical techniques to compare the four probability density functions. According to the results, alternative distributions to the normal distribution exhibited more peakedness and heavier tails than the normal distribution, and there was a high similarity between the results of the logistic and scaled-t distributions. Among three of the alternative distributions, exponential power distribution seemed to supply the greatest fit. Probability density functions (PDF) of the three alternative distributions based on 2,211 observed daily log prices exhibited more peakedness and heavier tails than the estimated normal distribution. Systematic pattern of deviations in the PDF of the normal distribution show that stock return distributions have fatter tails and more peakedness than the normal distribution.

After observing that the financial data are not normally distributed and their distributions have fatter tails than the normal distribution, academics in this area focused on the risk measures where they can approximately estimate the maximal and minimal values of the price changes in the market. One of the theories to get information about the risk of extreme is the extreme value theory (EVT). EVT has applications in finance as well as in many other disciplines. For example, approximately 40 % of the Netherlands is below the sea level and EVT is used to estimate the extreme rise in the sea level to protect the country against flooding. Finance, especially risk management is concerned with the largest observations and their frequencies. EVT restricts the behavior of the distribution function in the tail and by using this theory, the limiting distributions of the extremes can be found (Caserta and De Vries 2003).

Since distributions of returns are important for investors for evaluating risk and reward, many researchers continued focusing on determining whether returns are normally distributed: Jansen and De Vries (1991), Longin (1996), Aparicio and Estrada (1999), Harris and Kucukozmen (2001), Gettinby *et al*. (2004), LeBaron and Samanta (2004), Gençay and Selçuk (2004), Tolikas and Brown (2006), Behr and Potter (2009), Chión and Véliz (2008), Göncü *et al*. (2012), Arık *et al*. (2013), and Naumoski *et al*, (2017).

Goncu et al. (2012) examined the asymptotic distribution of the extreme returns in the Borsa İstanbul by using EVT for the period 1988 to 2010. They divided the period into four subintervals considering the bull and bear periods of the Turkish economy. Data consists of 5,503 daily log returns of BIST-100 index. They used three types of distributions named: Gumbel, Frétcet and Weibull. They also applied Anderson-Darling goodness of fit test, which is sensitive to the tails of a distribution. As the last step, they compared the value-at-risk (VAR) performance of the EVT with that of the normal distribution. The results showed that the tail behaviour of the daily returns showed deviations from the normal distribution. Gumbel distribution fitted the data better than others did when the entire sample was considered. However, the result changed for subsamples. For example, during the period 1988 to 1993, Weibull distribution fitted the best for the maximal returns whereas Gumbel distribution fitted the best for the minimal returns, which shows that positive and negative extreme returns do not share the same characteristics. Arık *et al*. (2013) investigated the distribution of BIST-100 returns over the period 1997 to 2012 by using two methods of EVT: block maxima method and peaks over threshold method. They found that VAR values that are calculated for daily maximum returns were lower than that of the series of monthly maximum returns. Naumoski *et al*, (2017) investigated the distribution of returns of 10 Southeast European emerging countries namely Bosnia and Herzegovina, Bulgaria, Crotia, Greece, Macedonia, Montenegro, Romania, Slovenia, Serbia, and Turkey over the period 2011 to 2016. They used daily, weekly and monthly observations. They found that stock returns followed a leptokurtic distribution and skewness of the distributions of returns for most of the countries were negative.

Although there are many studies which show that returns are not normally distributed in the Turkish stock market, those studies mainly focused on the aggregate market return. Apart from those studies, this study aims to investigate the behaviour of individual stock returns as well as aggregate market return. The study also aims to investigate whether distribution of returns approach normal when longer return periods are used. The rest of this paper is organized as follows. In Section 1, information about data and methodology are given. In Section 2, results of the normality tests are reported. In Section 3, findings about normality of returns for longer time periods are presented. Finally, in the conclusion part the article is summarized.

1 Data and Methodology

The daily returns of the BIST-100 index and 9 companies' daily returns in 3 sectors, i.e. banking, automotive and holding were used to investigate whether returns are normally distributed. The BIST-100 Index, one of the major indices of the BIST, comprises the stocks of 100 selected companies listed on the National Market. Among each sector top three firms that have the highest trading volume were chosen. These firms are T. Garanti Bankası, T. İş Bankası, and Akbank from banking sector, Karsan Otomotiv, Otokar and Tofaş Türk from automotive sector, and Doğan Şirketler Grubu Holding, Koç Holding, and Hacı Ömer Sabancı Holding from holdings, respectively. The realized time-series returns for each period are defined as

$R_t = \ln(P_t / P_{t-1})$ (1)

where P_t is the daily closing prices of the BIST-100 index, and of the 9 firms on day t.

The sample period is from January 1, 2004 to April 30, 2018. The data was retrieved from Datastream. Three types of normality tests, Shapiro-Wilk, Jarque-Bera and Kolmogorov-Smirnow tests were used to investigate normality of returns. The null hypotheses of these tests, H_0, imply that the variable is normally distributed. The null and alternative hypotheses are as follows

H_0: The daily returns series for each firm follows a normal distribution.

H_1: The daily returns series for each firm does not follow a normal distribution.

A significance level of 0.05 was chosen to evaluate the hypothesis tests.

To investigate whether the distribution of returns approaches normal distribution over time[1], blocks of 1, 5, 20, 60 and 120 consequtive market days were used. Returns were calculated as follows

$R_{Kt} = Ln(P_t / P_{t-k})$ (2)

In this equation, R_{Kt} is the return for a period of K block days on time t. K corresponds to 1, 5, 20, 60 and 120 block days. P_t is the daily closing value of the firms and of the BIST-100 index on day t. t equals to K+1, 2K+1, 3K+1, and so on, with k = K, K+1, K+2, and so forth. The null and alternative hypotheses are as follows

H_0: The daily returns series for each firm follows a normal distribution as the return period increases.

H_1: The daily returns series for each firm does not follow a normal distribution as the return period increases.

A significance level of 0.05 was chosen to evaluate the hypothesis tests.

2 Empirical Results

2.1 Sample Moments of BIST-100 Index

Table 1 gives information about the empirical distribution of BIST-100 index returns for the given data set. The statistics consist of the mean, the standard deviation and the coefficients of skewness and kurtosis. According to Table 1, distribution of returns of BIST-100 index showed significant levels of skewness and excess kurtosis. The coefficient of kurtosis of daily returns is well above zero, which is an indication of a non-normal distribution. Moreover the coefficient of skewness of daily returns is negative.

Table 1: Sample Moments of the Distributions of Daily BIST-100 Index Returns

Stock Name	N	Mean	Standard Deviation	Skewness	Kurtosis
BIST-100 Index	3605	0.0005	0.0166	-0.270	3.504

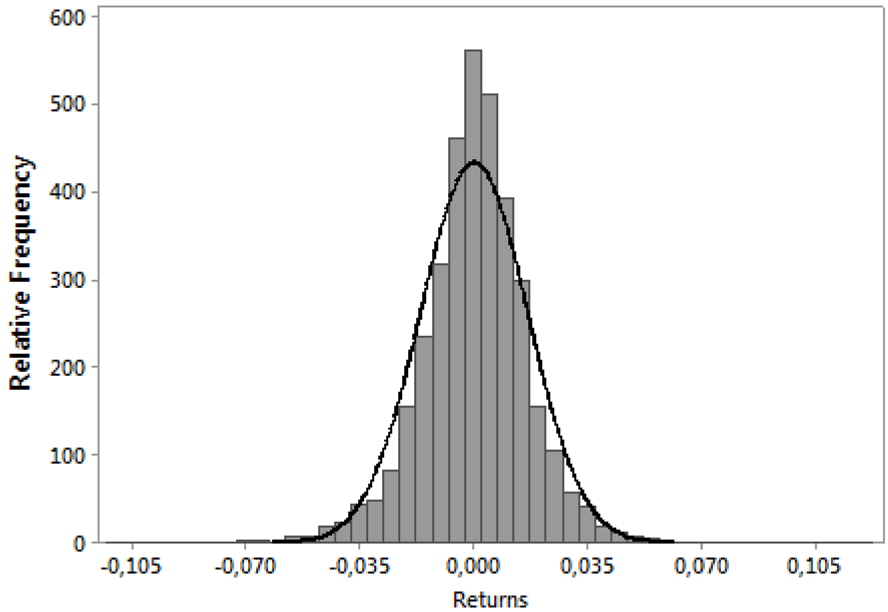
Source: Own research

As it is observed from the histogram in Figure 1, the distribution of BIST-100 index returns showed a high peak near the mean that declines rapidly and have heavy tails. Therefore, it can be concluded that the aggregate market return showed leptokurtic distribution. Distributions which show excess kurtosis when compared with a normal distribution are called leptokurtic

[1] The same method is used in Veliz and Chion's (2008) study.

distributions. For leptokurtic distributions, variance is not the appropriate measure of risk because of at least two reasons: (1) the variance is calculated from the two tails of a distribution, which is not ideal. For example, a distribution with one long tail has the same variance as its mirror image; however, they don't have the same risk. The lower tail of the distributions is the one that matters for the risk. (2) there are some distributions whose tails decay so slowly that the variance is infinitely large. This makes the measure of risk nearly impossible (Abadir 2011).

Figure 1: Relative Frequency and Normal Distribution of Daily Market Returns for BIST 100 Index: 2004 – 2018Q1



Source: Own research

2.2 Sample Moments of 9 Companies

Table 2 gives sample moments of the distributions of 9 companies' returns for the given data set. It is observed from Table 2 that 7 out of 9 firms have positive skewness. To explain the skewness discrepancy between the aggregate stock market return and firm-level returns, Albuquerque (2010) gave an example of portfolio of firms that have positively skewed returns. A portfolio return's skewness is composed of firm-level return skewness and co-skewness terms. It is similar to a portfolio's variance term as a portfolio's variance is composed of covariances. Like covariances, co-skewness terms are cross-sectional terms so that a portfolio may have lower skewness than the mean skewness and the mean variance of the component stocks.

According to Table 2, for all firms, values for kurtosis are well above zero, which is an indication of a non-normal distribution. Data sets with high kurtosis show a tendency to have a high peak near the mean that declines rapidly and fatter tails than the normal distribution.

Table 2: Sample Moments of the Distributions of 9 Companies' Returns

Stock Name	N	Mean	Standard deviation	Skewness	Kurtosis
T. Garanti Bankası A.Ş.	3605	0.0007	0.025	-0.078	2.672
T. İş Bankası A.Ş.	3605	0.0004	0.024	0.005	2.170
Akbank A.Ş.	3605	0.0004	0.025	0.209	2.665
Karsan Otomotiv Sanayi ve Ticaret A.Ş.	3605	0.0001	0.029	0.682	9.056
Otokar Otomotiv ve Savunma Sanayi A.Ş.	3605	0.0010	0.024	0.154	6.078
Tofaş Türk Otomotiv Fabrikası A.Ş.	3605	0.0008	0.025	-0.230	7.156
Doğan Şirketler Grubu Holding A.Ş.	3604	0.0001	0.028	0.167	6.550
Koç Holding A.Ş.	3599	0.0005	0.022	0.007	3.243
Hacı Ömer Sabancı Holding A.Ş.	3605	0.0003	0.030	0.072	2.496

Source: Own research

3 Normality over Time

In the following analyses, both aggregate market and firm-specific results are given. The results are summarized in the tables. The tables include the results of the normality tests for different block days of returns for the given firms. Specifically, the tables show the statistics and corresponding p-values for applied normality tests: Shapiro-Wilk, Jarque-Bera and Kolmogorov-Smirnow.

3.1 BIST-100 Index Returns

When normality test results are evaluated, Table 3 indicates that for 1 and 5 block days, the normality assumption is rejected by all tests. For 20, 60 and 120 block days, the normality assumption cannot be rejected by all tests. It can be concluded that as the length of time increases, distribution of aggregate market returns approaches normal.

Table 3: BIST-100 Index Returns: Normality Tests

		Shapiro - Wilk		Jarque-Bera		Kolmogorov-Smirnov	
	K	Statistic	p	Statistic	p	Statistic	p
BIST-100	1	0.949	0.000	262.46	0.000	0.088	0.000
	5	0.942	0.000	149.557	0.000	0.095	0.000
	20	0.992	0.378	2.955	0.228	0.062	0.090
	60	0.988	0.814	0.537	0.765	0.081	0.200
	120	0.966	0.438	2.861	0.239	0.092	0.200

Source: Own research

3.2 Banking Sector

As it is seen from the Table 4, while for K=1 and K=5 all tests reject that returns are normally distributed, for K=20, K=60 and K=120, normality of return distributions cannot be rejected for Garanti Bankası. For İş Bankası, it is observed that the normality assumption was rejected for periods K=1 and K=5 for all tests. For periods of K=20, K=60 and K=120, all tests failed to reject that the returns are normally distributed. For Akbank, it is observed that while for K=1 and K=5, all tests rejected that the returns are normally distributed, for K=20, K=60 and K=120, all tests failed to reject the normality assumption. Overall, for the banking sector it can be concluded that the distribution of returns for the selected firms approached normal with increasing block days.

Table 4: Banking Sector Firm Returns: Normality Tests Over Time

		Shapiro - Wilk		Jarque-Bera		Kolmogorov-Smirnov	
	K	Statistic	p	Statistic	p	Statistic	p
T. Garanti Bankası A.Ş.	1	0.887	0.000	484.500	0.000	0.172	0.000
	5	0.944	0.000	15,642.63	0.000	0.097	0.000
	20	0.987	0.098	2.311	0.314	0.053	0.200
	60	0.973	0.203	2.097	0.351	0.087	0.200
	120	0.952	0.195	4.773	0.092	0.100	0.200
		Shapiro - Wilk		Jarque-Bera		Kolmogorov-Smirnov	
	K	Statistic	p	Statistic	p	Statistic	p
T. İş Bankası (C) A.Ş.	1	0.962	0.000	502.500	0.000	0.087	0.000
	5	0.989	0.003	8.668	0.013	0.049	0.000
	20	0.986	0.064	2.894	0.235	0.048	0.200
	60	0.981	0.495	0.803	0.669	0.069	0.200
	120	0.943	0.106	2.321	0.313	0.115	0.200
		Shapiro - Wilk		Jarque-Bera		Kolmogorov-Smirnov	
	K	Statistic	p	Statistic	p	Statistic	p
Akbank A.Ş.	1	0.909	0.000	525.291	0.000	0.136	0.000
	5	0.978	0.000	41.645	0.000	0.067	0.000
	20	0.990	0.235	0.776	0.678	0.061	0.200
	60	0.985	0.657	0.252	0.882	0.063	0.200
	120	0.942	0.105	3.866	0.145	0.150	0.081

Source: Own research

3.3 Automotive Sector

It is observed from Table 5 that for Karsan Otomotiv while for K=1, K=5 and K=20 the normality of return distributions was rejected, for K=60 and K=120, none of the tests rejected the normality of return distributions. For Otokar., normality tests results for K=1 and K=5 showed that returns do not seem to be normally distributed. All of the tests rejected the normality of return distributions. For K=20 and K=60, p values are more than 0.05 which means that the normality assumption cannot be rejected. For K=120 results are different. While Jarque-Bera test failed to reject the normality of returns, other 2 tests rejected that returns are normally distributed. Results of the normality tests for Tofaş Türk showed that for K=1, K=5, K=20 and K=60 returns do not seem to be normally distributed. For K=120 normality of return distributions cannot be rejected by Kolmogorov-Smirnov test. As results show although the distribution of returns for the selected firms in this sector approached normal with increasing block days, for K=120 results differed.

Table 5: Automotive Sector Firm Returns: Normality Tests Over Time

		Shapiro - Wilk		Jarque-Bera		Kolmogorov-Smirnov	
Karsan Otomotiv Sanayi ve Ticaret A.Ş.	K	Statistic	p	Statistic	p	Statistic	p
	1	0.974	0.000	91.985	0.000	0.069	0.000
	5	0.978	0.000	49.343	0.000	0.057	0.000
	20	0.984	0.037	7.218	0.027	0.077	0.011
	60	0.976	0.292	1.427	0.490	0.074	0.200
	120	0.976	0.706	0.664	0.718	0.080	0.200
		Shapiro - Wilk		Jarque-Bera		Kolmogorov-Smirnov	
Otokar Otomotiv ve Savunma Sanayi A.Ş.	K	Statistic	p	Statistic	p	Statistic	p
	1	0.814	0.000	627.939	0.000	0.206	0.000
	5	0.933	0.000	121.307	0.000	0.111	0.000
	20	0.990	0.218	2.825	0.244	0.061	0.099
	60	0.985	0.693	0.216	0.898	0.085	0.200
	120	0.915	0.020	2.477	0.290	0.161	0.047
		Shapiro - Wilk		Jarque-Bera		Kolmogorov-Smirnov	
Tofaş Türk Otomotiv Fabrikası A.Ş.	K	Statistic	p	Statistic	p	Statistic	p
	1	0.964	0.000	173.440	0.000	0.064	0.000
	5	0.940	0.000	235.186	0.000	0.076	0.000
	20	0.883	0.000	357.092	0.000	0.124	0.000
	60	0.895	0.000	81.332	0.000	0.114	0.049
	120	0.919	0.026	6.053	0.048	0.146	0.104

Source: Own research

3.4 Holding Companies

According to normality test results that are summarized in Table 6, the returns are not normally distributed for Doğan Şirketler Grubu when 1 block day is used as the return period. This result is supported by all three tests. For K=5 while Shapiro-Wilk, and Kolmogorov-Smirnov tests rejected that returns are normally distributed, Jarque-Bera test failed to reject normal distribution. All tests failed to reject the normality of return distributions for K=20, K=60 and K=120. For Koç Holding A.Ş., for K=1, K=5, and K=20, all tests rejected the normality of return distributions. For longer return periods such as 60 and 120 days, all test results supported the normality of the return distributions. For Hacı Ömer Sabancı Holding A.Ş., results showed that for K=1 all tests except Kolmogorov-Smirnov rejected the normality of return distributions. For K=5 and K=20 all tests rejected the normality assumption. For K=60 while Shapiro-Wilk and Jarque-Bera failed to reject normality of return distributions, Kolmogorov-Smirnov did. For K=120 while Kolmogorov-Smirnov and Shapiro-Wilk tests failed to reject normality of distributions, Jarque-Bera test rejected that returns are normally distributed. In overall, it can be concluded that as the length of time increases, distribution of selected companies' returns in this sector approached normal.

Table 6: Holding Sector Firm Returns: Normality Tests Over Time

Firm	K	Shapiro - Wilk Statistic	Shapiro - Wilk p	Jarque-Bera Statistic	Jarque-Bera p	Kolmogorov-Smirnov Statistic	Kolmogorov-Smirnov p
Doğan Şirketler Grubu Holding A.Ş.	1	0.987	0.000	71.862	0.000	0.037	0.000
	5	0.988	0.000	3.918	0.141	0.054	0.000
	20	0.993	0.134	1.659	0.436	0.050	0.200
	60	0.977	0.302	5.773	0.056	0.082	0.200
	120	0.953	0.208	1.314	0.518	0.123	0.200
Koç Holding A.Ş.	1	0.930	0.000	301.988	0.000	0.114	0.000
	5	0.976	0.000	33.616	0.000	0.076	0.000
	20	0.984	0.035	8.004	0.018	0.080	0.006
	60	0.989	0.873	0.589	0.745	0.073	0.200
	120	0.974	0.649	0.152	0.927	0.086	0.200
Hacı Ömer Sabancı Holding A.Ş.	1	0.925	0.000	298.693	0.000	0.08	0.112
	5	0.974	0.000	57.228	0.000	0.062	0.000
	20	0.972	0.001	11.475	0.003	0.076	0.013
	60	0.977	0.301	0.733	0.693	0.116	0.040
	120	0.945	0.126	7.119	0.028	0.128	0.200

Source: Own research

Conclusion

In overall, the empirical data indicated that leptokurtic probability distributions could explain the behaviour of the returns for given firms and aggregate market better than the normal probability distribution could. For the Turkish stock market, daily market returns showed significant departures from normal distribution over the period 2004 to 2018Q1. Analyses results indicated that distributions of BIST-100 index returns were asymmetric and showed leptokurtic behaviour. Results are similar when sector based results were analysed. According to skewness and kurtosis values, the distributions showed leptokurtic behaviour for banking sector firms. Automotive sector results showed that the distributions of returns for the selected firms showed asymmetry and leptokurtic behavior. For holding firms, 3 firms' distributions were asymmetric and they had more peakedness and fatter tails than the normal distribution had. As it is explained in Chión and Véliz's study (2008), if investors focus on the downside risk of returns, decisions based on normality assumption gives inaccurate results. Moreover, for fat-tailed distributions, they should not measure risk with standard deviation since it is not the appropriate measure of risk for this type of distributions.

When shorter return periods such as K=1 and K=5 were used, normality of returns hypothesis was rejected with all tests performed at the 5 % significance level for the BIST-100 index. However, when longer periods were used, distributions approached normal. The same generalization can be made for individual firms as well: firms' return distributions approached normal for longer return periods. These results imply that investors consider the fact that normality of returns assumption may be valid for longer return periods.

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