TESTING RANDOM WALK HYPOTHESIS FOR ISTANBUL STOCK EXCHANGE

Oktay Tas[1], Cigdem Guleroglu Atac[2]
[1]Istanbul Technical University, Department of Management, 34367, Istanbul, Turkey.
 tasokta@itu.edu.tr, ORCID: 0000-0002-7570-549X
[2]Istanbul Technical University, Department of Management, 34367, Istanbul, Turkey.
 gulerogluatac16@itu.edu.tr, ORCID:0000-0003-2367-0878

ABSTRACT

Purpose- This study investigates weak form market efficiency of Istanbul Stock Exchange (ISE) via Random Walk Hypothesis (RWH).
Methodology- Two random walk tests, Dickey-Fuller and Runs test are used to search for random walk in stock market. Natural log returns of BIST-30 index firms, BIST-30 index, participation index firms and participation index are analysed by both tests over a five year period from 2013 to 2018. Therefore, BIST30 index returns together with BIST100 and BISTTUM indexes are analysed in a longer period from 2000 to 2018 including 2001 and 2008 financial crises in Turkey.
Findings- Weak form market efficiency is justified according to Dickey Fuller test, but not for Runs test.
Conclusion- While Dickey Fuller test results reject random walk in ISE, which leads that weak form market efficiency is not justified; Runs test are failed to give certain results on market efficiency for the same data set and time period.

Keywords: Market efficiency in weak form, Dickey Fuller random walk test, runs test, Istanbul Stock Exchange Indexes, efficient market hypothesis.
JEL Codes: G30, G32

1. INTRODUCTION

With financial markets becoming more and more important every day, the concept of effectiveness has become much more crucial than ever. According to Efficient Market Hypothesis (EMH), reflection of a relevant information to financial instrument specifies the forms of market. There are three types of market forms which are; weak form, semi strong form and strong form. Parallel to EMH, technical analysis, public information, and private information are no of use for weak form, semi strong form and strong form, respectively.

As an attractive emerging stock market, Istanbul Stock Exchange (ISE) has gained considerable interest from both academics and financial experts since last decades. Thus, market efficiency becomes an important concept. It is a common and efficient way to search for a random walk process in order to understand the market efficiency. If a stock price or market index follow random walk that prevents investors from earning abnormal returns, then it is convenient to say that market is efficient.

In this study, natural log returns of BIST-30 index firms, BIST-30 index, participation index firms and participation index are analysed by both Dickey-Fuller unit root test and Runs test over a five year period from 2013 to 2018. Therefore, we develop the study into a longer period from 2000 to 2018 including 2001 and 2008 financial crises in Turkey by examining BIST30 index returns together with BIST100 and BISTTUM indexes. The results shows that weak form market efficiency is justified according to Dickey Fuller test, but not for Runs test. Thus, it is concluded that while Dickey Fuller test results reject random walk in ISE, which leads that weak form market efficiency is not justified; Runs test are failed to give certain results on market efficiency for the same data set and time period.

2. LITERATURE REVIEW

The randomness of stock prices is one of the most challenged remedies of the finance literature from both theoretical and practical viewpoints. The fundamental null hypothesis of stock returns have correlation and follow random walk through time has been tested thoroughly applying couple statistical methods, mostly unit root or RUNS tests for major developed markets. Among many others, the pioneering studies of Grossman and Stiglitz (1980); Campbell et al (1997); Lo (2004); Lim (2007); Ito and Sugiyama (2009); Smith (2012) and Urguhart et al (2015) confirmed the statistically significant return predictability. On the other hand, there exist a considerable amount of studies as well advocating the random walk and market efficiency of well-known stock markets. They can be exemplified as: Chan and Gup

(1992); Cai et al (2005); Pham et al (2007); Liu (2010); Hamid et al (2010); Onali and John (2011) and Khrapko (2013). One crucial intuition behind the conflicting findings may result from using different econometric techniques and structural breaks/time-varying nature of data sets.Even most of the quantitative studies have been conducted for mature developed markets so far because of the robust firm and country specific data for variables; emerging and frontier countries have recently got paid interest of researchers. Urrutia (1995) for Argentina (+); Ely (2011) for Brazil (-); Lim et al (2013) for China (+); Kumar and Kumar (2015) for India (-); Jefferis and Graham (2005) for South Africa (+) and Niemczak and Smith (2013) for Middle East Stock Markets (-) can be named by countries particularly. Nonetheless, inconsistency of EMH conformity is valid for emerging markets as well which shown by +/- signs in brackets for countries. To adhere the purpose of this study, the limited Turkish literature is particularly scrutinized. Consistent with relevant prior research, an absolute judgement regarding random walk behavior cannot be concluded for Turkish Stock Market Borsa Istanbul. (eg. Balaban, 1995; Tas and Dursunoglu, 2005; Cevik and Erdogan, 2009; Ergul, 2009; Altunoz, 2016 and Aytekin and Erol, 2017).

3. DATA AND METHODOLOGY

In order to search the existance of market efficiency in weak form, we preferred to use two widely used random walk tests Dickey-Fuller and Runs test in the light of the study Tas and Dursunoglu (2005). For the overall analysis, the stock content and weights of BIST30, BIST100 and BISTTUM indexes are assumed to be same as the beginning of the period. Since the participation index is a relatively new index in ISE, we keep the current form of the index during the overall period. First, we employ Dickey-Fuller unit root test on natural log returns of stock prices of BIST30 index firms, daily BIST30 index price, prices of participation index firms and participation index prices on daily basis. Second, we apply Dickey-Fuller unit root test on natural log returns of daily BIST30, BIST100 and BISTTUM index prices. Another well known approach to detect statistical efficiencies which means randomness, is Runs test. This test is performed by examining a time series for returns of a security and testing whether the number of consecutive price gains or drops shows a pattern. In the following table, there are price differences of BIST30 index stocks during the period 2013-2018. Positive return is shown with a "+" sign, negative return is shown with "-" sign, and no change in return is shown with "0" in Table 1.

Table 1: Positive, Negative and Zero Change Returns of BIST30 Index Stocks in 2013-2018

Stocks	+	-	0
AKBNK	600	620	96
ARCLK	593	619	104
ASELS	616	570	130
ASYAB	214	263	839
BIMAS	626	606	84
DOHOL	418	458	440
EKGYO	553	579	184
ENKAI	613	575	128
EREGL	633	579	104
GARAN	612	626	78
HALKB	625	594	97
IHLAS	310	370	636
ISCTR	615	605	96
KCHOL	590	604	122
KOZAA	541	638	137
KOZAL	640	614	62
KRDMD	539	564	213
MGROS	610	612	94
PETKM	624	559	133
PGSUS	616	619	81
SAHOL	602	612	102
SISE	614	573	129
TAVHL	624	597	95
TCELL	622	576	118
THYAO	627	600	89
TOASO	598	621	97
TTKOM	596	612	108
TUPRS	663	571	82
VAKBN	619	605	92
YKBNK	581	614	121

For the random walk analysis, we first employ Runs test on natural log returns of stock prices of BIST30 index firms, BIST30 index price, participation index firms and participation index price data on daily basis between 2013-2018. Second, we apply Runs test on natural log returns of daily BIST30, BIST100 and BISTTUM index prices in a longer period 2000-2018. The following table shows variable definitions of Runs Test presented in the emprical results of the next section.

Table 2: Variable Definitions of Runs Test

Concepts and Variables used in Runs Test	
Definition	Abbreviation
Number of Runs	R
Number of Zeros	N0
Number of Ones	N1
Total Observation	N
Expected Runs	Ex. R
The Variance of Runs	Var R
The Standart Deviation of Runs	Stdev R
Z-score	Z

4. FINDINGS AND DISCUSSIONS

4.1. Empirical Results for Dickey-Fuller Test (ADF)

Dickey-Fuller unit root test results on natural log returns of daily stock prices of BIST30 index firms, daily BIST30 index price, daily prices of participation index and daily participation index price is shown in Table 3, where KATLM stands for participation index.

Table 3: Dickey-Fuller Test (ADF) Results I

BIST30 Firms	ADF Test Value	KATLM Firms	ADF Test Value	Indexes	ADF Test Value
AKBNK	-37,2780	AKCNS	-28,5545	BIST30	-37,2155
ARCLK	-36,5541	ALBRK	-14,2110	KATLM	-35,7988
ASELS	-13,3064	ALKIM	-35,8310		
ASYAB	-10,1873	ANELE	-34,4591		
BIMAS	-28,3140	ASELS	-13,4711		
DOHOL	-34,9694	AYGAZ	-36,0816		
EKGYO	-27,8923	BIMAS	-28,4370		
ENKAI	-20,7573	BUCIM	-35,6670		
EREGL	-36,5323	CEMTS	-17,1100		
GARAN	-39,3425	EGEEN	-38,8937		
HALKB	-37,4927	ERBOS	-38,8631		
IHLAS	-28,2415	EREGL	-7,3105		
ISCTR	-14,2245	FLAP	-29,2206		
KCHOL	-37,9101	FROTO	-38,0814		
KOZAA	-33,9220	GENTS	-36,8822		
KOZAL	-36,3052	GOODY	-23,8440		
KRDMD	-7,3140	IHLGM	-17,9772		
MGROS	-13,6373	KARTN	-14,1334		
PETKM	-24,4858	KONYA	-17,1925		
PGSUS	-14,3505	LOGO	-11,0500		
SAHOL	-37,3455	OZGYO	-12,5735		
SISE	-22,9905	PNSUT	-24,1659		
TAVHL	-27,5087	SELEC	-38,6506		
TCELL	-17,9124	TATGD	-25,1085		
THYAO	-13,2623	TMSN	-11,6559		
TOASO	-15,6673	VESBE	-27,6524		
TTKOM	-36,9437	YATAS	-26,4556		
TUPRS	-17,6530				
VAKBN	-13,4579				
YKBNK	-37,4965				

Dickey-Fuller unit root test is applied to each return series at level and ADF test values of each stock are found to be less than critical values at each 1%, 5% and 10% significence level. Thus, all return series has no unit root and random walk hypothesis is rejected. This results in the rejection of market efficiency in weak form. An example of critical values for AKBNK stock at each 1%, 5% and 10% significence level are shown in Table 4.

Table 4: Critical Values for AKBNK Stock at each 1%, 5% and 10% Significence Levels

Significance level	Test critical values for AKBNK
1% level	-3,9650
5% level	-3,4132
10% level	-3,1286

Furthermore, we apply the same analysis on natural log returns of daily BIST30, BIST100 and BISTTUM index prices. The results are shown in Table 5 where Pr represents the results for price data, LN is for natural logaritm of prices and Rt is for log returns of prices. According to the results, log returns of BIST30, BIST100 and BISTTUM index data has no unit root, in other words, they are stationary. Therefore, the random walk hypothesis is rejected which shows the existence of market inefficiency. Furthermore, this result is valid for the each selected time period. The periods are determined based on the financial crises time in Turkey where abnormal price returns are realised, in order to verify our findings under the effect of crises.

Table 5: Dickey-Fuller Test (ADF) Results II

TL	BIST-30			BIST-100			BIST-TUM		
	Pr	LN	Rt	Pr	LN	Rt	Pr	LN	Rt
2000-2018-ADF	-3,7090	-2,7897	-20,6897	-3,6350	-2,7867	-20,3460	-3,6105	-2,7476	-20,1929
2008-2018-ADF	-3,0904	-2,7183	-16,0030	-2,9821	-2,5435	-15,6710	-2,9517	-2,4809	-15,6300
2013-2018-ADF	-2,5838	-2,7534	-12,3864	-2,4727	-2,6455	-12,3330	-2,4346	-2,6305	-12,3523
Critical Value at %5	-3,4135								

4.2. Empirical Results for Runs Test

Runs test results on natural log returns of daily stock prices of BIST30 index firms and daily BIST30 index price are shown in Table 6. Runs test results on natural log returns of daily prices of participation index firms and daily participation index price are shown in Table 7, where KATLM stands for participation index.

Table 6: Runs Results I for BIST30 Index and Index Firms

	R	N0	N1	N	Ex. R	Var R	Stdev R	Z	p-value
BIST30	695	616	701	1317	329	326	18	20	1
AKBNK	703	620	697	1317	329	327	18	21	1
ARCLK	666	619	698	1317	329	327	18	19	1
ASELS	675	570	747	1317	324	317	18	20	1
ASYAB	712	348	969	1317	289	321	17	19	1
BIMAS	654	606	711	1317	328	325	18	18	1
DOHOL	660	458	859	1317	300	271	16	22	1
EKGYO	695	579	738	1317	325	319	18	21	1
ENKAI	673	575	742	1317	325	318	18	20	1
EREGL	646	579	738	1317	325	319	18	18	1
GARAN	753	626	691	1317	329	327	18	23	1
HALKB	715	594	723	1317	327	323	18	22	1
IHLAS	595	370	947	1317	267	215	15	22	1
ISCTR	717	605	712	1317	328	325	18	22	1
KCHOL	649	604	713	1317	328	325	18	18	1
KOZAA	667	638	679	1317	330	328	18	19	1
KOZAL	691	614	703	1317	329	326	18	20	1
KRDMD	649	564	753	1317	323	316	18	18	1
MGROS	671	612	705	1317	329	326	18	19	1
PETKM	687	559	758	1317	323	314	18	21	1
PGSUS	679	619	698	1317	329	327	18	19	1
SAHOL	691	612	705	1317	329	326	18	20	1
SISE	640	573	744	1317	325	318	18	18	1
TAVHL	686	597	720	1317	327	323	18	20	1
TCELL	639	576	741	1317	325	319	18	18	1
THYAO	698	600	717	1317	328	324	18	21	1
TOASO	672	621	696	1317	329	327	18	19	1
TTKOM	681	612	705	1317	329	326	18	20	1
TUPRS	671	571	746	1317	324	317	18	19	1
VAKBN	697	605	712	1317	328	325	18	20	1
YKBNK	689	614	703	1317	329	326	18	20	1

Table 7: Runs Results I for Participation Index and Index Firms

	R	N0	N1	N	Ex. R	Var R	Stdev R	Z	p-value
KATLM	640	586	731	1317	326	321	18	18	1
AKCNS	669	597	720	1317	327	323	18	19	1
ALBRK	680	510	807	1317	314	296	17	21	1
ALKIM	604	605	712	1317	328	325	18	15	1
ANELE	641	538	779	1317	319	307	18	18	1
ASELS	683	570	747	1317	324	317	18	20	1
AYGAZ	655	562	755	1317	323	315	18	19	1
BIMAS	660	606	711	1317	328	325	18	18	1
BUCIM	641	569	748	1317	324	317	18	18	1
CEMTS	634	531	786	1317	318	305	17	18	1
EGEEN	699	629	688	1317	330	328	18	20	1
ERBOS	667	635	682	1317	330	328	18	19	1
EREGL	654	578	739	1317	325	319	18	18	1
FLAP	639	582	735	1317	326	320	18	18	1
FROTO	674	581	736	1317	326	320	18	19	1
GENTS	633	474	843	1317	304	279	17	20	1
GOODY	671	597	720	1317	327	323	18	19	1
IHLGM	704	581	736	1317	326	320	18	21	1
KARTN	676	625	692	1317	329	327	18	19	1
KONYA	695	630	687	1317	330	328	18	20	1
LOGO	634	631	686	1317	330	328	18	17	1
OZGYO	669	533	784	1317	318	306	17	20	1
PNSUT	654	614	703	1317	329	326	18	18	1
SELEC	669	547	770	1317	321	310	18	20	1
TATGD	673	595	722	1317	327	323	18	19	1
TMSN	678	630	687	1317	330	328	18	19	1
VESBE	652	619	698	1317	329	327	18	18	1
YATAS	661	566	751	1317	324	316	18	19	1

In Table 6 and Table 7, p-values are found to be very close to 1, which means it is higher than the significance level of 5%. Thus, random walk hypothesis can not be rejected. Consequently, it is not possible to make a certain comment on the existence of market efficiency via random walk hypothesis and Runs test. Similarly, we apply the Runs test analysis on natural log returns of daily BIST30, BIST100 and BISTTUM index prices in a longer period 2000-2018. The results are shown in Table 8. According to results in Table 8, since p-values are higher than the significance level 5%, data seems to follow random walk. Thus, it is again not possible to be sure if the market is efficient or not, by the Runs test analysis method. Consequently, for our analysis and empirical result, Runs test results do not agree with the Dickey-Fuller test results.

Table 8: Runs Results II

BIST-30					
	Expected	Observed	St Dev	Test Stat	p-value
2000-2018	2.372	2.404	34,43	0,92	0,3578
2008-2018	1.374	1.374	26,19	0,00	0,9970
2013-2018	765	745	19,27	1,06	0,2889
BIST-100					
	Expected	Observed	St Dev	Test Stat	p-value
2000-2018	2.410	2.371	34,41	1,13	0,2577
2008-2018	1.390	1.373	26,17	0,65	0,5174
2013-2018	779	744	19,27	1,80	0,0726
BIST-TUM					
	Expected	Observed	St Dev	Test Stat	p-value
2000-2018	2.400	2.371	34,41	0,84	0,3995
2008-2018	1.382	1.373	26,17	0,36	0,7206
2013-2018	779	744	19,26	1,80	0,0715

5. CONCLUSION

In this study, we aim to investigate weak form market efficiency of Istanbul Stock Exchange (ISE) via Random Walk Hypothesis (RWH). Two well-known random walk tests, Dickey-Fuller and Runs test are used to search for random walk in stock market. Natural log returns of BIST-30 index firms, BIST-30 index, participation index firms and participation index are analysed by both Dickey-Fuller unit root test and Runs test over a five year period from 2013 to 2018. Therefore, we develop the study into a longer period from 2000 to 2018 including 2001 and 2008 financial crises in Turkey by examining BIST30 index returns together with BIST100 and BISTTUM indexes. The results shows that weak form market efficiency is justified according to Dickey Fuller test, but not for Runs test. Thus, it is concluded that while Dickey Fuller test results reject random walk in ISE, which leads that weak form market efficiency of ISE is not justified. On the other hand, Runs test are failed to give certain results on market efficiency for the same data set and time period in ISE.

REFERENCES

Aytekin, S. & Erol, A. (2017). A Testing the Weak–Form Market Efficiency on the Borsa Istanbul (BIST) Sustainability Index (XUSRD): Runs Test Application. International Journal of Business and Management Invention, Volume 6, Issue 5, pp. 68-75.

Balaban, E. (1995, February). Informational Efficiency of the Istanbul Securities Exchange and Some Rationale for Public Regulation. The Central Bank of the Republic of Turkey, Discussion Paper No: 9502, 1-27.

Cai, B. M., Cai, C. X. & Keasey, K. (2005). Market efficiency and returns to simple technical trading rules: further evidence from U.S., U.K., Asian and Chinese stock markets. Asia-Pacific Financial Markets, 12(1), 45-60.

Chan, K. & Gup, B. (1992). An empirical analysis of stock prices in major Asian markets and the United States. The Financial Review, 27(2), 289–307.

Ely, R. A. (2011). Returns predictability and stock market efficiency in Brazil. Brazilian Review of Finance, 9(4), 571-584.

Grossman, S. J., Stiglitz, J. E. (1980). On the impossibility of informationally efficient markets. The American Economic Review, 70(3), 393-408.

Hamid, K., Suleman, M. T., Shah, S. & Akash, R. (2010). Testing the weak form of efficient market hypothesis: empirical evidence from Asia-Pacific markets. International Research Journal of Finance and Economics, 58, 121-133..

Jefferis, K., & Graham, S. (2005). The changing efficiency of African stock markets. South African Journal of Economics, 73(1), 54-67.

Karahan, M., & Alsu, E. (2016). Are the eastern European markets efficient? Evidence from nonlinear unit root test. International Journal of Academic Research in Economics and Management Sciences. 5(4): 252-263.

Khrapko, V. (2013). Testing the weak-form efficiency hypothesis in the Ukranian stock markets versus those of the USA, Russia, and Poland. Ekonomika, 92(2), 108-121.

Kumar, S., & Kumar, L. (2015). Market efficiency in India: an empirical study of random walk hypothesis of Indian stock market - NSE midcap. ZENITH International Journal of Multidisciplinary Research, 5(1), 167-177.

Lim, T. C., Huang, W., Yun, J. L., & Zhao, D. (2013). Has stock market efficiency improved? Evidence from China. Journal of Finance & Economics, 1(1), 01-09.

Onali, E. & John, G. (2011). Are European equity markets efficient? New evidence from fractal analysis. International Review of Financial Analysis, 20(2), 59-67.

Pham, V., Nguyen, D. & Tô, T. (2007). Abnormal returns after large stock price changes: evidence from Asia-Pacific markets.

Tas, O., & Dursunoglu, S. (2005). Testing Random Walk Hypothesis for Istanbul Stock Exchange. International Trade and Finance Association 15th International Conference (s. 1-17). Istanbul: International Trade and Finance Association Conference Papers.

Urrutia, J. L. (1995). Tests of random walk and market efficiency for Latin American emerging equity markets. The Journal of Financial Research, 18(3), 299-309.