The weak form market efficiency investigation of American, European and Asian stock markets

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Abstract: This paper investigates the empirical validity of the Weak Form Efficient Market Hypothesis for American, European and Asian stock markets. Random Walk Hypothesis is used to prove weak form efficiency in American, European and Asian stock indices. ADF and PP Unit Root Tests have been used to test unit root in time series of daily data of American, European and Asian stock indices. Results show that sample of stock markets are weak-form efficient in terms of the Random Walk Hypothesis.

Key words: weak form efficiency; Random Walk Hypothesis; unit root tests

1. Introduction

Efficient market hypothesis defends that all of the information, which are offered to the public in the markets, reflected in the price of traded on the stock markets so that investors can not use this information to obtain abnormal gains. Efficient markets concept could be identified as markets that have a large number of people that supply and demand funds and in which investors can not obtain abnormal earnings by affecting market and in which investors' securities-related information can be reached instantly and zero/low cost. In other words, "Efficient Markets" called as markets that investors can not get extraordinary gains by using none of the information they have.

Random Walk Hypothesis is the fundamental of the efficient market hypothesis in an efficient market, random walk is equal to the meaning that represents all kinds of information that are offered to market and evaluated by the investors. Also, it represents as a price of any current stock that share of the real value. According to Random Walk Hypothesis, the price of a stock reflects all of the information offered or received in the market. At the same time, the price of stock that is based on information that everyone can get is that buyer/seller agree on. Movements in market prices of traded stock can be expressed as a random continuity in the market at the conditions of a new information entry in market and at the changes of current prices of stock completely independent of past price movements. It can be said that it is not possible to access any unusual or abnormal earnings by using fundamental and technical analysis approach in a market that adopted to be effective.

Fama (1970) divided markets into three form as weak form efficient market, semi-strong form efficient market and strong form efficient market due to differences in data input. Weak form efficient market claims that past price information can not be used for the using of price estimate; Semi-strong form efficient market claims the past price information, and publicly disclosed information will not be available for the price estimate; Strong form efficient market claims that the past price information, publicly disclosed information and people that know

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price from inside can not estimate the price.

In this study, using "Random Walk Hypothesis", the answer is sought whether the related markets are relevant for "Weak Form Efficient" by taking into account of the global financial crisis and using some of the stock indices of the American, European and Asian markets that are accepted as important for financial markets. In the next section of the study, the literature of market efficiency was determined, and then the price series of the normal distribution function was tested. Moreover, the time series that are relevant to price series have been tested for stationarity. In the last section, the main findings of the study and its results are described.

2. Literature

In the finance literature, "the determination of the level of stock market efficiency" constitutes one of the most researched topics. The most of those empirical studies used the Random Walk Hypothesis to analyse the level of efficiency in the securities markets. In the finance literature, there are too many supporting and non-supporting empirical studies about the weak form efficient of markets that were tested with the Random Walk Hypothesis. Accordingly, empirical studies are examined into two groups.

Bachelier (1900) found in their study that prices of various agricultural products vary randomly (Cootner, 1964, pp.11-21). Cowles and Jones (1937) have put forward that stock prices and similar economic time series share the same characteristics. Kendall (1953) have expressed that the prices of twenty-two stocks in the UK and agricultural products completely random series of price changes on a property, while a near-zero correlation between price changes. Roberts (1959) envisaged that the change in the level of prices compliance Random Walk Hypothesis by using the weekly data of Dow Jones Industrial Index in the year 1956. Fama (1965) has reached such a result that price movements are in similar distribution and independent and the American stock market prices verify the Random Walk Hypothesis. Samuelson (1965) has made observations about random walk in market prices formation and has revealed that unpredictable price changes follow a path. In the study that was covered by eighteen countries Poterba and Summers (1988) have achieved some results that market prices of stock created by the Random Walk Hypothesis in examined countries.

Panas (1990) has found that Efficient Market Hypothesis is available for Athens Stock Exchange. McQueen (1992) have concluded that Random Walk Hypothesis is available for American stock markets. Kocaman (1995) tested the presence of Weak Form Efficient Market, with Random Walk Hypothesis and has reached that price changes are random and independent. In a similar study made by Kılıç (1997) the unit root test was applied to stock price series and it was reached as a result that the market was weak form efficient. Kıyılar (1997) stated that past price information can not be used for future price estimation. Karamera, Ojah and Cole (1999) reveals that in the exchange among Latin American countries such as Argentina, Brazil, Chile and Mexico, Random Walk Hypothesis is valid and hence the markets are also effective in weak form. It has been reached from the study, that had done by Ozun (1999) using daily data of ISE100 Index, except 1995 and 1996, the ISE is weak form efficient.

Bakırtas and Karpuz (2000) had tested the effectiveness of market by studying the factors that could affect the price index and they were found the market to be weak form efficient. De Peña and Gil-Alana (2002) have proved that Spanish Stock Exchange showing property prices random walk. Buguk and Brorsen (2003) tried to measure the effectiveness of ISE by taking into account of the weekly closing prices of 1992-1999 period of the ISE Composite, Industrial and Financial Indices and using the unit root test, fractal integration test and variance ratio test and agreed Weak Form Efficient Market Hypothesis. Zengin and Kurt (2007) revealed ISE as weak form

efficient by using ADF and Perron Unit roots tests.

Kasman and Kırkulak (2007) tested whether the memory capacity of stock price is long-term by using conventional unit root and structural breaks unit root tests and according to the results of both methods, random walk feature of the series were presented. Al-Khazali, Ding and Phun (2007) have expressed the markets for those countries which are eight Middle Eastern countries and North African countries, as weak form efficient. Foster and Kharazi (2008) have expressed that they do not come across the short time intervals and abnormal course of the stock market prices in Tehran Stock Exchange and the expressed the exchange as an active. Ergul (2009) revealed that the ISE100 Composite Index, ISE National 50 Index, ISE National 30 Index, ISE Service Index, ISE Financial Index and the Stock Exchange Industrial Index show a random variation of the price series.

The above-mentioned studies are that generates supportive results for Efficient Market hypothesis. However, numerous studies have been concluded that the market is inefficient, even in the weak form. Branes (1986) has reported that the Kuala Lumpur Stock Exchange is inactive. Poterba and Summers (1988) revealed that long-term stock returns contain a significant predictable component. Lo and Mac Kinlay (1988) found that weekly stock returns of New York Stock Exchange in period 1962-1985 are not valid for Random Walk Hypothesis. Pan, Chiou, Hocking and Rim (1991) tried to measure market activity by using the variance ratio of daily and weekly returns of Hong Kong, Japan, Singapore, South Korea and Taiwan capital markets in period January 1982-June 1987, and found as a result that in all countries except for Japan the Random Walk Hypothesis is not valid. Kose (1993) tested the daily closing price of the stock by filter test and has expressed no weak form efficient market. After having performed correlation tests using the monthly price data of Swedish Stock Exchange. Frenberg and Hansson (1993) expressed that the prices are not random walk property. Muradoglu and Oktay (1993), Balaban, Candemir and Kunter (1996) have established in their studies that ISE is not weak form efficient. Kondak (1997) revealed that ISE market is inefficient until 1991, but the market information become more reliable and transaction volumes increase in 1991, so the market become informational efficient. Los Cornelis (1999) revealed that except Singapore stock exchange there is no market efficiency in Hong Kong, Indonesia, Malaysia, Taiwan and Thailand stock exchange.

Kabir, Islam and Basher (2000) have put forward that the Dhaka-Bangladesh Stock Exchange are not weak form efficient. Kvedaras and Basdevant (2004) said that Baltic countries such as Estonia, Lithuania and Latvia are not weak form efficient markets. Cevik and Yalçın (2003) expressed that Random Walk Hypothesis does not give sufficient information for determination of long-term trends and price levels. Worthington and Higgs (2003) revealed that the stock market indices of the fourteen countries except Germany, Ireland, Portugal, Sweden, England and Hungary belonging to stock market indices are valid for the Random Walk Hypothesis by using different unit root tests. Cajueiro and Tabak's (2004) study that was on effectiveness of capital markets of two advanced and eleven developing totally thirteen countries, it was established that the Asian securities markets of the Latin American securities markets show a higher level of inefficiency feature.

Filis (2006) stated that Athens Stock Exchange is inefficient for the term of analysis. Dorina and Simina (2007) tested the ISE's weak form efficiency with seven Balkan countries and reached such evidence that markets were inefficient. Dhankar and Chakraborty (2007) rejected Random Walk Hypothesis by reviewing the market of South Asian countries such as India, Sri Lanka and Pakistan. Ergül, Akel and Dumanoğlu (2008) revealed that the price series belong to ISE100 indices for the periods 1988-2007 showed efficient market property. However, it was revealed that when examined separately with respect to the period of the year, price series of ISE100 had inefficient market behavior. Ergul, Akel and Dumanoglu (2009a) put forward that Second National Market of the

Stock Exchange is not efficient. Ozcan and Yılanci (2009) have tested the efficieny of the ISE 100 Index and it have been established that the index data contained in the linear unit root, the error term showed the sequential dependencies, and therefore ISE was not efficient even in the weak form. Ergul, Akel and Dumanoglu (2009b) have revealed that the price series Stock Exchange Sector Indices does not show efficient market behavior.

As can be understood that in order to answer the question of whether financial markets are efficient, many researchers have done a large number of empirical studies. Half of the studies support Efficient Market Hypothesis, the other half support markets' inefficiency. The lack of consensus on the market efficiency provides new studies to be done about market efficiency and continuous popularity of issue.

3. Data and methodology

In this study, some key stock index of some important financial markets such as American, European and Asian stock markets were included for analysis by taking into account of the global financial crisis. The efficiency of stock indices of the countries that includes for analysis was being tested by using the stock market indices data from Table 1. The data used in the analysis were obtained from Matrix Information Distribution Services Inc. and ISE Directorate Education and Publications.

Table 1 Used in the analysis of stock indices and analysis period

Index code	Index name	Country	Analysis period
A-American Stock Markets			
DJI	Dow Jones Industrial Average	US	04.01.1988-25.09.2009
CCO	NASDAQ Combined CO	US	04.01.1988-25.09.2009
SPX	Standard & Poors 500 Index	US	04.01.1988-25.09.2009
MERVAL	MERVAL	Argentina	30.12.1999-25.09.2009
BOVESPA	BOVESPA	Brazil	27.04.1993-25.09.2009
B-European Stock Markets			
ASE	Athens Stock Exchange	Greece	26.04.2004-25.09.2009
HEX	Helsinki General Index	Finland	26.04.2004-25.09.2009
FTSE	Financial Times Stock Exchange	UK	18.03.1999-25.09.2009
XETRA	DAX Performance Index	Germany	26.11.1990-25.09.2009
CAC40	Index Paris	Fransa	18.03.1999-25.09.2009
ISE100	ISE100 Compounds Index	Turkey	04.01.1988-25.09.2009
C-Asian Stock Markets			
HANG SENG	Hang Seng Index	Hong Kong	29.10.1990-25.09.2009
NIKKEI	NIKKEI 225	Japan	04.01.1988-25.09.2009
KOSPI	South Korea Index	South Korea	27.07.2006-25.09.2009

The traditional efficiency analysis of the stock market indices that give ideas about development of capital markets of American, European and Asian countries, first the price series of the normal distribution function has been tested, then the existence of unit root in time series which means stationarity of series of stock price index were investigated.

Stationarity is expressed as a concept of a particular value to approach the other with an expression of the series, a constant mean, a constant variance and delay levels due to a covariance in time series. Time series that have stationarity property or absence of a unit root have a constant mean, a constant variance and covariance in each delay period.

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In order to understand that if a time series is stationary or not, the correlogram table of the expression of the autocorrelation function of the series should be checked. If a time series is stationary, the first or second delay of autocorrelation function should be cut to zero. In a series of delay is increased, the value of the autocorrelation function close to zero the series can be said as stationary, otherwise, it is not stationary. In the last phase of stagnation, Unit Root Test must be done.

In order to accept weak form efficiency, it is required to have unit roots in the series at the analysis of the series. Unit root contained series called as time series that has a feature of random walk. This type of time series does not turn to the average level of long-term trend after a temporary shock, they stay random. Random Walk Hypothesis refers that deviations are random in the short term at the analysis of the actual value of the series. Therefore, it can be said that the price of short-term random walk time series shows up or down properties in the long run. In other words, the Random Walk Hypothesis does not include long-term trend and any information about how to determine the level of the price (Cevik & Yalçın, 2003, p. 22). In addition, a regression estimation done by a series of random walks does not give accurate results, the assumptions of the least squares method will invalidate and the estimated coefficients are not consistent features. A random distribution of the time series implies the adoption of weak form efficiency hypothesis.

Presence of unit root in time series indices was investigated, and for this purpose, the weak form efficiency of some of the stock indices belonging to the American, European and Asian markets by using Augmented Dickey-Fuller (ADF) Unit Root Test and Phillips-Perron (PP) Unit Root Test. A brief summary has been tried to given below to give information about unit root tests that are used in the analysis.

3.1 Augmented Dickey Fuller (ADF) Unit Root Test

Dickey and Fuller (1979) developed a formula for make a series not stationarity. The main idea of the developed method based on "testing stationarity of a series is equivalent to testing unit root flour of the series". So, it can be said that the test is based on AR(1) in the form of first-degree autoregressive and the equations can be written as follows (Asteriou & Hall, 2007, pp. 295-296):

$$y_t = \phi y_{t-1} + u_t \tag{1}$$

In equation (1), equality of coefficient ϕ to 1 is investigated by testing the H_0: $\phi = 1$ and H_1: $\phi < 1$ hypothesis. At the end of this process, if the result of regression is $\phi = 1$, a problem occurs in the determined unit root time series, and this relationship can be rewritten in following form:

$$y_t = y_{t-1} + u_t \tag{2}$$

The presence of unit root means that the value of time series that was examined in the previous period and shocks that happened at that period stay within the system. It is possible to continue for all period analysis, so it means that earlier period shocks affect the value of the mean income. The value of the series is the total of past shock experiences. If these shocks show permanent nature, this means that the series is not stationary and the trend over time shows stochastic behavior. If coefficient ϕ is less than 1, the effects of previously resulting shocks continue temporarily, but it can be said that the force of this effect will decline and soon disappear entirely.

So, it is possible to rewrite the regression equation by subtracting y_{t-1} from both sides of the equation (1).

$$y_t - y_{t-1} = \phi y_{t-1} - y_{t-1} + u_t$$
$$\Delta y_{t-1} = (\phi - 1) y_{t-1} + u_t$$

Here, if $(\phi - 1) = \delta$, the equation become:

$$\Delta y_{t-1} = \delta y_{t-1} + u_t \tag{3}$$

From the 3rd regression equation H_0: $\delta = 0$ and H_1: $\delta < 0$ are the hypotheses that will be tested. If H_0

hypothesis is accepted ($\delta = 0$), it should be understood that y_t follows a complete Random Walking Model.

According to Dickey and Fuller (1979), the error term has an average of zero, normal distribution, constant variance and stochastic structure without autocorrelation, in other words, the error term is accepted as a white noise. In the case that the error term is not white noise, Dickey and Fuller (1979) suggested Augmented Dickey-Fuller test known as ADF test by including dependent variable belonging to the delay value to the period that testing unit root presence in order to eliminate long autocorrelation. This test can be written in three different forms (Asteriou & Hall, 2007, p. 297).

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-i} + u_t \tag{4}$$

$$\Delta Y_t = \alpha_0 + \delta Y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-i} + u_t \tag{5}$$

$$\Delta Y_t = \alpha_0 + \alpha_2 t + \delta Y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-i} + u_t \tag{6}$$

The difference between these three regression equations is that if it is involved to deterministic elements of α_0 and $\alpha_2 t$. In other words, α_0 and $\alpha_2 t$ are coefficients that can be used to estimate if there is examining systematic (deterministic) trend in determined time series. For Efficient Market Hypothesis, it is very important whether the trend is stochastic or deterministic. In the existence of a deterministic trend, the Efficient Market Hypothesis will invalid.

It is a very important question that which regression equation is appropriate in order to estimate the ADF test of determined time series. Dolado, Jenskinson and Rivero (1990, p. 255) stated that it is an accurate approach to initiate the prediction of equation (6) that belongs to ADF test to determine the stationarity of time series.

The ADF test investigates whether the coefficient δ statistically equal to zero at above equations. The results, which are obtained from ADF test, can be compared with McKinnon critical values at 1%, 5% and 10% significance level. If the results are higher than the McKinnon critical values, null hypothesis will be rejected, and the series is determined as not stationarity.

The unit root existence of stock price series that belong to American, European and Asian stock markets indices was tested by ADF test firstly, and then the equation (6) was calculated:

$$\Delta Y_t = \alpha_0 + \alpha_2 t + \delta Y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-i} + u_t$$

In the equation, ΔY_t refers to the first difference of time series which is analyzed for stationarity, t refers to the general trend variables, and Y_{t-1} is the lagged difference terms. The Akaike Information Criterion (AIC) or the Schwarz criterion (SC) used when deciding which delays of the dependent variable k in ADF test will be included in the regression equation. In this study, the Schwartz criterion (SC) was used.

3.2 Phillips-Perron (PP) unit root tests

The basic assumption that ADF test is based on is that the variation of the error term statistically is independent and constant. The PP test, which is a complete unit root test rather than alternative for ADF, is non-parametric method to control the high degree of correlation of time series. PP test (1988) allows weak dependence between the error term and heterogeneity contrast to Dickey and Fuller (1979) test and the lagged value of dependent value that expenses autocorrelation added to the regression equation. A simple AR(1) autoregressive process equation of PP test can be written as follows:

$$\Delta Y_{t-1} = \alpha_0 + \delta Y_{t-1} + \varepsilon_t \tag{7}$$

PP test provides a simple approach to test the presence of unit root test in the stationary and trend effected time series and univariate time series. It is decided whether there is unit root δ statistic which is calculated as a result of PP test was compared with the value MacKinnon table series likewise ADF test.

In this study, the stability of stock price indices was analyzed and interpreted PP test as well as the ADF test. EViews 5.1 is used when analyzing the data.

4. Empirical results

When the "Weak Form Efficiency" of some American, European and Asian stock markets' stock indices that are evaluated as analysis context, descriptive statistics which belongs to the time series of indices were calculated firstly. Descriptive statistics are those that help to determine normal distribution of series that are used in analysis. Descriptive statistics of index series are given in Table 2.

Table 2   America, Europe and Asia stock exchange indices: Descriptive statistics

	n	Mean	Median	Max.	Min.	Standard deviation	Skewness	Kurtosis	Jarque-Bera	p
American stock markets										
DJI	5,481	7,336	8,236	14,165	18,791	3,567	-0.101	1.542	495.04	0.00
CC0	5,608	1,561	1,572	5,049	325	934	0.709	3.377	503.28	0.00
SPX	5,482	860	916	1,565	243	404	-0.034	1.529	495.52	0.00
MERVAL	2,420	1,171	1,142	2,351	201	641	0.158	1.642	196.05	0.00
BOVESPA	4,076	20,251	13,453	73,517	24	17,540	1.135	3.267	886.85	0.00
European stock markets										
ASE	1,379	3,432	3,379	5,335	1,469	1,015	0.013	1.892	70.61	0.00
HEX	1,383	8,035	8,046	12,657	4,110	2,094	0.257	1.965	76.94	0.00
FTSE	2,794	5,378	5,474	6,930	3,287	901	-0.259	1.736	217.30	0.00
XETRA	4,759	4,147	4,150	8,106	1,323	1,880	0.212	1.912	270.10	0.00
CAC40	2,810	4,533	4,489	6,922	2,403	1,047	0.150	2.041	118.26	0.00
ISE100	9,064	1,432	9,602	58,522	4	15,823	0.968	2.682	1,453.26	0.00
Asian stock markets										
HANG SENG	4,701	12,286	11,690	31,638	2,932	5,125	0.694	3.743	485.02	0.00
NIKKEI	5,379	17,705	16,926	38,916	7,055	6,596	0.925	3.638	858.54	0.00
KOSPI	787	1,525	1,484	2,065	939	257	0.044	2.237	19.35	0.00

For normal distribution of a time series, it is required that skewness value of 0, no curvature to any direction, and kurtosis value of 3. Also Jarque-Bera statistic probability value p has to be high (Gujarati, 1999, p. 143). It is possible to say after examining Table 3 that the index series does not show normal distribution and according to the Random Walk Hypothesis, the series is weak form efficient.

In descriptive statistics, after determining that index series does not have normal distribution, for the unit root presence in the series some tests were done. In the study, American, European and Asian stock market indices' series were analyzed by using the ADF and PP Unit Root Tests. Analysis results are summarized as belows:

First, the ADF unit roots test was performed to the American, European and Asian stock market indices' series and test results are shown in Table 3.

<p align="center">**Table 3 American, European and Asian stock markets indices: ADF test results**</p>

Indices	ADF test statistics (level)		ADF test statistics (1st difference)	
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
DJIA	-1.3831	-1.5163	-57.3144	-57.3187
	(0.5922)	(0.8243)	(0.0001)*	(0.0000)*
CCO	-1.6170	-1.8232	-74.3045	-74.5674
	(0.4738)	(0.6935)	(0.0001)*	(0.0000)*
SPX	-1.4677	-1.2345	-57.5445	-57.5522
	(0.5501)	(0.9025)	(0.0001)*	(0.0000)*
MERVAL	-0.6821	-1.7994	-49.1767	-49.9169
	(0.8493)	(0.7050)	(0.0001)*	(0.0000)*
BOVESPA	-0.0459	-1.9210	-40.3908	-40.4068
	(0.9532)	(0.6432)	(0.0000)*	(0.0000)*
ASE	-1.0172	-0.9924	-38.7833	-38.8361
	(0.7490)	(0.9433)	(0.0000)*	(0.0000)*
HEX	-1.1110	-0.9294	-37.8243	-37.8680
	(0.7135)	(0.9510)	(0.0000)*	(0.0000)*
FTSE	-1.6808	-1.6698	-25.5493	-25.5462
	(0.4410)	(0.7645)	(0.0000)*	(0.0000)*
XETRA	-1.5303	-1.7571	-69.5467	-69.5429
	(0.5183)	(0.7254)	(0.0001)*	(0.0000)*
CAC40	-1.5243	-1.7266	-55.2435	-55.2405
	(0.5213)	(0.7394)	(0.0001)*	(0.0000)*
ISE100	-0.0832	-2.1672	-86.8499	-86.8566
	(0.9495)	(0.5074)	(0.0001)*	(0.0001)*
HANG SENG	-1.7046	-2.7311	-69.2273	-69.2200
	(0.4289)	(0.2239)	(0.0001)*	(0.0000)*
NIKKEI	-1.1631	-2.2836	-55.3225	-55.3183
	(0.6925)	(0.4423)	(0.0001)*	(0.0000)*
KOSPI	-1.4798	-1.5534	-27.7441	-14.1949
	(0.5436)	(0.8103)	(0.0000)*	(0.0000)*

Note: *indicates significance at 1% level.

From Table 3, it can be seen that the level of "Intercept" and "Intercept & Trend" with the test levels are not static in American, European and Asian stock market index series. Therefore, by taking first-degree difference of the index series unit root test were reapplied and it is concluded that the primary difference in the fixed-free and stable with a trended test levels of the series stabile, and this stability is make sense with 1% level of reliability. According to ADF test results, American, European and Asian stock index series contain unit root, so it is possible to said that series have a random distribution of feature and in the context of analysis stock market of examining 14 countries is "Weak Form Efficient Markets".

To detect the presence of a unit root, the Phillips-Perron test is an alternative method. By using this method, the stability of the prices of American, European and Asian stock index series is investigated and test results are given in Table 4.

Table 4 American, European and Asian stock markets indices: PP test results

Indices	PP test statistics (level)		PP test statistics (1st difference)	
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
DJIA	-1.3924	-1.5573	-79.1318	-79.1401
	(0.5876)	(0.8096)	(0.0001)*	(0.0001)*
CCO	-1.5964	-1.8083	-74.3243	-74.3206
	(0.4844)	(0.7009)	(0.0001)*	(0.0001)*
SPX	-1.4663	-1.2037	-79.8258	-79.8585
	(0.5508)	(0.9088)	(0.0001)*	(0.0001)*
MERVAL	-0.7529	-1.9059	-49.2619	-49.2541
	(0.8313)	(0.6511)	(0.0001)*	(0.0000)*
BOVESPA	0.1616	-1.6794	-65.9658	-65.9887
	(0.9702)	(0.7604)	(0.0001)*	(0.0000)*
ASE	-0.9958	-0.9658	-38.7907	-38.8205
	(0.7567)	(0.9467)	(0.0000)*	(0.0000)*
HEX	-1.0565	-0.8550	-37.8934	-37.9563
	(0.7346)	(0.9590)	(0.0000)*	(0.0000)*
FTSE	-1.7609	-1.7528	-56.4905	-56.4819
	(0.4004)	(0.7273)	(0.0001)*	(0.0000)*
XETRA	-1.4988	-1.6937	-69.5940	-69.5908
	(0.5344)	(0.7542)	(0.0001)*	(0.0000)*
CAC40	-1.4666	-1.6726	-55.2446	-55.2405
	(0.5506)	(0.7633)	(0.0001)*	(0.0000)*
ISE100	-0.0208	-2.1074	-86.7332	-86.7384
	(0.9556)	(0.5410)	(0.0001)*	(0.0001)*
HANG SENG	-1.6972	-2.6969	-69.2335	-69.2262
	(0.4327)	(0.2379)	(0.0001)*	(0.0000)*
NIKKEI	-1.2015	-2.5345	-72.5893	-72.5842
	(0.6761)	(0.3112)	(0.0001)*	(0.0000)*
KOSPI	-1.4932	-1.5668	-27.7442	-27.7276
	(0.5368)	(0.8053)	(0.0000)*	(0.0000)*

Notes: The bandwidth is developed by Newey and West is used in PP Test; * refers to 1% level of significance.

Like ADF test, PP test results show that stock index series are stationary after the first difference was taken. According to these results, H_0 hypothesis is rejected, it should be adopted that American, European and Asian stock market index series do not contain unit root hypothesis. PP test proved the unit roots presence, so that it can be expressed as series shows random distribution. Based on ADF test and PP test results, it is possible to conclude that Random Walk Hypothesis is valid in American, Asian and European stock markets, and those markets are "Weak Form Efficient Markets".

5. Conclusion

In this study, the presence of weak form efficiency of the American, European and Asian markets were tested by using the stock indices that belongs to American, European and Asian markets, such as the DJIA, CCO, SPX, Merval, Bovespa, ASE, HEX, FTSE, Xetra, CAC40, İMKB100, Hang Seng, Nikkei, Kospi indices. In order to determine weak form efficiency, Random Walk Hypothesis has been tested by using daily closing price indices. The analysis of weak form efficiency of American, European and Asian markets stock indices consists of two

steps. The first step of the analysis, descriptive statistics were applied to indices, and it was investigated that if the price range shows normal distribution. In the second step, the ADF, PP and unit root test method were applied in order to determine the stillness of price series indexing.

According to research results, descriptive statistics expressed that price indices of series do not show normal distribution function. Furthermore, the unit root tests of PP and ADF test results support each other in same way that the indices of the series have unit roots and the index series is not stationary. Accordingly, there is a random change in the price range of index, hence, in the Stock Market of America, Europe and Asia, the Random Walk Hypothesis is valid and proofs that they are weak form efficient markets.

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