Business and Economics Research Journal
Volume 6 Number 1 2015
pp. 19-33
ISSN: 1309-2448
www.berjournal.com

Tracking Ability and Pricing Efficiency of Exchange Traded Funds: Evidence from Borsa Istanbul*

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Abstract: *The purpose of this study is to evaluate the performance and pricing efficiency of the exchange-traded funds (ETFs) operating in the Turkish Capital Markets. In this paper, we examine the tracking errors and pricing efficiencies of 16 ETFs during the period 2005-2013. This is the first paper that makes an investigation with covering all ETFs in Turkish Capital Markets. Using daily data, we find out that Turkish ETFs underperform their underlying indices. We use three different methods (arithmetic mean, absolute mean and quadratic tracking error) to measure the tracking errors and find that these errors are significantly different from zero. The pricing efficiencies of ETFs are computed using four different methods: premiums and discounts calculated in Turkish Liras (TL) and percentage and absolute values of these calculations. As a result of our analysis, we find that Turkish ETFs are priced closely to their net asset values and there exists no arbitrage opportunities in this context.*

Keywords: Exchange traded funds, tracking error, pricing efficiency, Borsa Istanbul.

JEL Classification: G12, G23

1. Introduction

Increased mobility in today's financial markets, in parallel with the evolving demands of investors, has naturally boosted the search for new financial products. When we investigate the substantial developments during the past decade, ETFs are regarded as one of the important investment alternatives among such innovative products. This substantial development achieved by the ETFs that allow passive tracking of an index and daily trading is greatly associated with their advantages including relatively lower costs, as well as liquidity, flexibility and transparency compared to traditional mutual funds. It is observed that these funds are established based on the market-wide equity indices, sector indices and fixed-income indices. Moreover, as time passed such funds have diversified to include indices based on goods, currencies, precious metals, which also apply strategies such as replicating a short position in one index and a long position in another.

The motivation of our study is twofold: First, although the global success of ETFs has arisen interest of researchers, the number of studies in emerging markets focused on ETFs is very limited. Our study dealing with Turkish ETFs contributes in filling this gap. Second, to the authors' best knowledge, this is the first paper that makes an investigation with covering all ETFs in Turkish Capital Markets.

*Bu çalışma, 23-26 Ekim 2013 tarihleri arasında Muğla Sıtkı Koçman Üniversitesi tarafından düzenlenen 17. Finans Sempozyumu'nda bildiri olarak sunulmuş ve ikincilik ödülüne layık görülmüştür.

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The remainder of this study is structured as follows: Section 2 introduces the ETFs and explains the development of ETFs. Section 3 reviews the literature. Section 4 describes the data and the research design implemented and presents the empirical results, respectively. The final section concludes the study and makes suggestions for future research.

2. Definition and Function of Exchange Traded Funds

ETF is a type of mutual fund with a benchmark index which aims to reflect the performance of such index to investors. Three main reasons have played a role in the introduction of ETFs: (i) the increased investment activities as a result of the higher interest for capital markets and investment instruments for the past 30 years, (ii) the relation between the markets providing investors with an improved opportunity to access international markets and the need for products allowing market access at the end of this process and (iii) the evolving financial market dynamics due to the need of investors for increased savings, profitability and transparency as a result of increased liquidity and market effectiveness.

ETFs have some advantages to the traditional mutual funds. Firstly, these funds provide investors with high liquidity because they are traded on stock exchanges. They are more flexible than open-end mutual funds as they can be traded throughout the day. This advantage also allows them to be more transparent. Another major advantage of these funds is linked with their low costs. Adopting a passive management strategy, portfolio management fee for these funds is naturally very low. As a disadvantage, active investors have to pay commissions and bid-ask spreads when they buy or sell them.

ETFs started to be traded for the first time in North American stock exchanges; they have become one of the most popular financial instruments demanded by investors across Europe and other continents. Data from World Federation of Exchanges (WFE) shows that ETFs listed in 2003 totaled 331, while exactly 10 years later in 2012 this number increased by 24 times (7,712). Development of EFTs is even more remarkable based on trading volumes. For the past 10 years, the trading volume for this investment instrument has increased by more than 100 times (105,485 USD to 11,574,958 USD).

In Turkey, ETFs were launched as 'index funds' and either a 'full replication' or 'stratified sampling' method is applied while selecting securities for the benchmark index. Similar to the investment funds, ETFs are also classified as Type A and Type B. Type A ETFs invest a monthly weighted-average of at least 25% of its fund portfolio value into the securities of companies incorporated in Turkey, including State Owned Enterprises put under the scope of privatization as per the legislation. Other ETFs are included in Type B. Banks are authorized to issue ETFs as a common practice in mutual funds. Among ETFs traded at Borsa Istanbul (BIST), only the funds listed by Dow Jones DJIM Turkey Exchange Traded Fund and Bizim Menkul Type A Participation Index Exchange Traded Fund pay dividends to their investors. Others choose not to pay dividends in order to reinvest them in the portfolio. The first example of ETFs in the Turkish capital markets is "Dow Jones Istanbul Type A Exchange Traded Fund (DJIST)" which went public in 2005. Nine of those are Type A, whereas the remaining seven ETFs perform as Type B fund. The detailed information about ETFs is displayed in Appendix TableA1.

As implied from the increased portfolio sizes of ETFs following the global financial crisis, investors' changing risk perception and tendency for alternative investment products

have contributed to the development of these funds. Another indicative factor for the above implication is that overall portfolio size of Turkish ETFs reached 372 million liras as of the end of 2012 with a 99% increase compared to 2008. The detailed information about portfolio sizes, volume and number of listed ETFs in 2008-2012 is displayed in Appendix TableA2.

3. Literature Review

Literature on ETFs is classified under three general categories[1]: The first category of studies examines the fund performance to measure the success of funds in achieving their goals. These studies typically measure and compare ETF tracking errors. The second one includes the studies focused on the pricing efficiency of ETFs which examines the difference between the market price and net asset value of fund as well as the pace in eliminating this difference. These studies demonstrate the success of the processes including creation and redemption of shares in order to eliminate the arbitrage resulting from the difference between the price and value. The last category is composed of studies reporting the impact of the emergence of ETFs on the single assets constituting the benchmark index. These studies are focused on whether any change applies to the trading volumes or trading prices of equities/assets constituting the benchmark index, as the relevant ETF is traded. The studies basically explore the price discovery process by examining the market instruments' reaction to new data and their individual role in the processes.

As this study focuses on the pricing efficiency and how successful they are in achieving their goals, the literature review below includes studies examining the performance of ETFs and pricing efficiency, accordingly.

Most of the empirical studies on performance of ETFs focus on US-listed ETFs that track domestic or international equity market indices and conduct comparisons with conventional index mutual funds. Particularly in early 2000s, academic reviews focused on Standard and Poor's Depository Receipts (SPDR). One of the initial studies on these funds was made by Elton et al. (2002). It is found that SPDR performs 28.4 basis points below its benchmark index S&P500 and 18 basis points below low-cost index funds in a similar category. The main reasons are (i) management fees and (ii) income lost due to the policy of holding dividends received on the underlying shares in cash. Poterba and Shoven (2002) focused on SPDR and Vanguard index funds (both tracking the S&P500 index) and concluded that their pre- and after-tax performances are very close to one another despite the theory. Some empirical studies find that transaction costs of ETFs also should be considered when determining the performance and comparing it with the performance of index funds, as index funds are not subject to these types of costs[2]. Some other studies discuss that fund manager's tendency to adopt passive strategies in line with the policy of minimizing the tracking error plays an important role in the underperformance of ETFs[3].

Most of the studies concerning ETFs traded across European countries concluded that performances of ETFs are lower than their underlying indices. Both fund expenses and personal taxes are found to be the important reasons of these low performances[4].

Recently, it is observed that emerging markets attract much more interest due to fast growth trends in the economy. In parallel to this great interest, ETFs have experienced a similar trend of diversification and ETFs that track foreign market indices started trading at U.S. and European stock exchanges. Studies focused on this type of ETFs often report a higher frequency of tracking errors compared to the developed countries. Underlying reasons are identified as the differences between trading hours of stock exchanges, exchange rate fluctuations, low liquidity, high transaction costs and index replication strategies[5].

Except for U.S. and European countries, ETFs experience their initial phases and track the local market indices. There are few recent studies in the literature on these ETFs. Gallagher and Segara (2006) analyze the ETFs traded at Australian Stock Exchange and state that such funds track their individual benchmark indices very closely, resulting in fewer tracking errors compared to index funds. In their study, Lin and Chou (2006) demonstrates that tracking errors of the first ETF of Taiwan market are more frequently experienced during the dividend payment period of the companies within the index. Prasanna (2012) examines the EFTs in India concluded that performances of the funds are above market index. Chu (2011) states that tracking errors for ETFs traded in Hong Kong are higher than the ones in the US and Australia which may be a result of the stratified sampling method of benchmark indices.

Studies related to the pricing efficiency of ETFs typically investigate the circumstances including premiums and discounts. Some other studies examine how quickly the premium/ discount is removed. However, the reasons of arbitrage are referred to in a very limited number of reviews. Some of these studies find that premiums/discounts are low and temporary, especially for ETFs that track domestic stock indices. Ackert and Tian (2000) and Elton, Gruber, Comer and Li (2002) examine pricing efficiency of SPDR and find no economically significant arbitrage opportunity. Elton et al. (2002) also confirm that arbitrage mechanism is actively implemented and price discrepancies disappear within one day. Curcio (2004) examines the pricing efficiency of Cubes, one of the most traded global exchange traded funds, through intra-day data and also suggest that arbitrage works well. This study also confirms that volatility of price deviations in Cubes is greater than SPDR. At this point, it should be highlighted that conclusions about the non-US countries like Taiwan and China ETFs that track local benchmark indices indicate an effective pricing on general terms[6].

A major part of the studies on pricing efficiency focus on international ETFs, since arbitrage mechanism is not effective in these ETFs. Therefore, there is space for further review on pricing efficiency. Such temporary price deviations are explained to some extent through variables such as trading costs, trading volume, rate of institutional investors, fluctuations in the local exchange rate of the country tracked by ETF, and financial and political crises. Therefore, it is concluded that irrational investor behaviors might be the reason for the pricing errors. Additionally, recent reviews within the literature on international ETFs include the impact of the unsynchronized trading hours. However, these studies lack a common ground of findings[7].

When the literature available in Turkey regarding ETFs is examined, it is observed that the studies focus on only individual funds. The first study by Kayalı (2007a) examines the pricing efficiency of Dow Jones Istanbul 20 Type A Exchange Traded Fund (DJIST), the first exchange traded fund listed in Turkey. According to the findings from the study covering data from 2005, it is confirmed that the price of DJIST is discounted which is statistically valid with a significance level of 1%. However, this difference is not found to be economically significant when trading costs are not considered, and DJIST is determined to be effectively priced for the respective year. Another study by Kayalı (2007b) comprising the same data tested investor sentiment this time. The study investigates the relation between the benchmark index movements and the extent of premiums/discounts for DJIST and concluded that there is no statistically significant difference between rising and falling markets in terms of premiums. The author states that average discount value increase in rising markets is statistically significant and these findings conflict with investor sentiment.

Gözbaşı and Erdem (2010) review the performance and pricing efficiency of Dow Jones Turkey Type A Exchange Traded Fund (DJIMT). The study confirm low tracking errors, and effective pricing. Price variances are determined to be temporary and can be explained by trading costs, trading volume, intra-day volatility and institutional investor rate.

In their study providing a review on the pricing efficiency of Non-Financial Sector Istanbul 20 Type A Exchange Traded Fund (NFIST), Kayalı and Özkan (2012) confirm a statistically significant pricing error. The average premium is 2.40 kurus with a rate of 0.1958%. In other words, arbitrage opportunities for NFISTY are limited.

In a study featuring a broad practice regarding our national exchange traded funds, Gözbaşı (2010) reports three primary conclusions: The first conclusion is that index funds operating in Turkish Capital Market have superior return performance over those which are managed actively. Moreover, ETFs among index funds are superior and enables investors to establish more effective portfolios by combining different types of ETFs. The second one suggests that arbitrage opportunities are limited. The third conclusion highlights the factors driving premiums/discounts in ETFs as high trading costs, increased intra-day volatility, low level of daily trading volume, fund type and the increasing markets.

4. Methodology

4.1. Return and Risk

Before conducting the tests for tracking errors and pricing efficiencies, we first analyze the return and risk characteristics of ETFs and simply compare them with the return and risk characteristics of their benchmarks. The formulas below are used to calculate the returns for individual ETFs and their benchmarks:

$$R_{i,t} = \ln\left(1 + \left(\frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}\right)\right) \quad (1)$$

where $R_{i,t}$= ln return on ETF i's price on day t; $P_{i,t}$= price of ETF i on day t; $P_{i,t-1}$= price of ETF i on day t-1.

$$IR_{i,t} = \ln\left(1 + \left(\frac{I_{i,t} - I_{i,t-1}}{I_{i,t-1}}\right)\right) \quad (2)$$

where $IR_{i,t}$ = ln return of the benchmark index of ETF i on day t; $I_{i,t}$ = value of the benchmark index of ETF i on day t; $I_{i,t-1}$= value of the benchmark index of ETF i on day t-1.

And, the risks of the ETFs and indexes are defined using the standard deviation of returns:

$$\sigma_{R,i} = \sqrt{\frac{\sum_{t=1}^{n}\left(R_{i,t} - \overline{R_t}\right)^2}{n-1}} \quad (3)$$

$$\sigma_{IR,i} = \sqrt{\frac{\sum_{t=1}^{n}\left(IR_{i,t} - \overline{IR_t}\right)^2}{n-1}} \quad (4)$$

where $\sigma_{R,i}$ = standard deviation of ETF i; $\overline{R}_t$ = average return of ETF i's price; $\sigma_{IR,i}$ = standard deviation of the benchmark index of ETF i; $\overline{IR}_t$ = average return of benchmark index of ETFi.

4.2. Measurements of Tracking Errors

Tracking error is defined as the deviation between the performance of ETFs and their benchmark indexes. In the previous literature various methods are used to measure tracking errors. There is still no generally accepted method for the calculation of ETFs' tracking errors. The formula which uses just the difference between the returns of the ETFs and their benchmarks is as follows:

$$TE1 = \frac{\sum_{t=1}^{n} e_i}{n} \quad (5)$$

where e_i is the tracking error of ETF i, which is calculated using the formula below:

$e_i = NR_{i,t} - ER_{it}$

where $NR_{i,t}$ = ln return of ETF i's net asset value on day t; $IR_{i,t}$ = ln return of the benchmark index of ETF i on day t; *n* = number of observations. This method may underestimate the error because the differences can cancel each other out.

Roll (1992), Pope and Yadav (1994) and Larsen and Resnick (1998) use an alternative method which includes an arithmetic mean for the absolute values of daily tracking errors calculated:

$$\mathbf{TE2} = \frac{\sum_{t=1}^{n} |\mathbf{e_i}|}{\mathbf{n}} \quad (6)$$

The third method requires the calculation of the tracking error using the formula provided below[8]:

$$\mathrm{TE3} = \sqrt{\frac{1}{n-1}\sum_{t=1}^{n} e_i^2} \quad (7)$$

In this study, tracking error is measured using all of the three methods mentioned above.

4.3. Pricing Efficiency

An ETF has two indicators measuring its value. These are the Net Asset Value (NAV) and market price. The NAV of an ETF is calculated according to the market value of the securities held. However, the market price is determined by the supply and demand of the ETF in the market. Therefore, the market price of ETF may not be identical to the NAV. In order to analyze the pricing efficiency of ETFs, "daily premiums and discounts" resulting from the difference between the market prices and NAV are calculated at the end of the day. This study provides premiums and discounts calculated in Turkish Liras (TL) and percentage:

$$PD1\ (TL)_{i,t} = P_{i,t} - NAV_{i,t} \quad (8)$$

$$\mathbf{PD2}(\%)_{\mathbf{i,t}} = \frac{\mathbf{P_{i,t}} - \mathbf{NAV_{i,t}}}{\mathbf{NAV_{i,t}}}\mathbf{x100} \quad (9)$$

$$\mathbf{PD3(TL)_{i,t}} = \left|\mathbf{P_{i,t}} - \mathbf{NAV_{i,t}}\right| \quad (10)$$

$$\mathbf{PD4}(\%)_{\mathbf{i,t}} = \left|\frac{\mathbf{P_{i,t}} - \mathbf{NAV_{i,t}}}{\mathbf{NAV_{i,t}}}\mathbf{x100}\right| \quad (11)$$

where NAVi,t is the Net Asset Value of ETF i on day t. $PD1(TL)_{i,t}$ and $PD3(TL)_{i,t}$ show the value and absolute value of premium or discount for ETF i on day t. $PD2(TL)_{i,t}$ and $PD4(TL)_{i,t}$ shows the rate of premium or discount and absolute value of this rate, respectively.

5. Data Description

This research analyses the tracking errors and pricing efficiencies of 16 ETFs trading at Borsa Istanbul for which benchmark index data is available with complete daily data. The study covers the period between 14.01.2005 and 30.04.2013. The starting date is determined as January 14, 2005 as this is the day the first ETF started trading at Borsa İstanbul. The number of observations varies as each ETF started trading at Borsa İstanbul on different dates. Daily closing prices and end-of-the-day NAVs of ETFs are collected from FINNET database. This database provides total TL values for NAVs. NAV is calculated by dividing this total value by the number of shares acquired. End-of-the-day values for the benchmark indexes of ETFs are provided by national and international databases and founders of the ETFs. The table below provides data starting dates and the number observations for the ETFs included in the analyses:

Table 1. ETFs in the analysis

FUND NAME	STOCK CODE	DATA STARTING DATE	NUMBER OF OBS.
Dow Jones Istanbul 20 Type A ETF	DJIST	10.01.2005	1.500 for *** TE 2.095 for PD
Bizim Securities Dow Jones DJIM TurkeyType A ETF	DJIMT	02.02.2006	1.825
Istanbul Gold Type B Gold ETF	GLDTR	28.09.2006	1.659
Is Securities Intensive ISE 30 A Type ETF	ISY30	25.05.2007	1.465 for TE 1.494 for PD
FTSE İstanbul Type B FBIST ETF	FBIST	24.10.2007	1.389
İs Securities Type B Long Term Bond Index ETF	ISUVT*	08.08.2008 20.02.2009	1.056 for TE 1.187 for PD
Finansbank BIST 30 Type A ETF	IST30	07.04.2009	1.007 for TE 1.025 for PD
Turkeys High Market Value Banks Type A ETF	BNKTR**	01.09.2009	898 for TE 923 for PD
Garanti Bank EKO 10 Index Type A ETF	GARON	02.05.2012	252
Garanti Bank Type A MSCI Turkey Index ETF	GAREN	09.07.2010	708
Kuveyt Turk Katilim Bank Type B Gold ETF	GOLDP	02.08.2010	691
Finansbank GT 30 Type A ETF	GT30	03.11.2010	615 for TE 629 for PD
Istanbul Silver Type B Silver ETF	GMSTR	02.05.2012	252
US Treasury Bond Dollar Type B ETF	USDTR	02.05.2012	251
Bizim Securities Type A Participation Index ETF	KTLME	16.05.2012	241
Kuveyt Turk Katilim Bank Type B Silver ETF	SLVRP	21.05.2012	239

Note: * Although the public offering date for İş Yatırım Long term Bond Index Type B ETF with the code ISUVT is 24.07.2008, price and NAV data of the fund collected is valid as of 08.08.2008. Moreover, ISUVT Turkey Indicator Bond Index data is available as of 20.02.2009. ** Turkey Large-Cap Banks Type A ETF with the code BNKTR was traded as Small and Medium Scale Companies Istanbul 25 Type A ETF with the code SMIST until 01.09.2009. Although price and NAV data is available as of 24.08.2006 for BNKTR in the database, this study analyses data for the period starting as of the public offering date of BNKTR. *** TE is the tracking error and PD is the premium/discount of ETFs.

6. Empirical Results

Table 2 categorizes ETFs as Type A and Type B and shows in percentages the average daily returns and risks for individual ETFs calculated. Furthermore, returns and risks for the benchmark index of each fund are provided in the table next to the relevant fund. Based on the averages shown in the table, the average daily returns on ETFs are positive with 0.0438%. The average returns on benchmark indexes of ETFs are slightly higher, 0.0487%. This finding concludes that ETFs perform below their benchmark indexes. Only three type A (DJIST, GAREN andISY30) and one type B (SLVRP) funds among the 16 exchange traded funds have higher returns than the base index. GARON represents the fund with the highest average return, yet, in parallel to the general situation, the return is still below its benchmark index.

Table 2. Descriptive statistics of type A and type B ETFs

PANEL A: Type A ETFs					
	Daily Average Return (%)		**Standard Deviation**		**Number of Obs.**
	ETF	Index	ETF	Index	
BNKTR	0,0642	0,0691	1,9501	1,9417	898
DJIMT	0,0160	0,0249	1,5143	1,5143	1.825
DJIST	0,0521	0,0506	1,8543	1,8607	1.500
GAREN	0,0555	0,0537	1,3896	1,4005	708
GARON	0,1756	0,1983	1,3231	1,3360	252
GT30	0,0105	0,0236	1,3230	1,3574	615
IST30	0,1213	0,1264	1,5761	1,5677	1.007
ISY30	0,0536	0,0510	1,8751	2,0366	1.465
KTLME	0,0945	0,1073	0,8338	0,8482	241
Average	**0,0715**	**0,0783**	**1,5154**	**1,5403**	
PANEL B: Type B ETFs					
	Daily Average Return (%)		**Standard Deviation**		**Number of Obs.**
	ETF	Index	ETF	Index	
FBIST	0,0515	0,0542	0,2157	0,2076	1.389
GLDTR	0,0620	0,0643	1,3453	1,3867	1.659
GMSTR	-0,0877	-0,0852	1,6379	1,6464	252
GOLDP	0,0567	0,0574	1,1526	1,1467	691
ISUVT	0,0475	0,0594	0,1992	0,2164	1.056
SLVRP	-0,0795	-0,0827	1,6603	1,6533	239
USDTR	0,0068	0,0070	0,3944	0,4085	251
Average	**0,0082**	**0,0106**	**0,9436**	**0,9522**	
Average of Type A&B	**0,0438**	**0,0487**	**1,2653**	**1,2830**	

Note: This table shows the average daily return and risk for each ETF and its benchmark index.

When type B ETFs are considered separately, GLDTR represents the fund with the highest average return; however, this return level is still below the benchmark index. On the other hand, the lowest average return amongst all is provided by the type B fund GMSTR. Among type A ETFs, the lowest return belongs to DJIMT. Another interesting issue about returns is that none of type A fund returns were negative during the analysis period, whereas

both type B ETFs (GMSTR and SLVRP) with a silver benchmark index have negative average return for the period investigated. On a closer look to the ETF risks in the Table 2, average standard deviation is 1.2653%. As expected, risks of type A ETFs is higher than those of type B ETFs. On overall averages, risk of the benchmark index is slightly higher than the risk of ETF. The highest risk is demonstrated by BNKTR and the lowest risk by ISUVT.

Table 3. Tracking errors of ETFs (percentage)

PANEL A: Type A ETFs			
	TE1	**TE2**	**TE3**
BNKTR	-0,00491	2,11915	0,09166
DJIMT	-0,00897	1,49210	2,06728
DJIST	0,00621	1,90964	2,56418
GAREN	0,00179	1,50760	1,96883
GARON	-0,02265	1,49298	1,91091
GT30	0,15203	1,62388	4,50723
IST30	-0,00509	1,68000	2,20477
ISY30	0,00252	1,96299	2,64764
KTLME	-0,01280	0,89092	1,16454
AVERAGE	**0,01202**	**1,63103**	**2,12523**
PANEL B: Type B ETFs			
	TE1	**TE2**	**TE3**
FBIST	-0,00269	0,18143	0,27957
GLDTR	-0,00235	1,35334	1,95900
GMSTR	-0,00242	1,62792	2,23938
GOLDP	-0,00073	1,10498	0,05981
ISUVT	-0,01799	0,17634	0,24088
SLVRP	0,00311	1,61183	0,14266
USDTR	-0,00023	0,42420	0,58460
AVERAGE	**-0,00333**	**0,92572**	**0,78656**
GENERAL AVERAGE	**0,05303**	**1,32246**	**1,53956**

Note: This table provides the tracking errors and the average error values for individual ETFs included in the scope of the analyses. TE1 is the difference between the returns of the ETFs and their benchmarks, whereas TE2 represents the average of absolute value of the difference between the respective fund and its benchmark index. TE3 is the quadratic tracking error. Tracking errors are calculated based on the standard deviation as an alternative to TE3; however, these values did not presented in the tables as the values are found to be very close to TE3.

According to Table 3 average tracking errors for type B ETFs are lower than type A for the analysis period (valid for all three methods). This can be explained with the fact that no significant daily price fluctuations occurs in the benchmark indexes of type B funds, as expected. When we consider the table in terms of tracking error measurement methods, results obtained with TE1 method are lower than others. This is related to the combined effect of positive and negative values in the method. Tracking errors for TE1 change between 0.02265% and 0.15203%. Measurements based solely on the size where the signs of values are ignored shows how big the tracking errors in ETFs are (1.32246% and 1.53956%). This means that ETFs usually failed to track the performance of their benchmark indexes during the analysis period. Tracking errors for TE2 vary between 0.17634% and 2.11915%, while tracking errors for TE3 differs between 0.05981% and 4.50723%. If we examine Panel A in terms of funds, the most successful fund for TE1 is found to be GAREN while the most unsuccessful one is GT30. The most successful fund for TE2 is KTLME and the most unsuccessful one is BNKTR. When TE3 is examined, BNKTR and GT30 funds are the most successful and unsuccessful funds, respectively. GT30 is traded at Turkish and Greek markets

simultaneously. The global financial crisis has had a significant negative impact on the Greek Economy since 2010. We think that this impact is deemed to play an indicative role in the fund's performance. Besides, it should be noted that the high tracking error of GT30 has increased the average tracking errors of type A ETFs.

When we examine Panel B of Table 3, we see that the order of fund performances varies for each method. The most successful and unsuccessful funds for TE1 were determined as USDTR and ISUVT, respectively. Type B fund GMSTR is found to be the fund with the highest tracking error based on both TE2 and TE3 methods. The funds with the lowest tracking errors based on both TE2 and TE3 methods are ISUVT and GOLDP, respectively.

The results in Table 3 indicate that the tracking errors of ETFs traded in Turkey are found to be high for the analysis period. This finding is in line with the findings of other studies in the literature on ETFs traded at developing markets (Johnson, 2009; Chu, 2011; Shin and Soydemir, 2011)[9]. Moreover, the 2011 data from Bloomberg database confirms that the absolute tracking errors for iShares with global benchmark indexes is 0.81%; for those with European benchmark indexes 0.26%; and 1.22% for those with benchmark indexes of developing countries[10]. This finding can be related to several reasons. The leading cause among such factors is the high price volatility observed in developing markets, which is likely to be also relevant for this study. Other underlying reasons are identified as the differences between trading hours of stock exchanges, exchange rate fluctuations, high transaction costs and index replication strategies.

Table 4. Analysis of premiums and discounts of ETFs

PANEL A: Type A ETFs

	Mean		Minimum		Maximum		Standard Error	
	PD1(TL)	**PD2(%)**	**PD1(TL)**	**PD2(%)**	**PD1(TL)**	**PD2(%)**	**PD1(TL)**	**PD2(%)**
BNKTR	0,00000	0,00000	-0,00001	-0,00008	0,00001	0,00005	0,00000	0,00000
DJIMT	-0,00020	-0,00171	-0,37338	-3,12501	0,00001	0,00010	0,00020	0,00171
DJIST	-0,00006	-0,00077	-0,16045	-1,73913	0,11966	1,02041	0,00010	0,00105
GAREN	-0,00000	-0,00000	-0,00001	-0,00006	0,00001	0,00006	0,00000	0,00000
GARON	-0,00000	-0,00000	-0,00001	-0,00008	0,00001	0,00007	0,00000	0,00000
GT30	-0,00000	-0,00000	-0,00001	-0,00009	0,00001	0,00008	0,00000	0,00000
IST30	-0,00000	-0,00000	-0,00001	-0,00002	0,00001	0,00002	0,00000	0,00000
ISY30	-0,00000	-0,00000	0,00000	-0,00002	0,00000	0,00002	0,00000	0,00000
KTLME	-0,00000	-0,00000	-0,00001	-0,00005	0,00001	0,00006	0,00000	0,00000
Average	**-0,00003**	**-0,00028**	**-0,05932**	**-0,54050**	**0,01330**	**0,11343**	**0,00003**	**0,00031**

PANEL B: Type B ETFs

	Mean		Minimum		Maximum		Standard Error	
	PD1(TL)	**PD2(%)**	**PD1(TL)**	**PD2(%)**	**PD1(TL)**	**PD2(%)**	**PD1(TL)**	**PD2(%)**
FBIST	0,00019	0,00017	-0,00001	0,00000	0,27000	0,23405	0,00019	0,00017
GLDTR	-0,00007	-0,00221	-0,10000	-3,35704	0,00000	0,00002	0,00006	0,00203
GMSTR	0,00000	0,00000	0,00000	-0,00001	0,00000	0,00001	0,00000	0,00000
GOLDP	-0,00000	-0,00000	-0,00001	-0,00001	0,00001	0,00001	0,00000	0,00000
ISUVT	0,00000	0,00000	0,00000	-0,00001	0,00000	0,00001	0,00000	0,00000
SLVRP	-0,00000	-0,00000	0,00000	-0,00003	0,00000	0,00003	0,00000	0,00000
USDTR	-0,00000	-0,00000	-0,00002	-0,00001	0,00001	0,00001	0,00000	0,00000
Average	**0,00002**	**-0,00029**	**-0,01429**	**-0,47959**	**0,03857**	**0,03345**	**0,00004**	**0,00031**

Note: This table provides the incorrect pricing values both in TL and by percentage for each ETF included in the analysis.

There are only a few studies focused on the tracking errors of ETFs in Turkey. A recent study by Gözbaşı and Erdem (2010) measures only the tracking errors of only one ETF called DJIMT. Thus, it is not possible to compare this study with our paper. The second study is also prepared by Gözbaşı as a doctorate thesis (2010). Our findings are found to conflict with the findings of this thesis as both the analysis period and the ETFs included are different[11].

Tablo 5. Analysis of premiums and discounts of ETFs (absolute values)

PANEL A: Type A ETFs								
	Mean		**Minimum**		**Maximum**		**Standard Error**	
	PD3(TL)	**PD4(%)**	**PD3(TL)**	**PD4(%)**	**PD3(TL)**	**PD4(%)**	**PD3(TL)**	**PD4(%)**
BNKTR	0,00000	0,00002	0,00000	0,00000	0,00001	0,00008	0,00000	0,00000
DJIMT	0,00021	0,00172	0,00000	0,00000	0,37338	3,12501	0,00020	0,00171
DJIST	0,00017	0,00175	0,00000	0,00000	0,16045	1,73913	0,00010	0,00105
GAREN	0,00000	0,00001	0,00000	0,00000	0,00001	0,00006	0,00000	0,00000
GARON	0,00000	0,00003	0,00000	0,00000	0,00001	0,00008	0,00000	0,00000
GT30	0,00000	0,00001	0,00000	0,00000	0,00001	0,00009	0,00000	0,00000
IST30	0,00000	0,00000	0,00000	0,00000	0,00001	0,00002	0,00000	0,00000
ISY30	0,00000	0,00000	0,00000	0,00000	0,00000	0,00002	0,00000	0,00000
KTLME	0,00000	0,00002	0,00000	0,00000	0,00001	0,00006	0,00000	0,00000
Average	**0,00004**	**0,00040**	**0,00000**	**0,00000**	**0,05932**	**0,54050**	**0,00003**	**0,00031**
PANEL B: Type B ETFs								
	Mean		**Minimum**		**Maximum**		**Standard Error**	
	PD3(TL)	**PD4(%)**	**PD3(TL)**	**PD4(%)**	**PD3(TL)**	**PD4(%)**	**PD3(TL)**	**PD4(%)**
FBIST	0,00020	0,00017	0,00000	0,00000	0,27000	0,23405	0,00019	0,00017
GLDTR	0,00007	0,00222	0,00000	0,00000	0,10000	3,35704	0,00006	0,00203
GMSTR	0,00000	0,00000	0,00000	0,00000	0,00000	0,00001	0,00000	0,00000
GOLDP	0,00000	0,00000	0,00000	0,00000	0,00001	0,00001	0,00000	0,00000
ISUVT	0,00000	0,00000	0,00000	0,00000	0,00000	0,00001	0,00000	0,00000
SLVRP	0,00000	0,00001	0,00000	0,00000	0,00000	0,00003	0,00000	0,00000
USDTR	0,00000	0,00000	0,00000	0,00000	0,00002	0,00001	0,00000	0,00000
Average	**0,00004**	**0,00034**	**0,00000**	**0,00000**	**0,05286**	**0,51302**	**0,00004**	**0,00031**

Note: This table provides the "absolute values" in TL and by percentage for each ETF included in the analysis.

Table 4 and Table 5 report the findings of pricing efficiency analysis. Empirical findings included in Table 4 provide a perspective on the quantity and percentage of the premium/ discounted pricing for each ETF. As can be noted from the table that the average discount for type A ETFs is 0.003 kurus (0.00003 TL) and average premium for type B is 0.002 kurus (0.00002 TL). When Panel A and Panel B are examined in terms of funds, premium/discount figures are substantially low, which can be interpreted as ETFs are effectively priced and there is no arbitrage opportunity in Turkish Capital Markets.

The results of this analysis of absolute values of premiums and discounts of ETFs are provided in Table 5. As can be seen from the table, average premium is 0.004 kurus (0.00004 TL) for both type A and type B ETFs. Considering Panel A and Panel B, average premiums and discounts are substantially low. This finding is parallel with the results provided in Table 4. In other words, the entire analysis regarding the pricing efficiency suggests that ETFs are effectively priced and there is no arbitrage opportunity.

The results of this study are in line with the findings of the study considering the pricing efficiencies of the ETFs traded at local stock exchanges based on local benchmark indexes (Lin and Chou, 2006). When the studies employing data of ETFs traded in Turkey are examined, it is observed that all these studies serve the purpose of measuring the pricing efficiency of a single ETF. The findings of these studies point a statistically significant arbitrage opportunity. However, the academicians state that this arbitrage opportunity would not be economically significant considering the trading costs (Kayalı, 2007a and 2007b; Kayalı and Özkan, 2012; Gözbaşı, 2010 and Gözbaşı and Erdem, 2010).

7. Conclusion

According to one of the main findings of this study, the returns of ETFs are nearly the same with their benchmark index returns. The main reason for this finding is that ETFs use a passive investment strategy and adopt a full replication method. While these strategies and methods were commonly used during 1990s when ETFs were first started, today portfolio managers all around the world prefer a much more active management strategy. Consequently, ETFs have become diversified and leveraged ETFs began to be traded in order to achieve higher returns. Besides, ETFs replicating a short position in one index and a long position in another became popular (Charupat and Miu, 2013). In our opinion, these types of diversifications would render ETFs more attractive. This will also contribute to the Turkish Capital Market in gaining a deeper and more effective perspective.

Another significant finding of this study is that, tracking errors are higher compared to the tracking errors of ETFs traded in developed countries. On the other hand, this finding is in line with the findings of the studies focused on developing countries. There may be several reasons for these higher tracking errors. Most important among such reasons may be the higher volatilities observed in the markets of such countries. The reasons for these higher tracking errors must be examined in future studies.

The empirical results of this study points out that ETFs are priced efficiently and thus no arbitrage opportunity exists in the market. This finding stresses that the process of creation and redemption process of the ETFs functions effectively.

The contribution of this paper to the literature is to fill an important gap with covering all ETFs in Turkish Capital Markets. In-depth studies including comparisons between ETFs and other kinds of funds must be developed. These types of studies are likely to contribute to the development of ETFs as well as to investor consciousness. Another study area is to analyze the effect of the introduction of ETFs on underlying securities. These studies will enable the discovery of price establishment process by examining the market instrument's respond rate to new information as well as their individual roles in the establishment of pricing process.

Notes

1. *For this classification, see Charupat and Miu (2013)*
2. *For relevant studies see Dellva (2001), Guedj ve Huang (2009), Agapova (2010), Kotsovetsky (2003), Bernstein (2004).*
3. *Gastineau (2004), Blume and Edelen (2002)*

4. *As an example to such studies; Milonas and Rompotis (2006), Blitz,Huij and Swinkels (2010) and Elia (2002)*
5. *For relevant studies see Johnson (2009), Shin and Soydemir (2010) and Blitz and Huij (2012).*
6. *As an example to such studies; Lin and Chou (2006) and Lin, Chan and Hsu (2006) reviewing the pricing efficiency of Taiwan Top 50 Tracker Fund.*
7. *For relevant studies see Jares and Lavin (2004), Ackert and Tian (2008), Madura and Richie (2004), Tse and Martinez (2007) and Levy and Lieberman (2012).*
8. *This method is referred to as "quadratic tracking error" in the literature. Standard deviation is a more popular method for determining the tracking error. However, the quadratic tracking error is preferred as the same method is featured in Gözbaşı (2010), which is the only study that uses data from Turkey and can be compared with this study.*
9. *As one of the recent studies, Chu (2011) reviews the tracking errors of ETFs traded in Hong Kong. The author cites in the study that the tracking errors are substantially high in Hong Kong (absolute daily tracking errors between 0.2786% and 2.1736%). Chu refers that these errors represent a monthly rate of 0.039% – 0.110% in the US market and a monthly rate of 0.074% – 0.224% in Australian market.*
10. *Iversen and Soerensen (2012), pg.39.*
11. *Gözbaşı (2010), for type A ETFs, TE1 is 0.0022%; TE2 is 0.0317%; and TE3 is 0.1196%. For type B ETF (only GLDTR), TE1 is – 0.0057%; TE2 is 0.1230%; and TE3 is 0.3170%.*

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