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Comparison of ethical and conventional portfolios with second-order stochastic dominance efficiency test

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Abstract

Purpose – This paper aims to compare two groups of stocks to analyze the efficiency of an ethical portfolio in comparison with a conventional portfolio.

Design/methodology/approach – Efficiency test by second-order stochastic dominance (SSD) approach is applied on two groups, which consist of 12 stocks. Ethical portfolio is chosen from the stocks complying with the participation banking rules. Conventional portfolio is selected from Borsa Istanbul (BIST) with choosing the corresponding stocks for each ethical stock according to the sector and market capitalization. All the stocks of both groups are pairwise SSD compared.

Findings – Both groups of 12 stocks are inefficient portfolios; however, a group of 7 stocks constitute an efficient ethical portfolio with the total weight of 50.82 per cent among the set of 12 ethical stocks. On the other hand, a group of 6 stocks constitute an efficient conventional portfolio, with the total weight of 45.16 per cent among the set of 12 conventional stocks. By pairwise SSD comparison of corresponding stocks from both groups, despite none of the conventional stocks dominate ethical stocks, four ethical stocks dominated the conventional ones.

Originality/value – Back-testing and comparison with benchmark BIST 100 Index have been done for the selected portfolios. According to back-testing results, groups of SSD efficient stocks outperformed the groups, from which they were selected. Furthermore, both SSD efficient portfolios have higher returns than benchmark index, BIST 100.

Keywords Ethical investment, Back-testing, Portfolio efficiency, Second-order stochastic dominance

Paper type Research paper

1. Introduction

Portfolio efficiency is one of the most important aspects in finance. Main purpose of each investment is to select the efficient portfolio. It is also possible to select portfolios intuitionally, but since Markowitz (1952) invented the mean-variance (MV) theory, portfolio optimization has a more logical approach. It takes mean as an expected return and variance as a measure of risk. The basic objective of Markowitz' theory is the maximization of investor's utility.

JEL classification – G11, G14

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Although MV theory is accepted and widely used, it has many shortcomings according to Kraus and Litzenberger (1976), Athayde and Flores (1997), Dittmar (2002) and Post *et al.* (2008). It does not take skewness and kurtosis, third and fourth moments, into account. MV theory also assumes normal distribution, which is not the usual case for stock returns.

Hanoch and Levy (1969) invented the stochastic dominance method, which is common in several research areas, such as finance. There are mainly two types of stochastic dominance: first-order stochastic dominance (FSD) and SSD. In practice, SSD is widely used because of its occurrence in pairwise comparisons; however, FSD does not occur in pairwise comparisons and stays more theoretical. Advantages of SSD are various: first one is that SSD does not require another portfolio to compare the efficiency of a chosen portfolio. According to the MV theory, Jensen's (1969) alpha, Treynor (1965) measure and Sharpe (1966) ratio are invented to compare at least two portfolios because of expected return and risk or beta. Another advantage of SSD is that it gives also importance to the third and fourth moments, skewness and kurtosis, respectively. Finally, it does not assume normal distribution for stock returns. On the other hand, SSD is only available for risk-averse investors, which means that it is valid for all concave utility functions. Although this can be considered as a disadvantage of SSD, risk aversion is taken as an assumption for most of the researches in finance. Therefore, it does not have a serious impact on the appliance of SSD.

According to the modern finance theory, investment can be categorized in two main groups: ethical and conventional. One of the important issues, which this paper aims to comprise, is the Participation Index which is categorized under ethical investment. Participation Index is a sub-index of Borsa Istanbul (BIST) which only contains stocks chosen according to the ethical investment rules. This index does not include companies which mainly deal with the fields of interest-based financing, trade, services, intermediation, alcoholic drinks, gambling, games of chance, pork and similar food, press, publication[1], advertisement, tourism, entertainment, tobacco products, weapons and future contracts. It is checked from the principal agreement of the companies; however, it is also possible that the companies contain these fields as an activity area in the principal agreement could be included in the Participation Index due to its current inactivity in these fields. Furthermore, companies should have some financial ratios to appear in the index. First, total interest-bearing debt to market capitalization should be lower than 30 per cent. Second, interest-bearing cash and market securities to market capitalization should be lower than 30 per cent. Third, the rate of income from above mentioned fields to total income should be lower than 5 per cent (Table I).

As a global benchmark, Dow Jones Islamic Market Index (DJIMI) follows Sharia rules that have two screening processes on stocks. The first screening excludes companies whose primary business is interest-based financing (conventional financing), alcohol,

Table I. Second screening process comparison for DJIMI and participation index

#	Financial ratios	Benchmark: Dow Jones Islamic market index (%)	Benchmark: Participation index (%)
1	Total debt to market capitalization	<33	<30
2	Cash + interest bearing securities to market capitalization	<33	<30
3	Account receivable to market capitalization	<33	N/A
4	Income from activities specified in first screening to total income	<5	<5

gambling, pork (haram food), entertainment (haram content), tobacco products, and weapons. In addition, investment in derivative securities such as future contracts is not considered as ethical investment by Naughton and Naughton (2000), which is another DJIMI criterion. So far, the first screening process corresponds to the Participation Index in Turkey. The companies that successfully pass the first screening of DJIMI are further analyzed in the second screening. The second screening contains financial ratios and rejects firms that exceed:

(1) total debt divided by trailing 24-month average of market capitalization by 33 per cent;

(2) the sum of company's cash and interest-bearing securities divided by 24-month average market capitalization by 33 per cent;

(3) accounts receivable divided by trailing 24-month average market capitalization by 33 per cent; and

(4) the ratio of income activities that mentioned in the first screening to total income by 5 per cent.

As it is stated in Table I, the list of criteria for the second screening shows similarities with the Participation Index. However, in the Participation Index financial ratios (1) and (2) should not exceed 30 per cent. The criterion (3) does not exist and instead of it, number (4) is the same as DJIMI criterion.

In this paper; 12 ethical stocks, which have suited to the participation banking rules for all 12 revising quarters, are compared with 12 conventional stocks, which are the corresponding stocks for each ethical stock according to the sector and market capitalization. With this comparison, SSD pairwise efficiency test is applied. All the ethical stocks are SSD pairwise compared, and portfolio's weight of efficiency is calculated. Moreover, the same process is applied on the conventional stocks. It gives the opportunity of having the efficiencies of both groups and knowing the efficient stocks in both groups. Additionally, 12 corresponding stock pairs are pairwise compared. After that, a back-testing has been implemented for 13 months.

The rest of the paper is as follows: Section 2 gives the literature review. In Section 3, methodology, data and preliminary tests are defined. Section 4 exhibits the results, and Section 5 concludes and makes suggestions for further research.

2. Literature review

Stochastic dominance (SD) approach is a portfolio performance evaluation tool which requires fewer restrictions than the MV approach. Traditional MV approach uses the following assumptions: normally distributed stock returns and investor's quadratic utility functions (Markowitz, 1952; Treynor, 1965; Jensen, 1969). But, stock returns may exhibit skewness and kurtosis, and utility functions need not to be quadratic. Thus, in these cases, MV would be not appropriate. Rather, FSD approach assumes that all investors are rational and SSD also incorporates risk aversion, which means investors have concave utility function. Thus, SSD enables researchers to make portfolio evaluation to a wider extent than MV approach.

There have been several studies which deal with the efficiency of the stock market in Islamic countries. Some of them focus on the relationship between ethical investment and market efficiency, whereas a substantial part of them underline the importance of

the difference between conventional versus Islamic share indices. Obaidullah (2001) depicts in his study the overall picture of Islamic stock markets where he emphasizes that Islamic ethics and values should predominate concerns about efficiency. However, he found that no trade-off existed between Islamic values and market efficiency. Moreover, he added that the relationship between notions of Islamic ethics and market efficiency is mostly direct and straightforward.

In a similar approach, Jawadi *et al.* (2014) present the financial performance of Islamic and conventional indexes for Europe, the USA and the world. Their study aimed to capture the effects of the recent global financial crisis by covering the period 2000-2011. Interestingly, their findings reveal that Islamic funds outperformed conventional ones in turbulent times and that the impact of the 2008-2009 global financial crisis on Islamic markets was less significant than for conventional markets. In their country-specific research paper, Abdullah *et al.* (2007) analyze the differences in terms of performance between Islamic and conventional mutual fund in the context of Malaysian capital market. Their findings suggest that Islamic funds performed more efficiently than the conventional funds during bearish economic trends, whereas conventional ones showed better performance than Islamic funds during bullish economic conditions.

There are many studies which compare conventional and Islamic assets. As an example, Hassan *et al.* (2009) compare conventional and Islamic banks. This paper takes the evidence from the Middle East and uses the cross-country level data of the 40 banks in 11 Organization of Islamic Conference countries from 1990 to 2005. The main purpose of their paper is to analyze the differences in mean cost, revenue and profit efficiency scores of both groups. Another goal is to investigate the effect of size and age on cost revenue and profit efficiency of the mentioned 40 banks. The authors could not find out a significant difference between the overall efficiency of both groups. Findings are valid for conventional banks and Islamic banks. Banks use their resources more efficiently compared to their revenue and profit generation effectiveness. There is a possibility to improve the cost minimization and profit maximization for both systems. Another finding is that size and age do not have a significant effect on the efficiency scores.

There are even some studies which deal with the Islamic banks and the conventional, interest-based ones together. One of them investigates the causality between both groups in case of Turkey. Ergec and Kaytanci (2014) seek to test whether deposit rates of the interest-based banks affect the Islamic banks' rate of returns. Another purpose is to analyze whether they need to form some tools to manage the interest risk if they face. The paper applies the Granger causality test to the data of time deposit interest rates and Islamic bank rate of returns between 2002 and 2010 in Turkey. Same test is performed after the bisection of data, namely, 2002-2006 and 2006-2010. In conclusion, time deposit rates do Granger cause of the Islamic bank rate of returns. Furthermore, it is more obvious for the period after 2006. Therefore, Islamic banks should be cautious about interest rate risk.

Qiao *et al.* (2014) use FSD and SSD in their research, which is conducted by comparing risk averse and risk seekers investors in Taiwan stock and futures market. They found that SD relationship show differences on these markets according to the riskiness of the investor. Hence, for risk-averse investors, spot market dominates futures market. On the other hand, spot market is dominated by futures markets in case of risk seeker investors. The SD relationship is detected in second-order, but not in first-order.

Clark and Kassimatis (2014) apply SD test for the UK stock market between 1992 and 2013 to check the possibility of generating abnormal returns for a portfolio which is constituted by stocks. Their results suggested that an arbitrage portfolio can generate abnormal returns by taking a short position for dominated stocks and long position for the dominating ones in terms of SSD.

Fong (2009) asserts that SSD relationship can be obtained in China's stock market for A-shares and B-shares. Findings suggest that A-shares are preferred to B-shares by a rational investor according to the domination of A-shares to B-shares in terms of SSD. However, domination relationship is not determined by risk characteristics but by market inefficiency during the segmentation period in China's stock market.

Basdas (2011) uses SD approach and revisits the day-of-the-week effect for Istanbul Stock Exchange[2]. The most important finding of this study is that the SD results approve low Monday, Tuesday and high Friday returns, whereas one single day can neither separately dominate nor is dominated by other days of the week. Although the approach Basdas (2011) interprets the results is something of controversial, Basdas (2011) states that day-of-the-week effect is limited in the BIST in contrast to previous studies.

Al-Khazali *et al.* (2014) compare nine Dow Jones Islamic indices with their conventional peers by using SD approach. SD approach was applied to three separate periods: pre-crises, during crises and past-crises. According to the findings, all conventional indices stochastically dominate at second- and third-order, except the European market. However, three of the Islamic stock indexes dominate their conventional peers during the recession period (2007-2012). Consequently, authors suggest that Islamic indices outperform the conventional correspondents during the global financial crisis and state that Islamic investment performs better than conventional investment during recession times. Although this one is the only study that compares ethical and conventional assets with SSD, our paper is the first one which compares stocks of both groups in the Turkish market.

In Turkish market, Güran *et al.* (2013) apply efficiency test on BIST-30 index. They take 30 stocks from BIST-30 index to create a portfolio. Then SSD approach is applied to this portfolio to check whether it is efficient or not. Their findings suggest that 18 stocks are dominated at least by one stock which causes inefficiency of this portfolio. However, 12 stocks which are not dominated by others and have 35 per cent weight on this portfolio can be used to create an efficient portfolio.

Güran and Tas (2015) combine SSD, used by Güran *et al.* (2013), with mean-variance theory. First, their work eliminates the inefficient stocks by SSD, then applies MV optimization to the SSD efficient subset. After the application of this method in Turkish BIST-30 index sample, the Sharpe ratio maximizing portfolio was selected and compared with the BIST-30 index. However, there is not an important difference in terms of return or standard deviation between the SSD efficient and Sharpe ratio maximizing portfolio.

In a recent study, Tas *et al.* (2015) investigate the impact of using different weighting methods on the classification of SSD efficient portfolios. Three different weighting methods; equal, simple and logarithmic; were applied on the DJIA and BIST-30 indexes. Results reveal that there are differences in SSD efficient sets according to various weighting methods. The SSD efficient sets of Turkish market hardly outperformed the

market index, BIST-30. On the contrary, the SSD efficient sets out of DJIA easily outperform the market index.

Roman *et al.* (2013) compare the effectiveness of SSD efficient portfolios with the non-efficient ones in the context of enhanced indexation. Portfolio rebalancing and back-testing methods were implied to three main indices; FTSE 100, S&P 500 and Nikkei 225. There are mainly three conclusions. First of all, SSD efficient indices outperformed the indices and the traditional index trackers. Higher returns are obtained for SSD efficient portfolios in most of the back-testing period. All three indices are at loss over the back-testing period; however, portfolios obtained with the SSD models achieve profits in the bottom line. Second, because of small numbers of selected stocks, SSD-based models do not have cardinality constraints and the computational difficulty of index tracking models. Last, SSD-based models are robust to small changes in scenario set, and almost no balancing is necessary. This paper improves two previous studies in terms of out of sample performance of SSD models.

First, Roman *et al.* (2006) imply a model which aims to construct a portfolio that is not dominated by SSD and whose return distribution has "specified desirable properties". It is a multi-objective decision-making problem transformed into a single-objective one and two different models for having SSD efficient portfolios are constructed. Then, an empirical analysis for Hang Seng Index is conducted by the authors. First model has better statistics than the reference and better out-of-sample performance. An extended second model is especially used to model the left tail of the return distribution. The generated portfolios by second model even outperform the first model in terms of in-sample statistics and out-of- sample results.

Second, Roman *et al.* (2013) also improve the work done by Fábián *et al.* (2011), which is an enhanced version of Roman *et al.* (2006). Fábián *et al.* (2011) propose a portfolio choice model based on the SSD as the choice criterion. The model of Fábián *et al.* (2011) is a risk minimization model, and its objective function is a convex risk measure. It also formulates a natural generalization of the SSD-constrained model of Dentcheva and Ruszczynski (2006). Additionally, our paper will follow the out-of-sample back-testing framework of Roman *et al.* (2013) for the back-testing of SSD efficient groups and the benchmark indices.

3. Methodology

To determine the stocks that we are aiming to study, we examined 12 revising quarters of Participation Index in Turkish Stock Exchange. The stocks chosen in this study have complied with the participation banking rules for all 12 revising quarters, which is the only stock selection criterion taken forward. A stock that failed to comply with the rules even for a quarter of the period and have missed to remain in the Index would not be included in the sample. In Istanbul Stock Exchange, 63 stocks have managed to appear in the Participation Index at least for a quarter. However, only 12 of these stocks have maintained to remain in this Index continuously for 12 revising quarters. Thus, the portfolio that will be tested includes these 12 stocks with their weights.

After this process; 12 stocks are chosen from BIST, which are one by one corresponding to the group of 12 complying stocks with the participation banking rules. Selection of the corresponding firms is based on two criteria. First one is the sector of the firm and the second one is the market cap. It is aimed to select the firms in the same field with the closest market caps. First priority is to choose the corresponding firm in the

same sector and market caps of the corresponding firms sometimes varied because of the miss of a close-market cap company.

Market caps of the stocks at the end of the examination period are used to obtain the weights of stocks in both portfolios. It means that a capitalization-weighted index is obtained for both portfolios.

3.1 Theoretical background of stochastic dominance

SD concept is explained under the subtitle of comparison of payoff distribution by Mas Colell *et al.* (1995). To follow their definitions and propositions for this concept, FSD and SSD can be identified as the following.

For two different stocks X and Y, there exists FSD relationship if:

$$X \geq_{FSD} Y \Leftrightarrow F_1(x) \leq G_1(x), \ \forall x \in \mathbb{R} \quad \text{with at least one strict inequality}, \tag{1}$$

where $F_1(.)$ and $G_1(.)$ are the cumulative distribution functions (CDFs) of two stocks. Thus, if this is the case, a non-satiable investor would never invest in stock Y.

For the same stock pairs X and Y, SSD relationship exists if:

$$X \geq_{SSD} Y \Leftrightarrow \int_{-\infty}^{x} F_1(t)dt \leq \int_{-\infty}^{x} G_1(t)dt, \ \forall x \in \mathbb{R} \quad \text{with at least one strict inequality}. \tag{2}$$

Thus, there exists a relationship that is defined in equation (2), a non-satiable and risk-averse investor does not prefer to invest in stock Y, rather stock X would be chosen for investment.

3.2 Data and preliminary tests

Closing values of all the stocks are obtained from Thomson Reuters from 06.01.2011 to 02.12.2013. Daily returns of the stocks are used for 731 working days.

To understand the domination relation among series, we need to compare all series with each other. This is why, C_2^n number of pairwise combinations needs to be constituted; n is representing number of stocks to be compared. After that, SSD method is applied to understand the domination relationship among pairs.

There are C_2^{12} SSD pairwise comparisons for both groups. Additionally, 12 more SSD pairwise comparisons are done between corresponding stocks of both groups.

After obtaining the returns for each stock, cumulative distribution functions are constituted. The probability of each observation is equally weighted, which means that the probability of each observation is equal to 1/731. In Excel, returns of both compared stocks are sorted from the lowest to the highest return with respect to corresponding probabilities.

For SSD case, the return difference (r_i) of series is evaluated in the cumulative distribution functions. Suppose that the first series has the cumulative distribution function as $f(r_i)$ and the second series has the cumulative distribution function as $g(r_i)$. Both are discrete functions. Following calculation is needed to check SSD:

$$\sum_{i}^{N} [f(r_i) - g(r_i)] \leq 0 \text{ for all } i = 1, 2, \ldots, N \text{ with at least one inequality.} \quad (3)$$

As there are always negative terms in this equation, this means that first series is second orderly stochastic dominates second series. In contrast, if only non-negative terms are obtained from the above equation, this means that first series is second orderly dominated by second series for $i = 1, 2, \ldots, N$. If we obtain both positive and negative terms together, this means that there is no second-order SD association between the first and the second series.

In Appendix, descriptive statistics information for daily return series can be arranged. There is a remarkable point needs to be underlined that all return series have skewness and excess kurtosis.

We check Jarque-Bera test statistics to decide whether return series are normally distributed. Here are the null and alternative hypothesis that are tested for the normality check:

H0. Return series is normally distributed.

H1. Return series is not normally distributed.

According to the results, null hypothesis can be rejected at 1 per cent significance level, which means that all return series are not normally distributed. This is one of the factors that use non-parametric methods, such as SD approach.

4. Results

This paper compares two groups of stocks to analyze the efficiency of having an ethical portfolio in comparison with a conventional portfolio. Therefore, efficiency test by second-order stochastic dominance approach is applied on both groups, which consist of 12 stocks.

Tables of descriptive statistics and SSD pairwise comparisons of both groups, ethical and conventional ones, can be found in Appendix. "1" stands for that the stock in the row second-order stochastically dominates the stock in the column. Similarly, "2" means that stock in the column second-order stochastically dominates the stock in the row, and "3" represents that there is no second-order stochastic dominance relationship between the stocks; 0 is used for meaningless cells.

All the stocks are classified to four groups. Stocks which are not dominated constitute a group of efficient portfolio. We follow the classification of Güran *et al.* (2013) for the SD relationship, which is stated as the following:

- *A*: The stocks which dominate at least one stock and are not dominated by any stock.
- *B*: The stocks which do not dominate any stock are dominated by at least one stock.
- *C*: The stocks which dominate at least one stock and dominated by at least one stock.
- *D*: The stock which are neither dominate nor dominated.

It means that stocks in groups A and D are efficient, and stocks in groups B and C are inefficient.

Figure 1 illustrates SSD relationship among the ethical stocks. Table II is about the classification of ethical portfolio and shows the efficient stocks with respect to their weights.

Ethical stocks, which have been complied with the participation banking rules, are SSD pairwise compared. Stocks, which are not dominated, are the efficient ones, namely, AKCNS, ALBRK, BIMAS, FROTO, MRDIN, PNSUT and TTRAK. These stocks constitute the efficient group of 12 stocks. The chosen seven efficient stocks comprise a 50.82 per cent efficient portfolio based on capitalization-weighted index.

Figure 2 illustrates the SSD relationship among the conventional stocks. Table III is about the classification of conventional portfolio and shows the efficient stocks with respect to their weights.

Conventional stocks, which are corresponding with the participation index' stocks are SSD pairwise compared. Stocks, which are not dominated, are the efficient ones,

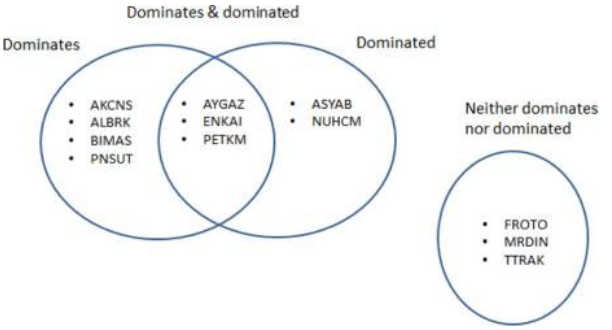

Figure 1.
Groups of ethical stocks according to SSD matrix

Stocks	Market caps (million TL)	Weights (%)	Groups	Efficiency (%)
AKCNS	2,202	3.55	A	3.55
ALBRK	1,584	2.55	A	2.55
ASYAB	1,791	2.89	B	–
AYGAZ	2,592	4.18	C	–
BIMAS	13,844	22.31	A	22.31
ENKAI	21,440	34.55	C	–
FROTO	9,124	14.70	D	14.70
MRDIN	501	0.81	D	0.81
NUHCM	1,630	2.63	B	–
PETKM	3,060	4.93	C	–
PNSUT	773	1.25	A	1.25
TTRAK	3,509	5.66	D	5.66
Total	*62,049*	*100.00*	–	*50.82*

Table II.
Classification of ethical stocks

which are CIMSA, OTKAR, SKBNK, TAVHL, TSKB and TATGD. These stocks constitute the efficient group of 12 stocks. The chosen six efficient stocks comprise a 45.16 per cent efficient portfolio based on the capitalization-weighted index.

Compared within a Turkish market context, Güran *et al.* (2013) also applied an efficiency test on BIST-30 index. By taking 30 stocks from BIST-30 index, they created a portfolio to which an SSD approach is applied for the sake of efficiency. As a result, 12 stocks which are not dominated by others have a weight of 35 per cent in BIST-30 index.

In an international context, the study of Ho *et al.* (2014) had mixed and not definitive results which have implications for individuals, institution and international investors. One of the most important results of this study is that the conventional investors could also diversify their investments into the less risky Islamic ones, especially during bear periods. Similar to that study, Jawadi *et al.* (2014) studied the financial performance of Islamic and conventional indexes for Europe, the USA and the world. Their results suggested that Islamic investments appear to outperform conventional finance, particularly during turbulent times, whereas standard funds seem to be preferred in calm periods. Similar to previous studies, they also found heterogonous results,

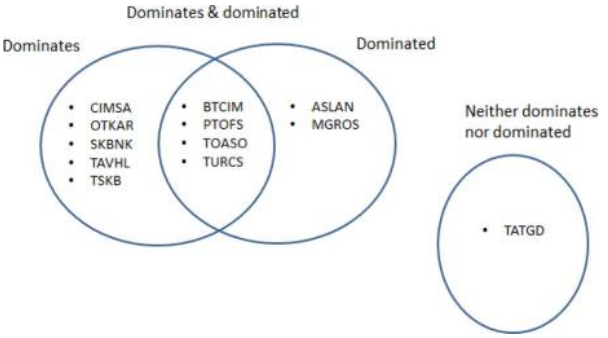

Figure 2.
Groups of conventional stocks according to SSD matrix

Stocks	Market caps (million TL)	Adjusted weights (%)	Groups	Efficiency (%)
ASLAN	2,570	8.53	B	–
BTCIM	506	1.68	C	–
CIMSA	1,743	5.78	A	5.78
MGROS	3,213	10.66	B	–
OTKAR	1560	5.18	A	5.18
PTOFS	2,899	9.62	C	–
SKBNK	1,920	6.37	A	6.37
TATGD	347	1.15	D	1.15
TAVHL	5,467	18.14	A	18.14
TOASO	6,625	21.98	C	–
TSKB	2,574	8.54	A	8.54
TURCS	718	2.38	C	–
Total weight	*30,142*	*100.00*	–	*45.16*

Table III.
Classification of conventional stocks

indicating the importance of the state of development of Islamic funds in the regions, the degree of screening of Islamic funds and the Islamic Index selected.

Last but not least, Abdullah *et al.* (2007) – in their risk-based approach – revealed that Islamic funds are less risky than conventional funds. They found that both Islamic and conventional funds have diversification levels which are less than 50 per cent of the diversification level of the market portfolio. Like the study of Jawadi *et al.* (2014), their work also stressed that Islamic funds perform better than conventional funds during bearish economic trend, i.e. during the crisis period.

In one by one SSD pairwise comparisons of participation index' stocks and corresponding conventional stocks; four of the participation index' stocks second-order stochastically dominate the conventional stocks. AYGAZ dominates TURCS, BIMAS dominates MGROS, PETKM dominates PTOFS and PNSUT dominates TATGD. Table IV shows the results of pairwise comparison of corresponding stocks; 1 stands for the participation index stock second-order stochastically dominates the conventional stock; 2 stands for the conventional stock second-order stochastically dominates the participation index stock; and 3 means that there is no second-order stochastic dominance relationship between the stocks (Table IV).

Last but not least, a back-testing has done for the selected portfolios from 03.01.2013 to 31.12.2014. Ethical and conventional portfolios without SSD selection, SSD selected ethical and conventional portfolios are compared. BIST 100 is also given as a benchmark index for the same time interval. All the portfolios and BIST 100 index starts from 100 in the beginning of December 2013. Figure 3 shows the back-testing results for monthly time frequency, and Figure 4 gives a more sensitive approach by using weekly returns and represents back-testing results for weekly time frequency.

Back-testing results state that both SSD portfolios outperform BIST 100 and, more importantly, both SSD chosen portfolios outperform their main portfolios. In 13-month time interval, ethical portfolio without SSD selection gives 4.46 per cent return. On the other hand, SSD selected portfolio have 16.50 per cent return. It is nearly four times better than the main portfolio for ethical stocks. Results for conventional stocks are not so dramatic, but still, SSD selected portfolio gives better results than the main one. Conventional portfolio without SSD selection achieves 17.86 per cent return, which is

Table IV.
SSD pairwise comparison of corresponding stocks in ethical and conventional portfolios

Stocks of participation index	Corresponding conventional stocks	SSD relationship
AKCNS	CIMSA	3
ALBRK	SKBNK	3
ASYAB	TSKB	3
AYGAZ	TURCS	1
BIMAS	MGROS	1
ENKAI	TAVHL	3
FROTO	TOASO	3
MRDIN	ASLAN	3
NUHCM	BTCIM	3
PETKM	PTOFS	1
PNSUT	TATGD	1
TTRAK	OTKAR	3

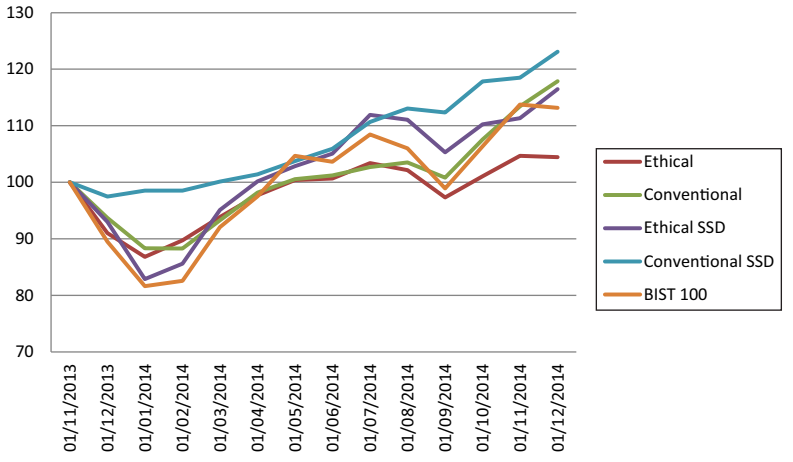

Figure 3.
Back-testing results for monthly time frequency

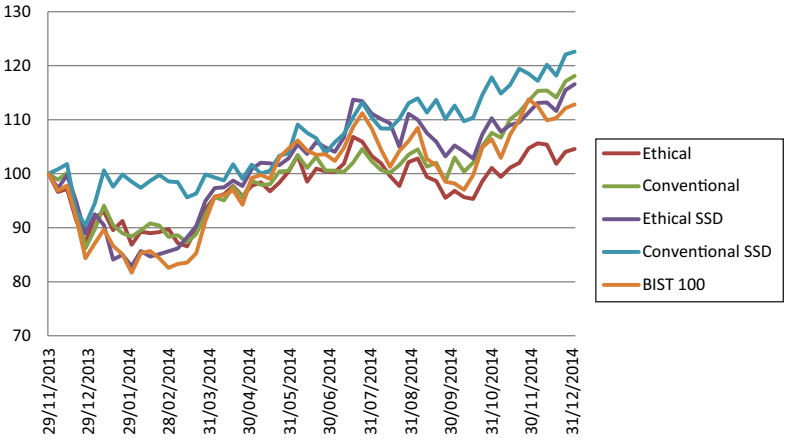

Figure 4.
Back-testing results for weekly time frequency

surpassed by SSD selected conventional portfolio with 23.11 per cent return. At the same time, return of BIST 100 is only 13.17 per cent.

5. Conclusion

Islamic banks started their operation in Turkey in 1985 in form of Special Finance Houses. These institutions have been converted into participation banks in 2006 by a legislation which made them subject to same rules with the interest-based banks. The participation banks operating in Turkey have displayed a striking improvement in the banking sector in terms of their active size and their market share in the deposits and loans since 2006. Since 2009, Participation Index is active under BIST, which covers not only banks mentioned above but also industrial companies. These developments in the financial sector increased the interest in researches on ethical investment and more general Islamic finance.

This paper compares ethical and conventional portfolios by second-order SD efficiency test. Therefore; 12 ethical stocks, which correspond to the banking participation rules for all 12 revising quarters, and 12 corresponding conventional stocks are examined. Also, 7 of the 12 ethical stocks constitute a 50.82 per cent efficient portfolio. On the other hand, 6 of the 12 conventional stocks constitute a 45.16 per cent efficient portfolio. It is possible to reveal that the group of ethical stocks forms a more efficient portfolio. It is clear that these results are valid only for the selected stocks; however, number of the efficient ethical stocks is also one more than the efficient conventional stocks.

Additionally, corresponding stocks of both portfolios are SSD pairwise compared, and four ethical stocks second-order stochastically dominated the four corresponding conventional stocks. With changing stocks, there can be some different results in SSD pairwise comparisons; however, it is another argument to suggest that ethical stocks comprise a more efficient portfolio than the conventional ones.

Back-testing results in following 13 months from the end of examination period show that both SSD selected portfolios outperform the main portfolios for both groups, ethical and conventional. SSD ethical portfolio indicates an enormous return difference compared to ethical portfolio. According to SSD pairwise efficiency test, ethical stocks are more efficient than conventional ones. Additionally, it could be asserted that our back-testing results are in line with those captured by Roman *et al.* (2013). Similar to our work, their results suggest that generated SSD efficient portfolios outperform benchmarked portfolios. Moreover, our back-testing results reveal that conventional stocks predominate ethical ones, which is not the case in Al-Khazali *et al.* (2014). The reason for this pattern may be the lack of back-testing or the global financial crisis where Islamic indices outperform their conventional peers. On the contrary, our data set is not affected by the global crisis.

In future studies, probabilities of each return can be changed according to the year of the returns. Another suggestion is that the portfolio weights of the stocks can be differentiated.

Notes

1. According to interest-free investment and Participation Banking principles of Borsa Istanbul (2016), it also includes trade, press and publication as "unethical invesment". In our opinion, it requires a rethinking of the context. However, it still has very similar financial ratio constraints with Dow Jones Islamic Market Index.
2. Borsa Istanbul after 2013.

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Appendix

Descriptives	AKCNS	ALBRK	ASYAB	AYGAZ	BIMAS	ENKAI	FROTO	MRDIN	NUHCM	PETKM	PNSUT	TTRAK
Mean	0.064	0.011	−0.0598	0.0009	−0.0212	0.0524	0.102	−0.0490	−0.0190	0.0277	0.0501	0.1663
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SD	1.753	1.938	2.101	1.861	3.300	1.989	2.195	1.296	1.889	1.897	1.652	2.487
Skewness	−0.111	−0.233	−0.7504	−1.0409	−1.5910	−0.5268	−0.6796	−0.6703	−0.1721	0.2275	−0.5011	−0.6151
Kurtosis	6.691	4.614	8.232	9.664	3.614	6.201	9.252	9.522	14.885	7.903	8.581	9.340
Jarque-Bera	416.48	85.997	902.38	1484.84	394.477	346.080	1247.00	1350.54	4306.02	738.588	979.493	1270.69
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Obs.	731	731	731	731	731	731	731	731	731	731	731	731

Table AI.
Descriptive statistics for logarithmic daily return series of conventional stocks

Table AII.
Descriptive statistics for logarithmic daily return series of ethical stocks

Descriptives	ASLAN	BTCIM	CIMSA	MGROS	OTKAR	PTOFS	SKBNK	TATGD	TAVHL	TOASO	TSKB	TURCS
Mean	−0.055	−0.009	0.063	−0.076	0.166	−0.040	0.048	−0.073	0.097	0.080	0.043	−0.034
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SD	4.139	2.182	1.806	2.473	2.389	2.358	2.058	1.986	2.217	2.567	2.158	2.232
Skewness	0.965	0.119	−0.660	−1.082	0.283	−0.564	−0.240	−0.789	0.094	−0.614	−0.362	−0.641
Kurtosis	10.955	18.437	12.432	12.763	10.435	16.788	5.933	9.297	4.713	8.225	5.386	8.843
Jarque-Bera	2041.46	7260.47	2762.82	3046.04	1693.80	5829.24	269.17	1281.95	90.5299	877.647	189.43	1090.34
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Obs.	731	731	731	731	731	731	731	731	731	731	731	731

SSD	AKCNS	ALBRK	ASYAB	AYGAZ	BIMAS	ENKAI	FROTO	MRDIN	NUHCM	PETKM	PNSUT	TTRAK
AKCNS	0	3	1	1	3	1	3	3	1	1	3	3
ALBRK		0	1	3	3	3	3	3	3	3	3	3
ASYAB			0	2	2	2	3	3	3	2	2	3
AYGAZ				0	2	3	3	3	3	3	2	3
BIMAS					0	1	3	3	3	1	3	3
ENKAI						0	3	3	3	3	3	3
FROTO							0	3	3	3	3	3
MRDIN								0	3	3	3	3
NUHCM									0	3	2	3
PETKM										0	2	3
PNSUT											0	3
TTRAK												0

Table AIII.
SSD matrix of ethical stocks

Table AIV.
SSD matrix of conventional stocks

SSD	ASLAN	BTCIM	CIMSA	MGROS	OTKAR	PTOFS	SKBNK	TATGD	TAVHL	TOASO	TSKB	TURCS
ASLAN	0	3	2	3	2	3	2	3	2	2	2	3
BTCIM		0	2	1	3	1	3	3	3	3	3	3
CIMSA			0	3	3	1	3	3	3	3	3	3
MGROS				0	2	2	2	3	2	3	2	2
OTKAR					0	3	3	3	3	3	3	3
PTOFS						0	3	3	3	3	3	3
SKBNK							0	3	3	3	3	1
TATGD								0	3	3	3	3
TAVHL									0	1	3	1
TOASO										0	3	3
TSKB											0	1
TURCS												0

Stocks	Dominates	Dominated	Neither dominates nor is dominated	Total
AKCNS	5	0	6	11
ALBRK	1	0	10	11
ASYAB	0	7	4	11
AYGAZ	1	3	7	11
BIMAS	4	0	7	11
ENKAI	1	2	8	11
FROTO	0	0	11	11
MRDIN	0	0	11	11
NUHCM	0	2	9	11
PETKM	1	3	7	11
PNSUT	5	0	6	11
TTRAK	0	0	11	11

Table AV. Number of dominations for each ethical stock

Stocks	Dominates	Dominated	Neither dominates nor dominated	Total
ASLAN	0	6	5	11
BTCIM	2	1	8	11
CIMSA	3	0	8	11
MGROS	0	7	4	11
OTKAR	2	0	9	11
PTOFS	1	2	8	11
SKBNK	3	0	8	11
TATGD	0	0	11	11
TAVHL	4	0	7	11
TOASO	1	1	9	11
TSKB	3	0	8	11
TURCS	1	3	7	11

Table AVI. Number of dominations for each conventional stock

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