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published in
International Review of Financial Analysis
2019

DOI (link to publisher)
10.1016/j.irfa.2017.12.003

document version
Publisher's PDF, also known as Version of record

document license
Article 25fa Dutch Copyright Act

Link to publication in VU Research Portal

citation for published version (APA)
Boudt, K., Raza, M. W., & Wauters, M. (2019). Evaluating the Shariah-compliance of equity portfolios: The weighting method matters. *International Review of Financial Analysis*, *63*, 406-417. https://doi.org/10.1016/j.irfa.2017.12.003

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Download date: 26. Aug. 2022

International Review of Financial Analysis 63 (2019) 406–417

Contents lists available at ScienceDirect

International Review of Financial Analysis

journal homepage: www.elsevier.com/locate/irfa

Evaluating the Shariah-compliance of equity portfolios: The weighting method matters☆

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ARTICLE INFO

Keywords:
Islamic finance
Shariah-compliant investing
Market capitalization
Fundamental weighting
Equal weighting
Low risk weighting

ABSTRACT

The choice of weighting method in constructing an equity portfolio affects not only the financial performance, but also its Shariah-compliance. We show how the implicit bets in market capitalization, fundamental value, equal and low risk weights can affect the individual's perception of Shariah compliance of the financial portfolio. For the universe of Shariah-compliant S&P 500 stocks over the period 1986–2014, we find that the risk-adjusted performance is improved when using the alternative weighting methods compared with the traditional use of market capitalization weighting. The choice of weighting method matters for the Shariah-compliant equity investor, both in terms of compliance with the primary objectives of Shariah investing and in terms of the secondary objective of optimizing the financial performance of the portfolio.

1. Introduction

Equity investing involves balancing various objectives and constraints. In addition to the traditional performance and risk criteria, a growing number of investors attach importance to compliance to ethical, religious, or sustainable investment objectives. This is often implemented through a screening step in which the investable universe is obtained by excluding all stocks that are not acceptable from a extra-financial perspective. The actual portfolio weights are then defined in the second step. Often, the weights are fully automated by following a pre-defined investment rule, such as the rule to assign weights in proportion to the stock's market capitalization (see, e.g., Sauer, 1997 and Consolandi, Jaiswal-Dale, Poggiani, & Vercelli, 2009). Since the financial crisis of 2008, alternative rule-based investments have become popular, such as equal-weighting, fundamental value weighting and low risk weighting. Like market capitalization weighting, they define the portfolio weights based on an investment algorithm, and exclude the possibility of using expert opinion to deviate from the algorithmic weights. An important practical question is how these choices in implementation affect the various dimensions of portfolio performance.

Bertrand and Lapointe (2015) study this question in the case of socially responsible investing. We extend their research by investigating the case of the Islamic investor for whom there is a strict prohibition to invest in firms for which the main business activities are *haram* (such as gambling, alcohol, tobacco or swine production) or firms that have substantial revenues from interest. In addition to these restrictions, the Shariah-compliant investor is expected to have an investment style that respects the Shariah principles of mutual cooperation between market participants. Since the introduction of the Dow Jones Investment Management Islamic equity market index in 1999, various Shariah-compliant equity market solution have been successfully commercialized (Vizcaino, 2015).

While most Shariah investment guidelines are explicit on selection criteria (see, e.g., Derigs & Marzban, 2009; Arslan-Ayaydin, Boudt, & Raza, forthcoming), they remain silent on the choice of weighting method. One notable exception is Derigs and Marzban (2009) who advocate a new paradigm that states that, in a portfolio framework, Shariah compliance should not be judged solely at the individual stock level, but also at the portfolio level. We contribute to this paradigm by providing both theoretical and empirical arguments stressing the importance of the choice of the weighting method.

We compare the traditional choice of market capitalization

☆ We are grateful to the Editor (Sabri Boubaker), two anonymous referees, Özgur Arslan, Dawood Ashraf, Jean-Charles Garibal, Bertrand Maillet, Pierre-Guillaume Méon, Valeri Zakamouline and participants at various seminars and conferences for useful comments. We also like to thank Shaheed Benazir Bhutto University, Dir, Pakistan and the Higher Education Commission, Pakistan for providing financial support. The comments, opinions, and views expressed in this paper, do not necessarily reflect those of the members, directors and officers of the Financial Services and Markets Authority.

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https://doi.org/10.1016/j.irfa.2017.12.003
Received 5 March 2017; Received in revised form 1 October 2017; Accepted 11 December 2017
Available online 13 December 2017
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weighting with the alternatives of fundamental value, equal-weighting and low risk weighting. By focusing on rule-based investments, instead of analyzing Islamic fund returns, we avoid that our results are influenced by the confounding effect of the fund manager's skill for stock selection (Sauer, 1997). Moreover, it allows us to analyze the performance over a time span that exceeds the track record of most Islamic funds.

We show that the investor seeking for Shariah-compliance can benefit in three ways from considering an alternative weighting method. Firstly, we note that in some cases, stock mispricing may lead to implicit bets in market capitalization weighted Shariah-compliant equity portfolios, which can be seen as inconsistent with the primary objectives of Islamic finance. Secondly, we find that, for the Shariah-compliant S&P 500 stocks over the period 1986–2014, the market capitalization weighted portfolio tends to lead to portfolios with a relatively higher allocation to stocks with high interest income compared to the approach of low risk weighting. However, the low risk weighting tends to have a high relative allocation to firms that are debt-financed. Thirdly, we show that the alternative weighting methods improve risk-adjusted performance for Shariah-compliant S&P 500 stocks over the period 1986–2014.

Our research adds to the growing literature questioning the efficiency of the market capitalization portfolio. There are several reasons to question the efficiency of market capitalization weighting in the context of Shariah-compliant equity investing. The first is that the Sharia-compliant equity screening is a direct violation of the assumption of the Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965a, 1965b) that investors can invest in all assets. It thus follows that, because of the restricted universe, there is no reason to conclude that the choice of market capitalization weights always leads to mean-variance efficient portfolio weights.

A second reason for the inefficiency is that, if there is mispricing in the stock market, the choice for market capitalization weighting leads to an outcome that is always undesirable for the Shariah-compliant investor. A market capitalization weighted investment strategy takes concentrated bets in the largest capitalization stocks and thus overweights the overpriced stocks relative to the underpriced stocks (see, e.g., Arnott, Hsu, & Moore, 2005). There are two possible outcomes in terms of the direction of the mispricing volatility. Either, the mispricing amplifies and the investor gains from speculating on a short run momentum effect in equity markets. Such a speculation gain violates the principle of prohibition of *Gharar* (excessive risk, uncertainty) and *Mujazafah* (speculation) in Islamic finance, as we explain in the next section. Or, the mispricing is reversed, which then leads to an amplified financial loss as a consequence of the overweighting of overpriced stocks. It is important to stress that these two outcomes are implicit consequences of the choice of portfolio weighting method. They exist whenever there is mispricing, even when it is completely unpredictable.[1]

Based on this mispricing model, we argue that market capitalization weighting may be inconsistent with the general objective of Islamic finance to create a “win-win” situation for all parties involved. This criticism is related to Obaidullah (2005), who argues that Shariah-compliant portfolio weights should reflect the fundamental value of the firm. In order to avoid the effects of booms and busts in stock prices, he suggests to use accounting-based measures that proxy for the replacement value of assets rather than market capitalization. We implement this suggestion using the fundamental value approach of Arnott et al. (2005), which sets portfolio weights as proportional to accounting and financial statement measures of company size.

In addition to studying the effect of using fundamental value weighting in a Shariah-compliant equity portfolio, we also consider the approach of equal and low risk weighting. Assigning equal weights to the portfolio components has the advantage that it implies a perfect diversification in terms of budget allocation across the different stocks in the equity universe. It is also aligned with the *Maqasad al Shariah* stipulating that one of the main objectives of Shariah law is to seek moderation in every aspect of life. The advantage of low risk portfolio is that it leads to underweighting high volatility stocks, and therefore reduce the exposure to mispricing. In fact, as shown by Hong and Sraer (2016), volatility increases the likelihood of mispricing. For this reason, the approach of low risk investing may also be more suitable for an Islamic investor.

Finally, we show that the choice of weighting method not only matters in terms of compatibility with the objectives of Islamic finance, but that it can also have substantial effects on the investment performance. We find that for the universe of Shariah-compliant S&P 500 stocks over the period 1986–2014, the fundamental value weighted, equal weighted and low risk portfolio allocation approach outperform the standard choice of market capitalization weighting, both in terms of total annualized returns and Sharpe ratio. This result is for gross returns, but our analysis of break-even transaction costs shows that the gains in performance are large enough to compensate for the higher turnover in the equal weighted and low risk portfolio, compared with the market capitalization weighted portfolio. To the best of our knowledge, our paper is the first to study the performance of Shariah-compliant portfolios using detailed stock data over such a long out-of-sample evaluation window (29 years).

The main message of this paper to the Shariah-compliant investor is to carefully consider the decision of equity weighting. The religious scriptures in the *Quran* and *Hadiths* provide the Shariah-compliant investor ample freedom to optimize the portfolio composition in order to be compliant with the primary objectives, while optimizing the secondary objectives. By considering alternatives to market capitalization weighting, the Shariah-compliant equity investor can obtain at the same time a higher risk-adjusted performance and avoid the undesirable effects of stock mispricing on the weights defined using stock's market capitalization.

The remainder of the paper is organized as follows. Section 2 studies the effects of mispricing on the payoff for a Shariah-compliant investor in a market capitalization weighted equity portfolio and shows the negative effects of the choice of market capitalization weighing in all possible states. Section 3 introduces the method used for setting the portfolio weights in Shariah-compliant equity portfolios. Section 4 presents the data and the empirical method used in the performance evaluation of the choice of weighting method. Section 5 discusses our main empirical results. Section 6 verifies the robustness of our results to the choice of time window and the alternative Shariah guidelines. Finally, Section 7 summarizes our main conclusions and highlights the implications for researchers and investors.

2. Stock mispricing and the Shariah-compliance of the market capitalization weighted equity portfolio

The evaluation of the Shariah-compliance of a portfolio has two sides. On the one hand, the portfolio is not Shariah-compliant if the portfolio is invested in strictly prohibited activities such as firms with core business centered around revenues received from interest, alcohol, pork products, gambling and adult entertainment services. This result is independent of the weight assigned to such activities. On the other hand, a certain number of activities are in the gray zone and, as advocated by Derigs and Marzban (2009), the Shariah compliance of the portfolio can then be evaluated based on the weight attached to the activities that are not perfectly aligned with the Shariah objectives. In those cases, the choice of equity weighting method matters.

[1] In some cases, the mispricing is partly predictable. This happens when the investor has privileged access to information (Diebold & Strasser, 2013) or is able to benefit from the time series persistence in mispricing (Barberis & Shleifer, 2003). The deliberate use of predicted mispricing in stocks can be considered as a violation of the general objective of fairness in Islamic finance.The investigation of the financial and extra-financial performance of active investing in Islamic finance is beyond the scope of this paper.

Indeed, the Shariah-compliance of a single stock is partly evaluated by the use of financial screens designed to exclude investments in the shares of a firm with a too high proportion of liquid assets, stocks that have a too high revenue from interests or firms for which the activities are financed by a high degree of leverage. This condition can be evaluated at the individual firm, but also at the aggregate portfolio level. Suppose e.g., that we have N firms for which the standardized measure of income from interest at time t is denoted by $x_{i,t}$ (with $i = 1,\ldots,N$), then individual compliance is verified by comparing $x_{i,t}$ with a threshold, while compliance at the portfolio level can be also evaluated using the weighted average compliance

$$x_t(w) = \sum_{i=1}^{N} w_{i,t} x_{i,t}, \tag{1}$$

with $w_{i,t}$ the portfolio weight of asset i at time t.

Derigs and Marzban (2009) propose approaches to integrate constraints on $x_t(w)$ in mean-variance optimization. However, few Islamic funds are mean-variance optimized. Instead, they use either an active approach to setting weights, follow the traditional approach of market capitalization based weighting or use smart beta portfolio weights such as fundamental value, equal or low risk weighting.

In this paper, we only consider rule-based Shariah compliant equity investments. Once the investor has decided on the investment rule, all the decisions are automated. This comes at the price of flexibility, but has the advantage of being systematic and excluding behavioral biases. Some rules are by definition prohibited for the Shariah-compliant equity investor, like investing in the top quintile performing financial firms Ashraf (2016). As we discuss next, the commonly applied rule of market capitalization weighting can be in some cases inferior with respect to alternative weighting methods, when one takes the presence of mispricing into account.

In the remainder of this section we argue that, in addition to preferences over the weighted stock attributes $x_t(w)$, the Islamic investor may also have preferences about the weighting method because of the way stock mispricing affects the profits and loss profile of the portfolio and thus its coherence with the fundamental Islamic finance principle of aiming at mutual cooperation in Shariah investing.

2.1. The mispricing model

There is a long-standing debate in financial economics on how stock prices are determined in financial markets and whether these prices reflect their fundamental value. Proponents of the Efficient Market Hypothesis of Malkiel and Fama (1970) argue that prices fully reflect all available information. If a price would be too high given the available information, arbitrageurs would, almost instantaneously, bid the price down and mispricing would be short-lived. On the other hand, there is the behavioral finance literature presenting empirical evidence of so-called market anomalies, which go against the hypothesis of stock market efficiency. The two schools of thought seem to find a consensus that there may be temporary deviations of the observed price from the so-called fundamental or efficient price, because of the limits to arbitrage and investor irrationality (Barberis & Thaler, 2003). Moreover, as argued by the market microstructure literature, there can be difference in access to information across traders (Diebold & Strasser, 2013).

Before investigating the effects of stock mispricing on Shariah-compliant equity investing, we formalize the mispricing as follows. Let $P_{i,t}$ be the observed price for stock i at time t, and denote $P^*_{i,t}$ as its fundamental value. The latter is defined as the discounted sum of expected future cash flows, obtained under the assumption that when forming the expectations, investors have correctly processed all available information and used the discount rate that is "consistent with a normatively acceptable preference specification" (Barberis & Thaler, 2003). Since the fundamental value is not directly observable, it may be that the actual price deviates from the fundamental value. If we denote by $\omega_{i,t}$ the extent of mispricing, then

$$P_{i,t} = P^*_{i,t} + \omega_{i,t}. \tag{2}$$

If $\omega_{i,t}$ is positive (negative), the stock is overpriced (underpriced). Such a mispricing model is also considered by, among others, Roll (1984), Poterba and Summers (1988), Brennan and Wang (2010) and Diebold and Strasser (2013).

2.2. The prohibition of Gharar and Mujazafah in Islamic finance

The general principle of aiming for mutual cooperation and a "win-win" situation for all parties involved in a transaction implies that there may be no asymmetries in terms of excessive risk or speculative gains (Obaidullah, 2005). This principle may be violated when there is mispricing, since, in that case, there is the risk of buying at a price that is substantially different from the fundamental value of the underlying asset. In general, the value of the mispricing is determined at the macro-financial level and not influenced by the individual investor. Nevertheless, there is the possibility that gains will be made by speculating on the mispricing. For conventional finance, this is well-understood and does not raise any concern. In Islamic finance, this may lead, however, to a violation of the principle of prohibition to participate in transactions that include either *Gharar* (i.e., transactions involving excessive risk for one of the parties) or *Mujazafah* (i.e., transactions involving speculation which would lead to easy accumulation of wealth without any effort).

The motivation of prohibiting *Gharar* and *Mujazafah* is thus similar. It requires that wealth must be the result of *Kasb* (efforts), and the profit one makes must not be at the expense of losses of others. As such, the prohibition of *Gharar* and *Mujazafah* in Islamic finance serves to protect both the buyer and seller involved in an economic transaction from injustice and exploitation (El-Gamal, 2001).

2.3. The effect of mispricing on the Shariah-compliant market capitalization weighted portfolio

Under the mispricing model in Eq. (2), the stock is not traded at the fundamental value, implying possible wealth transfers between the buyer and seller. These transfers can be analyzed from a static and dynamic viewpoint.

From a pure static viewpoint, the transaction implies a transfer of fundamental value $\omega_{i,t}$ from the buyer to the seller. In case of overpricing, the seller makes an effortless profit of $\omega_{i,t}$, while the buyer loses $\omega_{i,t}$, compared with the fundamental value of the transaction. Recall that we only consider rule-based investors, and thus exclude the analysis of an investor's talent to identify the mispricing at the stock level. If investors are active investment style switchers and deliberately change their investment rule to speculate about the mispricing, then they would act against the Shariah principle of prohibition of *Gharar*, which in this case involves making excess profit by not disclosing the underlying's mispricing value. In reality however, mispricing is typically latent and most investors are uninformed about it, and therefore cannot act against this. They may speculate on mispricing, which would be against the principle of prohibition of *Mujazafah*. The basic argument behind the prohibition of *Mujazafah* is that income or wealth must be the result of knowledge, efforts and work, *Kasb*, and not just by pure chance. In fact, the *Quran* prohibits all types of gambling and games of chance (speculation) on the ground that the profit one makes is based on the losses of others (Iqbal, Molyneux, & Conermann, 2006).

The dynamic case is also relevant since Shariah-compliant equity investments are rarely buy-and-hold investments. In case of the market capitalization weighted Shariah portfolio, the weights are rebalanced regularly because of changes in the Shariah-compliant investment universe. Such a rebalancing involves buying and selling stocks. Even when the underlying fundamental value remains constant, there may be

a profit when the mispricing value at the time of the selling is higher than the mispricing value at the time of the acquisition of the stock.

It follows that the choice of market capitalization weighting leads to mispricing related payoffs that are not desirable for the Shariah investor. Indeed, suppose that the mispricing $\omega_{i,t}$ increases over the investment horizon, then the investor makes an effortless profit and acts against the Shariah principles.[2] In the reverse case, when the mispricing $\omega_{i,t}$ decreases over the investment horizon, then the investor is twice penalized: she bought the stock at a too high value and she overweighted the stock in her portfolio. Under this interpretation, investors seeking adherence to Shariah compliance may wish to consider alternative approaches to portfolio weighting. We explore this further in the next sections.

3. Portfolio weights in Shariah-compliant equity portfolios

Shariah-compliant equity portfolios determine the portfolio weights in two steps. First, the universe is screened to remove all stocks that are not Shariah-compliant. Second, the portfolio weights are determined.

3.1. Shariah-compliant screening

Almost all Shariah-compliant equity portfolios track a universe of Shariah-compliant stocks obtained by the use of negative criteria. This means that the traditional investment universe (e.g., the universe of S&P 500 stocks) is screened to exclude all stocks that do not satisfy the conditions of the Shariah.[3] In practice, this is implemented using a series of qualitative and quantitative conditions.

In our main analysis, we follow the guidelines used in the Dow Jones Islamic Market (DJIM) indices. The DJIM indices apply screening rules formulated by a well-diversified Shariah board consisting of five Shariah scholars representing almost every school of thought in Shariah decision making. More precisely, DJIM uses two types of negative screens, namely sector screens and financial screens. The sector screens reflect the prohibition to invest in firms with core business as interest, alcohol, pork products, gambling and adult entertainment services.

The financial screens are designed to exclude investments in the shares of a firm with a too high proportion of liquid assets, stocks that have a too high revenue from interests or firms for which the activities are financed by a high degree of leverage. Importantly, the financial screens can be used in two ways. The traditional approach is to apply the financial screens to exclude stocks from the investment universe. Under the paradigm of Derigs and Marzban (2009) they also matter in terms of assessing Shariah compliance at the portfolio level using the weighted average performance measure in terms of the variables used to compute the financial screens.

In our main analysis we follow the screening practices mentioned in the factsheet of Dow Jones Islamic Market Indices (DJIM). The quantitative screens of DJIM exclude firms whose account receivables exceeds 33% of the market capitalization, as well as firms for which the cash and short-term investment exceed 33% of the market capitalization and the firms for which total debt exceeds 33% of the market capitalization, from the investment universe. The choice for the DJIM as the benchmark methodology is consistent with prior research (see, e.g., Shamsuddin, 2014; Hassan & Girard, 2011; Ho, Rahman, Yusuf, & Zamzamin, 2014; Charles, Darné, & Pop, 2015).

In the robustness section, we consider alternative selection guidelines provided by HSBC Amanah, which differ in the choice of financial screens. The financial screens of HSBC exclude firms whose account receivables plus cash and short term investment exceeds 50% of total assets, as well as firms for which the total interest exceeds 5% of total revenue and firms for which the total debt exceeds 30% of total assets. Note that, wile the DJIM criteria use market capitalization as divisor, the HSBC screening conditions are using total assets as denominator. While market capitalization is available at a higher observation frequency than total assets, the latter has the advantage of being less sensitive to pricing errors. Moreover, as noted by Obaidullah (2005), since the investable firms are in a state of going concern, the book value of total assets can be seen as a more realistic measure of the total replacement value of a firm.

3.2. Determining the portfolio weights

After the screening step, follows the decision of weight allocation to the stocks in the investment universe. The impact of the weighting method is the main focus of our paper. Before introducing the weighting methods considered, let us first fix the notation. Assume that the portfolio is rebalanced at times $t = 1,\ldots,T$. To construct the portfolios with different weighting methods, we start from a reference investment universe of S&P 500 stocks. We denote $I_{i,t}$ as the dummy variable indicating whether stock i belongs to the reference investment universe at time t and $i = 1,\ldots,N_t$, with N_t the number of stocks in the investment universe at rebalancing date t. In a second step, we determine whether the stock is Shariah-compliant. Therefore, we define $S_{i,t}$ as the dummy variable which is one if stock i at time t is Shariah-compliant. Finally, we determine the stock weight $w_{i,t}$ in the portfolio. We assume that the portfolio is fully invested and do not allow for short selling since this is prohibited by Shariah.

3.2.1. Market capitalization weighted

In the case of a market capitalization weighted portfolio, the stock's weight in the Shariah-compliant market capitalization portfolio is given by

$$w_{i,t}^{MC} = \frac{P_{i,t} \cdot n_{i,t} \cdot I_{i,t} \cdot S_{i,t}}{\sum_{j=1}^{N} P_{j,t} \cdot n_{j,t} \cdot I_{j,t} \cdot S_{j,t}}, \tag{3}$$

where $P_{i,t}$ is the stock price of individual asset i at time period t and $n_{i,t}$ is the number of common stocks outstanding of firm i at time t. The dummies $I_{i,t}$ and $S_{i,t}$ are as defined above. They ensure that only Shariah-compliant stocks belonging to the investment universe on selection date t receive a non-zero weight.

3.2.2. Fundamental weighted

Obaidullah (2005) criticizes the use of market capitalization in Islamic investing. In order to avoid the effects of the booms and busts in stock prices, he recommends to use proxies that reflect the replacement value of the firm. This suggestion is close to the approach of fundamental weighting, as popularized by Arnott et al. (2005). It uses the book value of the firm common equity, together with three other accounting-data based proxies, namely the five-year trailing averages of the yearly value of dividends, net operating cash flow and sales. The four proxies are combined by taking the mean of the normalized version of the four fundamental proxies.[4] This then leads to the following definition of fundamental weights in a Shariah-compliant portfolio:

[2] In most cases, this is not deliberate, since, as mentioned in Footnote 1, when the mispricing is unpredictable, there is no intentional gambling by the investor in choosing the investment rule. In the special case where mispricing is partly predictable (e.g. in case of a market rally where high market capitalization stocks increase relatively more than low market capitalization stocks) and market capitalization weights are chosen to deliberately exploit the mispricing, then the trading decisions can be considered as a violation of the general objective of fairness in Islamic finance.

[3] The Shariah conditions for portfolio investments are not explicitly stated in the *Quran* and *Hadiths* (sayings of the Prophet Muhammad). These rules are mostly the outcomes of *Qiyas* and *Ijma* of Shariah Board associated with the Shariah-compliant equity index providers (*Qiyas* is an arabic word that refers to the process of analogical reasoning based on the teachings of *Quran* and *Hadiths*, while *Ijma* means the mutual consensus of Shariah scholars). For details on the derivation and the use of Shariah screens, we refer the reader to Obaidullah (2005) and Derigs and Marzban (2008).

[4] For non-dividend paying firms, the composite portfolio weight is set to the average of the three remaining measures as proposed by Arnott et al. (2005).

$$w_{i,t}^{FW} \equiv \frac{1}{4}\sum_{k=1}^{4}\left(\frac{\max\{x_{k,1},0\}\cdot I_{i,t}\cdot S_{i,t}}{\sum_{j=1}^{N}\max\{x_{k,j},0\}\cdot I_{j,t}\cdot S_{j,t}},\ldots,\frac{\max\{x_{k,N},0\}\cdot I_{j,t}\cdot S_{j,t}}{\sum_{j=1}^{N}\max\{x_{k,j},0\}\cdot I_{j,t}\cdot S_{j,t}}\right), \tag{4}$$

where $x_{1,i}$ is the size of the firm i measured as the book value of the firm common equity. The variables $x_{2,i}$, $x_{3,i}$ and $x_{4,i}$ represent the five-year trailing averages of the yearly value of dividends, net operating cash flow and sales, respectively. We use the trailing averages to avoid excessive volatility in the final weights caused by variation in the fundamental indicators. As before, the variables $I_{i,t}$ and $S_{i,t}$ are the dummies that take the value of one when the firms belongs to the S&P 500 asset universe and is Shariah-compliant, respectively.

3.2.3. Equal weighted

The market capitalization and fundamental value weighting approaches have in common that they can lead to concentrated portfolios. This may be seen as inconsistent with the *Maqasad al Shariah* stipulating that one of the main objectives of Shariah law is to seek moderation in every aspect of life. While the market capitalization and fundamental value weighting are dominated by the investment in large firms, the equal-weighting is by definition equally spread over all Shariah-compliant stocks.

As a second alternative weighting method, we therefore consider the approach of equal-weighting, which totally ignores the market value of the assets in the universe. Under equal weighting, the Shariah-compliant weights are given by

$$w_{i,t}^{EW} = \frac{I_{i,t}\cdot S_{i,t}}{\sum_{j=1}^{N} I_{j,t}\cdot S_{j,t}}, \tag{5}$$

where N is the number of stocks included in the universe, and the dummies $I_{i,t}$ and $S_{i,t}$ are one, if stock i on selection date t is part of the investment universe and satisfies the Shariah screening conditions, respectively.

Equal weighted portfolios are widely used in practice (Benartzi & Thaler, 2001; Windcliff & Boyle, 2004). In addition to its simplicity in construction and its perfect diversification in terms of capital allocation, there is also some empirical evidence that equal weighting may outperform the market capitalization and price-based portfolios (Plyakha, Uppal, & Vilkov, 2014) and alternatives based on mean-variance optimization (DeMiguel, Garlappi, & Uppal, 2009). On rebalancing dates, the equal weighting approach sells high and buys low, and thus gains when there is a mean-reversion in the mispricing. Equal weighting also benefits from the size premium because, compared to the market capitalization weighted portfolio, it overweights small-cap stocks and underweights large-cap stocks.

3.3. Low risk weighted

The uncertainty about the market value of a firm is caused, among others, by the general presence of volatility in equity market returns. The larger the volatility, the more difficult it generally becomes to obtain the correct valuation of the firm (see, e.g., Hong & Sraer, 2016). When volatility is considered as a proxy for the likelihood and the size of mispricing, it follows that a natural way to avoid mispricing is to focus the investment on the low volatility stocks. This then corresponds to a low risk portfolio strategy, where the portfolio weights are defined such that the portfolio's risk is reduced compared with alternative weighting methods such as market capitalization weighting or equal weighting. This can be achieved by minimum variance optimization, as in De Carvalho, Lu, and Moulin (2012), or by using heuristic approaches which first select the low risk stocks and then weight the stocks inversely to their risk characteristics (Chow, Hsu, Kuo, & Li, 2014). The latter explain that the heuristic approach tends to mimic the portfolio allocations obtained by minimum variance optimization. This method is also used by the S&P 500 low volatility index and by Ardia, Boudt, and Wauters (2016). We follow this two-step approach and thus set the low risk approach based weights as follows:

$$w_{i,t}^{LR} = \frac{\frac{1}{\sigma_{i,t}}\cdot I_{i,t}\cdot S_{i,t}\cdot L_{i,t}}{\sum_{j=1}^{N}\frac{1}{\sigma_{j,t}}\cdot I_{j,t}\cdot S_{j,t}\cdot L_{j,t}}, \tag{6}$$

where $\frac{1}{\sigma_{i,t}}$ is the inverse volatility of stock i at time t, and $L_{i,t}$ is the dummy indicating that the selected stock is among the 100 least volatile Shariah-compliant stocks in the S&P 500 universe at selection date t. We take the volatility estimated over a 24-month rolling window.

4. Data and methodology

4.1. Data

To analyze the effect of the weighting method on a Shariah-compliant equity portfolio, we use the month-end constituents of the S&P 500 as the reference investment universe. The analysis period ranges from January 1986 to July 2014. We use the monthly adjusted price data obtained from COMPUSTAT. To obtain the subset of Shariah-compliant stocks, we apply sector and financial screens used by DJIM, as described in Section 3.1. More precisely, we use the Global Industrial Classification Standards (GICS) to screen the type of sector. To implement the financial screens, we use the total assets, common shares outstanding, total debt, accounts receivables, cash and short term investments and interest income, as reported in the COMPUSTAT database on an annual basis. We use the 24-month trailing average of market capitalization as denominator in calculating the financial ratios.[5] To calculate the fundamental weights in Eq. (4) we use four fundamentals, namely: book value of common equity, dividend, sales and net operating cash flow. COMPUSTAT provides these data on an annual basis. The net operating cash flow is calculated as the difference between the operating income before depreciation and total accruals.

4.2. Composition of the screened investment universe

The Shariah-compliant equity universe is obtained after applying sector and financial screens that significantly limit the investment universe. Fig. 1 shows the resulting number of Shariah-compliant stocks in the S&P 500 universe over the period 1986 to 2014. The Shariah-compliant stocks are obtained by following the screening guidelines of DJIM and HSBC. When following the screening guidelines of DJIM, the reference investment universe of S&P 500 constituents is reduced to on average 193 stocks with a minimum number of 143 stocks in 1986 and a maximum number of 257 stocks in 2007. As explained in Section 3.1, most of the DJIM Shariah screening rules use ratios of accounting variables with respect to the firm's market capitalization. Over the period, there has been an increase in the number of Shariah-compliant stocks, because of the higher average growth rate of the market capitalization relative to the growth rate of the accounting variables used (i.e., account receivables, cash and short-term investments, total debt). It follows that the DJIM screening conditions using market capitalization have become less restrictive over time.

Note that the average number of 193 stocks is consistent with the results reported in Derigs and Marzban (2008). This is a relatively high number and is expected to provide a sufficiently diversified portfolio, when the weights are sufficiently diversified (Statman, 1987). A similar conclusion holds for the Shariah screening based on the HSBC guidelines.

Importantly, the Shariah screening leads to a substantially different

[5] The 24-month trailing average market capitalization at month-end t is the average market capitalization for the company over the most recent 24 month-ends. Taking the trailing average has the advantage of smoothing out the fluctuations in market capitalization.

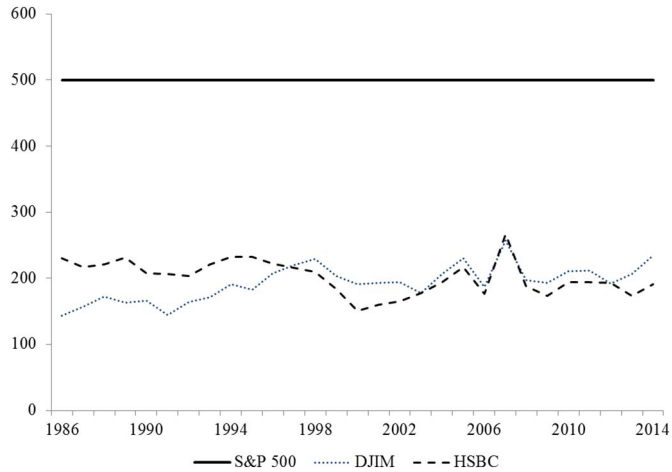

Fig. 1. The effect of Shariah-compliant equity screening on the cardinality of the S&P 500 investment universe. *Note*: This figure shows, in terms of the number of remaining S&P 500 stocks, the effect of reducing the investment opportunity set when applying the Shariah screening guidelines provided by DJIM and HSBC for the period 1986 to 2014. Here we report the number of compliant assets after qualitative and quantitative analyses. We used Global Industrial Classification Standards (GICS) for qualitative screening. Quantitative screening is carried out with the screening ratios and threshold limit provided by investment guidelines of DJIM and HSBC.

sector allocation compared with the original sector allocation of the S&P 500. This can be seen in Table 1 where, as a result of the Shariah screening, the financial sector is almost absent in the Shariah-compliant equity universe, while the non-financial sectors such as consumer staples, health care and information technology receive a substantially higher allocation, for all types of weighting methods considered. These sector bets are a direct consequence of the Shariah investment principles strictly prohibiting investing in firms with a relatively high income from interest (Derigs & Marzban, 2009; Khatkhatay & Nisar, 2007).

Note also that, compared to the complete S&P 500 universe in Panel A, we find that, when using a market capitalization weighting approach, the Shariah portfolio tilts more towards energy, consumer staples, health care and information technology, while the equal weighted and low risk portfolios tilt more towards the energy, materials, industrials, health, consumer staples and IT sectors.

4.3. Weighted Shariah compliance of the portfolios

As advocated by Derigs and Marzban (2009), Shariah compliance should not only be evaluated at the individual stock level, but also at the portfolio level. Here we study how the choice of weighting method affects the weighted average performance of the portfolio in terms of achieving a low value for the following six indicator that are potentially relevant for a Shariah investor seeking to avoid ownership in activities with a too high proportion of liquid assets, or activities with a too high revenue from interests or activities that are financed by a high degree of leverage. More precisely, we consider the union of indicators used by DJIM and HSBC, namely (i) cash and short term investments divided by market capitalization, (ii) account receivables divided by market capitalization, (iii) total debt divided by market capitalization, (iv) account receivables plus cash and short term investments divided by total assets, (v) total debt divided by total assets and (vi) total interest divided by total revenue. Each of these indicators are available at the firm-level, and then a weighted average is computed using the corresponding portfolio weights, as explained in Eq. (1).

The resulting values of these Shariah compliance indicators are presented in Table 2. The lower the value, the more the portfolio is in agreement with the objectives of the Shariah compliant equity investment. Panel A shows the results for the various portfolio weighting methods when the investment universe is the S&P 500, while Panels B and C focus on the portfolios obtained using the restricted universes obtained using the DJIM and HSBC financial screens.

Comparing the results across panels, we of course see that, by construction, imposing the screening conditions reduces substantially the difference in the values of the Shariah compliance indicators. The improvements tend to be larger when using the DJIM screening conditions than when the HSBC conditions are used. In fact we see that it is only income from interest where the HSBC screens show less exposure with all the weighting methods. For the rest of interest screens i.e. account receivables, cash and short term investment and total debt the values of Shariah compliance indicators are much lower with DJIM criteria.

Finally, note that after applying the screening conditions, the choice of weighting method has only a second order effect. The most interesting result seems to be that the equal weighted approach tends to perform worst in terms of the income received from interest and shows high exposure of 5.23% as compare to the 1.83% and 0.64% of fundamental and low risk strategies respectively. In terms of alternative

Table 1
The effects of Shariah screening on the sector allocation in the S&P 500 universe.

	Ener	Mat	Ind	C Disc	C Stap	Health	Fin	IT	TC	Uti
Panel A: All S&P 500 stocks										
Market Cap	9.85	5.32	11.60	13.21	11.76	11.79	14.45	12.33	5.35	4.28
Fund	13.99	6.76	13.55	16.92	11.79	8.84	4.47	7.49	7.75	8.39
EW	6.76	9.34	14.13	17.18	8.31	8.99	14.90	11.61	1.94	6.80
Low Risk	5.66	6.77	11.34	9.01	14.72	8.07	15.72	2.78	3.64	22.64
Panel B: Shariah restricted (DJIM)										
Market Cap	14.03	5.25	8.72	10.28	17.07	20.64	0.28	18.83	4.54	0.31
Fund	21.73	6.71	9.36	9.87	16.12	16.49	0.16	12.11	6.95	0.46
EW	7.03	10.32	14.84	16.94	12.03	16.23	0.68	19.76	1.74	0.38
Low Risk	9.19	9.71	15.72	10.20	27.28	17.88	0.62	4.83	3.17	1.34
Panel C: Shariah restricted (HSBC)										
Market Cap	16.75	6.24	9.25	11.11	13.99	20.55	0.18	14.36	6.40	1.11
Fund	23.44	7.74	9.95	11.95	11.63	14.33	0.11	9.57	9.36	1.89
EW	9.27	12.44	16.78	17.94	8.64	14.33	0.34	16.18	1.88	2.16
Low Risk	11.13	8.96	15.10	9.55	19.06	17.59	0.37	4.44	5.14	8.60

Note: This table reports the average sector allocation of different portfolios based on three asset universes. The first asset universe is not restricted (all S&P 500 stocks). The second universe is restricted with Shariah screening guidelines of DJIM, and the third is restricted by Shariah guidelines of HSBC. We then present the average sector weights for the four weighting methods: market capitalization (Market Cap), fundamental weighting (Fund), equal-weight (EW) and low risk (Low Risk) strategies. The weights are calculated with monthly rebalancing for the period 1986–2014. We adopt the Global Industrial Classification Standards System (GICS) for sector and sub-sector classification, where each company issuing equity has a unique sector code. The column names Ener, Mat, Ind, C Disc, C Stap, Health, Fin, IT, TC, and Uti represent the energy, material, industry, consumer discretionary, consumer staples, health care, financial, information technology, telecommunication and utilities sectors, respectively.

Table 2
Weighted performance of portfolios in terms of the six financial indicators used by DJIM and HSBC.

	DJIM criteria			HSBC criteria		
	AR (%)	CSI (%)	Debt (%)	AR + CSI (%)	Debt (%)	Interest (%)
Panel A: All S&P 500 stocks						
Mkt. Cap.	39.04	19.83	60.40	24.25	25.25	9.26
Fund.	44.79	16.25	84.79	22.31	26.77	3.62
EW	43.49	19.68	64.33	23.12	24.72	11.57
Low risk	24.66	8.90	47.80	17.25	27.21	5.55
Panel B: Shariah restricted S&P 500 stocks (DJIM criteria)						
Mkt. Cap.	8.98	6.37	11.30	15.35	11.30	1.63
Fund.	10.68	6.28	14.67	16.96	14.67	1.83
EW	10.27	7.12	12.31	17.39	12.31	5.23
Low risk	9.71	5.12	13.40	15.84	13.40	0.64
Panel C: Shariah restricted S&P 500 stocks (HSBC criteria)						
Mkt. Cap.	13.49	9.85	16.45	23.35	16.45	0.61
Fund.	13.44	7.93	17.65	21.37	17.65	0.48
EW	14.98	9.58	16.64	24.56	16.64	0.56
Low risk	13.83	7.42	17.79	21.25	17.79	0.46

Note: This table reports the average weighted value of the six financial indicators used in the Shariah screening guidelines of DJIM and HSBC, namely: cash and short term investments (CSI) divided by market capitalization, account receivables (AR) divided by market capitalization, total debt (Debt) divided by market capitalization, account receivables plus cash and short term investments divided by total assets, total debt divided by total assets and total interest divided by total revenue. For the first three screens, DJIM sets a threshold limit of 33%, while for the last three screens the HSBC uses a threshold level of 50%, 30% and 5% respectively. The averages are computed over monthly rebalancing dates for the period 1986–2014, and weight each firm's financial indicator with the firm's weight in the portfolio, for each of the weighting methods considered. Panel A shows the results when the universe includes all S&P 500 firms, while Panels B and C are the universe restricted by imposing the Shariah screening guidelines of DJIM and HSBC, respectively.

weighting methods, the low risk strategy dominated the equal weighted and fundamental weighting strategies as it shows comparatively less exposure to all interest screens.

4.4. Methodology for performance evaluation

A major goal of this paper is to study the effect of the weighting method on the out-of-sample performance of Shariah-compliant equity portfolios. We characterize the performance in terms of reward and risk by analyzing the monthly returns over the period 1986–2014. The reward is gauged using the annualized average return, computed as twelve times the simple average monthly return. The risk of the investments is measured in three ways. First, the annualized volatility is computed as the volatility of the monthly returns and annualized with the square root of time rule. Second, we report the maximum value of the portfolio drawdowns, defined as the percentage loss from peak to trough. Third, the risk of monthly losses is measured through the 95% historical value-at-risk, computed as the 5% quantile of the monthly returns.

To analyze the impact in terms of risk-adjusted return, we further report the annualized Sharpe ratio, the generalized Sharpe ratios of Zakamouline and Koekebakker (2009), and Jensen's alpha estimated as the intercept from the Carhart four-factor model (Carhart, 1997).[6] Compared to the Sharpe ratio, the generalized Sharpe ratios of Zakamouline and Koekebakker (2009) aim to take the non-normality of the return series into account. They propose both a Adjusted for Skewness Sharpe Ratio (ASSR) and a Adjusted for Skewness and Kurtosis Sharpe ratio (ASKR). The former is given by

$$ASSR = SR\sqrt{1 + \frac{skew}{3}SR},$$

where SR and $skew$ are the traditional Sharpe ratio and skewness of the portfolio return. The ASKSR is more complex, as it depends on the parameters of a non-normal inverse Gaussian distribution fitted to the portfolio return series. We refer to Zakamouline and Koekebakker (2009) for more details.

Because of the time-variation in performance, we report those statistics not only for the full period, but report also the results of a subsample analysis based on splitting the data around three major financial crises between 1986 and 2014. We identify those crises as the three periods reporting the largest drawdowns: Black Monday (September 1987–November 1988), the burst of the Dot-com bubble (September 2000–September 2002) and the global financial crisis (November 2007–February 2009.)

The risk and return measures mentioned above are for the gross returns before transaction costs. Imposing the Shariah restrictions and the use of alternative portfolio weights tends to increase the portfolio turnover. To quantify this, we first report the time series average of the portfolio's two-way turnover, defined as the sum of the absolute values of the transactions (both purchase and sales) needed to rebalance the portfolio weights, for all the N assets in the portfolio (DeMiguel et al., 2009). More precisely, the turnover for selection date $t+1$ is given by

$$Turnover_{t+1} = \sum_{i=1}^{N} |w_{i,t+1} - w_{i,t^+}|, \tag{7}$$

where $w_{i,t+1}$ is the new weight of security i at rebalancing time $t+1$ and w_{i,t^+} is the actual weight of security i before rebalancing at $t+1$.

The net return corresponds to the gross return performance from which the transaction costs need to be deducted. Instead of assuming a specific value of the transaction cost, we follow Kritzman, Page, and Turkington (2012) by reporting the break-even transaction cost for which the annualized Sharpe ratio of the portfolio with higher Sharpe ratio (and higher turnover) equals the Sharpe ratio of the market capitalization weighted portfolio. We assume the transaction costs to be proportional to the amount traded such that the net return is given by the gross return R_t from which the proportional transaction costs are deducted:

$$R_{t+1}^{Net} = R_t - \tau^* Turnover_t, \tag{8}$$

where τ is the transaction cost per dollar traded. We then evaluate how much the Shariah investor is willing to pay in terms of transaction cost to switch from a low turnover strategy (using no Shariah restrictions and market capitalization weighting) to a higher turnover strategy (using Shariah restrictions and alternative weighting methods). We determine the break-even transaction costs as the value of τ for which the Sharpe ratio of the higher turnover strategy equals the reference investment with the lowest turnover.

5. Results

How do the Shariah restrictions and choice of portfolio weights affect investment performance? This paper is among the first to answer this empirical question using a long time span of stock-level return data for the universe of S&P 500 stocks over the period 1986–2014.[7] In Section 5.1, we first present the results of the analysis on the impact of the Shariah restrictions on the portfolio performance. In Section 5.2, we show that the choice of weighting method has a substantial impact on

[6] The Sharpe ratio and Jensen's alpha use the risky portfolio return in excess of the risk free rate. This can be analyzed in two ways. First, it could be seen as comparing the investment in a risky portfolio with an investment in the risk free investment. Since a risk free investment is not allowed in Shariah investing, we prefer the second interpretation that the excess return denotes the return on a risky portfolio that is financed by borrowing at the risk free rate.

[7] Most other studies on the performance impact of Shariah restrictions compare the performance of Islamic and traditional funds (see, e.g., Ashraf, 2016, and the references therein).

Table 3
Performance impact of Shariah restrictions and choice of weighting method.

	Mean (%)	Vol (%)	SR	ASSR	ASKSR	MDD (%)	VaR (%)	Skew	Kurt	TO (%)	BETC
Panel A: Market capitalization weighted portfolio											
All S&P 500 stocks	7.96	15.13	$0.52^{-,-}$	0.44	0.23	53.29	−7.13	−0.79	2.58	2.97	–
Shariah (DJIM)	8.52	14.97	$0.56^{-,-}$	0.49	0.24	50.65	−6.85	−0.63	2.39	4.89	2.57
Shariah (HSBC)	8.22	14.55	$0.56^{-,-}$	0.48	0.24	52.20	−6.67	−0.74	2.44	4.71	2.29
Panel B: Fundamental weighted portfolio											
All S&P 500 stocks	8.47	14.59	$0.58^{-,-}$	0.48	0.23	51.85	−6.81	−0.79	2.78	6.70	1.56
Shariah (DJIM)	9.04	14.18	$0.63^{**,-}$	0.55	0.24	40.87	−6.38	−0.60	2.39	8.41	2.15
Shariah (HSBC)	8.76	14.31	$0.61^{-,-}$	0.51	0.26	44.35	−6.62	−0.73	2.30	8.28	1.70
Panel C: Equal weighted portfolio											
All S&P 500 stocks	9.97	17.20	$0.57^{-,-}$	0.49	0.23	57.41	−7.89	−0.74	3.44	7.06	1.81
Shariah (DJIM)	10.65	17.44	$0.61^{-,-}$	0.54	0.21	47.27	−7.67	−0.49	3.01	9.35	1.87
Shariah (HSBC)	10.77	17.64	$0.61^{-,-}$	0.53	0.22	50.90	−7.85	−0.59	3.30	9.32	1.89
Panel D: Low risk portfolio											
All S&P 500 stocks	7.78	12.40	$0.62^{-,-}$	0.49	0.26	44.46	−5.84	−0.93	3.22	18.78	0.05
Shariah (DJIM)	10.04	13.08	$0.76^{**,-}$	0.59	0.26	36.14	−5.82	−0.79	4.04	22.21	1.23
Shariah (HSBC)	9.64	13.00	$0.74^{*,-}$	0.57	0.27	36.37	−5.89	−0.80	3.19	22.97	1.05

Note: This table reports the annualized mean (Mean (%)), annualized volatility (Vol (%)), Sharpe ratio (SR), adjusted for skewness Sharpe ratio (ASSR), adjusted for skewness and kurtosis Sharpe ratio (ASKSR), maximum drawdown (MDD (%)), Value-at-Risk (VaR (95% confidence interval, in percent), skewness (Skew), excess kurtosis (Kurt), Turnover (TO %) and break-even transaction costs (BETC, in cents per dollar traded) for Shariah restricted portfolios and portfolios invested in all S&P 500 stocks. For the Sharpe ratio, the table also shows the results of significance tests, where *, **, and *** indicate that the Sharpe ratio differs significantly from the Sharpe ratio of the market capitalization portfolio on all S&P 500 stocks and the Shariah-compliant (DJIM) market capitalization portfolio, respectively, at the 10%, 5%, and 1% levels based on the t-test with HAC standard errors. Calculations are based on monthly data for the period of 1986–2014.

the portfolio performance.

5.1. Effects of Shariah restrictions on portfolio performance

For the market capitalization weighted, fundamental weighted, equal weighted and low risk approach to portfolio weighting, we compare the out-of-sample portfolio performance of using the S&P 500 universe versus its Shariah restricted version in Table 3. This table shows the annualized mean, volatility and (generalized) Sharpe ratio of the different types of investment strategies, together with the 95% historical value-at-risk, turnover and break-even transaction cost.

Let us first zoom in on the column "mean" indicating the effect of the Shariah investment decision and the weighting method on the annualized return. We find that, for the S&P 500 universe over the period 1986–2014, imposing the Shariah restriction tends to have a positive effect on the annualized mean returns and outperform the all S&P 500 stocks, hereafter called as market portfolio in all the four cases. For the market capitalization weighted portfolio, the annualized mean is 56 basis points higher in case of the Shariah portfolio. Similarly, we find that for the fundamental weighted equal weighted and low risk portfolio, imposing the Shariah restriction leads to an outperformance in terms of annualized returns of 57, 68 and 226 basis points, respectively.

The other columns of Table 3 indicate that the higher return obtained by imposing the Shariah restrictions comes at the price of a slightly higher value-at-risk, but a lower drawdown. For the market capitalization weighted portfolio and the fundamental weighted portfolio, the Shariah screening increases the turnover and leads to a small improvement in the volatility (14.97% vs 15.13%, 14.18% vs 14.59% respectively). For the low risk portfolio, which is invested in the 100 least volatility stocks, the additional condition of Shariah-compliance increases the portfolio turnover (18.78% against 22.21%). Because of the smaller scope of risk reduction when the universe is restricted by the Shariah screening conditions, the annualized volatility of the Shariah-compliant portfolio is substantially higher than when the low risk investor can invest in all S&P 500 stocks (annualized volatility of (13.08% vs 12.40%).

As in Walkshäusl and Lobe (2012), we find that in terms of Sharpe ratio, imposing the Shariah restriction leads for all portfolio allocations considered to a higher reward per unit of risk: a Sharpe ratio of 0.56 vs 0.52, 0.63 vs 0.58, 0.61 vs 0.57 and 0.76 vs 0.62 for the market capitalization weighted, fundamental weighted, equal weighted and low risk-weighted portfolios, respectively. Since the portfolios invested in the Shariah compliant stocks always have a less negative skewness than their counterpart invested in all S&P 500 stocks, we have that also for the ASSR, the Shariah-compliant stock screening always improves the relative performance. For the ASKSR, we find that all relative performance values are similar. They differ by at most one basis points.[8] We can thus conclude that alternative weighting and Shariah screening both improve the relative performance in terms of the (Adjusted for Skewness) Sharpe ratio, and has only minor effects on the ASKSR.

5.2. Effects of the portfolio weighting methods on portfolio performance

In the previous subsection, we show that Shariah restricting the investment universe tends to have a positive impact on the long run out-of-sample performance. Our main contribution is, however, to study the impact of alternative weighting methods on the performance of Shariah-compliant investments.

The answer to this question is obtained by comparing the results across the different panels in Table 3. We see that, in terms of mean-variance performance, the market capitalization weighted portfolio is dominated by the low risk portfolio. The latter has a higher annualized return (10.04% vs 7.96%) and a substantially lower volatility (13.08% vs 15.13%). In terms of Sharpe ratio and ASSR all the alternative weighting methods out-performed the market capitalization weighted benchmark. For ASKSR the fundamental weighted and the low risk Shariah portfolio outperformed the market capitalization market portfolio. We thus confirm that the findings of smart beta portfolios on general universes also apply to the Shariah restricted universe (see, e.g., DeMiguel et al., 2009 and Plyakha et al., 2014) for the outperformance of equal weighting, and Blitz and van Vliet (2007) for low risk weighting.

Fig. 2 reports also the downside risk of all S&P 500 stocks and Shariah restricted portfolios. The market capitalization weighted portfolio experienced maximum 53.29% drawdown over the period

[8] We also noticed that the value of the ASKSR is sensitive to choices in estimating the underlying Normal Inverse Gaussian (NIG) parameters. Closed form moment-based estimators of the NIG parameters are proposed in Eq. (33) of Zakamouline and Koekebakker (2009), but they tend to be inefficient compared to the maximum likelihood estimates. Unfortunately, the latter is numerically challenging because of the complexity of its likelihood function (see, e.g., Karlis, 2002).

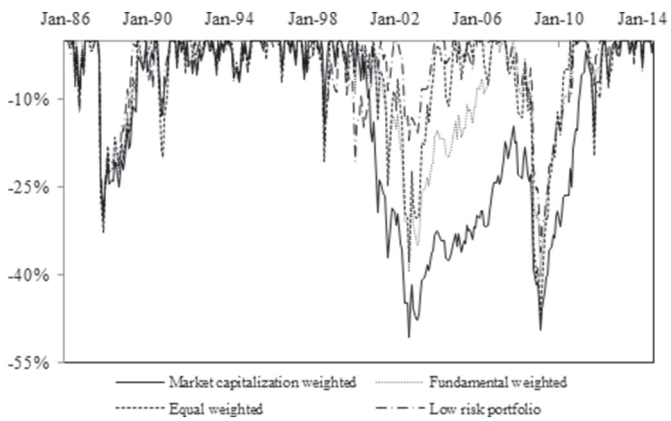

Fig. 2. Drawdowns of monthly rebalanced portfolios invested in the universe of Shariah-compliant S&P 500 stocks over the period 1986–2014. *Note*: This figure shows the time series of monthly drawdowns of the four portfolios invested in Shariah-compliant S&P 500 stocks using the market capitalization weighted, fundamental weighted, equal weighted and low risk allocation strategies. The series of drawdown shows the extent of loss incurred by a Shariah portfolio since the last peak. The drawdown series is calculated with cumulative net asset value of each Shariah portfolio with monthly rebalancing for the period 1986–2014.

1986–2014. Such a high drawdown often leads to fund redemption. The equal-weight market portfolio has relatively higher Sharpe ratio but is exposed to relatively higher drawdowns. Shariah restrictions tend to have positive effect on the drawdown for all the three weighting considered. However, it is the fundamental weighted strategy and low risk strategy which result in the lowest drawdown among all portfolios when applied to the Shariah restricted version of all S&P 500 stocks.

5.3. Style analysis

So far we have demonstrated that, in terms of average return and Sharpe ratio, superior financial performance is achieved by the Shariah-restricted portfolios and alternative allocation strategies compared with the market capitalization weighted portfolio invested in all S&P 500 stocks over the period 1986–2014. However, it is important to know whether this outperformance is driven by exposure to the risk-factors. In this subsection, we use the standard four-factor model of Fama and French (1992) and Carhart (1997) to examine whether the alternative weighted Shariah portfolios exhibit size, value, growth and momentum tilts, and whether the style-adjusted return has a positive and significant alpha. The results of the regression are reported in Table 4.

Results show that the risk-adjusted returns (Jensen's Alpha) increase when the unrestricted benchmark is restricted with Shariah guidelines. The fundamental weighted, the equal weighted and low risk Shariah portfolios are able to generate slightly higher alpha compared with the similarly weighted benchmark. In terms of the effect of the weighting method, we find that, for all weighting methods considered, the Shariah-restricted portfolio outperforms its unrestricted counterpart using the same weighting approach.

In terms of risk factor exposure, we see in Table 4 that the Carhart factors explain more than 85% of the return variation of the market capitalization, fundamental value and equal weighted Shariah restricted portfolios. In case of the low risk Shariah portfolio return, the explanatory power is above 73%. It is important to note that the exposures are different from the market capitalization weighted portfolio exposures. This holds in particular for the low risk portfolio, which has a lower market exposure. This explains why it tends to underperform the market portfolio in bull markets and outperform it in bear markets. It is also important to see the change in the factor exposures because of the Shariah restriction not to invest in the financial sector. As already shown in the weight allocations, this restriction tilts the portfolio towards growth stocks (information technology). This growth tilt in

Table 4
Alpha and factor exposures obtained using the four-factor Fama-French-Carhart model to explain the monthly 1986–2014 excess portfolio returns, when the universe consists of the (Shariah-compliant) S&P 500 stocks and market capitalization, fundamental value, equal weighting and low risk weighting are used.

	Alpha	MKT	SMB	HML	MOM	R^2
Panel A: Market capitalization weighted portfolio						
All S&P 500 stocks	-0.001*	0.96***	-0.18***	0.03	-0.03*	0.96
Shariah (DJIM)	-0.000	0.90***	-0.20***	-0.20***	-0.01	0.92
Shariah (HSBC)	-0.000	0.89***	-0.21***	-0.08***	-0.00	0.91
Panel B: Fundamental weighted portfolio						
All S&P 500 stocks	-0.000	0.89***	-0.15***	0.19***	-0.10***	0.92
Shariah (DJIM)	0.002	0.85***	-0.22***	-0.01	-0.07***	0.89
Shariah (HSBC)	0.000	0.86***	-0.19***	0.07***	-0.07**	0.89
Panel C: Equal weighted portfolio						
All S&P 500 stocks	-0.000	1.02***	0.03***	0.24***	-0.16***	0.92
Shariah (DJIM)	0.001	0.99***	0.03	-0.01	-0.15***	0.88
Shariah (HSBC)	0.000	1.02***	0.05	0.12***	-0.15***	0.88
Panel D: Low risk portfolio						
All S&P 500 stocks	-0.001	0.71***	-0.26***	0.30***	0.03	0.76
Shariah (DJIM)	0.000*	0.75***	-0.26***	0.19**	0.06	0.73
Shariah (HSBC)	-0.000	0.75***	-0.25***	0.25***	0.05***	0.75

Note: This table reports the results of the four-factor momentum model Carhart (1997). We regress the monthly returns of the considered portfolios (in excess of the risk free rate) on the constant, market excess returns (MKT), Small Minus Big returns (SMB), High Minus Low returns (HML) and Winners Minus Losers Momentum (MOM) Factor, using monthly returns for the period January 1986 to July 2014 with monthly rebalancing. We present here the intercept (Alpha), the coefficients (beta) for the factors, and the R^2 of the regression. ***,** and * represent the significance levels at the 1%, 5%, and 10% level, respectively, based on the t-test with HAC standard errors.

Shariah portfolios is consistent with the findings of Hoepner, Rammal, and Rezec (2011) and Walkshäusl and Lobe (2012). The low risk strategy does not have this growth tilt, because it is invested in the one hundred least risky stocks, which tend to be value stocks.

These findings further strengthen the analysis of raw performance demonstrated in the previous sections. The superior performance of equal weighting in terms of alpha is due to the contrarian nature of this allocation technique. The monthly rebalancing with equal weighting provides naive diversification and is able to exploit stock price reversals (Jegadeesh, 1990; Jegadeesh & Titman, 1993, 2002). The results for superior performance of alternative weighting approaches on a restricted investment universe is consistent with the findings of Bertrand and Lapointe (2015), however, their restricted universe is based on socially responsible investment screening rather than Shariah-compliant screening guidelines.[9]

5.4. Turnover analysis

The main results on the relative performance of the Shariah-compliant market capitalization weighted portfolio compared with the alternative allocation methods are in favor of the latter. The former has, however, the advantage of a lower turnover. The second last column of Table 3 shows the turnover of the portfolios.

A first important observation is that the turnover of the Shariah-compliant portfolios depends on the weighting method used. In case of market capitalization weighting and fundamental weighting it increases from 2.97% to 4.89% and 6.70% to 8.41% respectively, due to the Shariah restrictions. For equal weighting and low risk strategy, the turnover is 7.06% and 18.78% on the S&P 500 universe and increases to 9.35% and 22.21%, when imposing the Shariah screens.

[9] While Shariah-compliant equity investing is considered to be conceptually close to socially responsible investing (SRI), the Shariah-compliant equity universes are very different from those obtained using traditional SRI screens. For example, in contrast with the SRI universe, a Shariah-compliant equity universe typically has a large proportion of industrial and energy firms, while virtually not investing in financial firms (Erragragui & Revelli, 2016).

Turnover decreases the net returns. As explained in Section 4.3, since the higher turnover strategies have a higher Sharpe ratio than the plain-vanilla market capitalization weighted approach on the S&P 500 universe, we can compute the break-even transaction costs in terms of cost per dollar traded to equalize the performance in terms of net returns. The higher the break-even transaction costs (in cents per dollar traded), the more robust the outperformance is with respect to transaction costs.

The results of the break-even analysis are presented in the last column of Table 3. The break-even transaction costs are always positive and larger than one cent per dollar traded. This indicates that the profitability is robust to the presence of transaction costs.[10] Compared with the traditional market capitalization weighted portfolios, the highest gains, as measured by the break-even transaction costs, are achieved by imposing the Shariah screening conditions. Smaller, but still economically significant, gains are obtained by the use of the alternative weighting approach of using low risk weighting or equal weighting, especially when combined with Shariah screening.

6. Robustness

In this section, we test the robustness of our results against alternative implementations of the Shariah guidelines in screening the investment universe, and with respect to the period of analysis.

6.1. Alternative choice of Shariah restrictions

The consensus among Shariah scholars is that there must be both qualitative and quantitative screens in selecting the Shariah-compliant stocks, but the actual choice of quantitative screens may vary significantly in terms of financial ratios, threshold level and divisor between the leading Islamic equity index providers (S&P Shariah, DJIM, FTSE, MSCI and HSBC Amanah). Broadly speaking, these guidelines can be classified into two groups based on the difference in denominator in financial ratios, i.e. the use of market capitalization versus the use of the total assets value. DJIM and S&P Shariah use nearly identical financial ratios, threshold levels and market capitalization as divisor. In contrast, HSBC Amanah, FTSE and MSCI use total assets as a divisor in financial ratios. The differences in these two groups have an impact on the outcomes of stock screening. The Shariah-compliant universe obtained varies in the number of stocks and leads to different sector allocations, as can be seen in Fig. 1 and Table 1, respectively. The Shariah screening guidelines based on total assets results in relatively larger compliant assets universe. The average number of Shariah-compliant stocks with HSBC guidelines is 202 which is higher than the universe obtained by using DJIM criteria. In comparison to DJIM, the HSBC universe shows more exposure to energy, materials, telecommunication and utility sectors with market capitalization weighting strategy. Similarly the HSBC criteria shows more exposure to the consumer discretionary telecommunication and utility sector with fundamental weighting. However, when using the low risk or equal weighting methods, the average allocation in consumer staples, health care and information technology is reduced and relatively larger weights are assigned to the utilities and telecommunication sectors.

These difference in terms of cardinality and sector allocations are expected to affect the performance of the Shariah-compliant portfolios. Table 3 shows the raw and risk adjusted performance, using the HSBC criteria. Comparing it with the main results using the DJIM criteria in Table 3, we find that, also using the HSBC Shariah screening rules, the performance is improved by imposing the Shariah screening and the use of alternative weighting methods, but that the gains are smaller than when the DJIM screening criteria are used. This is in contrast with Obaidullah (2005), who favored strategies with book value of total assets as divisor, but is consistent with Derigs and Marzban (2009), who observed superior performance when using market capitalization as a divisor in the Shariah screening conditions (see Section 3.1).

6.2. Subperiod analysis and the effect of market turmoil

The main results are presented for the full sample period 1986–2014. Over this period, we find an outperformance of the fundamental weighting, equal weighting and low risk weighting compared with market capitalization weighting, and also that Shariah screening tends to improve performance. However, the actual relative performance is likely to be time-dependent.

In Table 5 we evaluate in detail the effect of portfolio design on portfolio performance in the three crises periods (Black Monday, Burst of Dot Com bubble and Global Financial crisis) and three bull market regimes over the 1986–2014 period. We expect that the low risk strategy, which overweights low beta stocks, tends to underperform the market capitalization weighted portfolio in bull markets, and outperform in bear markets. Similarly, the equal weighting approach is a value strategy which benefits from price reversals. We therefore expect the low risk portfolio to be less exposed to market downturns, and that, for the fundamental weighted portfolio and the equal weighted portfolio, it depends on the nature of the market drop.

The results in Table 5 confirm that the impact of the equity turmoil depends on the weighting method and the type of equity crisis. Consider first the results for the portfolio invested in all S&P 500 stocks. We find that the burst of the internet bubble leads to a loss of 25% for the market capitalization weighted portfolio. The alternative approach of fundamental value, equal and low risk weighting lead to a loss of 18%, 14% and 0% respectively. The resilience of the low risk portfolio can be explained by its low weight allocation to the growth stocks, as can be seen in Table 1. In the global financial crisis, the losses for all portfolios are between 42% and 46% except for the low risk portfolio which has a 34% loss.

The analysis at the right panel of Table 5 shows that, also for the Shariah restricted universe, the low risk portfolio has a high resistance during the equity turmoil. Table 5 also provides insight about the effect of Shariah screening on the portfolio performance in equity turmoil. In the Islamic finance literature, some authors argue that Shariah-compliant portfolios tend to perform better in economic crises (see, e.g., Alam & Rajjaque, 2010; Ashraf & Mohammad, 2014; Reddy & Fu, 2014), while others emphasize that the relative performance of the Shariah restricted portfolios compared with the conventional portfolios depends on the type of crisis (see, e.g., Nainggolan, How, & Verhoeven, 2015). We agree with the latter and expect that, for our S&P 500 universe, the Shariah-compliant market capitalization weighted portfolio will tend to underperform in the Black Monday and the Dot Com equity crisis and outperform in the 2008 global financial crisis. In fact, because of the overweighting of technology stocks and underweighting of financial stocks as shown in Table 1, it is natural to expect that the Shariah-compliant portfolio is more exposed to a correction in technology stock valuation, such as the burst of the internet bubble, than to a crisis in the banking sector. We investigate this hypothesis in Table 5, where we present the performance measure per subperiod, based on splitting the subsample around the three major financial crises in the 1986–2014 US equities market: Black Monday, the burst of Dot Com bubble and the Global Financial Crises. The results in Table 5 confirm that, in the first two major crises the Shariah-compliant portfolios underperform the market portfolio, while in the global financial crisis these portfolios generate superior performance.

[10] DeMiguel et al. (2009) note that a realistic value for the proportional transaction cost is around 50 basis points, thus 0.5 cents per dollar traded. Their reference value is based on studies conducted on NYSE stocks in the nineties. Since then, transaction costs have further diminished. Furthermore, when the application is on building smart Shariah equity portfolios, the replication strategy may be synthetic and thus leading to an even lower implementation cost.

Table 5
Sub-period analysis of the performance impact of Shariah restrictions and choice of weighting method.

	All S&P 500 stocks					Shariah restricted S&P 500 stocks				
	Mean (%)	SD (%)	Skew	Kurt	VaR (%)	Mean (%)	SD (%)	Skew	Kurt	VaR (%)
Panel A: Market capitalization weighted portfolio										
Jan 1986–Aug 1987	29.44	16.74	-0.15	0.42	-5.63	33.49	17.45	-0.13	1.13	-5.59
Black Monday	-14.77	24.13	-1.76	3.16	-14.68	-18.07	24.36	-1.50	2.46	-14.84
Dec 1988–Aug 2000	15.12	13.43	-0.37	1.22	-5.40	16.44	13.52	-0.12	0.67	-5.13
Burst of Dot Com bubble	-25.20	17.42	0.19	-0.73	-10.16	-27.57	18.90	0.32	-0.68	-10.86
Oct 2002–Oct 2007	12.15	9.55	0.27	0.59	-3.24	11.85	10.42	0.27	1.09	-3.62
Global financial crisis	-42.55	19.30	-0.47	-0.31	-13.97	-32.68	17.27	-0.62	-0.01	-11.89
Mar 2009–July 2014	22.52	13.35	-0.11	0.13	-4.62	20.17	11.87	-0.08	0.12	-4.06
Panel B: Fundamental weighted portfolio										
Jan 1986–Aug 1987	29.68	15.86	0.03	0.07	-5.00	35.24	16.94	-0.01	0.77	-5.12
Black Monday	-10.66	23.52	-1.68	2.87	-13.90	-15.75	23.12	-1.44	1.96	-13.93
Dec 1988–Aug 2000	12.25	12.46	-0.36	0.70	-5.18	13.58	12.41	-0.16	0.73	-4.85
Burst of Dot Com bubble	-17.53	17.82	-0.36	-0.46	-10.30	-19.64	16.80	-0.02	-0.68	-9.60
Oct 2002–Oct 2007	14.08	10.35	0.48	0.40	-3.28	13.98	10.74	0.58	1.43	-3.29
Global financial crisis	-42.20	19.43	-0.55	-0.08	-14.07	-32.06	17.57	-0.62	-0.10	-11.96
Mar 2009–July 2014	24.16	12.84	0.26	0.50	-3.84	21.36	12.05	-0.03	0.15	-4.01
Panel C: Equal weighted portfolio										
Jan 1986–Aug 1987	30.05	18.07	-0.15	0.00	-6.24	34.90	19.99	-0.16	0.20	-6.80
Black Monday	-12.97	28.01	-1.89	4.06	-16.69	-16.59	28.51	-1.51	2.99	-16.83
Dec 1988–Aug 2000	13.21	14.65	-0.26	1.06	-6.02	15.02	14.83	0.23	2.27	-5.26
Burst of Dot Com bubble	-13.93	20.73	-0.15	-0.60	-11.04	-18.14	22.75	0.16	-0.91	-11.83
Oct 2002–Oct 2007	16.70	11.85	0.55	0.40	-3.64	16.54	13.53	0.44	0.59	-4.46
Global financial crisis	-45.87	24.27	-0.54	-0.23	-16.94	-36.93	22.63	-0.80	0.37	-15.28
Mar 2009–July 2014	29.09	16.30	0.44	1.53	-4.66	27.02	15.61	0.31	0.93	-4.75
Panel D: Low risk portfolio										
Jan 1986–Aug 1987	28.79	16.26	-0.34	0.09	-5.72	36.28	18.93	-0.39	0.26	-6.54
Black Monday	-11.70	20.58	-1.54	2.64	-12.24	-12.63	23.40	-1.69	2.79	-14.03
Dec 1988–Aug 2000	9.36	2.35	-0.32	0.16	-5.34	11.93	13.07	-0.13	1.24	-5.21
Burst of Dot Com bubble	-0.01	12.77	-0.55	-0.33	-6.45	0.88	12.53	-0.10	-0.56	-5.83
Oct 2002–Oct 2007	10.64	6.63	-0.05	0.30	-2.27	11.94	6.88	-0.08	-0.62	-2.34
Global financial crisis	-34.18	17.67	-0.90	0.30	-12.58	-28.23	17.41	-0.78	-0.18	-11.64
Mar 2009–July 2014	18.70	8.70	-0.21	-0.58	-2.80	19.86	9.09	-0.03	-0.56	-2.78

Note: This table shows the portfolio performance statistics for the pre-crises, post-crises and three major crises over 1986–2014, namely Black Monday (Sep 1987–Nov 1988), the burst of the Dot Com bubble (Sep 2000–Sep 2002) and the global financial crisis (Nov 2007–Feb 2009). The crises are those periods with the largest drawdown in terms of cumulative loss from peak to trough. We report the annualized mean, annualized standard deviation (SD), Skewness (Skew), excess kurtosis (Kurt) and 95% historical value at risk (VaR) per subperiod.

7. Conclusion

It has become popular to use stock screening rules and weighing methods to automate the dynamic rebalancing decision of the equity investor. Often, the rule of thumb in standard financial theory is to invest in all available stocks in proportion to their market capitalization. This practice is, however, not acceptable for the Islamic finance investor. The Shariah law strictly prohibits investments in sectors that are considered to be *haram* and also prohibit investing in firms with high revenues from interest. It follows that a Shariah-compliant equity portfolio is obtained as the result of first screening the universe for permissible stocks and then deciding on the portfolio weights.

In general, the Shariah-compliant investment community is rather explicit on the motivation for the stock exclusion criteria, but silent on the choice of weighting method. Most often, market capitalization weighting is used. In this article, we contribute to the paradigm of Derigs and Marzban (2009) that Shariah-compliance should not only be seen as an attribute at the individual asset level, but also at the portfolio level. It implies that, even when a so-called Shariah compliant equity universe has been obtained using sector and financial screens, the objective of Shariah-compliance may still lead to preferences in terms of the weighting method used. We investigate this by comparing the traditional approach of market capitalization weighting with the alternatives of equal-weighting, fundamental-weighting and low risk weighting. We provide theoretical and empirical arguments that, in some cases, the alternative rule-based weighting methods are to be preferred over the use of market capitalization weights, both in terms of achieving the primary objectives of Shariah investing, and in terms of the secondary objective of optimizing the financial risk-adjusted performance. In fact, for the period 1986–2014, we show that these three alternative weighting methods lead to a better risk-adjusted performance for the Shariah restricted S&P 500 universe. Our second contribution is thus to provide empirical evidence to the increasing literature questioning the efficiency of market capitalization based equity weighting. We show that this result also holds for the Shariah restricted portfolios.

The bottom line of this paper is that the recent popularity of smart beta portfolio allocations in conventional equity portfolio investing can be expected to lead to improvements in the design of Shariah-compliant equity portfolios. Alternative choices of weighting like the use of fundamental weighting, equal weighting and low risk investing can be seen as more adhering to the Shariah investment principles, and, over sufficiently long investment horizons, they tend to have a better risk-adjusted performance, as shown in this paper for the Shariah-compliant stocks in the 1986–2014 S&P 500 universe. Further research is needed to confirm the robustness of our findings with respect to non-US stocks.

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