

A new model for screening Shariah-compliant firms

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Abstract

In this paper, a new quantitative measure is developed to assess how well a firm complies with Shariah compared to other firms in a particular region. Investors can customize this measure according to their goals, constraints, and beliefs. The following two reasons make the use of this measure preferable to the existing use of ratio thresholds. First, it provides the Shariah-compliant investor with a clear understanding of the relative compliance status of each company he wishes to invest in. Second, it can be incorporated into any portfolio optimization model to ensure Shariah-compliance without compromising investment returns. Finally, the paper makes use of a sample of US publicly traded companies to demonstrate its illustrative results.

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1. Introduction

When investing in the equity capital markets, countries and investors that adhere to sharia law often apply qualitative and quantitative screens to exclude equity firms that are non-compliant with sharia. Qualitative screens are sectoral screens enabling firms to exclude industries that are not permitted by sharia law (e.g., gambling, tobacco, alcohol) (Arslan-Ayaydin et al., 2018; Ashraf, 2016; Derigs & Marzban, 2008). Implementing sectoral screening is relatively straightforward and excludes only a small proportion of equity firms. Firms that can pass the qualitative screens are subject to quantitative financial screening through which only firms that are involved in

negligible impermissible activity (e.g., minor interest payments or occasional sale of liquor) are deemed sharia compliant. Those with impermissible activities that exceed a “subjectively specified” threshold are considered sharia noncompliant. Unlike sectoral screening, financial screening methods are vague (Ashraf, 2016) and apply to nearly all equity firms because almost all firms make interest payments.

Although sharia experts have arrived at an overwhelming consensus that interest is a grave and sinful act in Islam, many contemporary sharia experts argue that minor impermissible acts do not render an entire firm impermissible, as in today's world it is almost impossible to find a firm that is fully sharia compliant. There might be a few, but they cannot cater to all sharia-compliant investors and might lead to a concentration of wealth, risking the assets of sharia-compliant investors (DeLorenzo, 2000). In addition, sharia-compliant equity investors, in most cases, are minority investors with limited control and voting power. If a shareholder objects to an impermissible contract, and his objection is overruled by

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majority vote, one cannot conclude that the contract is approved by that shareholder (Derigs & Marzban, 2008; Rahman et al., 2010). Hence, investing in some sharia-noncompliant firms became permissible because of the absence of an ideal alternative and because there is a need (*darurah*) that must be satisfied with the least harm and the most benefit. However, investors are required to express their disapproval of impermissible dealings and to protect their earnings from any impermissible income.

Based on this view, several sharia-compliant equity funds and index providers have emerged.¹ Most of them follow similar criteria in implementing sectoral screening. Yet as a consequence of different interpretations of sharia, noteworthy discrepancies arise between the different kinds of financial screening.² This is the reason for different threshold values, which are subjective in nature (Ashraf & Khawaja, 2016; Derigs & Marzban, 2009; Nisar & Khatkhatay, 2007). For example, regarding the ratio of interest-bearing debt to total assets, a wide threshold dispersion, ranging from 25 to 50 percent, exists among the different financial screening guidelines. In addition to these discrepancies, using thresholds to classify firms as “sharia compliant” or “Islamic” is problematic. For example, a debt-to-assets ratio threshold of 33 percent implies that firms with a debt ratio of 34 percent are sharia noncompliant, whereas firms with a debt ratio of 32 percent are indeed sharia compliant. It also implies that firms with a 15 percent debt ratio are as compliant as firms with a 5 percent debt ratio. The reality is that none of these firms are fully compliant, but some are more compliant (i.e., transgress sharia less) than others.

In the absence of clear guidelines on sharia screening in the Qur’an and the Sunnah, sharia scholars devised different sharia investment methodologies (Ho, 2015) (Derigs & Marzban, 2008). These variations in the current sharia screening practices have resulted in conflicting and inconsistent classifications, leaving sharia-compliant investors confused and discouraged (Ashraf & Khawaja, 2016; Obaidullah, 2005). This can even lead to sharia-screening arbitrage, in which, using current technology and big data analytics, one can easily construct models for sharia-compliant investors that maximize the benefits and minimize the harms of investing and participating in the world’s equity capital markets. Furthermore, the existing literature points to performance deviations among Islamic equity indexes based on four major index providers’ sharia screening criteria. In other words, using the book value of total assets or the market value of equity as a denominator makes a significant difference in the riskiness of those indexes (Ashraf, 2016; Ashraf & Khawaja, 2016; Derigs & Marzban, 2009).

Among the ways to address these issues are streamlining (Ashraf, 2016), reaching a consensus (Ashraf & Khawaja, 2016), harmonization (Rahman et al., 2010), and unification

or standardization (Derigs & Marzban, 2008; Ho, 2015) of sharia screening methods. Thus the development of an integrated screening framework that is customizable and understandable would surely enhance the reliability and practicality of sharia-compliant equity investment.

Based on these suggestions and the issues raised briefly above (discussed in more detail below), this paper proposes a weighted average sharia-compliance (WASC) percentile. This measure reflects the extent to which a firm adheres to sharia relative to other firms located in a certain region at a certain time. The WASC is a financial quantitative measure that ranges from zero to one and applies only to firms that pass the sectoral screens. Firms whose core business is impermissible are initially excluded and are deemed sharia noncompliant. Firm that pass the sectoral screening is then given various percentile ranks, which are then used to calculate the WASC. For example, a US firm with a 90 percent WASC in 2015 is more sharia compliant than 90 percent of the US firms in 2015. This simple number provides a sharia-compliant investor with a clear precise understanding of the relative compliance status of each firm that is of interest for investment. Hence, it is more sharia appropriate and practicable than the use of thresholds. Also, this single number can easily be incorporated into portfolio optimization models.

The WASC can be customized by specifying the set of financial ratios, the dataset, and the weight for each of its various accounts. Current screening practitioners do not all use the same set of financial ratios when performing the quantitative screens. For example, a debate has arisen among sharia experts as to whether to use market or accounting book values to value the worth of a firm, and this value is used as a denominator for various financial ratios (Nisar & Khatkhatay, 2007). Specification of the dataset is also necessary because the WASC is a relative percentile measure. Because some equity funds are limited to investing their asset base across certain regions, equity funds may have distinctive datasets. Although the availability of multiple formats weakens the consistency of equity screens, it accommodates all the existing views of sharia experts. It can also be designed to be consistent with each portfolio’s objectives and constraints, making the WASC suitable and applicable to a wide number of sharia-compliant equity investors. The WASC cannot take a unified format simply because investors will always have different objectives, constraints, and views about the appropriate set of financial ratios and weights. Hence, each screening practitioner is expected to have distinctive sets of weights, financial ratios, datasets, and WASC values.

Finally, the paper presents illustrative results using a sample of all publicly traded US firms from 2010 to 2016. The results are discussed and compared across different firms, years, sets of weights, and sets of financial ratios. The results indicate that firms with considerable monetary assets and liabilities have varying WASC values, depending on whether book or market values are used as ratio denominators. Moreover, the use of different sets of WASC weights may have significant effects on the WASC if there are large discrepancies between the various percentile accounts used to calculate the WASC. Lastly, the

¹ For example, the Dow Jones Islamic Index, Financial Times Islamic Index, Standard & Poor’s Islamic Index, Morgan Stanley Capital International Islamic Index, Dubai Islamic Bank Fund, and HSBC Amanah Fund.

² Sharia experts consider the opinions of the four major Islamic schools: Hanifah, Malik, Al-Shafie, and Hanbali.

results suggest a negative relationship between each account ratio and its percentile that varies from account to another due to changing aggregate firm behavior over time.

The rest of the paper is organized as follows. Section 2 gives a brief overview of the current sharia-compliant equity screening practices. Section 3 analyzes all the formats used to customize the WASC. We present a general case for the WASC in Section 4. In Section 5, the results are reported, and in Section 6, the conclusion is presented.

2. Current equity screening practices: an overview

In order for an investment opportunity to be considered sharia compliant, it must undergo a series of screening processes. As a general rule, there are two kinds of screening processes: qualitative and quantitative (Arslan-Ayaydin et al., 2018; Ashraf, 2016; Ashraf et al., 2017; Ashraf & Khawaja, 2016; Derigs & Marzban, 2009; Ho, 2015; Nisar & Khatkhatay, 2007; Rahman et al., 2010). The majority of sharia-compliant equity investors begin their screening process by excluding companies that operate primarily in specific industries that are prohibited by sharia (e.g., tobacco and alcohol). Three main industry classification codes are used to perform the sectoral screening: GICS, ICB, and SIC.³ The benefit of using the SIC is that a firm can have multiple SIC codes based on its different business activities, whereas only one GICS and ICB code is assigned to each firm based on its core business activity (Derigs & Marzban, 2008). Table 1 shows the different SIC codes for industries that are deemed sharia noncompliant. Next, firms that pass the sectoral screens are subject to quantitative financial screens. These screens filter out firms involved in impermissible financial contracts that exceed a subjectively specified threshold and are considered sharia noncompliant.

Most sharia-compliant equity investors apply four sets of quantitative financial screens: interest, debt, liquidity, and impermissible income screens.⁴ Interest and debt screens merely focus on investigating the level of interest-bearing investment and finances, respectively. Because sharia experts concur that paying interest is impermissible, the different contemporary debt and interest screens have lower threshold discrepancies than the monetary and impermissible income screens.

Impermissible income screens focus on investigating the level of earnings generated from sharia-noncompliant activities. For instance, they are applied to airlines to measure the amount of income generated from alcohol sales. These screens

are used less frequently by screening practitioners, probably because sectoral screens are already conducted and current accounting standards do not require firms to disclose all sources of income. If the impermissible revenue is significant, it will most likely be reflected in the sectoral classifications (e.g., SIC codes). One can always conduct a thorough investigation of each firm's revenue sources, but such an investigation is costly and impractical, especially because the reliability of the results is only as good as the disclosures.

Liquidity or monetary screens focus on investigating the level of monetary assets.⁵ Because not all sharia experts have the same views regarding the permissibility of monetary assets, a larger threshold dispersion is found among the different contemporary monetary screens. To understand why sharia favors nonmonetary assets (e.g., inventory and plant, property and equipment (PP&E) over monetary assets (e.g., cash and cash equivalents, short- and long-term debt, and accounts receivable), consider these two rather extreme examples. If a firm holds cash as its only asset, then the total value of the firm's outstanding shares must equal the total value of cash holdings. This is because, according to sharia, when money is traded for money, the trade must be precisely equal.⁶ Similarly, if a firm holds accounts receivable and marketable securities as its only assets, then purchasing shares from that firm is viewed as purchasing debt. Sharia clearly prohibits the purchase or sale of debt, regardless of whether it involves interest. Sharia experts all agree about the restrictions involved in purchasing solo monetary assets, but they have different views about attributing the stock price to monetary assets. The least restrictive view suggests that as long as a firm holds nonmonetary assets and the total value of the firm's outstanding shares exceeds that of the total monetary assets, the firm is deemed sharia compliant, because the excess value can be attributed to nonmonetary assets (Nisar & Khatkhatay, 2007).

Similar arguments that apply to monetary assets also apply to monetary liabilities. Specifically, all sharia experts agree about the restrictions involved in selling any solo debt obligations, but they have different views about carrying debt obligations by common stockholders. The least restrictive view suggests that because of the limited liability feature of publicly traded companies, the sale of a firm's common stock is independent of the firm's debt obligations (Nisar & Khatkhatay, 2007).

Ho (2015) identify 34 different sharia investment screening methodologies, and Derigs and Marzban (2008) find nine different methods used by index providers, sharia service providers, Islamic banks, regulators, and funds. According to their findings, equities that are subject to different sharia screening criteria may have significantly different components.

³ The SIC (standard industry classification) was developed in 1937 by the US government. The GICS (global industry classification standard) was developed in 1999 by Standard & Poor's and MSCI. The ICB (industry classification benchmark) was developed in 2005 by Dow Jones and the FTSE.

⁴ See the Dow Jones Islamic Market Indices Methodology (2018), MSCI Islamic Index Series Methodology (2015), S&P Sharia Indices Methodology (2018), and FTSE Sharia Global Equity Index Series (2018). For a comprehensive review of sharia-compliant equity screening practices, see also Derigs and Marzban (2008).

⁵ Monetary assets involve the right to receive a previously determined amount of currency. However, monetary liabilities involve an obligation to deliver a previously determined amount of currency. Most sharia-compliant equity investors use the term "liquid" assets, rather than "monetary" assets. The accounting term "liquid" is inappropriate in this context because it includes inventory and excludes long-term interest-bearing investment. The more appropriate and relevant accounting terminology uses the term "monetary."

⁶ According to sharia, the trade also must be immediate.

Table 1
Industry classification.

Panel A: SIC codes			
SIC Code	Noncompliant Industries	SIC Code	Noncompliant Industries
0132	Tobacco Farming	60xx	Depository Institutions
0213	Hog and Pig Farming	61xx	Nondepository Credit Institutions
2013	Sausage Products	62xx	Security & Commodity Brokers
2082	Breweries	63xx	Insurance Carriers
2084	Wineries	64xx	Insurance Agents Brokers & Service
2085	Distilleries	6797	Mortgage Institutions
21xx	Tobacco Products Manufacturers	6798	Mortgage Institutions
5181	Beer and Ale Merchant Wholesalers	7011	Casino Hotels
5182	Alcoholic Beverage Merchant Wholesalers	78xx	Motion Pictures
5194	Tobacco Merchant Wholesalers	791x	Dance Studios
5735	Musical Instrument and Supplies Stores	792x	Theatrical Producers
5736	Musical Instrument and Supplies Stores	866x	Religious Organizations
5813	Alcoholic Beverages	93xx	Public Finance
5921	Beer, Wine, and Liquor Stores	9711	Weapon Related Establishments
5993	Tobacco Stores		
Panel B: GICS codes			
GICS Code	Noncompliant Industries	GICS Code	Noncompliant Industries
20101010	Aerospace & Defense	30201010	Brewers
25301010	Casinos & Gaming	30201020	Distillers & Vintners
25301020	Hotels, Resorts & Cruise Lines	30203010	Tobacco
25301040	Restaurants	4010xxxx	Banks
25401020	Broadcasting	4020xxxx	Diversified Financials
25401025	Cable & Satellite	4030xxxx	Insurance
25401030	Movies & Entertainment		

Notes: This table reports the different codes for industries that are deemed sharia noncompliant by most sharia compliance screening practitioners. x denotes all discrete numbers from 0 to 9. xx denotes all discrete numbers from 0 to 99. xxxx denotes all discrete numbers from 0 to 9999. The SIC (Standard Industry Classification) was developed in 1937 by the US government. The GICS (Global Industry Classification Standard) was developed in 1999 by Standard & Poor's and MSCI. For more information, see the Dow Jones Islamic Market Indices Methodology (2018), MSCI Islamic Index Series Methodology (2015), S&P Sharia Indices Methodology (2018), and FTSE Sharia Global Equity Index Series (2018).

Similarly, in comparing the screening criteria of the Kuala Lumpur Stock Exchange Islamic Index (KLSESI) and the Dow Jones Islamic Market Index (DJIMI), [Rahman et al. \(2010\)](#) find that the sharia screening standard used by the KLSESI was not as stringent as that of the DJIMI. In another study, [Ashraf \(2016\)](#) suggests the possibility of a meaningful comparison of the intensity of sharia screening standards but fails to acknowledge that indexes following different sharia standards do not share the same investment universe. Different mathematical methods may be used for portfolio construction, and the rebalancing time and frequency may differ. Because of the differences in investment universes, index calculation methodologies, and rebalancing timing of sharia-compliant indexes, a direct comparison of the performance of portfolios with different sharia standards is likely to be biased ([Ashraf & Khawaja, 2016](#)).

Furthermore, according to [Arslan-Ayaydin et al. \(2018\)](#), existing sharia screening methods (especially interest-based revenue ratios) are flawed. In investing, the truly relevant question is whether the firm will have interest-based revenues over the investment horizon, not just whether it had substantial interest-based revenues during the most recent period. Consequently, they propose a forward-looking autoregressive model to forecast the ratio of total interest revenue to total revenue (TI/TR). Although this model outperforms the traditional one, it

addresses only one quantitative measure used in sharia screening.

In short, a lack of consistency in sharia screening processes makes investment by Islamic investors, especially worldwide diversification, cumbersome. Even though the model proposed by [Arslan-Ayaydin et al. \(2018\)](#) partially addresses this issue, a more comprehensive model is urgently needed to make sharia-compliant investment decisions easier. Therefore, the current study proposes a new and relatively simple model that addresses these concerns and offers an alternative method of screening sharia-compliant investment.

3. Specifying the ratios, the dataset, and the weights

3.1. Specifying the ratios

[Table 2](#) presents the main debt, interest, impermissible income, and monetary ratios used by the major sharia-compliant equity funds and Islamic index providers.

3.1.1. Book and market firm value

One major cause of the ratio variations presented in [Table 2](#) is the disagreement over the variable representing the worth of a firm, and this variable is used as a denominator for the various financial ratios ([Arslan-Ayaydin et al., 2018](#); [Ashraf,](#)

Table 2
Definitions of financial ratios commonly used.

	Debt Ratios	Interest Ratios	Impermissible Income Ratios	Monetary Ratios
First Ratio	$\frac{\text{Total Debt}}{\text{Total Assets}}$	$\frac{\text{Cash} + \text{Short} - \text{Term Investments}}{\text{Total Assets}}$	$\frac{\text{Total Impermissible Income}}{\text{Total Revenue}}$	$\frac{\text{Accounts Receivable}}{\text{Total Assets}}$
Second Ratio	$\frac{\text{Total Debt}}{\text{Market Capitalization}}$	$\frac{\text{Cash} + \text{Short} - \text{Term Investments}}{\text{Market Capitalization}}$	—	$\frac{\text{Accounts Receivable}}{\text{Market Capitalization}}$
Third Ratio	—	$\frac{\text{Short} - \text{and Long} - \text{Term Investments}}{\text{Total Assets}}$	—	$\frac{\text{Accounts Receivable} + \text{Cash}}{\text{Total Assets}}$
Fourth Ratio	—	$\frac{\text{Short} - \text{and Long} - \text{Term Investments}}{\text{Market Capitalization}}$	—	$\frac{\text{Accounts Receivable} + \text{Cash}}{\text{Market Capitalization}}$
Sixth Ratio	—	$\frac{\text{Short} - \text{and Long} - \text{Term Investments} + \text{Cash} + \text{Accounts Receivable}}{\text{Total Assets}}$	—	$\frac{\text{Short} - \text{Term Investments} + \text{Cash} + \text{Accounts Receivable}}{\text{Market Capitalization}}$
Seventh Ratio	—	$\frac{\text{Short} - \text{and Long} - \text{Term Investments} + \text{Cash} + \text{Accounts Receivable}}{\text{Market Capitalization}}$	—	—
Eighth Ratio	—	$\frac{\text{Total Interest Income and Expense}}{\text{Total Revenue}}$	—	—

Notes: This table presents the main debt, interest, impermissible income, and monetary ratios used by the major sharia-compliant equity funds and Islamic index providers. Market capitalization is the total market value of a firm's outstanding common shares at a certain time. Cash denotes cash and cash equivalents.

2016; Ashraf et al., 2017; Ashraf & Khawaja, 2016; Derigs & Marzban, 2008). Some funds and indexes use market capitalization as a ratio denominator.⁷ But when stocks are mispriced, market capitalization can lead to undesirable performance for the sharia-compliant investor.⁸ Specifically, overpriced stocks will falsely appear more sharia compliant, whereas underpriced stocks will inaccurately appear less sharia compliant, leaving investors who try to optimize their degree of sharia compliance misled and disadvantaged.⁹

Also, a large body of the corporate finance literature suggests that the amount of corporate leverage collateralized by existing assets will be more than is collateralized by future growth, holding other things equal. Myers (1977) explains why managers often set firms' target leverage ratios relative to book as opposed to market values: "it is not that book values are more accurate than stock market values, but simply that they refer to assets already in place. A significant part of many firms' market values is accounted for by assets not yet in place (i.e., by the present value of future growth opportunities)." Myers's (1977) debt overhang theory explains that corporate leverage can reduce firm value by weakening their incentive to undertake good future investment. Consistent with the debt overhang theory, several empirical studies document that leverage is negatively associated with firms' market value and future growth (e.g., Ahn et al., 2006; Aivazian & Qiu, 2005; Cai & Zhang, 2011; Lang et al., 1996; McConnell & Servaes, 1995). These studies imply that leverage should not be measured relative to market value because growth decreases with leverage and is not yet realized.

In summary, the use of market capitalization is advantageous in that it is independent of discrepancies in accounting standards and reflects the market value of the firm, but the use of market capitalization can be: (1) inappropriate because it mostly accounts for future growth opportunities that are not yet realized, (2) disadvantageous when stocks are mispriced, (3) unstable when prices are volatile, and (4) irrelevant when prices are driven by external market factors. To reduce the effect of price volatility, some investors use average monthly market capitalization to smooth the measure. However, even this is not free of flaws.

Alternatively, the worth of a firm can be accounted for using total book asset value. Indeed, book values tend to be stable and reflect assets already in place, but are more susceptible to discrepancies in accounting standards and reporting biases. To reduce the effects of such discrepancies, time must be spent on correcting the accounting practice differences between countries. Rajan and Zingales (1995) analyze the different accounting practices of multiple countries and describe the modifications required for leverage measures to be

⁷ Or as average monthly market capitalization to smooth the measure and eliminate any seasonality effects.

⁸ Despite an ongoing debate over asset price drivers, both behavioral- and rational-based asset pricing theories tend to agree that there may be temporary price deviations from the fundamental or efficient price.

⁹ The empirical results in Section 5 discuss further why the use of market value as a ratio denominator can disadvantage sharia-compliant investors.

internationally comparable. Alternatively, one can simply use distinctive datasets for each country to avoid the effects of discrepancies in accounting standards.

3.1.2. Monetary assets and liabilities

Another main cause of the ratio dissimilarity in Table 2 is the specification of monetary and interest-bearing assets used to calculate monetary and interest ratios, respectively. Clearly, there is a noticeable overlap in the monetary and interest ratios. This is because all interest-bearing assets are also monetary assets.¹⁰ It is also important to note that some monetary assets are more sharia noncompliant than others. For example, monetary assets that earn greater interest (e.g., bonds) are more sharia noncompliant than monetary assets that earn less interest (e.g., certificates of deposit) or zero interest (e.g., some accounts receivable). In general, long-term interest-based investments and liabilities are likely to be more sharia noncompliant than short-term interest-based investments and liabilities. This is because long-term interest-based investments and liabilities imply an intention to hold these noncompliant deals for a longer time. Also, interest yields often increase with maturity because investors demand higher interest rates for riskier longer-term investments.

To account for this matter, interest and monetary screens can be combined and represented by one measure. This measure can be calculated as a weighted average of several monetary asset accounts with greater weights assigned to the more sharia-noncompliant monetary asset accounts.¹¹ The general equation for the weighted average monetary assets percentile at time t for firm i can be represented as:

$$\text{Monetary Assets}_{i,t} = W_{IBI} \text{Interest} - \text{Bearing Investments}_{i,t} + W_C \text{Cash}_{i,t} + W_R \text{Receivables}_{i,t} \quad (1)$$

where *Interest-Bearing Investments* denotes the monetary investments percentile. It reflects the relative rate at which a firm complies with sharia in that a lower proportion of its total assets are interest-bearing investments. *Cash* denotes the percentile of cash and cash equivalents and reflects the degree to which a firm complies with sharia in that a lower proportion of its total assets are recorded as cash and cash equivalents. *Receivables* denotes the receivables percentile and reflects the extent to which a firm is more sharia compliant in that a lower proportion of its total assets are documented as receivables. W_{IBI} , W_C , and W_R denote the weights of the percentiles of monetary investments, cash and cash equivalents, and receivables, respectively.

Panel A in Table 3 presents the different monetary asset ratios used to calculate the percentiles of monetary investments, cash and cash equivalents, and receivables. Long-term interest-bearing investments can include investments in bonds and long-term notes receivable. Short-term interest-

bearing investments can include investments in certificates of deposit, commercial paper, and short-term notes.

Debt screens can also be decomposed and calculated as a weighted average of several monetary liability accounts with greater weights assigned to the more sharia-noncompliant monetary liability accounts. The general equation for the weighted average monetary liabilities percentile at time t for firm i is:

$$\text{Monetary Liabilities}_{i,t} = W_{LD} \text{LT Debt}_{i,t} + W_{SD} \text{ST Debt}_{i,t} + W_P \text{Payables}_{i,t} \quad (2)$$

where *LT Debt* and *ST Debt* denote the percentile of long- and short-term debt. They reflect the degree to which a firm is more sharia compliant in that a lower proportion of its total liability and equity is classified as long- and short-term debt. *Payables* denotes the percentile of payables and reflects the scale at which a firm adheres to sharia in that a lower proportion of its total liability and equity is recorded as payables. W_{LD} , W_{SD} , and W_P denote the weights of the percentiles of long-term debt, short-term debt, and payables, respectively.

Panel B in Table 3 presents the different monetary liability ratios used to calculate the percentiles of long-term debt, short-term debt, and payables. Long-term debt can include corporate bonds, capitalized lease obligations, nonconvertible debt, and other long-term debt. Short-term debt can include the current portion of long-term debt, commercial paper, convertible debt, and other short-term debt. Payables can include accounts payable and income taxes payable.

In addition to screens for monetary assets and liabilities, other secondary screens may include those for interest revenue and expense and impermissible income. Unlike screens for monetary assets and liabilities, interest screens focus on gauging and verifying interest revenue and expense levels using a firm's income statement, as opposed to using a firm's balance sheet. Impermissible income screens can also be used to verify the level of engagement in impermissible acts, other than interest, that are not captured by the sector screens. Panel C in Table 3 presents the different financial margins used to calculate the percentiles of interest income, interest expense, and impermissible income.

One major limitation in using these secondary screens is that firms tend not to report their insignificant revenue and expense constituents in their financial statements. Hence, these screens may require a thorough investigation of all the sources of each firm's revenues and expenses. But these investigations may not be robust or practical, especially because current accounting standards do not require detailed disclosure of all revenue and expense elements.

3.2. Specifying the dataset

Because the WASC is a relative measure, the dataset must be distinctively specified. The dataset can be all publicly traded companies in one country, multiple countries, one continent, multiple continents, or the entire world. For economic or political reasons, some sharia-compliant equity funds may be

¹⁰ But not all monetary assets (e.g., some accounts receivable) are interest-bearing assets.

¹¹ All sorts of short- and long-term equity investments (e.g., equity stocks, equity investments in other companies) are nonmonetary assets.

Table 3
Definitions of proposed financial percentiles.

Panel A: Monetary Asset Ratios			
	Interest-Bearing Investment Ratios	Cash Ratios	Receivables Ratios
Using Total Assets	$\frac{LT \text{ and } ST \text{ Interest – Bearing Inves.}}{Total \text{ Assets}}$	$\frac{Cash}{Total \text{ Assets}}$	$\frac{Receivables}{Total \text{ Assets}}$
Using Market Capitalization	$\frac{LT \text{ and } ST \text{ Interest – Bearing Inves.}}{Market \text{ Capitalization}}$	$\frac{Cash}{Market \text{ Capitalization}}$	$\frac{Receivables}{Market \text{ Capitalization}}$
Using Average Market Capitalization	$\frac{LT \text{ and } ST \text{ Interest – Bearing Inves.}}{Average \text{ Market Capital.}}$	$\frac{Cash}{Average \text{ Market Capital.}}$	$\frac{Receivables}{Average \text{ Market Capital.}}$
Panel B: Monetary Liability Ratios			
	Long-Term Debt Ratios	Short-Term Debt Ratios	Payables Ratios
Using Total Assets	$\frac{Total \text{ Long – Term Debt}}{Total \text{ Assets}}$	$\frac{Total \text{ Short – Term Debt}}{Total \text{ Assets}}$	$\frac{Payables}{Total \text{ Assets}}$
Using Market Capitalization	$\frac{Total \text{ Long – Term Debt}}{Market \text{ Capitalization}}$	$\frac{Total \text{ Short – Term Debt}}{Market \text{ Capitalization}}$	$\frac{Payables}{Market \text{ Capitalization}}$
Using Average Market Capitalization	$\frac{Total \text{ Long – Term Debt}}{Average \text{ Market Capital.}}$	$\frac{Total \text{ Short – Term Debt}}{Average \text{ Market Capital.}}$	$\frac{Payables}{Average \text{ Market Capital.}}$
Panel C: Income Statement Margins			
	Interest Income Margin	Interest Expense Margin	Impermissible Income Margin
	$\frac{Total \text{ Interest Income}}{Total \text{ Revenue}}$	$\frac{Total \text{ Interest Expense}}{Total \text{ Revenue}}$	$\frac{Total \text{ Impermissible Income}}{Total \text{ Revenue}}$

Notes: Panel A presents the different monetary asset ratios used to calculate the percentiles for long- and short-term interest-bearing investments, cash and cash equivalents, and receivables. Panel B presents the different monetary liability ratios used to calculate the percentiles for long-term debt, short-term debt, and payables. Panel C presents the different financial margins used to calculate the percentiles for interest income, interest expense, and impermissible income. Market capitalization is the total market value of a firm's outstanding common shares at a certain time. Average market capitalization is the average monthly market capitalization over a certain period. Total interest-bearing investments can include investments in bonds, certificates of deposit, commercial paper, and notes. Cash denotes cash and cash equivalents. Receivables can include trade receivables and other current receivables. Total long-term debt can include corporate bonds, capitalized lease obligations, nonconvertible debt, and other long-term debt. Total short-term debt can include the current portion of long-term debt, commercial paper, convertible debt, and other short-term debt. Payables can include accounts payable and income taxes payable.

restricted from investing their asset base in certain countries or sectors. Also, for diversification purposes, some equity funds may initially allocate certain proportions of their asset base across different countries or sectors. Hence, different screening practitioners may have distinctive datasets that are consistent with their objectives and constraints or may have multiple datasets, one for each country or sector.¹²

3.3. Specifying the weights

The general rule is that greater weights should be assigned to accounts that are more agreed-upon by sharia experts, more sharia noncompliant, and more reliably measured.

4. The WASC model

Using Equations (1) and (2), the general equation for the WASC at time t for firm i is:

$$WASC_{i,t} = W_{ML} \times (Monetary \ Liabilities_{i,t}) + W_{MA} \times (Monetary \ Assets_{i,t}) + W_{IRE} Interest \ R / E_{i,t} \quad (3)$$

or:

$$WASC_{i,t} = W_{ML} \times (W_{LD} Long - Term \ Debt_{i,t} + W_{SD} Short - Term \ Debt_{i,t} + W_P Payables_{i,t}) + W_{MA} \times (W_{IBI} Interest - Bearing \ Investments_{i,t} + W_C Cash_{i,t} + W_R Receivables_{i,t}) + W_{IRE} Interest \ R / E_{i,t} \quad (4)$$

where $Interest \ R/E$ denotes the percentile for interest revenue and expense and reflects the relative rate at which a firm complies with sharia in that it has lower interest revenue and expense margins in its income statement. W_{ML} , W_{MA} , and W_{IRE} denote the weights of the percentiles for weighted average monetary assets, weighted average monetary liabilities, and interest revenue and expenses, respectively.

To calculate a percentile, its relevant financial ratios are calculated for all firms in a specific region in a specific year. For each ratio (e.g., ratio of long-term debt to assets), firms with a ratio of zero are initially excluded and are immediately given a percentile of 100 percent. Firms with a ratio higher than zero are counted and ranked numerically from bottom to top based on their ratio. Following the Allen Hazen (1869–1930) method, the percentile of ratio r at time t for firm i is¹³:

¹² Having multiple datasets can be useful for avoiding the effects of discrepancies in accounting standards.

¹³ Ratio r can be any of the ratios presented in Table 3 (e.g., ratio of long-term debt to assets).

Table 4
Descriptive statistics.

Panel A: Using Total Assets and Market Capitalization as Ratio Denominators									
Ratio	Total Assets as a Ratio Denominator				Market Capitalization as a Ratio Denominator				Significance tests
	Obs.	Mean	SD	Median	Obs.	Mean	SD	Median	Difference in means
Interest-Bearing Inv.	19756	0.0740	0.1552	0.0032	19756	0.0559	0.1200	0.0031	0.0181 (0.0000)
Cash	19685	0.1676	0.1951	0.1025	19685	0.1375	0.1557	0.0865	0.0301 (0.0000)
Receivables	19300	0.1207	0.1092	0.0996	19300	0.1421	0.1713	0.0825	−0.0214 (0.0000)
Monetary Asset	18353	0.3647	0.2580	0.3012	18353	0.2967	0.2172	0.2387	0.0680 (0.0000)
LT Debt	18086	0.1555	0.1743	0.1056	18086	0.1800	0.2345	0.0775	−0.0245 (0.0000)
ST Debt	19489	0.0431	0.0923	0.0063	19489	0.0580	0.1312	0.0057	−0.0149 (0.0000)
Payables	19640	0.0718	0.0733	0.0502	19640	0.0955	0.1391	0.0458	−0.0238 (0.0000)
Monetary Liability	16696	0.2517	0.1978	0.2264	16696	0.2562	0.2555	0.1701	−0.0045 (0.0016)

Panel B: Using Market Capitalization and Average Market Capitalization as Ratio Denominators									
Ratio	Average Market Cap. as a Ratio Denominator				Market Capitalization as a Ratio Denominator				Significance tests
	Obs.	Mean	SD	Median	Obs.	Mean	SD	Median	Difference in means
Interest-Bearing Inv.	15970	0.0518	0.1070	0.0033	15970	0.0556	0.1180	0.0033	−0.0038 (0.0000)
Cash	15873	0.1255	0.1379	0.0812	15873	0.1348	0.1543	0.0842	−0.0093 (0.0000)
Receivables	15528	0.1362	0.1579	0.0837	15528	0.1421	0.1673	0.0847	−0.0059 (0.0000)
Monetary Asset	14656	0.2805	0.2006	0.2298	14656	0.2908	0.2115	0.2348	−0.0103 (0.0000)
LT Debt	14506	0.1772	0.2234	0.0860	14506	0.1804	0.2279	0.0877	−0.0032 (0.0000)
ST Debt	15749	0.0536	0.1171	0.0062	15749	0.0582	0.1293	0.0062	−0.0046 (0.0000)
Payables	15832	0.0888	0.1224	0.0454	15832	0.0955	0.1363	0.0470	−0.0067 (0.0000)
Monetary Liability	13355	0.2510	0.2428	0.1740	13355	0.2555	0.2464	0.1778	−0.0045 (0.0000)

Notes: This table reports several descriptive statistics for a sample of 19,960 yearly observations from 2010 to 2016. For each ratio, the number of observations, mean, median, and standard deviation are reported. The last column reports the difference in ratio means. The numbers in parentheses are *p*-values associated with the parametric two-sample *t*-test.

$$Percentile_{r,i,t} = \frac{Rank_{r,i,t} - 0.5}{Number\ of\ Firms\ with\ a\ Positive\ Ratio_{r,t}} \quad (5)$$

5. Illustrative results

To illustrate the use of the WASC, we use merged annual Compustat and CRSP datasets for all publicly traded firms in

the United States over the period from 2010 to 2016. The SIC codes presented in Table 1 are used to exclude all firms that operate primarily in sharia-impermissible industries. This resulted in the exclusion of about 22 percent of our sample database. For the date on which each firm reports its annual financial statements, market capitalization is calculated as share price times total shares outstanding. Average market capitalization is the average monthly market capitalization over the

Table 5
Average ratio frequencies.

	Interest Inv.	Cash	Receivab.	Monetary Asset	LT Debt	ST Debt	Payables	Monetary Liability	Observ.
2010	0.0747 (0.0606)	0.1675 (0.1429)	0.1316 (0.1552)	0.3763 (0.3218)	0.1299 (0.1633)	0.0450 (0.0640)	0.0762 (0.1001)	0.2380 (0.2509)	2921
2011	0.0682 (0.0653)	0.1627 (0.1609)	0.1266 (0.1694)	0.3589 (0.3353)	0.1356 (0.1793)	0.0410 (0.0645)	0.0740 (0.1141)	0.2382 (0.2651)	2833
2012	0.0681 (0.0588)	0.1582 (0.1473)	0.1251 (0.1612)	0.3533 (0.3127)	0.1479 (0.1831)	0.0426 (0.0654)	0.0735 (0.1053)	0.2508 (0.2675)	2768
2013	0.0703 (0.0471)	0.1749 (0.1248)	0.1234 (0.1276)	0.3703 (0.2729)	0.1623 (0.1698)	0.0428 (0.0491)	0.0719 (0.0831)	0.2655 (0.2435)	2813
2014	0.0770 (0.0494)	0.1746 (0.1218)	0.1177 (0.1261)	0.3723 (0.2714)	0.1745 (0.1805)	0.0437 (0.0491)	0.0708 (0.0854)	0.2796 (0.2537)	2947
2015	0.0797 (0.0562)	0.1695 (0.1357)	0.1099 (0.1337)	0.3634 (0.2872)	0.1820 (0.1934)	0.0495 (0.0591)	0.0689 (0.0940)	0.2906 (0.2617)	2923
2016	0.0804 (0.0540)	0.1679 (0.1289)	0.1103 (0.1213)	0.3617 (0.2764)	0.2010 (0.2022)	0.0553 (0.0602)	0.0715 (0.0868)	0.3130 (0.2743)	2551
Average	0.0740 (0.0559)	0.1680 (0.1375)	0.1207 (0.1421)	0.3654 (0.2966)	0.1613 (0.1812)	0.0456 (0.0587)	0.0724 (0.0956)	0.2674 (0.2591)	–

Notes: This table displays the yearly average ratio frequencies from 2010 to 2016. The ratios are calculated using total assets as a ratio denominator. The ratios in parentheses are calculated using market capitalization as a ratio denominator. Observ. reports the number of firms in a given year in the sample.

Table 6
Average ratio and percentile frequencies and WASC calculations across different sectors from 2010 to 2016.

Sector	SIC Code	Interest Inv.	Cash	Receivab.	Monetary Asset	LT Debt	ST Debt	Payables	Monetary Liability	WASC	Observ.
Agriculture, Forestry, Fishing	0100 to 0999	0.0477 (0.7459)	0.1032 (0.6670)	0.0940 (0.6237)	0.2449 (0.7319)	0.1606 (0.6831)	0.0333 (0.6744)	0.0601 (0.6784)	0.2540 (0.6794)	0.7030	144
Mining	1000 to 1499	0.0269 (0.8460)	0.1052 (0.6595)	0.0597 (0.7202)	0.1918 (0.8211)	0.2203 (0.6010)	0.0615 (0.7379)	0.0691 (0.5964)	0.3509 (0.6555)	0.7301	2244
Construction	1500 to 1799	0.0347 (0.7389)	0.1174 (0.5391)	0.1860 (0.4586)	0.3381 (0.7049)	0.2243 (0.5776)	0.0538 (0.6468)	0.1001 (0.4360)	0.3782 (0.5982)	0.6462	436
Manufacturing	2000 to 3999	0.0912 (0.7042)	0.2262 (0.4432)	0.1269 (0.4963)	0.4443 (0.6677)	0.1416 (0.7257)	0.0559 (0.7050)	0.0869 (0.4887)	0.2844 (0.7055)	0.6885	14286
Transport. & Public Utilities	4000 to 4999	0.0317 (0.7411)	0.0514 (0.7786)	0.0762 (0.6628)	0.1592 (0.7410)	0.3013 (0.4536)	0.0443 (0.6420)	0.0457 (0.6885)	0.3913 (0.5406)	0.6308	3875
Wholesale Trade	5000 to 5199	0.0205 (0.8482)	0.0875 (0.6683)	0.2300 (0.2821)	0.3380 (0.8019)	0.1951 (0.6352)	0.0667 (0.6536)	0.1737 (0.3119)	0.4355 (0.6264)	0.7054	1173
Retail Trade	5200 to 5999	0.0310 (0.8085)	0.1029 (0.5947)	0.0646 (0.7297)	0.1985 (0.7832)	0.2076 (0.6189)	0.0503 (0.7282)	0.1206 (0.3836)	0.3785 (0.6509)	0.7104	2018
Finance, Insurance, Real Estate Services	6000 to 6799	0.1536 (0.5904)	0.1811 (0.5551)	0.1214 (0.6800)	0.4560 (0.5914)	0.1833 (0.6889)	0.0784 (0.6842)	0.0425 (0.7569)	0.3042 (0.6904)	0.6459	937
Services	7000 to 8999	0.0703 (0.6989)	0.1941 (0.4619)	0.1658 (0.4371)	0.4301 (0.6621)	0.1656 (0.7022)	0.0574 (0.7021)	0.0694 (0.6211)	0.2924 (0.6981)	0.6819	5850
Public Admin.	9100 to 9999	0.1124 (0.7311)	0.2753 (0.5103)	0.0619 (0.7868)	0.4497 (0.7118)	0.0450 (0.9054)	0.1101 (0.7225)	0.0678 (0.7115)	0.2229 (0.8226)	0.7727	390
Average	–	0.0700 (0.7276)	0.1740 (0.5283)	0.1226 (0.5381)	0.3666 (0.6982)	0.1790 (0.6674)	0.0564 (0.6973)	0.0812 (0.5433)	0.3166 (0.6731)	0.6844	–

Notes: This table displays the average ratio and percentile frequencies across different sectors from 2010 to 2016. The numbers without parentheses are average ratio frequencies, whereas the numbers in parentheses are average percentile frequencies. The weights of the various accounts of the WASC are reported in Table 10. Observ. reports the number of firms in a given sector in the sample. Total book value of assets is used as the ratio denominator. The ten sectors are classified according to SIC major group classifications.

twelve months before each firm's annual reporting date. All the ratios in Table 3 are then calculated using total book assets, market capitalization, and average monthly market capitalization as ratio denominators. To show how using different ratio denominators can affect our main financial ratios, in Table 4 we report descriptive statistics for several ratios. For each ratio, the total number of observations, mean, standard deviation, and median are reported. Panel A compares the ratios calculated using total assets as a ratio denominator and using market capitalization as a ratio denominator. Panel B compares the ratios calculated using average monthly market

capitalization as a ratio denominator and using market capitalization as a ratio denominator. The last column displays a statistically and economically significant difference in means for ratios in Panel A, but minor economic significance for ratios in Panel B. Table 5 displays the yearly average ratio frequencies from 2010 to 2016. Of all the other ratios, the average long-term debt ratio remarkably and continually trended upward over time. The other ratios remained relatively stable over the sample period.

Before calculating the percentiles, we divide our database into seven parts, one for each year. It is important to separate

Table 7
Correlation coefficients.

Percentiles	Interest Inv.	Cash	Receivab.	Monetary Asset	LT Debt	ST Debt	Payables	Monetary Liability	WASC
Interest Inv.	1.0000								
Cash	0.1044***	1.0000							
Receivables	−0.0642***	−0.0733***	1.0000						
Monetary Asset	0.9932***	0.2049***	−0.0149***	1.0000					
LT Debt	−0.1231***	−0.3699***	−0.0175***	−0.1616***	1.0000				
ST Debt	−0.1035***	−0.0746***	−0.0104**	−0.1105***	0.1561***	1.0000			
Payables	−0.2374***	0.0275***	0.2915***	−0.2146***	−0.0619***	0.2551***	1.0000		
Monetary Liability	−0.1629***	−0.3165***	−0.0012	−0.1941***	0.8314***	0.6757***	0.1523***	1.0000	
WASC	0.6236***	−0.1014***	−0.0121**	0.6033***	0.5529***	0.4652***	−0.0397***	0.6652***	1.0000
Percentiles with Ratios	−0.7778***	−0.8402***	−0.8605**	−0.4260***	−0.0798***	−0.0761***	−0.0929***	−0.0501***	–

Notes: The table reports the pairwise correlation coefficients between WASC and its various percentile accounts from 2010 to 2016. Total book value of assets is used as the ratio denominator. The weights of the various accounts of the WASC are reported in Table 10. Statistical significance of correlation coefficients: ***, **, and * 1%, 5%, and 10%, respectively. The last row reports the correlation between the ratio and the percentile of each account.

Table 8
WASC calculations for sample companies.

	2013	2014	2015
Panel A: Lumber Liquidators			
WASC using total assets as a ratio divisor	0.9502	0.9648	0.9166
WASC using market capitalization as a ratio divisor	0.9767	0.9772	0.8934
WASC using average market capitalization as a ratio divisor	0.9581	0.9656	0.9121
Market-to-Book Ratio	6.0455	3.6671	1.4489
Panel B: Tesla			
WASC using total assets as a ratio divisor	0.5751	0.5046	0.5667
WASC using market capitalization as a ratio divisor	0.7828	0.7096	0.7367
WASC using average market capitalization as a ratio divisor	0.7352	0.6852	0.7123
Market-to-Book Ratio	8.6492	5.4403	4.6279
Panel C: General Motors			
WASC using total assets as a ratio divisor	0.4249	0.4134	0.3953
WASC using market capitalization as a ratio divisor	0.1649	0.1208	0.1234
WASC using average market capitalization as a ratio divisor	0.1440	0.1158	0.1012
Market-to-Book Ratio	1.1830	1.1403	1.0966

Notes: Panels A, B, and C present the WASC for Lumber Liquidators, Tesla, and General Motors, respectively. For each firm, the WASC is reported over the period from 2013 to 2015 using total assets, market capitalization, and average market capitalization as ratio divisors. Market-to-book ratio is also reported. Market capitalization is the total market value of a firm's outstanding common shares on the firm's annual reporting date. Average market capitalization is the average monthly market capitalization over the twelve months prior to each firm's annual reporting date.

Table 9
WASC calculations for general motors (2015).

	2015	Weight 1	Weight 2	Weight 3
Interest-bearing Investments	0.2937 (15%)	[70%]	[85%]	[85%]
Cash	0.5765 (8%)	[20%]	[10%]	[10%]
Receivables	0.3655 (14%)	[10%]	[05%]	[05%]
Monetary Assets	–	0.3575 [45%]	0.3256 [45%]	0.3256 [35%]
Long-Term Debt	0.5561 (22%)	[55%]	[55%]	[55%]
Short-Term Debt	0.3363 (10%)	[35%]	[40%]	[40%]
Payables	0.2397 (12%)	[10%]	[05%]	[05%]
Monetary Liabilities	–	0.4476 [55%]	0.4524 [55%]	0.4524 [45%]
Interest R/E	–	–	–	0.5436 [20%]
WASC	–	0.4070	0.3953	0.4263

Notes: This table reports the WASC along with its various percentile accounts for General Motors for 2015 using total assets as the ratio divisor. All financial ratios used to calculate the WASC are also reported in parentheses. Three different WASC values are presented using three different sets of weights. The numbers in square brackets denote the weights of the various accounts of the WASC.

Table 10
WASC calculations for general motors (2013–2015).

	Weights	2013	2014	2015
Interest-bearing Investments	[85%]	0.2771 (15%)	0.2876 (15%)	0.2937 (15%)
Cash	[10%]	0.4870 (12%)	0.5079 (11%)	0.5765 (8%)
Receivables	[05%]	0.3891 (14%)	0.3523 (14%)	0.3655 (14%)
Monetary Assets	[45%]	0.3037 (41%)	0.3129 (40%)	0.3256 (36%)
Long-Term Debt	[55%]	0.6635 (13%)	0.6093 (18%)	0.5561 (22%)
Short-Term Debt	[40%]	0.3682 (9%)	0.3698 (8%)	0.3363 (10%)
Payables	[05%]	0.2387 (14%)	0.2522 (13%)	0.2397 (12%)
Monetary Liabilities	[55%]	0.5242 (36%)	0.4957 (39%)	0.4524 (45%)
WASC	–	0.4249	0.4134	0.3953

Notes: This table reports the WASC along with its various percentile accounts for General Motors over the period 2013 to 2015 using total assets as the ratio divisor. All financial ratios used to calculate the WASC are also reported in parentheses. The numbers in square brackets denote the weights of the various accounts of the WASC.

the observation years because the WASC is a relative cross-sectional percentile measure. Firms with a ratio of zero are initially excluded and are immediately given a percentile of 100 percent. For each ratio, firms with a positive ratio are counted and ranked from bottom to top based on their ratio. As per Equation (5), percentiles are then calculated. As per Equation (4), the WASC is then calculated for each firm using three different sets of financial ratio denominator and three different sets of weights. Table 6 displays the average ratio and percentile frequencies across ten sectors based on SIC major group classifications. The last column reports the number of firms in a given sector in the sample after the exclusion of firms that operate primarily in sharia-impermissible industries. A high proportion of our sample firms operate in the manufacturing sector, whereas only 144 yearly firm observations are from the agricultural sector. Table 6 also shows that the average WASC across all sectors is not widely dispersed,

Table 11
WASC calculations for sample companies (2015).

	Weights	Lumber Liquidators	Tesla	General Motors
Interest-bearing Investments	[85%]	1.0000 (0.0%)	0.8635 (0.3%)	0.2937 (15%)
Cash	[10%]	0.6426 (6%)	0.4015 (15%)	0.5765 (8%)
Receivables	[05%]	0.7303 (4%)	0.8569 (2%)	0.3655 (14%)
Monetary Assets	[45%]	0.9508 (10%)	0.8170 (17%)	0.3256 (36%)
Long-Term Debt	[55%]	0.8681 (4%)	0.5079 (25%)	0.5561 (22%)
Short-Term Debt	[40%]	1.0000 (0.0%)	0.1771 (33%)	0.3363 (10%)
Payables	[05%]	0.2247 (13%)	0.2337 (13%)	0.2397 (12%)
Monetary Liabilities	[55%]	0.8887 (17%)	0.3618 (71%)	0.4524 (45%)
WASC	–	0.9166	0.5667	0.3953

Notes: This table reports the WASC along with its various percentile accounts for Lumber Liquidators, Tesla, and General Motors for 2015 using total assets as the ratio divisor. All financial ratios used to calculate the WASC are also reported in parentheses. The numbers in square brackets denote the weights of the various accounts of the WASC.

mainly because the ratios tend to offset one another (e.g., the effect of a relatively low interest-bearing investment ratio in the mining sector is offset by the effect of a relatively high long-term debt ratio in another sector).

Table 7 reports the pairwise correlation coefficients between WASC and its various percentile accounts. Because of the weights format, WASC is highly correlated with the percentiles of interest-bearing investment and debt. Moreover, Table 7 displays a remarkable negative correlation between the percentiles for cash and long-term debt. Firms with larger cash holdings tend to have less long-term debt. Furthermore, all the monetary liability percentile accounts are negatively correlated with the interest-bearing investments percentile. This is probably because firms with high monetary liabilities outstanding are not in a condition to invest in considerable amounts of monetary assets. Lastly, the payables percentile is notably correlated with the percentiles of interest-bearing investment, receivables, and short-term debt.

For demonstration purposes, we present our results for three publicly traded US firms: Lumber Liquidators, Tesla, and General Motors. Table 8 presents the WASC for Lumber Liquidators, Tesla, and General Motors over the period from 2013 to 2015, using total assets, market capitalization, and average market capitalization as ratio divisors. As Panel A indicates, Lumber Liquidators has high WASC values using all three ratio divisors. This is apparent because Lumber Liquidators generally has low levels of monetary assets and liabilities, so using different ratio divisors would not significantly affect the ratios. Firms with considerable amounts of monetary assets and liabilities, however, have varying WASC values depending on the ratio divisor used.

On the one hand, firms with a high market-to-book ratio have higher WASC values when market values (e.g., market capitalization or average market capitalization) are used as ratio divisors. As indicated in Panel B, because Tesla's market-to-

book ratio is high in all three years, its WASC values are higher when market values, as opposed to book values, are used as ratio divisors. On the other hand, firms with a low market-to-book ratio have higher WASC values when the total book asset value is used as a ratio divisor. Panel C shows that General Motors' WASC values are higher when book values are used as ratio divisors. This is because its market-to-book ratio is low in all three years.

Table 8 signifies the importance of choosing the appropriate ratio divisor to calculate the WASC. As discussed in Section 3, the use of market values as ratio divisors may be inappropriate for assessing sharia compliance because they mainly reflect future growth opportunities, rather than current holdings of assets and liabilities. Also, and most important, the use of market values is expected to lead to undesirable investment performance when stocks are mispriced.

Table 9 presents three different WASC values using three different sets of weights for General Motors in 2015 using total assets as a ratio denominator. It seems that the weight effect (i.e., the use of different sets of weights) does not significantly change the WASC. Unlike the first set of weights, the second set of weights assigns different weights to the different accounts for monetary assets and liabilities, whereas the third set of weights assigns different weights to both monetary assets and liabilities and their different accounts. The weight effect may become significant if there are large discrepancies between the various percentile values used to calculate the WASC. Table 10 reports the WASC along with its various accounts for General Motors over the period from 2013 to 2015, using total assets as a ratio divisor. The WASC seems to be stable and consistent over time. To test for WASC persistence, we use the Durbin-Watson statistic and residual plots. Our unreported results show that the time series is positively autocorrelated. This implies that WASC tends to remain the same from one year to the next. In other words, future values of WASC are probabilistically predictable and depend on past and current values.

Table 11 reports the WASC along with its various accounts for Lumber Liquidators, Tesla, and General Motors in 2015, using total assets as a ratio divisor, with the financial ratios used to calculate the WASC reported in parentheses. Lumber Liquidators seems to have a low proportion of monetary assets and liabilities, making it more sharia compliant than 91.66 percent of publicly traded US firms in 2015. It does not have any interest-bearing investment or short-term debt and hence was given a percentile of 100 percent for both accounts. By contrast, Tesla has a very significant proportion of short-term debt and hence was given a short-term debt percentile of 17.71 percent. This percentile means that Tesla's short-term debt obligations are more sharia compliant than only 17.71 percent of publicly traded US firms in 2015. Stated differently, in terms of sharia compliance, Tesla's holdings of short-term debt are worse than 82.29 percent of those of publicly traded US firms in 2015.

Fig. 1 displays the ratios and percentiles of the various WASC accounts for General Motors over the period from 2010 to 2016, using total assets as a ratio divisor. A negative relationship clearly exists between each ratio and its percentiles,

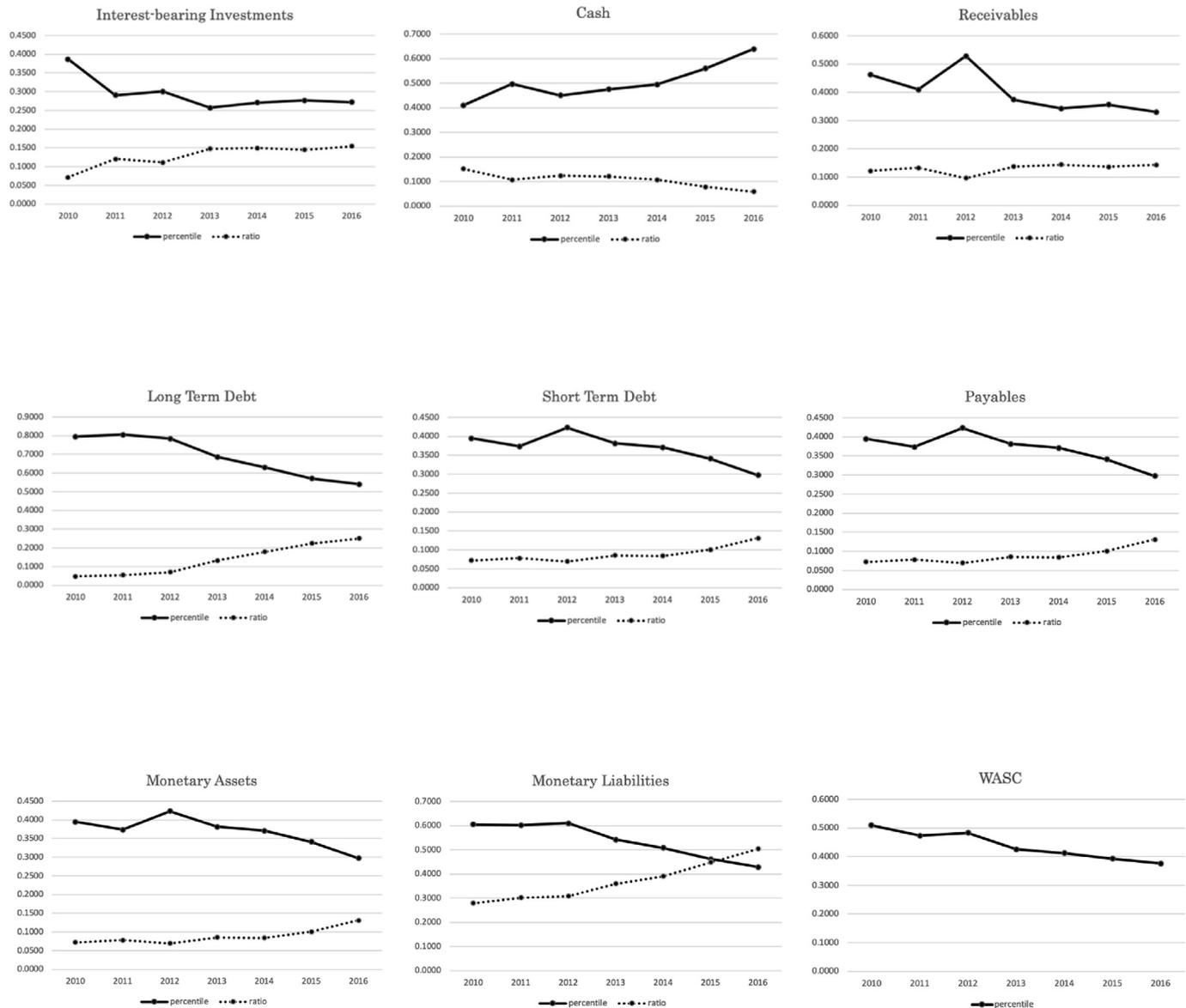


Fig. 1. WASC Ratio and Percentile Calculations for General Motors (2013–2015). *Notes:* These figures report the ratios and percentiles of the various WASC accounts for General Motors over the period 2010 to 2016 using total assets as a ratio divisor. The weights of the various accounts of the WASC are reported in [Table 10](#). The correlation between the interest-bearing investments percentile and ratio is -0.9455 . The correlation between the cash percentile and ratio is -0.9841 . The correlation between the receivables percentile and ratio is -0.9678 . The correlation between the long-term debt percentile and ratio is -0.9929 . The correlation between the short-term debt percentile and ratio is -0.9672 . The correlation between the payables percentile and ratio is -0.9587 . The correlation between the monetary assets percentile and ratio is -0.6369 . The correlation between the monetary liabilities percentile and ratio is -0.9891 .

though this negative relation is not perfect and varies among accounts because of the changing aggregate firm behavior over time. For example, while General Motors' interest-bearing investments ratio remained constant at 15 percent from 2013 to 2015, its interest-bearing investments percentile increased gradually, from 27.71 percent to 29.37 percent over the same period. This is probably because US firms have, on average, experienced an increase in the interest-bearing investments ratio over the sample period (i.e., aggregate US firms' interest-bearing investments behavior has worsened from the perspective of sharia).

[Fig. 2](#) lists the ratios and percentiles of monetary assets and liabilities, along with the WASC for Lumber Liquidators, Tesla, and General Motors over the period from 2010 to 2016 using total assets as a ratio divisor. Because firms are ranked from bottom to top based on their ratio value, firms with the highest ratio for a given account always have the lowest percentile for that account. Also, firms with the second-highest ratio always have the second-lowest percentile, and so on. For example, [Fig. 2](#) shows that, among the three firms, Lumber Liquidators has the lowest monetary assets ratio but the highest monetary assets percentile over the sample period.

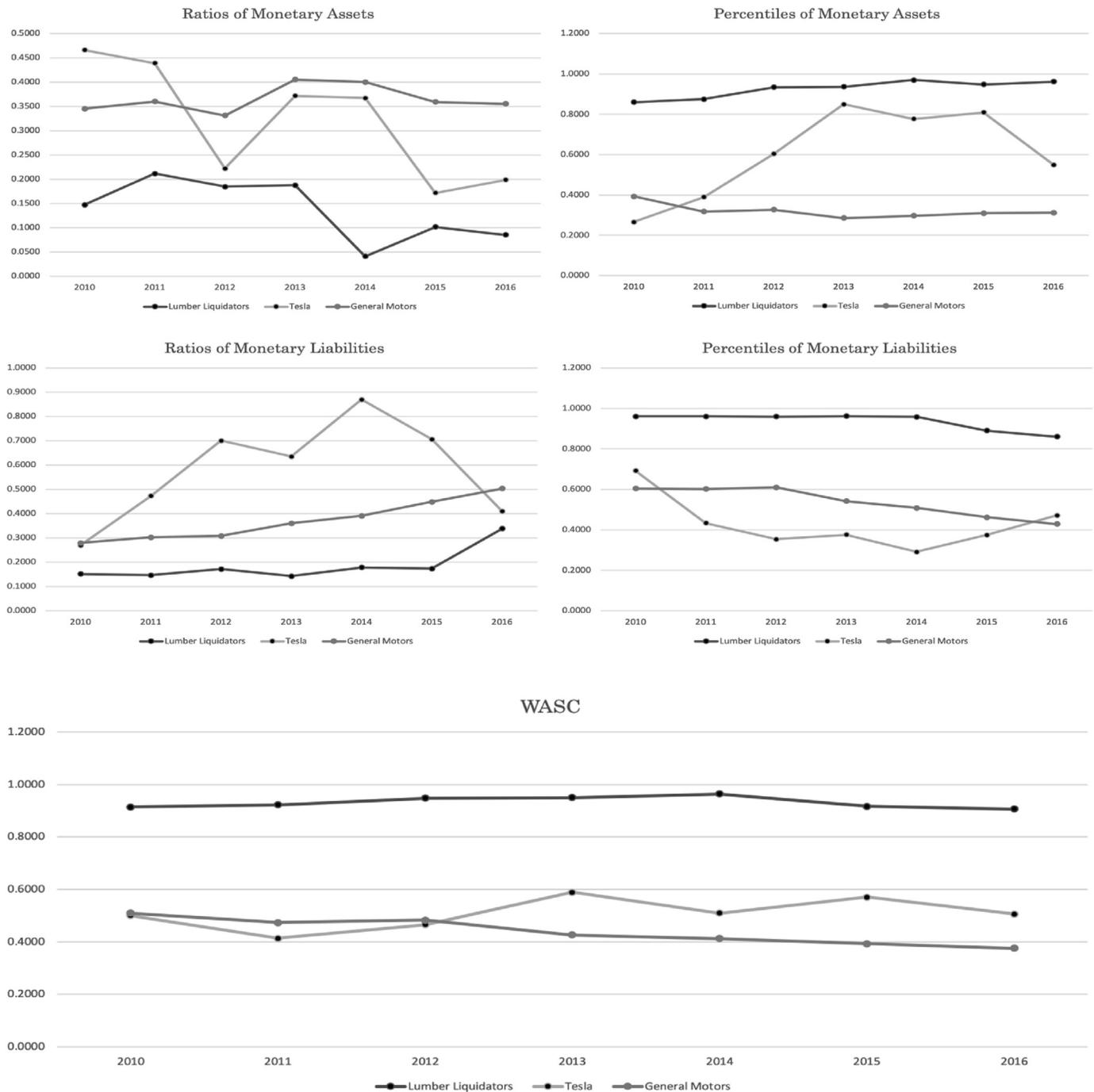


Fig. 2. Ratios, Percentile and WASC for Sample Companies from 2010 to 2016. *Notes:* These figures report the percentiles and ratios of monetary assets and liabilities along with the WASC for Lumber Liquidators, Tesla, and General Motors over the period 2010 to 2016 using total assets as the ratio divisor. The weights of the various accounts of the WASC are reported in Table 10.

6. Conclusion

This paper develops a quantitative financial measure (i.e., WASC) that reflects the rate at which a firm complies with sharia relative to other firms located in a certain region at a certain time. The appealing feature of the WASC is its ability to translate financial sharia-compliance assessments into a simple single precise number, which then can be tested and compared over time and across firms. WASC can be used by academics

to proxy for financial sharia compliance and by fund managers to create a balance between optimizing investment returns and sharia compliance. Furthermore, policy makers could use WASC in their own evaluation and ranking of sharia-compliant investments.

Nevertheless, as with any new proposal, this study has some limitations. First, we analyze all publicly traded firms in the United States. We should consider applying WASC to other countries and regions as well. Furthermore, this study is based

on an analysis of the market as a whole. An assessment of relative compliance by companies would be facilitated by including different sectors and comparing compliance levels within the same sector.

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