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Understanding the Risks in Faith-Based Equity Investments: A Markov Regime Switching Analysis

Nayanjyoti Bhattacharjee[a,*], **Anupam De**[b]

[a.] Department of Management Studies, Bodoland University, Assam, India.
[b.] Department of Management Studies, NIT Durgapur, West Bengal, India.
* Corresponding Author, E-mail: nayanjyotibhattacharjee@buniv.edu.in

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ABSTRACT

Understanding the risks associated with faith-based equity investments assumes greater significance in the wake of the COVID-19 pandemic, which has once again exposed the susceptibility of the financial space to shocks. We use the nonlinear Markov regime-switching model to capture the time-varying beta and idiosyncratic volatility of the US Islamic, US Catholic and Switzerland Islamic equity portfolios provided by Morgan Stanley Capital International (MSCI) using daily index returns data during July 2017 to July 2021. Further complementing the country-level evidence, we refer to the global ACWI Islamic index and World Catholic Values Custom Index. The evidence suggests that the US and Switzerland Islamic portfolio have lower systematic risks during the calm and crisis period. Further, the global Islamic portfolio has lower systematic risks during the calm and crisis period, which signifies the robustness of the evidence. The US and global Catholic portfolio does not exhibit the same risk characteristics.

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1. Introduction

The financial space has evolved with products designed to cater to various faiths (Hill, 2020). There is a growing interest in faith-based equity investments from investors as well as the academics. Faith-based equity investments are based on the religious principles. It allows one to invest without compromising on one's religious beliefs. For instance, there are Islamic indices, which follow Sharia investment principles provided by the Accounting and Auditing Organisation for Islamic Financial Institutions and allow investments in companies with no more than 5 percent revenues from businesses related to alcohol, tobacco, and pork,

traditional financial services based on interest, weapons, gambling or adult industry. Similarly, there are indices, which follow Catholic principles provided by the United States Council of Catholic Bishops. Thus, faith-based equity investments have become increasingly accessible for investors.

Any prudent investment decision is backed by understanding of the associated risks in the investment as envisaged in the classical portfolio theory (Markowitz, 1952). This becomes more pertinent as the World fights the COVID-19 pandemic. The pandemic has disrupted societies and economies around the world like never before. The financial markets have been deeply impacted as well. The equity markets witnessed sharp sell offs in the early days of the pandemic around March 2020. As for instance, we take the reference of MSCI indices for the developed, emerging and frontier market economies. From January 1, 2020 until its March lows, the MSCI World index lost 32.07 percent. Similarly, the Emerging Markets and the Frontier Markets index lost 31.97 percent and 41.5 percent respectively. The equity markets have been associated with heightened volatility due to the COVID-19 pandemic in studies such as Ashraf (2020), Al-Awadhi et al. (2020), Baker et al. (2020), Zaremba et al. (2020) etc. The pandemic has been termed as a "Black Swan Event" (Antipova, 2020; Morales and Andreosso-O'callaghan, 2020) which has exposed the susceptibility of financial markets to shocks. In this view, there is a need to revisit our understanding of the risk dynamics of faith-based investing in an uncertain world we currently live in.

With this objective, we employ the nonlinear Markov regime-switching model (Hamilton, 1989) to analyse the time-varying systematic and idiosyncratic risks in faith-based equity portfolios. We observe that the literature on time-varying behaviour of risks in Islamic and Catholic equity portfolios is scant. Studies which do not take into account the time-varying nature of risks are limited (Rizvi and Arshad, 2017) as they fail to capture the shifts in risks structures with changes in the market environment. The non-linear Markov regime-switching model addresses the limitations of linear models like the autoregressive models (Granger and Terasvirta, 1993; Korley and Giouvris, 2021). It can be effectively used to examine the time series behaviour of the beta (the measure of the systematic risk for a portfolio) in different regimes (states of the market) as the model allows for switching between states. Further, the nuances of the idiosyncratic risk during different states can be also examined through the implied standard deviation or the volatility parameter. To this end, we refer to the MSCI (Morgan Stanley Capital International) indices popularly tracked by industry practitioners for global equity investment decisions for Islamic and Catholic faith to gain insights on the risk profiles of faith-based equity investments. The risk dynamics is studied within the framework of the classical Capital Asset Pricing Model (CAPM) proposed by Sharpe (1964) and Lintner (1965). The choice of the model for the study is guided

by Rivzi and Arshad (2017), Lin and Falk (2021) and Bhattacharjee and De (2022). It may be mentioned that we are also limited in view of the available data for the relevant indices in the study. The motivation for this study is to understand if the systematic and idiosyncratic risk in faith-based equity portfolios change (time-varying character) in different regimes of the market corresponding to prevailing state of the market conditions. Further, we also seek to understand if faith-based equity portfolios have low/high systematic risk with reference to their counterpart mainstream or conventional benchmark equity portfolios. The results of the study provide insights to investors on the risk profiles of faith-based investing especially during a crisis period and thus, facilitate informed investment decisions. The evidence also underscores the relevance of faith-based business models and the diversification benefits of faith-based equity investments. To the best of our knowledge, this is the first study, which explores the dynamics of risks in global equity portfolios based on the principles of religious faith using the Markov regime-switching model based on a sample period, which includes the COVID-19 crisis.

2. Literature Review

Researchers have attempted to understand the risk dynamics of faith-based investments. We provide the review of literature available in reputed outlets indexed by Scopus, Web of Science etc. relating to the risks dynamics of faith-based investments in two parts. First, we provide an account of the studies prior to the COVID-19 and second, we provide the details of the very few studies during the COVID-19 period.

2.1 Studies Prior to COVID-19

In one of the earliest studies, Al-Zoubi and Maghyereh (2007) compared the performance of Dow Jones Islamic index with the World index based on Value-at-Risks (VaR) analysis. The authors explained that the Islamic index is less risky because of the profit and loss sharing principle of the Islamic finance (Mudarabah and Musharaka).

Lyn and Zychowicz (2010) used three different samples between May 2001 to February 2008 to study the performance of faith-based funds and observe that the faith-based funds outperform the market. The faith-based funds also outperform socially responsible investment funds.

Beer et al. (2014) examined the risk dynamics of faith-based mutual funds before and after the financial crisis of 2008. The authors observed high level of co-

movement between Islamic and conventional funds and increased volatility in Islamic funds than the S&P 500 index.

Dewandaru et al. (2015) studied the systemic risks, return, volatility and correlation using Dow Jones Islamic indices for 11 countries, mostly emerging markets. The study used wavelet decomposition in the study using a sample between 2008 and 2012. The study observed that the difference in betas for Islamic and conventional indices is not statistically significant at most timescales with the exception of higher time scales.

Sensoy (2016) compared the systematic risks of Islamic and conventional equity portfolios and documented that Islamic portfolios does not lower market risks during crisis periods with reference to the financial crisis of 2008.

Rizvi and Arshad (2017) examined the time-varying nature of the systematic risk of Islamic and conventional sectoral indices based on estimates of the beta. The authors observed that Islamic equity portfolios have lower systematic risks. The authors highlighted the diversification benefits of Islamic indices. The study used wavelet decomposition and exponential GARCH in the analysis. It was the first study to document the time-varying nature of systematic risks of Islamic equity portfolios. The period of the study was January 1, 1996 to December 31, 2015.

Anwer et al. (2019) compared the risk dynamics of socially responsible investments and faith-based investments with market indices and found socially responsible portfolios have higher systematic risks than Islamic portfolios.

Alam and Ansari (2020) compared the performance of Islamic indices with their mainstream counterparts in India using various risk adjusted performance measures. Measures based on the asset pricing models namely CAPM, Fama-French three-factor model and Carhart four-factor model showed that the performance of Islamic indices vis a vis their mainstream counterparts are not statistically different. The authors highlighted the role of Islamic indexes in diversification. The period of study was from December 2006 to December 2018.

Abduh (2020) investigated the volatility of conventional and Islamic indexes of Malaysia during the global financial crisis and found that the Islamic index was more volatile during the crisis period compared to the conventional index.

2.2 Studies during COVID-19

Umar and Gubareva (2021) used wavelet-based analysis to study the effect of the media coverage of the pandemic on the volatility of the sectoral Islamic equity indices provided by Dow Jones. The study observed that Islamic equity investments have diversification potential during the systemic crisis.

Haroon et al. (2021) examines the systematic risks in Islamic and Conventional sectoral indices during the COVID-19 pandemic. The study is one of the very few researches, which explicitly address the time-varying behaviour of risks in Islamic

indices apart from Rizvi and Arshad (2017) to the best of our knowledge. The authors observe that the behaviour of risks changes as the outbreak assume the status of a pandemic from an epidemic in sectors such as Consumer services, Financials, Healthcare and Oil and Gas. Further, the study highlights the diversification benefits of Islamic equity portfolios.

2.3 Our Contribution to the Literature

Based on the review of the related literature, we observe that the evidence on the risk dynamics in faith-based equity investments is far from conclusive. In the related literature spanning over a decade, we find only a few studies that have systematically delved into the time-varying behaviour of risks in Islamic equity portfolios. These studies provided a sectoral perspective on the subject using Dow Jones sectoral indices. Further, the methodology used in the related literature was based on the Wavelet decomposition and exponential GARCH approach. Wavelet decomposition was used to decompose the original time series data and then the EGARCH model was used on the decomposed time series to estimate the short run and long run beta, which measures the systematic risks. Thus, we can observe that there is dearth of studies, which account for time-varying behaviour of risk corresponding to structural shifts in market regimes owing to economy wide factors. In this context, our contribution to the existing literature on the subject is in two ways. First, we contribute to the scant literature on the time-varying risks in faith-based investments related to Islamic as well as Catholic faith. The evidence in our study is based on global indices provided by MSCI for two large developed markets namely the US and Switzerland. The study also provides a global perspective by examining the global ACWI Islamic Index, which represents the equity portfolio, based on Sharia or Islamic principles for 23 developed markets and 27 emerging markets and World Catholic Index, which represents the equity portfolio based on Catholic principles for 23 developed markets. Second, the use of the Markov regime-switching model in the analysis adds to the debate on the risk in faith-based equity portfolios from a methodological perspective. Our approach does not require priori judgement of different states of the equity market and is determined by the model using the underlying data. This enables an objective assessment of the risk dynamics. This is useful and critical in effectively capturing the dynamic behaviour of the systematic and idiosyncratic risk of faith-based equity investment during a crisis event such as the COVID-19 pandemic. Besides, our work also adds to the limited literature on the impact of COVID-19 on faith-based equity portfolios.

3. Data and Methodology

3.1 Data Sources

We calculate the daily returns (in US dollars terms) of the MSCI US Islamic index, US Catholic index, Switzerland Islamic index, ACWI Islamic and World Catholic Values Custom index to examine the dynamics of risks associated with the equity investments based on Sharia or Islamic and Catholic principles. The list of countries, which are part of ACWI Islamic and World Catholic Values Custom index, is provided in Appendix A for reference. The daily data used in the analysis ranges from July 3, 2017 to July 2, 2021, which is freely accessible from the MSCI website. The study period includes the COVID-19 crisis, which started in the beginning of 2020 until the most recent data. The daily returns are calculated as logarithmic changes in daily closing index prices of the relevant indices. The choice of US Islamic index for the purpose of the study is guided by the fact that the US stocks, which comply with Sharia investment principles, constitute 42.12 percent of the ACWI Islamic index weight as on June 30, 2021. To obtain evidence outside the US, we refer to the Switzerland Islamic Index as Switzerland stocks which comply with Sharia investment principles constitute 8.52 percent of the ACWI Islamic index weight as on June 30, 2021 next only to the US. The high index weights for US and Switzerland underscore the importance of the two developed markets included in the study for global investors. The two markets together constitute 50.64 percent of the ACWI Islamic index. The US Catholic Index included in the study is the only country level index on Catholic Investment principles for which requisite index data is available through the MSCI website. The ACWI Islamic and World Catholic Values Custom index gives us a global perspective on the subject. The country specific US Index and Switzerland Index serves as the mainstream equity portfolios for US and Switzerland. The ACWI and MSCI World index serves as the mainstream global equity portfolio. Further, all indices in the study consists of large and mid-capitalisation stocks. Therefore, the faith-based indices are similar to the benchmark mainstream counterparts in respect to the composition of the size of stocks included in the index. This is imperative for unbiased results (Ahern, 2009).

The summary statistics for the relevant indices is provided in Table 1. The US Islamic index has lower mean daily returns compared to the US Index. The US Catholic index has higher mean return compared to the mainstream US index. The Switzerland Islamic index has an equal mean return compared to the mainstream Switzerland index. The ACWI Islamic index has lower mean return compared to the mainstream ACWI index. The World Catholic index has higher mean return compared to the mainstream World index. The standard deviation of daily returns is lower in case of all Islamic Indices compared to the respective mainstream index. However, the standard deviation of the US and the World Catholic index is slightly

higher than the mainstream index. All index return data series exhibit negative skewness and excess kurtosis.

Table 1. Summary Statistics

Index	Mean	Median	Standard Deviation	Skewness	Kurtosis	N
US Islamic	0.04	0.05	1.27	-0.965	20.943	1044
US Catholic	0.07	0.07	1.36	-1.135	23.436	1044
US	0.06	0.07	1.31	-1.177	23.178	1044
Switzerland Islamic	0.03	0.07	0.93	-1.351	18.494	1044
Switzerland	0.03	0.07	0.95	-1.751	25.885	1044
ACWI Islamic	0.03	0.08	0.96	-1.505	23.721	1044
ACWI	0.04	0.08	1.03	-1.673	26.727	1044
World Catholic	0.05	0.08	1.12	-1.521	27.577	1044
World	0.04	0.08	1.07	-1.597	26.766	1044

Source: Research finding.
Note: N indicates the number of data points. Mean, median and standard deviation are in percentage.

3.2 Stationary Variables

Before estimation of the model, we must ensure that the data series is stationary. We check if the data are stationary using the ADF test (Dickey and Fuller, 1979) and the KPSS test (Kwiatkowski et. al., 1992) on the return data of the indices. The ADF tests checks the null hypothesis that there is unit root in the data while the KPSS test checks the null hypothesis that the data is stationary. In table 2, the test statistic for the ADF test and the KPSS test is presented along with the test results. The data is stationary for the variables under consideration and therefore, we can proceed with further analysis of the data using the Markov regime-switching model.

Table 2. Test Results

	ADF Test		KPSS Test	
Variable	**Test Statistic**	**Null Hypothesis**	**Test Statistic**	**Null Hypothesis**
US Islamic	-9.231*	Reject	0.086	Accept
US Catholic	-9.464*	Reject	0.108	Accept
US	-9.381*	Reject	0.102	Accept
Switzerland Islamic	-32.007*	Reject	0.111	Accept
Switzerland	-32.088*	Reject	0.111	Accept
ACWI Islamic	-9.541*	Reject	0.103	Accept
ACWI	-9.418*	Reject	0.101	Accept
World Catholic	-9.386*	Reject	0.104	Accept
World	-9.373*	Reject	0.105	Accept

Source: Research finding. **Note:** * = 1 percent level of significance.

3.3 Markov Regime Switching Model

The risk dynamics of the equity returns is examined using a two state Markov regime-switching model (Liu et al., 2012; Lin and Falk, 2021) for the US Islamic, US Catholic, Switzerland Islamic, ACWI Islamic and World Catholic index in the study. The model effectively captures the shifts in times series behaviour of underlying data and does not require prior determination of time periods with regard to the events which might cause the shift (Pericoli and Sbracia, 2003). An unobservable regime prevails for a random period of time after which it switches to another regime. From the model, we can estimate the probabilities of switches from one regime to another along with the length of time it takes to switch between regimes. The analysis is based within the framework of the classical capital asset pricing model. Guided by Stapleton and Subrahmanyam (1983) and Lin and Falk (2021), the model used in this paper is given by:

$$\begin{cases} \text{Return}_{t,i} = \beta_1 \, Market_{\,t,m} + \sigma_1 \varepsilon_{\,t,i}\,, \; when \; s = 1 \\ \text{Return}_{t,i} = \beta_2 \, Market_{\,t,m} + \sigma_2 \varepsilon_{\,t,i}\,, \; when \; s = 2 \end{cases} \quad (1)$$

In equation 1, s is the unobservable state (regime) taking the value 1 when the process is in state 1 and 2 when the process is in state 2 respectively. The model follows a first-order Markov process and the parameters are regime dependent. Further, $\varepsilon_t \sim \text{i.i.d.N}(0, \sigma^2)$. The Broyden, Fletcher, Goldfarb and Shanno (BFGS) method is used for model estimation guided by Czech and Wielechowski (2021). $\text{Return}_{t,i}$ is the index return at time t given by the US Islamic, US Catholic, Switzerland Islamic, ACWI Islamic and World Catholic indices respectively. $\text{Market}_{t,m}$ is the market return at time t given by the US Index, Switzerland Index, ACWI index and World index respectively. The selection of the benchmark model is guided by Ahern (2009). The beta (β) captures the systematic risks of the faith-based portfolio and the volatility parameter (σ) captures the idiosyncratic risk of the faith-based portfolio in different regimes. Beta equal to 1 implies that returns of faith-based equity portfolios fluctuate to the same degree as the market returns. Beta less (more) than 1 implies that the return of the faith-based equity portfolio fluctuate less (more) than the market return. In line with the objective of the study, we are primarily interest in the measure of beta and the volatility of the faith-based equity investments and therefore, the intercept term in the CAPM model is not relevant (Liu et al., 2012; Lin and Falk, 2021). The transition probability that regime i will be followed by regime j is given by the following matrix:

$$P = \begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix}, \; P_{i,j} > 0 \quad (2)$$

where i, j =1 and 2.

The regimes can be classified based on the values of the volatility parameter σ_1 and σ_2. We confirm that the two regimes are statistically different through the Wald test guided by Liu et al. (2012), and Lin and Falk (2021). We classify the

high-volatility regime as 'Crisis' period and the low-volatility regime as 'Calm' period in our study based on the estimated parameters of σ_1 and σ_2 for each of the indices. Further, after estimating the transition probabilities between regimes, the expected duration in each regime may be estimated using the equation:

$$E(D_s) = \frac{1}{P_{ij}} \quad (3)$$

where s =1and 2 and i, j =(1,2) .

We also present the smoothed transition probabilities between crisis regime and calm regime during the period of the study. As an additional robustness check, we also test the performance of the Markov regime-switching model used in the analysis against ordinary least squares (OLS) and the asymmetric exponential GARCH based estimates guided by Liu et al., (2012). Guided by Engle and Ng (1993), the mean and the variance equation of the EGARCH (1, 1) is specified as:

$$y_t = m_t + \varepsilon_t \quad (4)$$

$$\text{Log}(h_t) = \omega + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \delta \log(h_{t-1}) \quad (5)$$

In equation 4, y_t is the index return at time *t*, m_t is the market return at time t and the error term is ε_t and in equation 5, the conditional variance is given by h_t, ω is the constant, α is the ARCH term , δ is the GARCH term and γ is the asymmetric term.

The OLS estimate is specified as:

$$y_t = m_t + \varepsilon_t \quad (6)$$

In equation 6, y_t is the index return at time *t*, m_t is the market return at time t and the error term is ε_t .

The widely used minimum Akaike information criterion (AIC), Baynesian information criterion (BIC) and the greater log-likelihood criterion is used for the purpose of performance evaluation of the competing models (Psaradakis and Spagholo, 2003; Liu et al., 2012).

4. Results

4.1 Testing the Presence of Two Regimes

We begin by examining if there is evidence for two distinct regimes in the returns of the US Islamic, US Catholic, Switzerland Islamic, ACWI Islamic and World Catholic index included in the study. We first fit the return data series for each of the indices to a simple linear model with constant mean and volatility and compare its performance with the two state Markov Regime Switching model with no regressor. Our approach is guided by Liu et al. (2012). We present the AIC, BIC and the log-likelihood values for the two models in Table 3. We observe that the Markov regime switching model is favoured by minimum AIC and BIC criterion

for all the indices included in the study supporting the presence of two distinct regimes for all the indices. Further, the greater log-likelihood criterion also favours the Markov regime-switching model for all the indices included in the study supporting the presence of two distinct regimes for all the indices. We also employ the Likelihood Ratio (LR) test (Hansen, 1992; Garcia, 1996; Liu et al., 2012) to compare the models for each of the indices included in the study. The test compares the log likelihoods values of two models and tests whether this difference is statistically significant. The LR test statistic is calculated in the following way:

$$\text{LR test statistic} = 2\{\text{loglik (Model 2)} - \text{loglik (Model 1)}\}$$

where, loglik is the log likelihood value. Model 1 is the simpler model with lesser parameters than the model 2.The values for the test are presented in part D of table 3. The computed values are in excess of the critical values of the 5% and 1% critical values of 13.52 and 17.67, respectively (Garcia, 1998). This underscores the appropriateness of the Markov regime-switching model in the analysis as we confirm the presence of two distinct regimes in the returns of the indices included in the study.

Table 3. Model Performance

Criteria	US Islamic	US Catholic	Switzerland Islamic	ACWI Islamic	World Catholic
Part A.AIC					
OLS	-5.887	-5.754	-6.502	-6.443	-6.127
MRS	**-6.559**	**-6.466**	**-6.786**	**-6.962**	**-6.836**
Part B.BIC					
OLS	-5.882	-5.749	-6.497	-6.438	-6.122
MRS	**-6.531**	**-6.438**	**-6.757**	**-6.934**	**-6.825**
Part C. Log Likelihood					
OLS	3074.342	3004.614	3395.091	3364.476	3199.571
MRS	**3430.086**	**3381.593**	**3548.373**	**3640.405**	**3574.735**
Part D. LR Test					
Test Statistic	**711.488***	**753.958***	**306.564***	**551.858***	**750.328***

Source: Research finding.

Note: OLS signifies ordinary least square model and MRS stands for Markov regime switching model. Values for the best performing model are in bold. The likelihood ratio test statistic follows a chi-square distribution with degrees in freedom equal to the difference in the number of parameters in the two competing models (Garcia, 1996). *=1 % level of statistical significance.

Further, we also assess if the two state model would suffice by running the same analysis with three states for each return series. However, we observe that none of the return series for the indices included in the study has statistically significant parameters for the three state model. Therefore, we may proceed with the two state

model for further analysis in the study. For the sake of brevity, we do not report the results of the analysis in the paper.

4.2 Results from Markov Regime Switching Model

In this section, we present the estimated results of the Markov regime-switching model in Table 4. For the US Islamic index, regime 1 is classified as the crisis period and regime 2 is taken as the calm period based on the estimate of the volatility parameter ($\sigma_1 > \sigma_2$). Thus, we observe that the idiosyncratic risk for US Islamic equity portfolio increases during the crisis period. Further, the US Islamic equity portfolio have lower systematic risks with reference to the US mainstream portfolio during the pandemic in both the regimes ($\beta_1 , \beta_2 < 1$). However, the coefficient estimate of the systematic risks is not statistically different in the two regimes as indicated by the Wald test. This signifies that there is no statistically significant change in the systematic risks of the US Islamic equity portfolio during the crisis and the calm periods. The probability of staying in the crisis regime is slightly lower compared to the calm regime (P_{11}= 96.1 percent versus P_{22} = 96.9 percent) for the US Islamic index. Using equation 3, the duration of the crisis period is expected to be 26 days while the duration of the calm period is expected to be 32 days for the US Islamic index.

For the US Catholic index, regime 1 is classified as the crisis period and regime2 is taken as the calm period based on the estimate of the volatility parameter ($\sigma_1>\sigma_2$). We confirm that the two regimes are statistically different through the Wald test. Thus, we observe that the idiosyncratic risk for US Catholic equity portfolio increases during the crisis period. Further, the US Catholic equity portfolio have higher systematic risks with reference to the US mainstream portfolio during the pandemic in both the regimes ($\beta_1 , \beta_2 > 1$) . Further, the coefficient estimate of the systematic risks is statistically different in the two regimes as indicated by the Wald test. This signifies that there is a statistically significant higher systematic risk during the crisis for the US Catholic equity portfolio compared to the calm period. The probability of staying in the crisis regime is lower compared to the calm regime (P_{11}= 84.9 percent versus P_{22} = 97.1 percent) for the US Catholic index. Using equation 3, the duration of the crisis period is expected to be 7 days while the duration of the calm period is expected to be 34 days for the US Catholic index.

For the Switzerland Islamic index, regime 1 is classified as the crisis period and regime 2 is taken as the calm period based on the estimate of the volatility parameter ($\sigma_1 > \sigma_2$). We confirm that the two regimes are statistically different through the Wald test. Thus, we observe that the idiosyncratic risk for Switzerland Islamic equity portfolio increases during the crisis period. Further, the Switzerland

Islamic equity portfolio have lower systematic risks with respect to the Switzerland mainstream portfolio during the pandemic in both the regimes ($\beta_1, \beta_2 < 1$) . Further, the coefficient estimate of the systematic risk is statistically different in the two regimes as indicated by the Wald test. This signifies that there is a statistically significant lower systematic risk during the crisis period for the Switzerland Islamic equity portfolio compared to the calm period. The probability of staying in the crisis regime is lower compared to the calm regime (P_{11}= 95.6 percent versus P_{22} = 99.4 percent) for the Switzerland Islamic index. Using Equation 3, the duration of the crisis period is expected to be 23 days while the duration of the calm period is expected to be 167 days for the Switzerland Islamic index.

Table 4. Estimated Coefficients of Markov Regime Switching Model

Estimate	US Islamic	US Catholic	Switzerland Islamic
Part A. Regime 1			
$\boldsymbol{\beta_1}$	0.947*	1.053*	0.912*
	(0.010)	(0.011)	(0.021)
$\boldsymbol{\sigma_1}$	-5.593*	-6.0*	-5.449*
	(0.044)	(0.098)	(0.116)
$\boldsymbol{P_{11}}$	0.961	0.849	0.956
$\boldsymbol{P_{12}}$	0.039	0.151	0.044
$\boldsymbol{D_1}$	26	7	23
Part B .Regime 2			
$\boldsymbol{\beta_2}$	0.963*	1.027*	0.985*
	(0.014)	(0.003)	(0.008)
$\boldsymbol{\sigma_2}$	-6.273*	-6.847*	-6.251*
	(0.047)	(0.038)	(0.034)
$\boldsymbol{P_{22}}$	0.969	0.971	0.994
$\boldsymbol{P_{21}}$	0.031	0.029	0.006
$\boldsymbol{D_2}$	32	34	167
Wald test			
$\beta_1=\beta_2$	0.695	4.533**	22.63*
$\sigma_1=\sigma_2$	160.29*	96.281*	188.67*
Durbin Watson Statistic			
d	1.99	2.01	2.01
d-4	2.01	1.99	1.99

Source: Research finding.

Note: ** =5 % level and *=1 % level of statistical significance. D_1 and D_2 are in days. Implied standard deviations can be calculated from the σ parameter. χ^2 values of the Wald test are reported to test the null of equality of parameters in two regimes. The Durbin Watson test statistic d and 4-d is above the critical value of 1.748 (Farebrother, 1980; Lin and Falk, 2021) indicating the residuals are free from first-order autocorrelations.

As a robustness check for the results of the study, we once again do the analysis for the ACWI Islamic and World Catholic index. The results for the ACWI Islamic and World Catholic index would reflect the nuances of time-varying systematic

and idiosyncratic risks with reference to the mainstream equity portfolio at the global level and complement the evidence for the country specific analysis based on the US and Switzerland indices in the study.

4.3 Robustness Check

We present the estimated results of the Markov regime-switching model for the ACWI Islamic index and World Catholic Values Custom Index in Table 5. For the ACWI Islamic index, regime 1 is classified as the crisis period and regime 2 is taken as the calm period based on the estimate of the volatility parameter ($\sigma_1 > \sigma_2$). We confirm that the two regimes are statistically different through the Wald test. Thus, we observe that the idiosyncratic risk for global Islamic equity portfolio increases during the crisis period. Further, the global Islamic equity portfolio have lower systematic risk with reference to the global mainstream portfolio during the pandemic in both the regimes ($\beta_1, \beta_2 < 1$). Further, the coefficient estimate of the systematic risk is statistically different in the two regimes as indicated by the Wald test. This signifies that there is a statistically significant lower systematic risk during the crisis period for the global Islamic equity portfolio compared to the calm period. The probability of staying in the crisis regime is slightly lower compared to the calm regime (P_{11}= 97.1 percent versus P_{22} = 98.1 percent) for the global Islamic index. Using equation 3, the duration of the crisis period is expected to be 34 days while the duration of the calm period is expected to be 51 days for the ACWI Islamic index. For the World Catholic Values index, regime 1 is classified as the crisis period and regime 2 is taken as the calm period based on the estimate of the volatility parameter ($\sigma_1 > \sigma_2$). We confirm that the two regimes are statistically different through the Wald test. Thus, we observe that the idiosyncratic risk for global Catholic portfolio increases during the crisis period. Further, the global Catholic portfolio have higher systematic risk during the pandemic in both the regimes ($\beta_1, \beta_2 > 1$). Further, the coefficient estimate of the systematic risk is statistically different in the two regimes as indicated by the Wald test. This signifies that there is a statistically significant higher systematic risk during the crisis period for the global Catholic portfolio compared to the calm period. The probability of staying in the crisis regime is lower compared to the calm regime (P_{11}= 87.4 percent versus P_{22} = 96.6 percent) for the global Catholic portfolio. Using equation 3, the duration of the crisis period is expected to be 8 days while the duration of the calm period is expected to be 29 days for the global Catholic portfolio.

Table 5. Estimated Coefficients

Estimate	**ACWI Islamic**	**World Catholic**

Part A. Regime 1		
$\boldsymbol{\beta_1}$	0.899* (0.012)	1.062* (0.008)
$\boldsymbol{\sigma_1}$	-5.765* (0.042)	-6.379* (0.081)
$\boldsymbol{P_{11}}$	0.971	0.874
$\boldsymbol{P_{12}}$	0.029	0.126
$\boldsymbol{D_1}$	34	8
Part B .Regime 2		
$\boldsymbol{\beta_2}$	0.979* (0.011)	1.021* (0.004)
$\boldsymbol{\sigma_2}$	-6.581* (0.038)	-7.201* (0.048)
$\boldsymbol{P_{22}}$	0.981	0.966
$\boldsymbol{P_{21}}$	0.019	0.034
$\boldsymbol{D_2}$	53	29
Wald test		
$\beta_1=\beta_2$	21.562*	18.196*
$\sigma_1=\sigma_2$	263.7*	143.65*
Durbin Watson Statistic		
d	2.05	1.96
d-4	1.95	2.04

Source: Research finding.

Note: *=1 % level of statistical significance. D_1 and D_2 are in days. Implied standard deviations can be calculated from the σ parameter. χ^2 values of the Wald test are reported to test the null of equality of parameters in two regimes. The Durbin Watson test statistic d and 4-d is above the critical value of 1.748 (Farebrother, 1980; Lin and Falk, 2021) indicating the residuals are free from first-order autocorrelations.

4.4 Smoothed Transition Probabilities of Regimes

In Figure 1, we present the smoothed transition probabilities between crisis regime and calm regime during the period of the study to visualise the model effectiveness in capturing the regime shifts associated with known events. We can observe that the Markov regime-switching model effectively captures the transition in regimes (from calm regime to crisis regime) at the beginning of the pandemic with probability of crisis regime close to 1 for each of the indices included in the study. The subsequent regime shifts during the period of the COVID-19 crisis reflects the uncertainty as the pandemic continues to evolve. Thus, we can conclude that the model is effective in reflecting the dynamics of the indices under study.

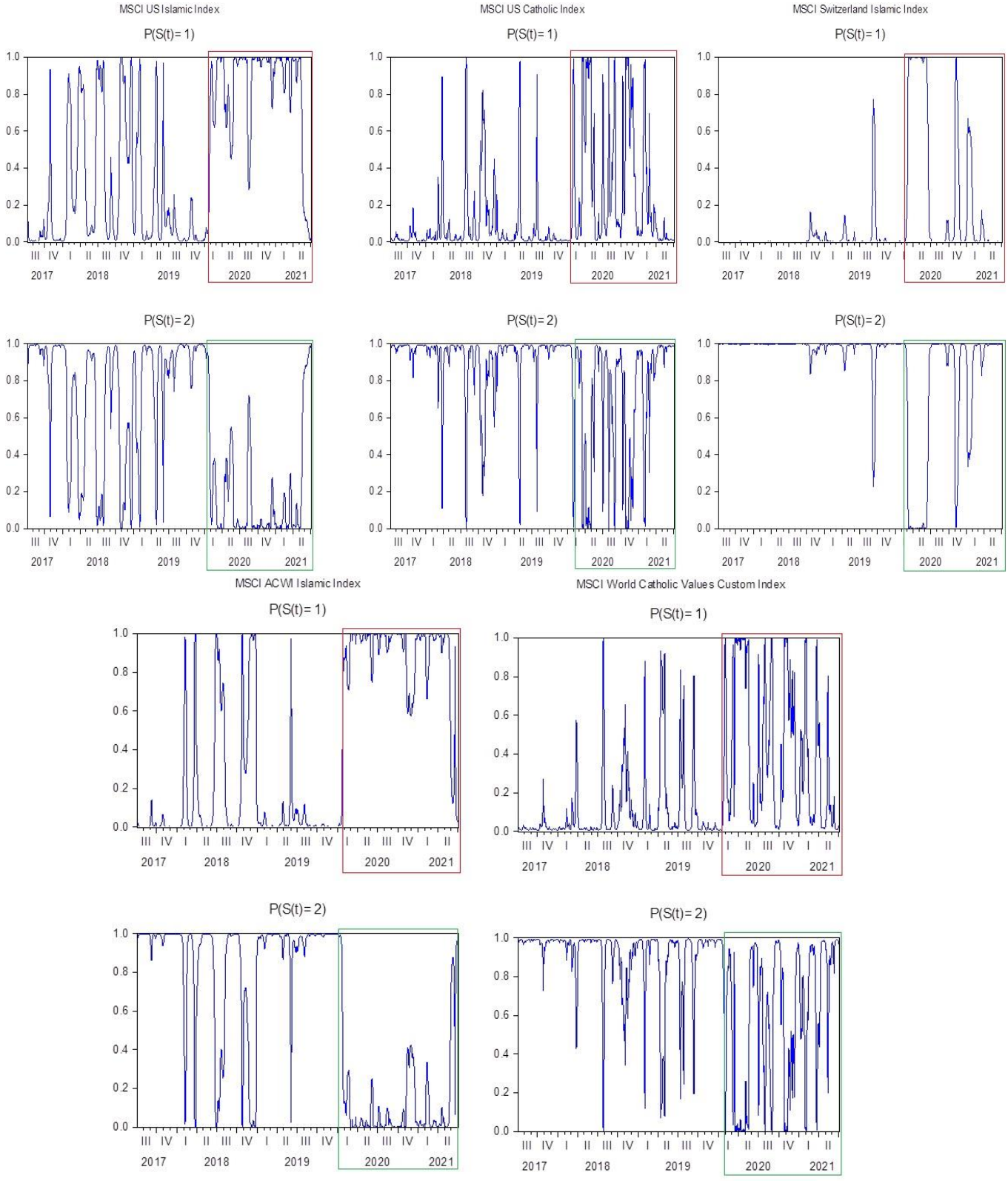

Figure 1. Area in borderline shows regime probabilities during the crisis regime (P(S(t)=1) and the calm regime(P(S(t)=2) during the COVID-19 pandemic for the indices under study

Source: Research finding.

4.5 Additional Checks for Model Performance

We present the estimated AIC, BIC and the log likelihood values for the OLS, EGARCH (1,1) and the Markov regime switching model for the US Islamic, US Catholic, Switzerland Islamic, ACWI Islamic and World Catholic index in Table6. We observe that the Markov regime switching model used in the study performs better than the OLS and EGARCH (1,1) model for estimation of the parameters based on the minimum AIC and BIC criteria as well as the greater log likelihood criterion for all the indices. It may be added that the character of the evidence based on the OLS and EGARCH (1,1) model conforms to the evidence based on the Markov regime switching model. However, the estimated parameters from the OLS and EGARCH (1,1) models are not reported for brevity.

Table 6. Model Performance

Criteria	US Islamic	US Catholic	Switzerland Islamic	ACWI Islamic	World Catholic
Part A.AIC					
OLS	-8.863	-10.295	-9.264	-9.305	-10.875
EGARCH(1,1)	-8.962	-10.402	-9.406	-9.533	-11.039
MRS	**-8.974**	**-10.448**	**-9.426**	**-9.543**	**-11.071**
Part B.BIC					
OLS	-8,849	-10.281	-9.251	-9.291	-10.861
EGARCH(1,1)	-8.933	-10.374	-9.378	-9.501	-11.011
MRS	**-8.936**	**-10.411**	**-9.388**	**-9.505**	**-11.032**
Part C. Log Likelihood					
OLS	4629.923	5377.265	4838.981	4860.291	5780.26
EGARCH(1,1)	4679.751	5431.158	4911.503	4977.923	5763.15
MRS	**4688.305**	**5456.981**	**4923.867**	**4984.731**	**5781.48**

Source: Research finding.

Note: OLS signifies ordinary least square model and MRS stands for Markov regime switching model. Values for the best performing model are in bold.

4.6 Goodness of Forecasts from the Markov Regime Switching Model

We examine the goodness of forecasts obtained from the two state Markov regime-switching model using the residual analysis approach guided by Persio and Vettori (2014). The normality assumption for the residuals can be tested using the Jarque –Bera test and Lilliefors test (Persio and Vettori, 2014). We test the residuals of the Markov regime-switching model for the full sample period used in the analysis, Pre-COVID period (July 3, 2017- December 31, 2019) and the COVID period (January 1, 2020 to July 2, 2021). The results are reported in part A and part B of Table 7. We observe that the Jarque-Bera and the Lilliefors test statistic is statistically significant for the residuals of all the indices included in the study for the full sample period as well as the pre-COVID period, which signifies the goodness of fit of the model, used in the analysis. Further, the Jarque-Bera and

Lilliefors test statistic is statistically significant for the residuals of US Catholic, Switzerland Islamic and World Catholic index for the COVID period. The Lilliefors test statistic is statistically significant for the residuals of US Islamic index while the Jarque-Bera test statistic is statistically significant for the residuals of the ACWI Islamic index for the COVID period.

Table 7. Goodness of Forecasts

Test Statistic	US Islamic	US Catholic	Switzerland Islamic	ACWI Islamic	World Catholic
Part A. Jarque-Bera Test					
Full Sample	75.827*	1407.267*	293.001*	730.573*	1355.802*
Pre-COVID	134.525*	28.164*	3.412***	54.777*	89.396*
COVID	3.336	412.668*	80.496*	75.772*	248.909*
Part B. Lilliefors Test					
Full Sample	0.042*	0.049*	0.041*	0.041*	0.055*
Pre-COVID	0.066*	0.051*	0.251*	0.059*	0.047*
COVID	0.063*	0.058*	0.054*	0.039	0.059*

Source: Research finding.

Note: ** =5 % level and *=1 % level of statistical significance.

5. Conclusion

In this paper, we examine the time-varying systematic and idiosyncratic risks associated with faith-based equity investments using Markov Regime Switching model. For this purpose, we refer to the relevant MSCI country level and global indices based on Islamic and Catholic principles. The evidence in the study highlights the time-varying behaviour of beta and volatility in Islamic and Catholic indices. We observe that the US and Switzerland Islamic equity portfolio have lower systematic risk with reference to the mainstream equity portfolio for US and Switzerland in both crisis and calm regimes of the market. Our results for the global Islamic index are also consistent with the country level findings, which signify the robustness of the evidence. We also observe that the Switzerland and Global Islamic equity portfolio have lower systematic risks in a crisis period compared to a calm period. The findings in the study signify the diversification opportunities of Islamic equity portfolios consistent with evidence provided by Rizvi and Arshad (2017), Haroon et al. (2021) and Umar and Gubareva (2021). The lower systematic risk for Islamic equity portfolios compared to mainstream equity portfolios may be attributed to the low financial leverage for Islamic stocks with higher asset backing resulting in low beta (Dewandaru et al., 2015; Sensoy, 2016; Haroon et al., 2021). This is consistent with the Sharia screening criterion that imposes zero interest based leverage with a certain degree of tolerance as observed by Dewandaru et al. (2015). It may be pointed out that a high financial leverage of a

firm will translate into higher required rate of return for equity shareholders due to increased risk arising out of fixed financial commitments to service the debt out of uncertain cash flows of the firm especially during a crisis period (Christie, 1982; Dewandaru et al., 2015; Haroon et al., 2021). To put this into perspective, we compare the sectoral portfolio weights of the Islamic equity indices with their mainstream counterparts as on June 30, 2021 using the index description available from the MSCI website and observe that none of the Islamic equity index included in the study has exposure to the financial sector (typically having high financial leverage) in excess of 1 percent compared to a much higher exposure (in excess of 10 percent) in case of their mainstream counterparts. However, for the Catholic equity portfolios included in the study, we observe higher systematic risk in the crisis and calm periods with reference to the market portfolio. Further, the systematic risk is higher in the crisis period compared to the calm period. Besides, we also establish the superior performance of the Markov regime-switching model compared to competing OLS and GARCH based estimates, which underscore the robustness of the results from a methodological perspective. From our study, investor gain insights on the risk profiles of faith-based investing globally and the evidence facilitate informed investment decisions. The relevance of faith-based business models are also brought into light through our work. We would like to add that our current work primarily provided evidence for large developed markets. Although the global Islamic index fairly capture the evidence for 27 emerging market but the catholic index had no representation of emerging markets. As a follow up study, future work could explore the time-varying risks in faith-based equity portfolios from emerging market economies.

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References

Abduh, M. (2020). Volatility of Malaysian Conventional and Islamic Indices: does Financial Crisis Matter? *Journal of Islamic Accounting and Business Research*, *11*(1), 1-11.

Ahern, K. R. (2009). Sample Selection and Event Study Estimation. *Journal of Empirical Finance, 16*(3), 466-482.

Alam, M., & Ansari, V. A. (2020). Are Islamic Indices A Viable Investment Avenue? An Empirical Study of Islamic and Conventional Indices in India. *International Journal of Islamic and Middle Eastern Finance and Management, 13*(3), 503-518.

Al-Awadhi, A. M., Al-Saifi, K., Al-Awadhi, A., & Alhamadi, S. (2020). Death and Contagious Infectious Diseases: Impact of the COVID-19 Virus on Stock Market Returns. *Journal of Behavioral and Experimental Finance, 27*, 1-8.

Al-Zoubi, H. A., & Maghyereh, A. I. (2007). The Relative Risk Performance of Islamic Finance: A New Guide to Less Risky Investments. *International Journal of Theoretical and Applied Finance, 10*(02), 235-249.

Antipova, T. (2021). Coronavirus Pandemic as Black Swan Event. *Lecture Notes in Networks and Systems (LNNS), 136,* 356-366.

Anwer, Z., Mohamad, S. M. R., & Rasid, M. E. S. M. (2019). Is there a Cost for Adopting Faith-Based Investment Styles? In *Islamic Corporate Finance* (1st Ed.). London: Routledge.

Ashraf, B. N. (2020). Stock Markets' Reaction to COVID-19: Cases or Fatalities? *Research in International Business and Finance, 54*, 1-10.

Baker, S. R., Bloom, N., Davis, S. J., Kost, K., Sammon, M., & Viratyosin, T. (2020). The Unprecedented Stock Market Reaction to COVID-19. *The Review of Asset Pricing Studies, 10*(4), 742-758.

Beer, F., Estes, J., & Deshayes, C. (2014). The Performance of the Faith and Ethical Investment Products: A Comparison Before and After the 2008 Meltdown. *Financial Services Review, 23*(2), 151-167.

Bhattacharjee, N., & De, A. (2022). Time-Varying Risks in ESG Equity Investments during the COVID-19 Pandemic. *Global Business Review, 23*(6), 1388-1402.

Christie, A. A. (1982). The Stochastic Behavior of Common Stock Various Value, Leverage and Interest Rate Effects. *Journal of Financial Economics, 10*, 407-432.

Czech, K., & Wielechowski, M. (2021). Is the Alternative Energy Sector COVID-19 Resistant? Comparison with the Conventional Energy Sector: Markov-Switching Model Analysis of Stock Market Indices of Energy Companies. *Energies, 14*, 988-998.

Dewandaru, G., Bacha, O. I., Masih, A., Mansur, M., & Masih, R. (2015). Risk-Return Characteristics of Islamic Equity Indices: Multi-Timescales Analysis. *Journal of Multinational Financial Management, 29*, 115-138.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association, 74*(366), 427-431.

Engle, R. F., & Ng, V. K. (1993). Measuring and Testing the Impact of News on Volatility. *Journal of Finance, 48*(5), 1749-1778.

Farebrother, R. W. (1980). The Durbin-Watson Test for Serial Correlation when there is no Intercept in the Regression. *Econometrica, 48*(6), 1553-1563.

Granger, C. W., & Terasvirta, T. (1993). *Modelling Non-Linear Economic Relationships*. Oxford: Oxford University Press.

Garcia, R., & Perron, P. (1996). An Analysis of the Real Interest Rate under Regime Shifts. *Review of Economics and Statistics, 78*, 111-125.

Hansen, B. (1992). The Likelihood Ratio Test under Non-Standard Conditions: Testing the Markov Switching Model of GNP. *Journal of Applied Econometrics, 7*, 61–82.

Hamilton, J. D. (1989). A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle. *Econometrica, 57*(2), 357-384.

Haroon, O., Ali, M., Khan, A., Khattak, M. A., & Rizvi, S. A. R. (2021). Financial Market Risks during the COVID-19 Pandemic. *Emerging Markets Finance and Trade, 57*(8), 2407-2414.

Hill, J. (2020). *Environmental, Social, and Governance (ESG) Investing*. New York: Elsevier.

Korley, M., & Giouvris, E. (2021). The Regime-Switching Behaviour of Exchange Rates and Frontier Stock Market Prices in Sub-Saharan Africa. *Journal of Risk and Financial Management, 14*(3), 1-30.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., & Shin, Y. (1992). Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root. *Journal of Econometrics*, *54*(1-3), 159-187.

Lin, X., & Falk, M. T. (2021). Nordic Stock Market Performance of the Travel and Leisure Industry during the First Wave of Covid-19 Pandemic. *Tourism Economics, 28*(5), 1240-1257.

Lintner, J. (1965). The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *Review of Economics and Statistics, 47*, 13-37.

Liu, X., Margaritis, D., & Wang, P. (2012). Stock Market Volatility and Equity Returns: Evidence from a Two-State Markov-Switching Model with Regressors. *Journal of Empirical Finance, 19*, 483-496.

Lyn, E. O., & Zychowicz, E. J. (2010). The Impact of Faith-Based Screens on Investment Performance. *The Journal of Investing*, *19*(3), 136-143.

Markowitz, H. (1952). Portfolio Selection. *Journal of Finance, 7*(1), 77-91.

Morales, L., & Andreosso-O'callaghan, B. (2020). Covid-19-Global Stock Markets "Black Swan." *Critical Letters in Economics & Finance, 1*(1), 1-14.

Pericoli, M., & Sbracia, M. (2003). A Primer on Financial Contagion. *Journal of Economic Surveys, 17*(4), 571-608.

Persio, L., & Vettori, S. (2014). Markov Switching Model Analysis of Implied Volatility for Market Indexes with Applications to S&P 500 and DAX. *Journal of Mathematics, 753852*, 1-18.

Psaradakis, Z., & Spagnolo, N. (2003). On the Determination of The Number of Regimes in Markov - Switching Autoregressive Models. *Journal of Time Series Analysis, 24*(2), 237-252.

Rizvi, S. A. R., & Arshad, S. (2018). Understanding Time-Varying Systematic Risks in Islamic and Conventional Sectoral Indices. *Economic Modelling, 70*, 561-570.

Sensoy, A. (2016) Systematic Risk in Conventional and Islamic Equity Markets. *International Review of Finance*, *16*(3), 457-466.

Sharpe, W. F. (1963). A Simplified Model for Portfolio Analysis. *Management Science, 9*(2), 277-293.

Stapleton, R. C., & Subrahmanyam, M. G. (1983). The Market Model and Capital Asset Pricing Theory: A Note. *The Journal of Finance, 38*(5), 1637-1642.

Umar, Z., & Gubareva, M. (2021) Faith-based Investments and the Covid-19 Pandemic: Analyzing Equity Volatility and Media Coverage Time-Frequency Relations. *Pacific Basin Finance Journal*, *67*, 1-10.

Zaremba, A., Kizys, R., Aharon, D. Y., & Demir, E. (2020). Infected Markets: Novel Coronavirus, Government Interventions, and Stock Return Volatility around the Globe. *Finance Research Letters*, *35*, 1-15.

Appendix

Table A1. List of the Countries in the paper

Index	Countries
MSCI ACWI Islamic Index	
Developed Countries	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, UK and USA.
Emerging Countries	Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Korea, Kuwait, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Qatar, Russia, Saudi Arabia, South Africa, Taiwan, Thailand, Turkey and United Arab Emirates.
MSCI World Catholic Values Index	
Developed Countries	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, UK and USA.

Note: As on June 30, 2021.