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# In Search of Zero Beta Assets: Evidence from the Sukuk Market

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***Abstract*—**The financial crises caused a collapse in prices of most asset classes, raising the attention on alternative investments such as sukuk, a smaller, fast growing but often misunderstood market. We study diversification benefits of sukuk, their correlation with other asset classes and the effects of their inclusion in investment portfolios of institutional and retail investors, through a comprehensive comparison of their risk/return profiles during and after the financial crisis.

We find a beneficial performance adjusted for the specific volatility together with a lower correlation especially during the financial crisis. The distribution of sukuk returns is positively skewed and leptokurtic, with a risk/return profile similarly to high yield bonds. Overall, our results suggest that sukuk present diversification opportunities, a significant volatility-adjusted performance and lower correlations especially during the financial crisis.

Our findings are relevant for a number of institutional investors. Long term investors, such as life insurers would benefit from sukuk's protective features during financial crisis yet keeping return and growth opportunities, whereas banks would gain due to their role of placers, advisors, market makers or underwriters.

***Keywords*—**Asset allocation, asset performance, sukuk, zero beta asset.

## I. Introduction

THE recent financial crises had a huge impact on prices of several asset classes, raising doubts on their contribution to the portfolio maximization according to the classic portfolio theory. Moreover, globalization and advances in technology increased cross-class correlations, complicating the portfolio diversification and exposing institutional investors to heavy losses. By reflex, academics, asset managers and institutional investors increased their attention on Islamic finance, in search for lower correlations and higher return and growth opportunities. In this area, sukuk (or "Islamic bonds") are bound to the same Shari'ah principles as the overall society (see [1])and their specialties often led to misconceptions about their inner functioning. Sukuk, as in [2], are defined as "certificates […] representing a proportional undivided ownership right in tangible assets, or a pool of predominantly tangible assets, or a business venture". Differences with conventional bonds include the identification of specific assets backing the transaction and the temporary transfer of ownership over them to holders of such securities.

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The topic is of particular relevance in the light of the fast growth of Islamic markets and financial products, with sukuk expected, over the next few years, to double their current asset value in excess of 1 USD trillion [3]. In mid-2014, the UK became the first Western country to host such assets, attracting more than 10 times the size of the new issue (over 3 billion USD). It is reasonable to expect others to follow and this market to keep its growing pace (see [4]).

The aim of this paper is twofold and revolves around the following research question: are sukuk a zero-beta asset? By comparing the risk/return profile of Islamic to conventional bonds, we show that sukuk index returns are positively skewed, with a leptokurtic distribution and behave more similarly to high yield bonds rather than corporate and developed countries government bonds. They present diversification opportunities through lower correlations with other asset classes, in particular during the financial crisis.

The analysis is based on the construction of a comprehensive index of high-liquidity sukuk listed in developing and developed countries, comparing it with established corporate and sovereign fixed-income indexes. Our comparison adopts a multiple time-series analysis.

The remainder of the paper is organized as follows. Section II summarizes our literature review and the development of our hypothesis. Section III describes the data used and explains our research methodology. Section IV presents and discusses our findings, whereas Section V concludes with our final remarks and suggestions for future research.

## II. Literature Review and Hypothesis Development

Despite the rising importance of thesukuk market, research on Islamic finance is still at an early stage, with most part of papers being published relatively recently. The most important contributions focus on the banking industry, comparing Islamic and conventional institutions. While some authors argue for a substantial indifference between the two groups, in terms of efficiency and stability [5], others point to a higher stability of Islamic banks [6]. A higher asset quality, a greater capitalization and a better stock performance of listed Islamic banks, particularly during subprime financial crisis, is highlighted in [7]; instead, [8]-[10] show that the efficiency of Islamic banks varies significantly across countries. Few academic papers, f.i. [11] and [12], compare Islamic and conventional mutual funds, showing mixed results regarding their asset allocation and performance.

By contrast, little attention has been devoted so far to thesukuk market. Most studies, as in [13]-[15], analyze the sukuk structure and specialties, dividing them into different

sub-categories based on their contractual nature (*al mudarabaha*, *al ijara*, *al istisna*, *al musharaka*, *al istithmar*) and discussing theirdifferent exposure to risks (market, credit, operational and foreign exchange).

More recent studies examine the volatility of sukuk through the Dow Jones Citigroup Sukuk Index (as in [16]), finding that the structural breaks associated with the recent global financial crisis significantly alter their behavior. More specifically, they find that pre- and during-crisis volatility is more sensitive to market events than later, and in addition positive shocks are more volatile than negative shocks. Other authors compare the risk/return profile of sukuk with conventional bonds, focusing on a specific market ([17] in Indonesia; [18] and [19] in Malaysia), showing that the average yield to maturity and returns of sukuk certificates are greater than that observed on conventional bonds. Among others, authors in [20] show that the behavior of sukuk and Eurobonds issued by the same entity is significantly different and the inclusion of sukuk in a portfolio could strongly reduce the portfolio's value-at-risk.

In [21] authors investigate whether markets investors react differently to announcements of sukuk and conventional bond issues, finding that the reaction is worse for the former due to the great demand for Islamic investment certificates and to adverse selection (apparently promoting sukuk issuance by lower quality debtors).

To the best of our knowledge, the first study that critically analyzes the portfolio diversification opportunities available to sukuk investors, through an held-to-maturity strategy, is [22]. Using the Malaysian and the GCCsukuk markets as a case study, authors find that returns of local currency sukuk in different markets have low levels of long-term correlations, allowing gains in portfolio diversification; but international currency sukuk in different markets exhibit high level of long-term correlations, impeding portfolio diversification benefits for held-to-maturity investments.

At this early stage of academic research, with a number of potential implications and mixed results, this paper aims to contribute in three ways.

First of all, to the best of our knowledge, this is the first paper extending the literature on Islamic Finance by building a comprehensive index of highly-liquid sukuk and comparing its behavior to conventional bonds.

Secondly, we add our findings on the risk/return profile of sukuk, focusing on a post-crisis time frame.

Our hypothesis is that sukuk index risk provide a better risk/return relationship than conventional bond one, especially during financial crises. Focusing on conventional bonds, authors in [23] show that geographical diversification benefits decrease during recessions since cross-market volatility is subject to contagion issues, despite this happens to a lower extent than for stocks. Moreover, the same authors argue that correlations across time tend to increase due to synchronization effects between economic cycles and monetary policies of a specific geographical area.

TABLE I
SELECTED BLOOMBERG FIXED-INCOME INDEXES

| Market | Name | Ticker |
|---|---|---|
| | *Corporate* | |
| USD Corporate | Bloomberg USD Corporate Bond Index | BUSC |
| USD High-Yield Corporate | Bloomberg USD High Yield Corporate Bond Index | BUHY |
| USD Emerging Market Corporate | Bloomberg USD Investment Grade Emerging Market Corporate Index | BIEM |
| USD Investment Grade Emerging Market | Bloomberg USD High Yield Emerging Market Corporate Bond Index | BEAC |
| Investment Grade European Corporate | Bloomberg Investment Grade European Corporate Bond Index | BECO |
| Global High Yield Corporate | Bloomberg Global High Yield Corporate Bond Index | BNHY |
| EUR High Yield Corporate | Bloomberg EUR High Yield Corporate Bond Index | BEUH |
| | *Sovereign* | |
| US Government | Bloomberg US Government Bond index | BUSG |
| USD Emerging Market Sovereign | Bloomberg USD Emerging Market Sovereign Bond Index | BEMS |
| Eurozone | Bloomberg Eurozone Sovereign Bond Index | BEUR |
| Other Europe Developed | Bloomberg Other Europe Developed Sovereign Bond Index | BEUX |
| Pacific Rim Developed | Bloomberg USD Emerging Market Sovereign Bond Index | BPAC |

TABLE II
SUKUK SAMPLE AND INDEX STRUCTURE

| Features | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|
| **Issue type:** | | | | |
| - *al mudarabah* | 3 | 4 | 4 | 4 |
| - *al ijiara* | 7 | 8 | 16 | 20 |
| - *al musharakah* | 3 | 2 | 1 | 1 |
| - *al wakala* | 1 | 3 | 5 | 6 |
| **Total** | **14** | **17** | **26** | **31** |
| **Mean values:** | | | | |
| Issue size ('000 USD) | 880 | 825 | 750 | 750 |
| Market value ('000 USD) | 101,617 | 138,855 | 185,562 | 252,943 |
| Rating | A+ | A+ | A | A+ |
| Coupon | 5.13 | 5.02 | 4.78 | 4.15 |
| Time-to-maturity | 3.74 | 3.63 | 4.05 | 3.91 |
| Effective duration | 3.10 | 3.09 | 3.28 | 3.5 |
| Yield-to-maturity | 7.17 | 4.59 | 2.97 | 2.54 |
| Option-adjusted spread | 253.21 | 236.51 | 252.95 | 184.38 |

We expect that the close link with a real underlying asset and the Shari'ah compliant nature of sukuk could provide a better hedging during crisis development.

Finally, we contribute to the literature, examining the sukuk behavior within a diversified investment portfolio, trying to assess if they are a zero beta asset class.

Indeed, in line with [22], [23], we expect a low correlation between sukuk and other asset classes. Despite a higher liquidity risk due to the limited strength of specific secondary markets, the special structure of sukuk makes this asset class unique within the wide range of financial instruments.

The close link to the underlying tangible asset makes sukuk more similar to asset-backed securities and the profit and loss sharing principle implicit in Shari'ah compliant investments makes them more similar to equity. On the other hand, as a few sukuk provide some floating LIBOR-indexed coupon, we

could easily consider them as a floating rate notes.

We expect that those peculiar characteristics of sukuk could have potential benefit to portfolio diversification of investors, reducing overall risk for a given return.

## III. Data and Methodology

### A. Data

Market indexes are widely used for benchmarking purposes and recognized for their helpfulness to portfolio managers.In order to test our hypothesis; we collect daily data from selected Bloomberg Professional Service indexes that, based on the literature, are consistent and meaningful to be compared to sukuk (Table I). The sample period is 1 January 2010 – 31 December 2013.

For each index, we collect the following daily information: bid prices, option-adjusted spread, effective duration, yield to maturity, time to maturity, coupon, and rating.

Finally, we collect the same daily data for listed sukuk in Bursa Malaysia, Nasdaq Dubai and London Stock Exchange. We decided to build a market-capitalization weighted index with our sample of 41sukuk, as an alternative to a focus on each issuance, acknowledging that sukuk portfolio managers typically use a buy and hold strategy (see [22]), similarly to the approach on asset management of institutional investors such as life insurers.

We build our index following the multiple criteria methodology used by Bloomberg for fixed-income indexes (see [24]). We consider only highly-liquid sukuk, namely those with an outstanding amount in excess of 200 million USD. We excluded sukuk with less than 12 months before maturity. In terms of credit risk, we considered sukuk that received at least one credit rating from Moody's, S&P, RAM or MARC. Finally, we focused on dollar-denominated sukuk (the majority within this market). Rebalancing of the index took place at the beginning of each month, with new issues satisfying the selection criteria included while those failing the maturity test are automatically removed. Our final sample is summarised in Table II.

Despite a number of alternative structures for sukuk exist, issues are concentrated in few contractual forms [25]. Our index is composed by four of them. As in [2], [13] and [14], among others, these structures have the following features:

- *almudarabah*, where the capital provider and the manager share profits, whereas the former bears all losses except those attributable to misconduct, negligence or breach of contract from the latter;
- *alijara*, involving a lease of a specific asset;
- *al musharakah*, where the capital provider and manager share profits as established in the contract and losses in proportion to the quota held;
- *alwakala*, a more recent model similar to an agency agreement, where the manager acts on behalf of the capital provider.

### B. Methodology

In order to test our hypothesis, we analyze and compare the moments of the distribution of daily total returns of each index. Moreover, we obtain a preliminary risk measure represented by a daily index delta-normal Value-at-Risk. In a second phase, we compute correlation coefficients across our indexes, in order to assess their variability across time. Finally, we compare our indexes on the basis of more specific risk indicators, encompassing interest as well as credit risks.

Despite the Islamic law prohibits interest-earning contracts (*riba*), sukuk are subject to interest rate risk, since their majority is based on fixed interest rates. In addition, some floating sukuk certificates carry a LIBOR-indexed coupon.

We measure interest risk through the effective duration (or equivalently the option-adjusted spread duration) of each index, which takes into account both the discounting effect at different interest rates and how the expected cash flows may change. We decided to use this measure instead of the modified duration because it takes into account how changes in yields will affect expected cash flows, as in [26]. The assumption that cash flows will not change when the yield changes is meaningful for option-free bonds but not for bonds with embedded options (potentially present in some of our selected fixed-income indexes): we argue that our choice leads to more accurate measures of interest rate risk. To complement this measure, we compare indexes also on the basis of their yield volatility (on the importance for bond price volatility of duration and yield volatility, see [27]).

TABLE III
Daily Returns Descriptive Statistics

| | Mean (%) | StDev (%) | Skew. | Kurt. | VaR 95% | VaR 99% |
|---|---|---|---|---|---|---|
| SUKUK | 0.036 | 0.176 | 1.42 | 15.89 | -0.25% | -0.37% |
| *Corporate Bonds* | | | | | | |
| BUSC | 0.023 | 0.298 | -0.41 | 1.53 | -0.47% | -0.67% |
| BUHY | 0.037 | 0.182 | -2.35 | 15.67 | -0.26% | -0.39% |
| BIEM | 0.025 | 0.214 | -1.99 | 15.45 | -0.33% | -0.47% |
| BEAC | 0.036 | 0.254 | -1.95 | 16.91 | -0.38% | -0.55% |
| BECO | 0.020 | 0.561 | 0.11 | 0.96 | -0.90% | -1.29% |
| BNHY | 0.040 | 0.713 | -0.09 | 2.02 | -1.13% | -1.62% |
| BEUH | 0.040 | 0.266 | -1.15 | 8.86 | -0.40% | -0.58% |
| *Sovereign Bonds* | | | | | | |
| BUSG | 0.013 | 0.253 | -0.13 | 0.91 | -0.40% | -0.58% |
| BEMS | 0.027 | 0.279 | -1.78 | 17.91 | -0.43% | -0.62% |
| BEUR | 0.016 | 0.258 | 0.99 | 12.10 | -0.41% | -0.58% |
| BEUX | 0.024 | 0.558 | -0.03 | 1.23 | -0.89% | -1.27% |
| BPAC | -0.001 | 0.641 | -0.43 | 3.00 | -1.06% | -1.49% |

Sukuk are not exempt from credit risk, as other fixed-income securities. This includes both the risk that the issuer will default on its obligation and the risk that the value of the financial instrument will decrease because markets require higher spreads due to a generalized perceived increase in the risk of default. Several credit rating agencies release opinions also on sukuk. Due to their risk-sharing feature, the performance of sukuk issuers affects the final rating of the sukuk emission. However, in the case of *al ijarah*, the asset's performance does not influence credit risk due to their lease basis. Finally, in [28] authors argue that sukuk are perceived to be safer than bonds in case of default, due to the transfer of

assets' ownership to holders.

In order to measure credit risk we analyse and compare credit ratings and spreads over the yield curve. The spread over the yield curve can be measured by the option-adjusted spread (briefly, OAS), which is the spread to short-term interest rates that equals the theoretical price of a bond to its market price (see [26]). OAS offers an efficient and more standardised way to compare indexes with different underlying features.

Finally, we tested if returns of sukukshow autocorrelations similar to those of fixed income indexes. Bond index returns exhibit substantially more autocorrelation than stock index returns (see [29]): this implies that future returns can be predicted by a time series model that incorporates information on past returns. Following [28], we tested a third order moving average process ARMA(3,1):

$$r_t = \emptyset_0 + \sum_{i=1}^{p} \emptyset_i r_{t-i} + a_t - \sum_{i=1}^{q} a_{t-i}$$

where $\emptyset_0$is the constant term, $\emptyset_i$are the regression parameters to be estimated, $r_{t-i}$is the market return series, $a_t$represents the white noise series and *p,q* are non-negative integers.

Financial markets are increasingly interdependent due to globalization and advances in technology; hence our interest in comparing our indexes also in terms of joint correlations. In respect to this, we implement a vector autoregressive model (VAR). To avoid a potential spurious regression problem (see [31] and [32]), we determine if our variables are stationary by plotting their values, examining autocorrelation functions and evaluating an augmented Dickey-Fuller (ADF) test statistic on both levels and first differences. Stationary processes cannot capture some main features of our time series; in addition a VAR process can generate stochastic and deterministic trends if the determinant polynomial of the VAR operator has roots on the unit circle.

To test for co-integration we adopted the Johansen maximum likelihood procedure (as in [33] and [34]), more powerful than for a finite order VAR than the Engle-Granger methodology. To determine the appropriate lag structure to use in the VAR, we use the log-likelihood, the Schwartz criterion, the Hannan Quinn and the F-statistics.

Finally, VAR models might be too restrictive because of the possible co-integration across indexes: we control for this issue applying a vector error correction model (VECM).

## IV. Findings and Discussion

### *A. Return Distributions and Correlations*

Table III presents the descriptive statistics of the sample variables for the period under investigation (2010-2013).

We find a similar behaviour in terms of mean returns between the sukukindex and the US high yield corporate bond index, but with a lower standard deviation. The lower volatility is due to a lower level of sukuk trading in secondary markets, attributable to a number of different factors (see [35]). Also in conventional markets, however, a low level of liquidity could enhance the low volatility of returns, as shown in [36]. We carried a bid-ask spread analysis (omitted), suggesting an average spread equivalent to 0,60% of the asset's value, significantly larger than typical values for conventional bonds.

In terms of skewness, the sukuk index, unlike others, is positively skewned. Sukuk issuances have been successful and frequently oversubscribed: returns were maintained at high levels even during the Eurozone sovereign debt crisis. All indexes show leptokurtic distributions of returns.

We carried a Jarque-Bera normality test on all indexes (omitted), confirming also for the sukuk index the assertion in [37] on the non-normal probability distribution of bond indexes.

Finally, the delta-normal Value at Risk shows that the sukuk index confirms a lower level in terms of this risk measure. Our result is similar to [20], suggesting that also a lower volatility contributes to a lower risk together with the low portfolio correlation examined by those authors.

Table V shows the results of our preliminary analysis of correlations across indexes. We find lower correlations between corporate bonds and sukuk, ranging from 0,16 to 0,43 and all significant at the 99.99% level. The emerging market corporate indexes reveal the highest correlations with sukuk.

Moreover, correlations vary across time. In an omitted analysis we find that despite their tendency to remain low all over our sample period, they significantly decrease during bear periods (2011 and 2013).Results are consistent with the analysis on conventional bonds in [23]: international diversification benefits in bond markets decreased during recession periods. Despite markets' turmoil of 2011 and 2013, sukuk show higher returns than those of bonds. The reason could lay in them being less prone to speculative shocks due to their stronger connection with the real economy, as argued in [38]. In comparison with sovereign bonds, these are lower with certain indexes (like the US government bond index and the Pacific Rim sovereign index) and higher with the emerging market sovereign index. Correlations among sovereign bonds and the sukuk index increased during the time span, suggesting an increase in their integration.

### *B. Risk/Return Analysis*

Table VI illustrates the duration-adjusted spread of our indexes, the YTM and the option-adjusted spread. The sukuk index shows a lower duration, similar to that observed for the European high-yield corporate bond. This is due to higher coupon rates and ashorter average life of sukuk. A higher yield volatility is found for sukukin 2010 and 2011, whereas it returned to lower values in more recent years. The yield-to-maturity decreased considerably during the time span, due to a higher demand for Islamic bonds. Despite the higher standard deviation of the yield to maturity, sukuk volatility remains lower. This could be due to sukuk portfolio managers adopting a held to maturity portfolio strategy, but also to the risk-sharing mechanism that drives returns of these securities.

TABLE IV
COUPONS, TIME TO MATURITY AND RATINGS

| | *Coupon* | | | | *Time to maturity* | | | | *Ratings* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2010 | 2011 | 2012 | 2013 | 2010 | 2011 | 2012 | 2013 |
| SUKUK | 5.13 | 5.02 | 4.78 | 4.15 | 3.74 | 3.63 | 4.05 | 3.91 | A+ | A+ | A | A+ |
| *Corporate* | | | | | | | | | | | | |
| BUSC | 5.72 | 5.52 | 5.25 | 4.78 | 6.19 | 6.45 | 6.96 | 6.87 | A | A | A- | A- |
| BUHY | 8.03 | 8.08 | 7.95 | 7.52 | 5.73 | 5.39 | 5.14 | 4.98 | B+ | B+ | B+ | B+ |
| BIEM | 6.60 | 6.19 | 5.84 | 5.31 | 8.57 | 8.46 | 8.84 | 8.71 | BBB+ | BBB+ | BBB+ | BBB+ |
| BEAC | 8.80 | 8.73 | 8.64 | 7.98 | 5.74 | 5.57 | 5.15 | 5.09 | BB- | BB- | BB- | BB- |
| BECO | 4.82 | 4.79 | 4.76 | 4.37 | 6.06 | 6.06 | 6.21 | 6.15 | A+ | A | A | A- |
| BNHY | 7.26 | 7.29 | 7.14 | 6.93 | 5.05 | 4.83 | 4.35 | 3.84 | BB- | BB- | BB- | BB- |
| BEUH | 7.15 | 7.14 | 6.94 | 6.70 | 4.49 | 4.52 | 4.07 | 3.62 | BB- | BB- | BB- | BB- |
| *Sovereign* | | | | | | | | | | | | |
| BUSG | 3.33 | 3.02 | 2.72 | 2.48 | 6.45 | 6.63 | 7.12 | 7.00 | AAA | AAA | AAA | AA+ |
| BEMS | 7.59 | 7.32 | 6.98 | 6.68 | 11.25 | 11.23 | 12.01 | 11.38 | BB+ | BBB- | BBB- | BBB- |
| BEUR | 4.25 | 4.10 | 3.93 | 3.79 | 8.59 | 8.47 | 8.50 | 8.37 | AA+ | AA | AA- | A+ |
| BEUX | 4.62 | 4.43 | 4.21 | 4.00 | 12.75 | 13.06 | 13.49 | 13.23 | AAA | AAA | AAA | AA+ |
| BPAC | 1.51 | 1.49 | 1.50 | 1.50 | 7.43 | 7.66 | 8.28 | 8.59 | AA | AA- | A+ | A+ |

TABLE V
CORRELATION MATRIX BETWEEN SUKUK, CORPORATE AND SOVEREIGN BONDS

| | BUSC | BUHY | BIEM | BEAC | BECO | BNHY | BEUH | BUSG | BEMS | BEUR | BEUX | BPAC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SUKUK | 0.176 | 0.372 | 0.396 | 0.409 | 0.168 | 0.265 | 0.433 | 0.086 | 0.365 | 0.114 | 0.079 | -0.057 |
| *Corporate* | | | | | | | | | | | | |
| BUSC | 1 | 0.117 | 0.600 | 0.116 | 0.077 | -0.068 | 0.069 | 0.951 | 0.229 | 0.369 | 0.266 | 0.270 |
| BUHY | | 1 | 0.625 | 0.806 | 0.285 | 0.461 | 0.741 | -0.099 | 0.607 | 0.112 | 0.127 | -0.089 |
| BIEM | | | 1 | 0.710 | 0.326 | 0.335 | 0.530 | 0.448 | 0.836 | 0.380 | 0.318 | 0.126 |
| BEAC | | | | 1 | 0.316 | 0.474 | 0.723 | -0.087 | 0.705 | 0.173 | 0.131 | -0.071 |
| BECO | | | | | 1 | 0.916 | 0.349 | -0.007 | 0.387 | 0.248 | 0.749 | 0.268 |
| BNHY | | | | | | 1 | 0.602 | -0.200 | 0.429 | 0.178 | 0.530 | 0.082 |
| BEUH | | | | | | | 1 | -0.129 | 0.512 | 0.239 | 0.099 | -0.149 |
| *Sovereign* | | | | | | | | | | | | |
| BUSG | | | | | | | | 1 | 0.086 | 0.331 | 0.245 | 0.299 |
| BEMS | | | | | | | | | 1 | 0.318 | 0.294 | 0.048 |
| BEUR | | | | | | | | | | 1 | 0.233 | 0.091 |
| BEUX | | | | | | | | | | | 1 | 0.376 |
| BPAC | | | | | | | | | | | | 1 |

In terms of credit risk (Table VI), sukuk exhibit an upper-medium grade rating that remains relatively stable during the sample period and is similar to the judgement of corporate investment grade bonds. The average sukuk credit rating is better than that observed in the bond index of emerging markets, confirming the assertion that sukuk certificates are perceived as safer than conventional bonds (as in [28]). Linking these results with OAS, we find similarities between sukuk and sovereign or corporate bonds in emerging markets. Despite a similar rating, sukuk have a higher spread than corporate investment grade indexes. Regarding the OAS standard deviation, we find that it is similar to values observed in emerging markets for both sovereign and corporate investment-grade bonds.

Coupon rates and time to maturity are alsopresented in Table IV: sukuk in terms of coupons are similar to corporate investment grade bonds, even though the time to maturity is almost always the shortest in our sample.

The strong decrease in sukuk yield-to-maturity is attributable to two effects: the strong and growing demand of these securities but also the significant reduction in market rates due to worldwide monetary policies. This strong decrease has lead to higher mean returns during the years 2010 and 2011.

Despite the lower effective duration, the higher yield volatility, similar to that observed in high yield corporate bond indexes, suggests that sukuk certificates exhibit a higher interest risk. In terms of credit risk, we find that sukuk certificates exhibit an OAS similar to that observed in bond indexes from the same geographical region, despite the better credit rating. We believe that the higher spread compensates investors for the risk of having to buy and sell sukuk certificates in a thin secondary market.

*C. Autocorrelations and VECM*

Accordingly with [29], autocorrelation of returns varies across fixed-income indexes due to their differences in average maturities. Short-term bonds returns are mainly driven by accrued interests (which are predictable) and so the total return of these bonds would demonstrate substantial autocorrelation. Sukuk exhibit a higher autocorrelation,

similar to that observed in fixed-income indexes with a lower average life.

TABLE VI
DURATION-ADJUSTED SPREAD, OPTION-ADJUSTED SPREAD AND YTM

| | *Duration-adjusted spread* | | | | *YTM* | | | | *Option-adjusted spread* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2010 | 2011 | 2012 | 2013 | 2010 | 2011 | 2012 | 2013 |
| SUKUK | 3.10 | 3.09 | 3.28 | 3.50 | 7.17 | 4.59 | 2.97 | 2.54 | 253.21 | 236.51 | 252.95 | 184.38 |
| | (0.15) | (0.14) | (0.13) | (0.10) | (0.96) | (0.83) | (0.36) | (0.20) | (25.38) | (47.91) | (37.95) | (11.67) |
| *Corporate* | | | | | | | | | | | | |
| BUSC | 6.19 | 6.45 | 6.96 | 6.87 | 3.87 | 3.71 | 3.08 | 3.03 | 161.82 | 179.19 | 182.85 | 142.93 |
| | (0.10) | (0.18) | (0.15) | (0.13) | (0.32) | (0.16) | (0.29) | (0.28) | (13.63) | (42.31) | (23.67) | (7.70) |
| BUHY | 4.26 | 4.29 | 4.17 | 4.28 | 8.52 | 7.55 | 7.08 | 6.48 | 590.30 | 554.03 | 555.95 | 462.42 |
| | (0.09) | (0.15) | (0.08) | (0.18) | (0.67) | (0.73) | (0.40) | (0.37) | (48.40) | (122.01) | (47.95) | (30.81) |
| BIEM | 5.81 | 5.90 | 6.17 | 6.13 | 4.87 | 4.63 | 3.95 | 4.01 | 258.48 | 271.20 | 277.39 | 246.31 |
| | (0.10) | (0.07) | (0.20) | (0.16) | (0.39) | (0.19) | (0.37) | (0.48) | (24.03) | (55.86) | (35.29) | (22.62) |
| BEAC | 4.53 | 4.42 | 4.09 | 4.16 | 8.03 | 8.64 | 8.54 | 7.45 | 586.56 | 683.74 | 751.01 | 602.95 |
| | (0.05) | (0.10) | (0.08) | (0.12) | (0.69) | (1.15) | (0.70) | (0.66) | (51.73) | (169.46) | (73.15) | (49.72) |
| BECO | 4.59 | 4.67 | 4.86 | 4.95 | 3.25 | 3.85 | 2.84 | 2.14 | 137.83 | 182.38 | 183.59 | 110.39 |
| | (0.08) | (0.05) | (0.10) | (0.06) | (0.17) | (0.15) | (0.46) | (0.14) | (18.23) | (49.47) | (31.69) | (11.28) |
| BNHY | 3.97 | 3.88 | 3.57 | 3.37 | 8.00 | 8.67 | 7.66 | 5.42 | 541.69 | 617.14 | 626.68 | 422.23 |
| | (0.07) | (0.06) | (0.14) | (0.09) | (0.65) | (1.55) | (1.11) | (0.27) | (54.44) | (192.55) | (85.64) | (35.71) |
| BEUH | 3.75 | 3.70 | 3.41 | 3.21 | 7.91 | 8.56 | 7.43 | 5.13 | 537.24 | 603.67 | 601.09 | 402.55 |
| | (0.07) | (0.06) | (0.14) | (0.10) | (0.69) | (1.61) | (1.11) | (0.29) | (58.38) | (195.36) | (83.23) | (36.19) |
| *Sovereign* | | | | | | | | | | | | |
| BUSG | 5.05 | 5.29 | 5.76 | 5.65 | 1.88 | 1.54 | 1.00 | 1.27 | 9.49 | 5.99 | 5.80 | 5.79 |
| | (0.11) | (0.25) | (0.11) | (0.12) | (0.35) | (0.38) | (0.10) | (0.23) | (1.52) | (0.88) | (0.79) | (0.71) |
| BEMS | 6.92 | 6.89 | 7.48 | 7.26 | 5.31 | 5.11 | 4.34 | 4.63 | 252.19 | 280.55 | 289.83 | 283.15 |
| | (0.20) | (0.16) | (0.34) | (0.28) | (0.47) | (0.20) | (0.45) | (0.59) | (26.82) | (59.30) | (41.28) | (33.17) |
| BEUR | 6.40 | 6.25 | 6.46 | 6.52 | 2.96 | 3.94 | 2.89 | 2.14 | 77.69 | 155.15 | 154.10 | 90.18 |
| | (0.14) | (0.07) | (0.11) | (0.07) | (0.22) | (0.27) | (0.52) | (0.14) | (26.52) | (47.09) | (28.73) | (11.06) |
| BEUX | 8.53 | 8.88 | 9.58 | 9.27 | 2.89 | 2.59 | 1.66 | 1.95 | -0.27 | -0.55 | -0.17 | 1.08 |
| | (0.21) | (0.43) | (0.17) | (0.18) | (0.27) | (0.49) | (0.15) | (0.25) | (0.84) | (0.72) | (0.53) | (1.01) |
| BPAC | 6.67 | 6.88 | 7.42 | 7.68 | 0.80 | 0.83 | 0.70 | 0.69 | -1.07 | -1.87 | -1.25 | 0.88 |
| | (0.12) | (0.09) | (0.11) | (0.12) | (0.08) | (0.08) | (0.05) | (0.06) | (1.41) | (1.27) | (2.08) | (0.51) |

TABLE VII
VECM EQUATION RESULTS: CORPORATE BONDS

| | T-1 | | | T-2 | | | T-3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coeff. | t-value | Sign. | Coeff. | t-value | Sign. | Coeff. | t-value | Sign. |
| SUKUK | -0,263 | 0,051 | *** | -0,213 | 0,044 | *** | -0.112 | 0.033 | *** |
| BUSC | -0,133 | 0,053 | *** | -0,119 | 0,042 | ** | -0.045 | 0.028 | |
| BUHY | -0,035 | 0,078 | | -0,171 | 0,073 | * | 0.193 | 0.063 | ** |
| BIEM | 0,307 | 0,071 | *** | 0,276 | 0,064 | *** | 0.099 | 0.054 | * |
| BEAC | -0,249 | 0,053 | *** | -0,148 | 0,052 | ** | -0.175 | 0.044 | *** |
| BECO | -0,006 | 0,071 | | -0,004 | 0,055 | | 0.032 | 0.036 | |
| BNHY | -0,002 | 0,067 | | -0,001 | 0,052 | | -0.023 | 0.033 | |
| BEUH | 0,072 | 0,073 | | 0,104 | 0,060 | * | 0.057 | 0.042 | |

In order to analyze with greater detail the short-term response to interest rate risks of our indexes, we modelled their returns through and ARMA(3,1), selected through the methodology described in [30] (omitted).

Findings show a high level of autocorrelation. The interest-rate effect has a strong effect that is enhanced by a lower exposure of sukuk to high volumes of trading on secondary markets, that produce more significant effects on other indexes. Therefore, results are similar to investment grade bonds of emerging markets and only for the shortest term in the AR(1) model: when extending the period further, sukuk diverge in behavior from all other indexes when the market momentum component produces a stronger effect than interest rates.

In order to strengthen our preliminary analysis on long-term correlations and at the same time include cointegration effects across indexes, we considered a vector auto-regressive model.

The log-likelihood, and the F-statistics suggest a VAR with a three period lag, whereas the Hannan-Quinn and the chwartz criterion recommend a one period lag. We decide to set a VAR with three-lag periods.

Table VIII reports the summarized results of the Johansen

procedure for the comparison between the sukuk index and the corporate bond indexes. The null hypothesis of *r=0* states that there is no cointegrating vector; the test statistics strongly reject it for all the corporate bond indexes and the sukuk index, implying that there is at least one cointegrating vector for all indexes. We select the appropriate rank of cointegration by using the information criterion provided in [39].Test results (omitted) suggest that seven is the suitable rank of cointegration. Therefore, due to cointegration, we need to extend our analysis from a VAR to a VECM model. With a lag of three and a cointegrating rank of seven the model is as follows:

$$\begin{aligned} SUKUK_T = {} & SUKUK_{T-1} + BUSC_{T-1} + BUHY_{T-1} + BIEM_{T-1} + BEAC_{T-1} \\ & + BECO_{T-1} + BNHY_{T-1} + BEUH_{T-1} + SUKUK_{T-2} \\ & + BUSC_{T-2} + BUHY_{T-2} + BIEM_{T-2} + BEAC_{T-2} \\ & + BECO_{T-2} + BNHY_{T-2} + BEUH_{T-2} + SUKUK_{T-3} \\ & + BUSC_{T-3} + BUHY_{T-3} + BIEM_{T-3} + BEAC_{T-3} \\ & + BECO_{T-3} + BNHY_{T-3} + BEUH_{T-3} + u_t \end{aligned}$$

Results are shown in Table VII. In order to validate the results, we checked the VECM residual autocorrelations by using the portmanteau and LM tests (omitted), that do not indicate the presence of autocorrelation in the residuals.

Results reveal a positive higher correlation between the sukuk index and the emerging market investment grade index in all of the three lags and a negative relationship with the emerging market high yield index. Interestingly we find a negative long-run correlation with US fixed-income indexes; regarding to the European indexes we do not find a significant relationship.

The higher correlation between the sukuk index and corporate emerging market indexes could be explained by the business cycle synchronization, as suggested by [23]. On the contrary, the different synchronization with US economic cycle leads to a negative correlation.

We adopted the same process for comparing sukuk with sovereign bonds. Similarly, the log-likelihood, and the F-statistics recommend a VAR with three period lag, the Hannan-Quinn and the Schwartz criterion recommend a one period lag. Table VIII reports summarized results of the Johansen procedure for the second model: also here the test strongly rejects the null hypothesis of no cointegrating vector. By using the information criteria (results omitted) we find that five is the appropriate order of cointegration.

Therefore, we run a VECM model with a cointegration rank of five and a lag order of three:

$$\begin{aligned} SUKUK_T = {} & SUKUK_{T-1} + BUSG_{T-1} + BEMS_{T-1} + BEUR_{T-1} + BEUX_{T-1} \\ & + BPAC_{T-1} + SUKUK_{T-2} + BUSG_{T-2} + BEMS_{T-2} \\ & + BEUR_{T-2} + BEUX_{T-2} + BPAC_{T-2} + SUKUK_{T-3} \\ & + BUSG_{T-3} + BEMS_{T-3} + BEUR_{T-3} + BEUX_{T-3} \\ & + BPAC_{T-3} + u_t \end{aligned}$$

Results are provided in Table IX. Again, by using the portmanteau and LM tests (results omitted) we can exclude the presence of autocorrelation in the residuals.

We do not find a long run relationship between the sukuk index and the selected sovereign indexes. In particular, we find a correlation of zero between sukuk and emerging market sovereign bonds. This result could be interesting for institutional investors because investing in sukuk could allow a better portfolio diversification due to the low correlation with conventional bonds. In terms of geographical diversification, however, results from a direct investment in conventional bonds of emerging markets are not per se significantly different.

TABLE VIII
JOHANSEN COINTEGRATION TEST: SOVEREIGN BONDS

| H = 0 | Test | Critical Values | | |
|---|---|---|---|---|
| | | 90% | 95% | 99% |
| *r <= 5* | 171.47 | 7.52 | 9.24 | 12.97 |
| *r <= 4* | 247.47 | 13.75 | 15.67 | 20.20 |
| *r <= 3* | 290.57 | 19.77 | 22.00 | 26.81 |
| *r <= 2* | 328.14 | 25.56 | 28.14 | 33.24 |
| *r <= 1* | 368.70 | 31.66 | 34.40 | 39.79 |
| *r = 0* | 405.24 | 37.45 | 40.30 | 46.82 |
| *Eigenvalues* | | | | |
| | Sukuk | BUSG | BEMS | BEUR |
| | *0.275* | *0.298* | *0.270* | *0.243* |
| | BEUX | BPAC | | |
| | *0.211* | *0.152* | | |

TABLE IX
VECM EQUATION RESULTS: SOVEREIGN BONDS

| | T-1 | | | T-2 | | | T-3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coeff. | t-value | Sign. | Coeff. | t-value | Sign. | Coeff. | t-value | Sign. |
| SUKUK | -0.263 | 0.047 | *** | -0.213 | 0.039 | *** | -0.101 | 0.029 | *** |
| BUSG | -0.029 | 0.042 | | -0.002 | 0.033 | | -0.001 | 0.021 | |
| BEMS | -0.001 | 0.002 | *** | -0.001 | 0.002 | * | 0.001 | 0.001 | * |
| BEUR | -0.001 | 0.002 | | 0.002 | 0.002 | | 0.099 | 0.054 | |
| BEUX | 0.001 | 0.001 | | 0.001 | 0.001 | | 0.001 | 0.001 | |
| BPAC | 0.001 | 0.007 | * | 0.001 | 0.001 | * | 0.001 | 0.001 | |

Significance codes: *** at the 99.9%, ** at the 99% and * at the 95% level.

## V. CONCLUSION

Our risk-return comparison of sukuk with corporate and sovereign bonds served two purposes: extend the literature on Islamic finance and analyze its long-run relationship with conventional securities. The presence of comparable performances together with low correlations calls for further research on diversification opportunities stemming from investments in these asset classes.

Our results confirm these expectations and provide evidence of similarities with high yield indexes and securities issued in emerging markets. In addition, the financial turmoil appears to have a lower impact on sukuk than on conventional bonds. This feature, if proved to be structural, would provide significant benefits to long-term institutional investors, in particular, but not limited to, insurance companies.

We have also underlined the exposure to interest rate risk of sukuk, in spite of the prohibition of *riba* within *Shariah* principles: higher autocorrelations affirm that their returns reflect accrued interest changes in a similar manner to conventional bonds with similar maturities. In terms of credit risk, although sukuk show a relatively stable upper-medium rating, we find that required spreads are similar to those of emerging markets with a lower average credit rating, due to the lower liquidity levels of their secondary markets.

Finally, with reference to diversification opportunities, our VECM models suggest that sukuk could provide benefits for institutional investors, especially in the long-run. We do not find a significant relationship with sovereign exposures.

In conclusion, we are not able to argue that sukuk represent a zero-beta asset, as they exhibit a relatively stable level of correlation with bond indexes of emerging markets, a potential effect of cross-country links between economic cycles. Since the literature on emerging market bonds is rather poor, future research is needed to better analyse the relationship between high yield bond and sukuk.

Moreover, monetary policies of emerging markets influence sukuk returns in a similar manner as conventional bonds through the exposure to interest rate risks.

Despite the benefits in terms of diversification and the increasing growth of the sukuk market, investing in this asset class remains a challenge for institutional investors, due to their lower liquidity levels. The widening and deepening of the secondary market can make this asset class more attractive to institutional investors, especially for European life insurers, due to the lack of correlation with the European fixed income market.

The benefits associated with investments insukuk are not subordinated only to an increase in their liquidity, but also on how regulation would weight their risk-return profiles. However, the expansion of secondary markets for sukuk and a future slowing down of their demand could represent a driver for a higher cross-market cointegration and the fading of diversification benefits and performances.

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