Does shariah stock index lead or lag the exchange rate and macroeconomic variables? evidence from Japan based on ARDL

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Abstract

This paper aims to investigate whether shariah stock index, exchange rate and macroeconomic forces in Japan have any long run relationship or not. If the relationship exists, does the Shariah stock index lead or lag? The paper is likely to be the first study that investigates the causal relationship of aforementioned variables and the Shariah Index in Japan. Current literature on the topic in different countries gives either contradictory or inclusive results. This study will try to fill two gaps, one relating to Japan, and another relating to Islamic Indices.

This study employed quarterly data from 2007 to 2017. Auto-Regressive Distributed lag (ARDL) time series technique is applied to conduct the study. This technique is free from major limitations of the conventional cointegrating tests which suffer from the pre-test biases involved in the unit roots and cointegration.

The empirical evidence tends to suggest that both in the short- and long- run, money supply, exchange rate, and GDP have a significant relationship with Japan's Shariah stock prices. However, ARDL's long run coefficients suggest that inflation does not have such impact on the Shariah stock price. The findings of the study tend to indicate that investors of shariah stocks in Japan and the Japanese government need to be more attentive to the money supply and exchange rate of the country. The findings of this study are plausible and have strong policy implications for an export-oriented country such as Japan.

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1. Introduction / Problem statement

The interaction among exchange rate, macroeconomic variables and the stock market have been investigated in previous literatures. It is crucial to know about stock prices because they are considered leading indicators in the economy. For instance, through EMH theory suggests that asset (stock) prices fully reflect available information. If stocks indeed are leading indicators, should the policy makers be focusing on stock prices rather than other macroeconomic variables?

However, previous studies also concluded that macroeconomic variables can affect the stock prices. For example, based on the Dividend Discount Model, changes in stock prices are due to changes in expected returns and growth of the dividends. If this is true, should the policymakers focus more on macroeconomic variables than Shariah stock prices in Japan?

The study of exchange rate and stock market relationship is very crucial because it has impact on both monetary and fiscal policies. This relationship is also controversial because some studies show that if the stock market is doing well, there will be a positive effect on aggregate demand; an expansionary monetary and contractionary fiscal policies could be used simultaneously to neutralize exchange rate and interest rates. While other Studies show that in order to boost the export sector, a currency depreciation would be a better option. The controversy exists in empirical studies as well. For instance, the Flow-oriented model suggests exchange rate leads stock prices, while portfolio-balance model states the stock market leads exchange rate.

Moreover, other empirical studies (discussed under literature review) also debate the lead lag relationship between stock prices and money supply, inflation (CPI), and economic growth (GDP). The question relevant to policy makers is which variable to shock?

The causality between the stock market and macroeconomic variables have been examined through a number of studies reported in the literature; however, in terms of Islamic stock prices it is rather limited. The contribution of this study is to enrich the literature by investigating the causality relationship between Islamic (Shari'ah) stock prices in Japan, the exchange rate and macroeconomic variables; namely money supply, gross domestic product, and inflation. This study is also important for all the investors in general, and Muslim investors in particular. For this purpose, investors need to know the backdrop of Islamic equities in Japan.

This paper is organized as follows. Section 2 reviews the theoretical underpinning and section 3 reviews the literature review. Data and methodology are discussed in section 4 while empirical results follow in section 5. Section 6 briefly discusses the limitation of the study and the last section (7) of the paper ends with the concluding remarks and policy implications.

2. Theoretical underpinnings

There are various studies and literatures that discuss the relationship between exchange rate and stock prices. Flow-oriented and portfolio-balance models among those studies are mentionable. Dornbusch and Fischer (1980s) in the flow-oriented model stated that international competitiveness and trade balance is affected by exchange rate which ultimately

affect the output and real income. Stock prices being the present value of future cash flows of a company will be eventually affected as well.

The model shows a positive relationship between currency depreciation and stock prices where exchange rate is shown as a leader and stock prices as follower.

Branson and Frankel, 1983 through portfolio-balance model looks at this issue the other way around. According to this model, changes in stock price can affect exchange rate through capital account transactions. Due to stock market movements, when foreign or domestic investors shift their investments towards domestic stocks (denominated in foreign currency), it will affect the exchange rate.

Based on above conflicting views, the question that needs to be answered is, does exchange rate lead or lag the stock prices?

Theoretical relationship between money supply and stock prices also exist. For instance, the studies of Bruner and Friedman (1961) in the late 20th century stated that money supply positively affect stock prices, based on the monetary portfolio theory where money supply affects the aggregate economy. This is also explained well through aggregate demand and aggregate supply framework. Keynes (1973) where higher liquidity of money increases desire of investors to hold more stocks in portfolio.

Reilly & Brown (2011) provided a rationale for the negative relationship between inflation and stock market prices. Since the companies cannot pass on the production costs to the customers during inflationary periods, the company stock prices will eventually decrease. However, if the firms can pass on the production cost to the customers, the relationship between inflation and stock prices could be positive.

From a theoretical perspective, stock prices are considered lead indicators which contain information for future economic growth because they are the outcome of discounted future dividends. On the other hand, Investors do keep in mind the reports on GDP because it depicts the overall health of the economy. Dissecting GDP into its component it could be observed that higher GDP corresponds with higher consumer spending, exports, and investment. This could lead to higher profits of the company in the long run.

Therefore, due to above conflicting theoretical views, the question is whether the GDP leads the stock market or vice versa?

3. Literature review

The flow-oriented and portfolio-balance models regarding the causality relationship between exchange rate and stock prices have contrary results. Flow-oriented model suggests exchange rate leads stock prices, while portfolio-balance model states the opposite.

However, the notion that currency depreciation can boost export growth and therefore an increase in volume of sales is supported by Aggarwal (1981) and Roll (1992). They state that

increase in sales volume will increase cash flows of the companies which will ultimately increase their stock prices.

On the other hand, Ibrahim and Aziz (2003) found that currency depreciation has a negative impact on stock market, the reason being that a depreciation of domestic currency could lead to an increase in production-cost domestically. Therefore, rising domestic prices which will eventually affect the cash flows, i.e. profits of the companies and ultimately the stock prices. The literature on money supply and stock market relationship is also mixed with different reasons and justifications in different countries.

For example, Dhakal, Kandil, and Sharma (1993) agreed that there is a positive relationship between money supply and stock prices, producing evidence from the US stock market.

Fama (1981), on the other hand, suggests that the relationship between money supply and stock prices could be negative. The rationale is that when the money supply and inflation are positively related, increase in money supply increase prices of goods and services; thus the discount rate is affected (increased) which reduces the stock prices (low demand) and other instruments (e.g. bonds) become favorable investments.

The relationship of real activities and stock market have also been investigated by many in the literature. For example, Engle, Ghysels, & Sohn (2013) found that there is a long-term relationship between industrial output and stock market, i.e. stock market is driven by industrial out and the relationship between the two is positive based on the data of 50 countries' stock markets. In addition, Ratanapakorn & Sharma (2007) investigated the US stock market from 1975 to 1999 and concluded that industrial production has a positive impact on the stock market. Overall, the rationale given is that when there is expansion, company's production increases due to high demand in the economy which in turn increases the profits of the company and ultimately its stock price.

The relationship between inflation and stock market is inconsistent throughout the literatures.

For example, Ibrahim & Yusoff, (2001) stated that there is positive relationship between the Malaysian stock index (KLCI) and CPI, supporting the view that the stock prices are a good hedge against inflation. What this means is that in order for investors to protect the value of their assets during inflationary times, they could invest in stocks.

On the other hand, Kaul (1987) investigated the relationship between inflation and stock market of US, UK, Germany and Canada post World War II and attributed a negative relationship between stock returns and inflation to money demand and counter-cyclical money supply effects.

Another possible explanation is that inflation could affect company's future earnings and therefore increasing discount rates which lead to decline in stock value.

Overall, theoretical and empirical findings are contradictory whether the stock market lead or lag other mentioned variables.

4. Data and methodology

Quarterly data from 2007 to 2017 is used to conduct this study. The year 2007 is chosen as the starting point for the study because FTSE Shari'ah Japan 100 index was launched on 30th July 2007.

The macroeconomic variables chosen in this study are money supply (M3), Gross Domestic Product (GDP), consumer price index (CPI) to represent domestic factors. In this study, exchange rate is also included to reflect international disturbances. Data is extracted from Thomson Reuters' Datastream.

The following five regressions are constructed without any prior information as to the direction of the relationship between the variables. The ARDL model specifications of the functional relationship among above mentioned variables can be estimated below:

$$\Delta FSJ_t = a_0 + \sum_{i=1}^{p} b_i \Delta FSJ_{t-i} + \sum_{i=1}^{p} c_i \Delta M3_{t-i} + \sum_{i=1}^{p} d_i \Delta GDP_{t-i} + \sum_{i=1}^{p} d_i \Delta CPI_{t-i} + \sum_{i=1}^{p} e_i \Delta EX_{t-i} + \delta_1 FSJ_{t-1} + \delta_2 M3_{t-1} + \delta_3 GDP_{t-1} + \delta_4 CPI_{t-1} + \delta_5 EX_{t-1} + \varepsilon_t$$

$$\Delta M3_t = a_0 + \sum_{i=1}^{p} b_i \Delta FSJ_{t-i} + \sum_{i=1}^{p} c_i \Delta M3_{t-i} + \sum_{i=1}^{p} d_i \Delta GDP_{t-i} + \sum_{i=1}^{p} d_i \Delta CPI_{t-i} + \sum_{i=1}^{p} e_i \Delta EX_{t-i} + \delta_1 FSJ_{t-1} + \delta_2 M3_{t-1} + \delta_3 GDP_{t-1} + \delta_4 CPI_{t-1} + \delta_5 EX_{t-1} + \varepsilon_t$$

$$\Delta GDP_t = a_0 + \sum_{i=1}^{p} b_i \Delta FSJ_{t-i} + \sum_{i=1}^{p} c_i \Delta M3_{t-i} + \sum_{i=1}^{p} d_i \Delta GDP_{t-i} + \sum_{i=1}^{p} d_i \Delta CPI_{t-i} + \sum_{i=1}^{p} e_i \Delta EX_{t-i} + \delta_1 FSJ_{t-1} + \delta_2 M3_{t-1} + \delta_3 GDP_{t-1} + \delta_4 CPI_{t-1} + \delta_5 EX_{t-1} + \varepsilon_t$$

$$\Delta CPI_t = a_0 + \sum_{i=1}^{p} b_i \Delta FSJ_{t-i} + \sum_{i=1}^{p} c_i \Delta M3_{t-i} + \sum_{i=1}^{p} d_i \Delta GDP_{t-i} + \sum_{i=1}^{p} d_i \Delta CPI_{t-i} + \sum_{i=1}^{p} e_i \Delta EX_{t-i} + \delta_1 FSJ_{t-1} + \delta_2 M3_{t-1} + \delta_3 GDP_{t-1} + \delta_4 CPI_{t-1} + \delta_5 EX_{t-1} + \varepsilon_t$$

$$\Delta EX_t = a_0 + \sum_{i=1}^{p} b_i \Delta FSJ_{t-i} + \sum_{i=1}^{p} c_i \Delta M3_{t-i} + \sum_{i=1}^{p} d_i \Delta GDP_{t-i} + \sum_{i=1}^{p} d_i \Delta CPI_{t-i} + \sum_{i=1}^{p} e_i \Delta EX_{t-i} + \delta_1 FSJ_{t-1} + \delta_2 M3_{t-1} + \delta_3 GDP_{t-1} + \delta_4 CPI_{t-1} + \delta_5 EX_{t-1} + \varepsilon_t$$

Where:

FSJ = FTSE Shariah Japan 100 Index

M3 = Money Supply

GDP = Gross Domestic Product

CPI = Consumer Price Index

EX = Exchange Rate

Methodology

There are many reasons why time series ARDL (cointegration) approach is chosen for this study.

Many previous literatures are time-series studies but they have used regression analysis for testing long term relationship among variables which has many shortcomings.

First, regression assumes that the variables are stationary in the level form. However, in reality most of the finance and economic variables are non-stationary. The T-ratios and F-statistics would be invalid in this case as they do not apply to non-stationary variables.

Second, during the regression analysis we determine the exogeneity and endogeneity of the variables in advance. The causality relationship may be the other way around i.e. our exogenous variable could be endogenous and vice versa. In ARDL technique the data and methodology will determine the causality among the variables.

Third, the cointegration techniques keep the dynamic interaction among the variables intact which is not done in traditional regression analysis.

Moreover, the ARDL technique is selected because the estimates from Johansen cointegrating tests, and stationarity tests such as augmented Dicky-Fuller (ADF), Phillips-Peron (PP) and Kwiatkowski-Phillips- Schmidt-Shin (KPSS) are biased due to intercept / trend inclusion or a change in lag order.

ARDL method has two stages; testing for long run relationship and estimation of the long run coefficients. In the first stage, each variable is separately treated as dependent variable and tested against all variables' lagged levels to check the long run relationship. The computed F-statistics is compared with two critical values (upper and lower bounds) from Pesaran et al. (2001). If at least one of error-correction equations is significant, it means there is cointegration among the variables; the dependent variable in this case would be endogenous.

Second stage of ARDL involves estimation of the long run coefficients. Next, ECM (error correction model) is estimated order to estimate the adjustment coefficients of the error-correction term. In line with our quarterly data, for our model below we have chosen four as order of lags for variables.

$$DLFSJ = a_0 + \sum_{i=1}^{4} b_i DLFSJ_{t-i} + \sum_{i=1}^{4} c_i DLM3_{t-i} + \sum_{i=1}^{4} d_i DLGDP_{t-i} + \sum_{i=1}^{4} e_i DLCPI_{t-i} + \sum_{i=1}^{4} f_i DEX_{t-i} + \delta_1 LM3_{t-1} + \delta_2 LGDP_{t-1} + \delta_3 LCPI_{t-1} + \delta_4 EX_{t-1} + u_t$$

5. Empirical Results and Discussions

5.1 Unit root test

Three different kinds of unit root tests (Dickey Fuller (ADF), Phillip Peron and KPSS) are carried out to test whether the variables are stationary or non-stationary both in the level and differenced forms. The results of the ADF test, PP tests and KPSS tests are shown in table 1, 2 and 3 respectively. Based on the ADF test results in table 1, all variables in differenced form are stationary. However, all variables in level form are non-stationary except GDP which is stationary in the level form. Moreover, the KPSS test in table 3 confirms that the GDP is stationary in the level form. KPSS goes a step further and shows that money supply is non-stationary in the differenced form. PP test shows no issues at all i.e. all variables are non-stationary in level form and stationary in differenced form.

Based on ADF and KPSS tests, since there is an existence of both I(0) and I(1) variables, ARDL method can be used to investigate the long-run relationships among the variables.

Table 1. ADF Test

Null Hypothesis: Variable has a Unit Root

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULTS
		ADF(5) =				NON-
DIFF FORM	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULTS
	DM3	ADF(4) =	153.4945	-3.2224	-2.9499	NON-
	LCPI	ADF(1)=AIC	132.3723	-2.7941	-3.5426	STATIONARY
	DCPI	ADF(1)=AIC	124.0880	-3.8104	-2.9499	STATIONARY
	LFSJ	ADF(2)=AIC	38.6528	-1.7495	-3.5426	NON-
	DFSJ	ADF(1)=AIC	37.1204	-5.8420	-2.9499	STATIONARY
	LEX	ADF(1)=AIC	52.3810	-2.0131	-3.5426	NON-
	DEX	ADF(1)=AIC	50.5034	-4.8632	-2.9499	STATIONARY
	LGDP	ADF(1)=AIC	112.2642	-6.2452	-3.5426	STATIONARY
	DGDP	ADF(1)=AIC	97.4180	-3.9376	-2.9499	STATIONARY

Table 2. PP Test

PP test				
LOG FORM	VARIABLE	PP	P-VALUE	RESULT
	LM3	PP	0.2645	Non-Stationary
	LCPI	PP	0.8428	Non-Stationary

	LFSJ	**PP**	0.2298	Non-Stationary
	LEX	**PP**	0.4668	Non-Stationary
	LGDP	**PP**	0.3843	Non-Stationary

Null Hypothesis: Variable has a Unit Root

PP test				
DIFFERENCE FORM	**VARIABLE**	**PP**	**P-VALUE**	**RESULT**
	DLM3	**PP**	0.0000	Stationary
	DLCPI	**PP**	0.0002	Stationary
	DLFSJ	**PP**	0.0010	Stationary
	DLEX	**PP**	0.0003	Stationary
	DLGDP	**PP**	0.0004	Stationary

Table 3: KPSS Test

KPSS TEST					
LOG FORM	**VARIABLE**	**KPSS**	**T-STAT.**	**C.V.**	**RESULT**
	LM3	KPSS	0.211627	0.146000	Non-Stationary
	LCPI	KPSS	0.166828	0.146000	Non-Stationary
	LFSJ	KPSS	0.178115	0.146000	Non-Stationary
	LEX	KPSS	0.167737	0.146000	Non-Stationary
	LGDP	KPSS	0.128606	0.146000	Stationary

KPSS TEST					
DIFF FORM	**VARIABLE**	**KPSS**	**T-STAT.**	**C.V.**	**RESULT**
	DLM3	KPSS	0.165629	0.146000	Non-Stationary
	DLCPI	KPSS	0.088753	0.146000	Stationary
	DLFSJ	KPSS	0.110003	0.146000	Stationary
	DLEX	KPSS	0.141928	0.146000	Stationary
	DLGDP	KPSS	0.068745	0.146000	Stationary

Null Hypothesis: Variable is Stationary

5.2 Var order

As the selection of the lag length is crucial in estimating the ARDL regression, the test runs over 5 lag length of 1, 2, 3 4 and 5 to determine the optimal lag length. The lag length determined by SBC and AIC produced conflicting results. SBC suggests lag length of 0, while 5 lag lengths are suggested by AIC. Based on an Adjusted LR Test for AIC in Table 4 and quarterly data limitation, lag length of 4 has been determined. The log likelihood value is 23.5934, (Probability = 0.703), thus we cannot reject the null hypothesis of no misspecification at lag length 4. Therefore, lag length of 4 is selected to proceed to the next step in this study.

Table 4: Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Order	*AIC*	*SBC*	*Adjusted LR Test*
5	486.1891	407.0914	---
4	487.3130*	405.6572	23.5934[.703]
3	472.4315	410.2176	44.1039[.708]
2	485.1376	442.3655	50.4265[.987]
1	486.8875	463.5573	62.3836[.999]
0	481.8144	477.9260	77.8498[0.543]

AIC=AkaikeInformation Criterion SBC=Schwarz Bayesian

5.3 F-test for long run relation.

Cointegration test specifies the presence of long-run equilibrium relationship, it demonstrates whether a long run relationship among the variables exist or not. Our results of the F-test for cointegration are presented in Table 5.

Table 5: F-Statistics for Testing the Existence of Long-Run Relationship

Models	F-statistics
F_{LFSJ} (LFSJ | LEX, LM3, LCPI, LGDP)	6.2754*
F_{LM3} (LM3 | LCPI, LGDP, LFSJ, LEX)	1.3779
F_{LCPI} (LCPI | LGDP, LFSJ, LEX, LM3)	6.1317*
F_{LEX}(LEX | LM3, LCPI, LGDP, LFSJ)	4.3874*
F_{LGDP}(LGDP | LFSJ, LEX, LM3, LCPI)	2.4142
F-stat- Lower bound: 3.189 Upper bound: 4.329 At 95%	

The critical values are taken from Pesaran et al. (2001), with intercept and trend with five variables.
* denote rejecting the null at 5 percent level.

The ARDL bound test in table 5 reveals that not all the five estimated models show cointegration. However, three models (in green color of table 5) show there is a long term relationship among the variables at 95% significance level (lower critical value of 3.189 and upper critical value 4.329).

5.4 Results of estimated long-run coefficients using the ARDL approach:

Table 6: Long Run Coefficients by AIC Criterion

	LFSJ	LM3	LCPI	LEX	LGDP

K	Model 1	Model 2	Model 3	Model 4	Model 5
LFSJ		-0.17821	0.085053*	-1.3746	.048687
LM3	3.7516*		-0.11211	-3.2571	.53092***
LCPI	-3.5226	2.359*		24.7674	-1.0867***
LEX	1.31***	0.066232	-0.0132		.0014758
LGDP	2.7462**	0.95289**	0.16015	9.9331	
INPT	0.91023	-8.6561	3.5101*	-184.1607	10.3648***

*Significant at 10% **Significant at 5% ***Significant at 1%

Table 6 (based on AIC criterion) confirms that there is a long term relationship between Shari'ah stock prices, money supply and GDP. However, the relationship between CPI and Shari'ah stock prices is not significant.

Based on Table 6 (AIC criterion), the analysis of the long run relationship among the variables are interpreted as follow. A one percent increase in money supply will lead to 3.75% increase in Shari'ah stock prices. They are both positively correlated. However, the opposite is not true i.e. the Shari'ah stock prices do not cause any changes in the money supply. This finding is line with theory. For example, the monetary portfolio theory by Bruner and Friedman (1961) states that money supply positively affect stock prices. The rationale given is that money supply affects the aggregate economy and through transmission process it positively affects the stock prices.

Moreover, a one percent increase in exchange rate (1% increase in depreciation of Yen) will lead to 1.31% increase in Shari'ah stock prices. They are both positively and highly significant (at 1%). This finding supports the flow-oriented model (by Dornbusch and fischer, 1980s) which states that exchange rate of a country impact international competitiveness and trade balance which ultimately affect the output and real income. The causation relationship intuitively makes since because Japan is an export-oriented economy. Japan gains when its currency is depreciated for two main reasons; first, input cost is reduced. Second, overall exports increase because foreigners can now buy more Japanese goods. Therefore, boost in exports increases the cash flows of the company and ultimately increase company's stock prices.

Despite flat GDP of Japan post global financial crisis, Table 6 shows that GDP leads Shariah stock prices. In line with theory, investors do keep in mind the reports on GDP because it gauges the overall health of the economy. Higher GDP corresponds with higher consumer spending, exports, and investment. This could lead to higher profits of the company in the long run.

Lastly, Table 6 shows that that CPI's relationship with Shariah stock prices is insignificant. We will test this further with variance decomposition in the later part.

5.5 Error correction model of ARDL

As discussed earlier, cointegration shows that there is a long run relationship among the variables but it does not distinguish the endogeneity or exogeneity of the variables. This is done by the error correction model. Table 7 (based on AIC criterion) below contains the ecm(-1) part of all the equations of the model through which the endogeneity and exogeneity of variables is detected. The table shows that only exchange rate is the only exogenous variable.

Table 7: Error Correction Model of ARDL (All Variables)

ecm(-1)	Coefficient	Standard Error	T-Ratio [Prob.]	Significance	C.V.	Result
dLFSJ	-0.47966	0.15879	-3.0208[.005]	Significant	1%	Endogenous
dLM3	0.063453	0.027088	2.3424[.028]	Significant	5%	Endogenous
dLCPI	-0.36353	0.10509	-3.4593[.002]	Significant	1%	Endogenous
dLEX	-0.16468	0.13166	-1.2508[.224]	Not Significant	5%	Exogenous
dLGDP	0.64652	0.11757	5.4990[.000]	Significant	1%	Endogenous

To comprehend the short run adjustment process, we need to refer to the error-correction model result (Table 8). A significant error-correction coefficient is a confirmation of earlier findings i.e. long run relationship among variables. The size of the error-correction coefficient shows the speed of short term adjustment of the dependent variable. The error correction coefficient estimated in Table 8 is -0.47966 (0.005) which is very significant. It has the correct sign (negative) and implies a moderate speed of adjustment to equilibrium after a shock. The coefficient of error-correction coefficient tells us how long it will take to get back to long term equilibrium if that variable is shocked. Approximately 47.9 % of disequilibria from the previous quarter's shock adjusts to the long run equilibrium in the current quarter. In other words, the dependent variable (dLFSJ) will take about two quarters to move towards equilibrium. We observe that exchange rate is the most exogenous (leader) variable, a shock in which will bring change in other variables (followers). Therefore, it is important for policy makers to focus more on exchange rate as it has a profound effect on the economy. Moreover, the significance of the impact of differenced variables on the dependent variable (FSJ) in short run is determined by the 't' or 'p' values of the corresponding differenced variables. We observe that in short run, Money supply, exchange rate, and GDP has significant impact on Shariah price index of Japan while CPI does not. These short run results are consistent with the long run

Table 8: Error Correction Model Result (FSJ as a Dependent Variable)

Dependent variable is dLFSJ

Independent Variable	Coefficient	Standard Error	T-Ratio	P-Value
dLM3	1.7995	.50734	3.5469	[.001] ***
dLCPI	.37896	2.0787	.18231	[.857]
dLEX	1.0771	.20505	5.2526	[.000] ***
dLGDP	1.3172	.90970	-1.4480	[.058] *
dC	.43660	10.6482	.041002	[.968]
Ecm(-1)	-.47966	.15879	-3.0208	[.005] ***

*Significant at 10% **Significant at 5% ***Significant at 1%

5.6 Variance decompositions (VDC)

Although the error correction model indicates the endogeneity/exogeneity of variables based on the sample size, we move a step further and apply the generalized variance decomposition technique (Tables 9 to 11) to investigate the relative degree of endogeneity or exogeneity of the variables. The relative exogeneity or endogeneity of a variable could be found by the proportion of the variance explained by its own past. Generalized VDC is selected over Orthogonalized VDC because generalized VDC is not affected by changing the order of variables in the VAR i.e. it is invariant to order of variables. Moreover, generalized VDC does not have the restrictive assumption of switching off other variables in the system to see impact of a shock in another variable.

To test and make sure that the relative exogeneity and endogeneity of all the variables are consistent in various horizons, we have investigated all variables in 3 different horizons i.e. 15, 30 and 60. The generalized VDC output for the three horizons is shown in Table 9, 10, and 11 respectively. In Table 9, at the end of the forecast horizon number 15, the contributions of own shocks towards explaining the forecast error variance of each variable are as follows:

Money supply variable (68%), exchange rate variable (57%), GDP variable (48%), CPI variable (38%) and Shariah stock price index / FSJ variable (23%). These results of horizon 30 and 60 of the generalized VDC are not too different from horizon 15 i.e. they are consistent in terms of the exogeneity and endogeneity of variables. The results tend to indicate that the money supply is the most exogenous variable followed by exchange rate. It is also noticeable that our focus variable of Shariah stock price index is the most endogenous variable.

To begin with, the money supply leads the exchange rate in Japan. From purchasing power parity condition, we would expect the exchange rate to increase and Yen to depreciate. Therefore, the causality explained by the VDC results confirms that money supply could lead the exchange rate. Japan has been accused of a currency war i.e. by deliberately increasing the money base and bank reserves. An increase in money supply could benefit japan in two ways: currency depreciation and increase in Inflation (as mild inflation is good for the economy). Japanese government has used various monetary tools to increase economic growth and boost the economy. One such tool was expansionary monetary policy. In 2013, the Japanese government started to buy bonds and inject money into the economy in anticipation that increase in money supply will boost production and consumer spending which will eventually increase price levels and help Japan to get away from deflation. However, this did not work. According to IMF, the annual inflation rate was 0.36% in 2013 which increased to 2.75% in 2014; however, it fell back to 0.79% in 2015.

Depreciation of Yen may have put Japan in a better position in terms of increasing exports but a prolong depreciation may hurt the country because it scares international investors to hold government debt as it loses the value. Also, a weaker yen is a double-edged sword, can increase import prices which could reduce consumer demand and lead to reduced spending.

Moreover, VDC shows that exchange rate leads GDP of Japan. Despite depreciation of Yen, the Japanese economy is growing slowly. Economists believe that the positive effect of weak

yen on GDP is overshadowed by the negative of effect of deflation. Deflation has reduced consumer spending which is one of the major causes of slower economic growth. Table 6 confirms this phenomenon that CPI (as current deflation) in Japan and GDP are negatively and significantly associated with each other. The VDC results show that GDP leads Inflation, but ground reality in Japan is more complex. Japan's deflation may be the main culprit of hurting the economic growth.

Having said that, many economists believe that economic growth and inflation go hand in hand (while economic growth and deflation are negatively associated). A possible reason is that during the slow economic growth, the producers cannot increase prices, but rather lower it due to lower aggregate demand and lower input costs. Therefore, in Japan the slower economic growth may have possibly caused the deflation.

Lastly, the CPI leads the Shariah stock prices. This relationship is not straight forward because Table 6 (long run relationship) and Table 8 (short run relationship) have contradictory results. The long term relationship is shown to be negative while short run is positive. Intuitively, when the prices go lower, in the short run the consumers are happy to purchase more goods with less money; but in the long run it will hurt the businesses i.e. companies are forced to sell the goods for even cheaper and eventually cut back on production costs, reduce employee wages, lay off workers or even close production facilities. Stock prices begin to fall as people sell off their investments because they no longer pay good returns; in other words, a decreased cash flows of companies will result in lower stock prices.

Shariah Stock Price Index ← CPI ← GDP ← Exchange Rate ← Money Supply

Table 9: Generalized VDC at Horizon 15

	Horizon	LFSJ	LM3	LCPI	LEX	LGDP	Total	Ranking
LFSJ	15	23%	3%	23%	47%	5%	100%	5
LM3	15	6%	68%	4%	4%	18%	100%	1
LCPI	15	14%	1%	38%	42%	6%	100%	4
LEX	15	12%	1%	24%	57%	7%	100%	2
LGDP	15	13%	15%	11%	14%	48%	100%	3

Table 10: Generalized VDC at Horizon 30

	Horizon	LFSJ	LM3	LCPI	LEX	LGDP	Total	Ranking
LFSJ	30	21%	3%	22%	47%	6%	100%	5
LM3	30	3%	67%	3%	4%	22%	100%	1
LCPI	30	13%	1%	36%	43%	6%	100%	4
LEX	30	11%	1%	23%	57%	7%	100%	2
LGDP	30	12%	17%	10%	14%	47%	100%	3

Table 11: Generalized VDC at Horizon 60

	Horizon	LFSJ	LM3	LCPI	LEX	LGDP	Total	Ranking
LFSJ	60	20%	5%	22%	46%	7%	100%	5
LM3	60	2%	68%	3%	4%	24%	100%	1
LCPI	60	13%	3%	35%	42%	7%	100%	4
LEX	60	11%	2%	23%	57%	7%	100%	2
LGDP	60	11%	22%	10%	13%	45%	100%	3

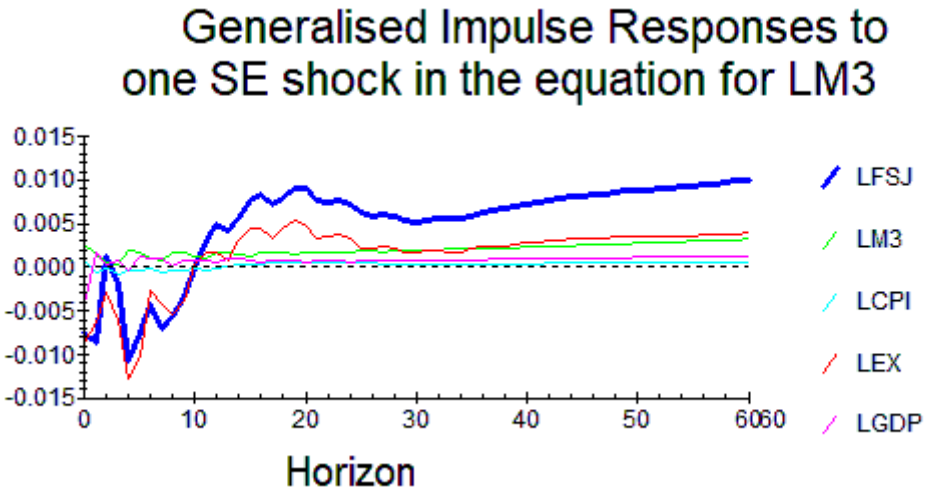
The VDC results tend to be slightly different than error correction model. Per error correction model (Table 7), the only exogenous variable (leader) is the exchange rate that affects all other endogenous variables; however, per VDC results the money supply is the most exogenous variable which affects the exchange rate and ultimately the shariah stock prices. We will rely on variance decomposition rather than error correction model due to two reasons. First, error correction model tells us the absolute exogeneity and endogeneity where the degree of either of those is unknown. However, variance decomposition tells us the relative exogeneity and endogeneity. Second, variance decomposition forecasts beyond the sample period which gives us a better picture of the causality and interaction among the variables. Error correction model; however, only relies on the sample size and period.

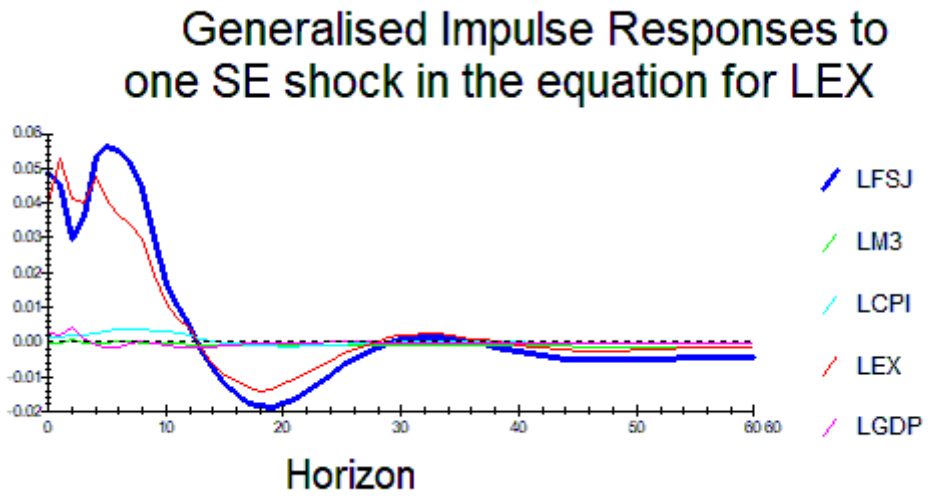
5.7 Impulse response function

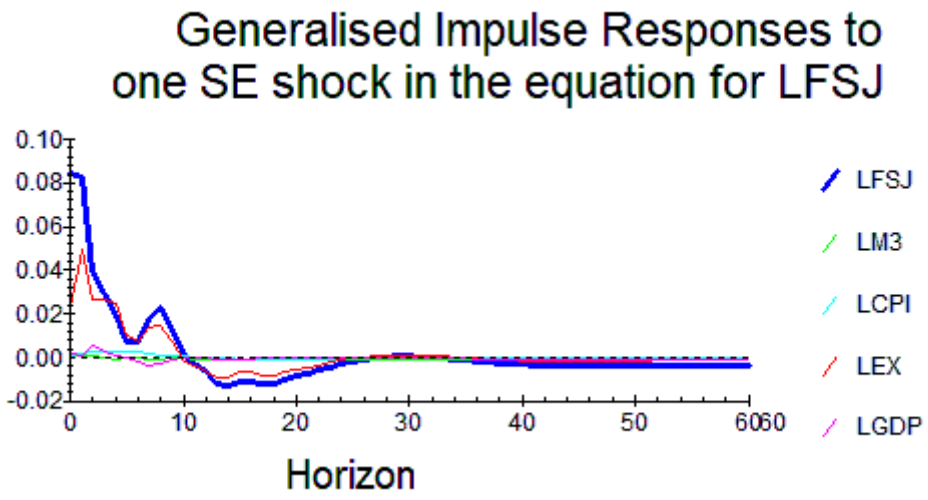
Interpreting based on the graphs in Figure 1, it is quite interesting to note that the shock of money supply and exchange rate greatly affects the other variables. In other words, when there is a shock in exogenous variable, the endogenous variables are affected more compared to exogenous variables. If we focus on the first graph in Figure 1, an increase in money supply leads to Yen depreciation and an increase in Shariah stock prices. Moreover, graph 2 of Figure

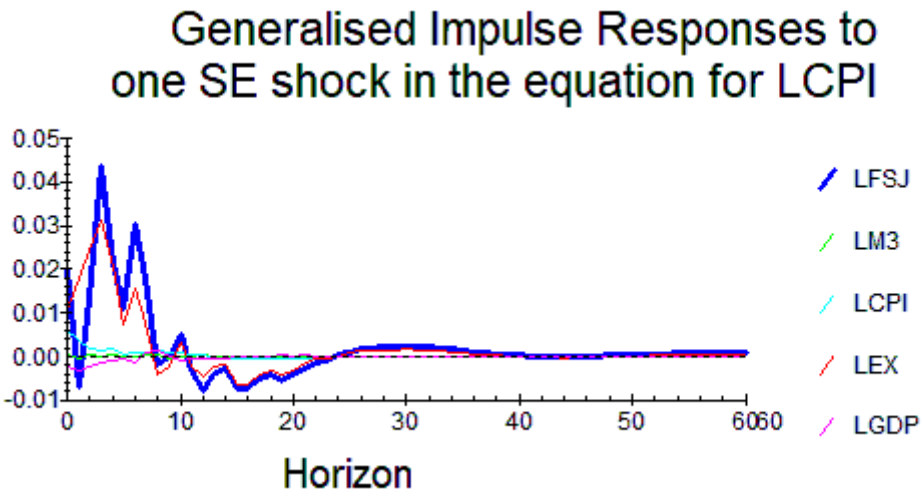
1 shows that a fall in exchange rate (appreciation of Yen) leads to a decrease in Shariah stock prices.

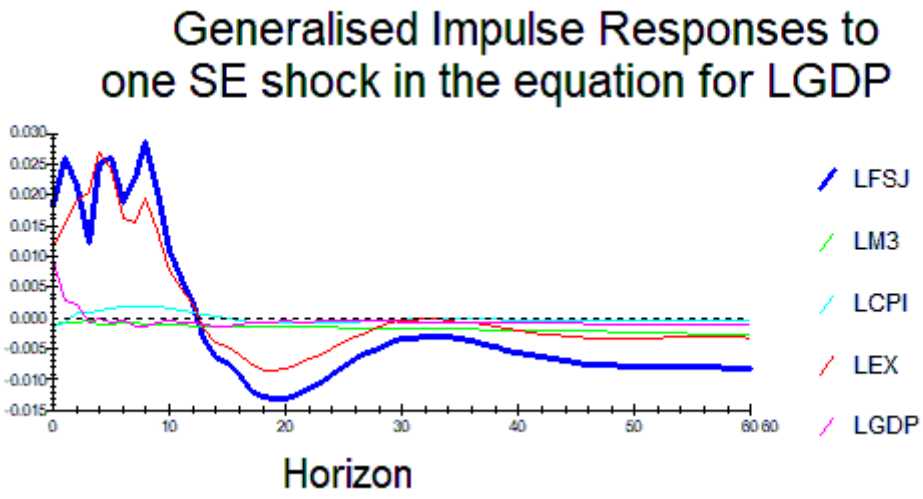
Figure 1: Impulse Response Functions









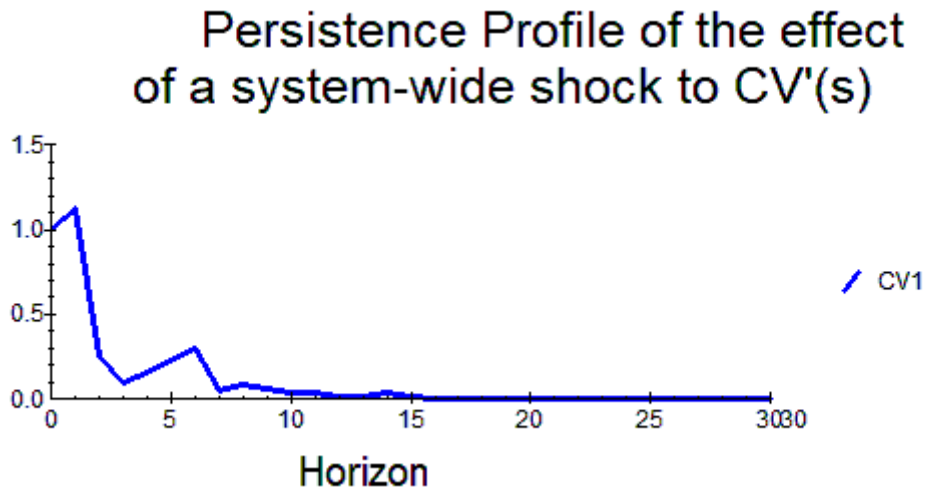


5.8 Persistence profile (PP)

Persistence profile shows in a graphical way when there is shock in the whole system, how long does it take for the cointegrating relationship to come back to equilibrium and for these variables to move together.

Figure 2 confirms that if there is a system wide shock, the long run relations will take approximately 10 to 15 quarters to return back to equilibrium.

Figure 2: Persistence Profile



6. Limitation of the study

It is crucial to note here that our study does not include a large sample period. A larger data sample is favorable to get ideal results but since the FSJ (FTSE Shariah price index of Japan) was launched in 2007, and GDP is available on quarterly and yearly basis (not monthly) , the aforementioned time-span (2007-2017) is chosen for the study. Nonetheless, these limitations do not seriously undermine the usefulness of the study with respect to Shariah Stock prices, exchange rate and macroeconomic variables.

7. Concluding remarks and policy implications

This study investigates the long run relationship between Shariah stock prices, exchange rate and other macroeconomic variables such as money supply, CPI and GDP. The study is likely to be the first on Japanese shariah compliant stocks and its relationship with aforementioned variables. The study answers the question of whether the shariah stock prices lead or lag other variables. Based on the empirical results, shariah stock index in Japan does not lead mentioned variables; instead, it is the most endogenous among all. The study further provides answer to the question of which variable is the most exogenous that should be the center of focus for policy makers? Empirical results from error correction model and variance decomposition show that money supply and exchange rate are the most exogenous among all. Intuitively, empirical results are in line with Japan's ground reality. Japan's quantitative easing has increased the money supply in the country which leads to the depreciation on Yen. Deprecation of Yen boosts the exports of Japan as an export-oriented country. More exports leads to more cash flows for the Shariah-compliant companies which in turn leads to higher prices of the Shariah stock index; the rationale being that stock prices are discounted future cash flows. Moreover, the study shows that Japan's deflation is possibly due to slower economic growth.

These findings are based on a 'Auto-Regressive Distributed Lag' (ARDL) which is free of major limitation of the conventional cointegrating tests as they suffer from the pre-test biases involved in the unit roots and cointegration.

The findings of the study have implications which are not only crucial for the Japanese government but also practitioners and Muslim investors. The Japanese government and companies have shown interest in Islamic finance in order to boost the economy by tapping into shariah compliant industry. Moreover, Muslim investors are keen to know what macroeconomic variables they need to keep an eye on before investing in the world's third largest economy (Japan). The empirical results suggest that Shariah stock prices in Japan are driven by changes in domestic money supply. Moreover, an external shock such as exchange rate changes also affect the prices of shariah stocks in Japan. An increase in money supply enables investors to expand more, increase cash flows of the company which ultimately increase equity prices. Similarly, in an export-oriented country, a depreciation of the Yen enables Japanese shariah-compliant companies to be more competitive and export more which in turn increases cash flows and lead to higher equity prices.

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