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THE TREND ANALYSIS OF ISLAMIZATION IN MALAYSIA USING ISLAMIZATION INDEX AS INDICATOR

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ABSTRACT

This paper empirically analyses the trend of Islamization in Malaysia using the Islamization Index as an indicator to determine whether the time series dataset of the Islamization index possess deterministic trends or stochastic properties. The result determines the appropriateness of the employment of the Islamization index as a proxy of Islam in the empirical study of Islam and economic performance such as economic growth and development, and not as a spurious relation as in the case of the non-stationary stochastic trend.

Keywords: Islamization, Malaysia, Islamization index, Trend analysis, Root test, Diagnostic test.

JEL Classification: A130, C320.

Contribution/ Originality

This study originates the application of Islamization index as a plausible indicator of Islam which passes all stationary and diagnostic tests as deterministic trend properties time series. The index could be employed into other Muslim majority countries to monitor Islamization process and to investigate its empirical effects on economic performance.

1. INTRODUCTION

There have been several attempts by Islamic scholars to measure the development of Islam in Muslim-majority countries using an Islamic-based index on time series data (Ahmad Sarji, 2005; Rehman and Askari, 2010). The Institute of Islamic Understanding Malaysia (IKIM) has proposed an *Ummah* Development Index (UDI) to indicate the achievement of the Muslim population in their economic development. The index was further developed into a comprehensive development index known as the Malaysian *Ummah* Development Index (MUDI) as a new indicator to measure the level of *ummah* development in Malaysia, as the existing economic and social development indicators are not sufficient to comprehensively measure the development in Malaysia from the Islamic perspective. Rehman and Askari (2010) propose an Economic Islamicity Index (EI^2) to indicate the degree of Islamicity of a country in adherence to the doctrines and teachings of Islam, which encompasses measurements of four sub-indices: (a) economic Islamicity index (EI^2), (b) legal and good governance Islamicity index (LGI^2), (c) human and political right Islamicity index (HPI^2) and (d) international relation Islamicity index (IRI^2). For non-Islamic countries, EI^2 is to measure the economic performance from the Islamic perspective. Like MUDI, EI^2 is also a comprehensive index comprising 12 economic indicators and 32 sub-indicators, based on a theoretical framework for investigating the effect of religion on economic activities.

The general religiosity index for each country in the world has been published by Gallup International Association, Duke University, Pew Research Center and other organizations, based on sampling values surveys conducted during particular periods in each country. The main difference between the general religiosity index and the Islamic-based religiosity index is the nature of the data. The general religiosity index is based on the values survey which was periodically conducted in the selected states, while the Islamic-based religiosity index is a time series dataset which is computed from the existing data on the Muslim population and Islamic-based economic activities. The religiosity index has been used as a proxy for religion to investigate its effect on the economic growth variables (Grier, 1997; Blum and Dudley, 2001; Barro and McCleary, 2003; Mangeloja, 2005).

Basically, a positive result on the effect of religion on economic growth was reported by the researchers but the lack of significant robustness due to data heterogeneity problem between proxy of religion, factors of economic growth and indicator of economic growth. Time series with deterministic and stochastic trend components have been known as a plausible approach in empirical research to study the economic relationship between variables. The problem of robustness, therefore may be remedied through the introduction of time series data for the proxy of religion. It may be effective to remedy the problem provided the proposed time series data of religious proxy passes the trend-stationarity process or otherwise spurious regression exists (Granger and Newbold, 1974).

Trends refer to persistent upward/downward movements of variables over time. Trend analysis is often used to predict the future, and it could also be used to estimate uncertain events in the past. In statistics, trend analysis refers to techniques for extracting an underlying pattern of behaviour in a time series which would otherwise be partly or nearly completely hidden by noise. From the econometric perspective, trend estimation is based upon the notion that a time series is composed of several components of independent origin. Trends can threaten the consistency and asymptotic normality of ordinary least square (OLS) due to auto-correlated error in regression analysis: (a) estimates of the regression coefficients are inefficient, (b) forecasts based on the regression equations are sub-optimal and (c) the usual significance tests on the coefficients are invalid

(Granger and Newbold, 1974). This paper concerns the introduction of the Islamization index as an indicator of Islam and its capabilities to pass all the requirements in the trend analysis.

We propose a simple Islamization index to indicate the degree of Islamization trend which occurs in Malaysia based on the adherence to Islamic faith, Islamic teachings and Islamic economics; these are three of the five pillars of Islam[i]. The index is basically a time series dataset that could be employed for empirical investigation on the effect of Islam on economic performance such as economic growth and development. The usage of time series data in empirical investigation is subject to stationarity assumption, autocorrelation assumption if the data is not stationary, and the problem of spurious or nonsense regression (Gujarati, 2003). If a time series is stationary, its statistical mean, variance and auto-covariance (at various lags) remain constant over time. Such a time series will tend to return to its mean if fluctuation occurs due to economic shock or other short-run causes. Stationary time series tends to reach an equilibrium state in the long-run, which we may use an econometric method to study or estimate the relationship between groups of time-based variables. In contrast, if a time series is non-stationary, we can study its behaviour only for the period under consideration (short-run) using the random walk model (RWM). Regression between a non-stationary time series on other non-stationary time series is subject to spurious or nonsense regression results – very high R^2 albeit there is no meaningful relationship between the variables, extremely low Durbin-Watson *d*-value, and R^2 is more than Durbin-Watson *d*-value (Gujarati, 2003). The existence of an equilibrium or stationary relationship among two or more time series, or some linear combination of stationary and non-stationary series; that is, while the component time-series may have moments such as means, variances, and covariances varying with time, some linear combination of these series, which defines the equilibrium relationship, has time-invariant linear properties, could be described through the concept of cointegration.

Cointegration refers to a meaningful (not spurious) long-run, or equilibrium relationship between the two or more time series. Basically a series is said to be integrated if it accrues some past effects; such a series is non-stationary because its future path depends upon all such past effects, and is not tangled to some mean to which it must eventually return. To transform an integrated series to achieve stationarity, we must difference it at least once. Therefore, a non-stationary time series is called integrated by order 1 (I(1)) if it has to be differenced once in order to make it stationary, or integrated by order *d* (I(d)) if it has to be differenced *d* times. However, a linear combination of series may have a lower order of integration than any one of them has individually. In this case, the variables are said to be co-integrated. Thus, for example, if $\{x_t\}$ and $\{y_t\}$ are integrated of order 1 or I(1) and are also co-integrated, then $\{\Delta x_t\}$, $\{\Delta y_t\}$, and $\{x_t+\alpha y_t\}$, for some α, are all stationary series even though $\{x_t+\alpha y_t\}$ individually is integrated of order 0 or I(0) (Banerjee *et al.*, 2003). An integrated process specification for time series has several important statistical implications: potential risk of misspecification of the generating mechanism, inappropriate inference that the trend is significant, and detrended random walks will exhibit spurious correlation (Durlauf and Phillips, 1987).

The purpose of this paper is to empirically study the trend of Islamization in Malaysia based on the proposed Islamization index dataset collected from 1969 to 2011. The paper is structured into four sections. The first section discusses the introduction of the subject matter. The second section details out the data, model and trend analysis procedure. The third section discusses the empirical results on unit root tests, diagnostic tests, hypothesis result and is followed by discussion and implication. The fourth section concludes the study.

2. DATA AND METHODOLOGY

The dimensions and components in the Islamization index are illustrated in Table-1. The index measures the development of Islam based on the three basic pillars of Islam – faith, knowledge or teachings of Islam, and Islamic economics or capital.

2.1. Islamic Faith (Iman)

Islamic faith (iman) is based on five basic tenets – shahadah, compulsory prayers (shalat), zakat, fasting in the month of Ramadhan, and performing hajj. It is not an easy task to quantify shahadah, compulsory prayers (shalat), and fasting in the month of Ramadhan. However, there are time series data on the total number of mosques and suraus in the country, the number of zakat payers available through zakat-based institutions, and the number of hajj prospectives with the hajj management institution.

Table-1. Dimensions and Components of Islamization Index

Dimension	**Religion**		**Human Capital**		**Capital**	
Ratios	Population per mosque and *surau*; Zakat payer per Muslim pop.	Hajj depositor per Muslim pop.	Adult literacy rate among Muslims.	Enrollment rate in Islamic Schools.	Islamic Bank and Takaful to total financial services.	Islamic capital + PNB to GDP.
Dimension index	Islamic faith		Islamic education		Islamic capital	
	Islamization index					

The Islamic faith indicator therefore, is compromised to constitute only three of the five basic tenets of Islam (*rukun Islam*), namely *shalat*, zakat and hajj ratios. Population in the number of mosque and *surau* is the indicator for *shalat*. Zakat ratio is measured by the ratio of zakat payers to the total number of Muslims in the country. The hajj ratio is calculated by the number of depositors in *Tabung Haji* (hajj management institution) to the total number of Muslims in the country. The weighted average of both ratios gives the Islamic faith index. The higher the indicates the higher the religious faith among the Muslims in the country.

2.2. Islamic Education ('Ilmu)

Literacy rate, enrollment rate and average years of schooling have been extensively used in economic growth empirical investigation as proxies for education or investment in human capital (Barro and Sala-i-Martin, 1995). Islamic education in Muslim countries, more so in Malaysia, plays a lesser role compared to the secular system which becomes the backbone of the education system in the country. Muslim parents send their children to Islamic schools because of their religious belief that their children should have adequate knowledge in Islam.

The Islamic education indicator measures human capital development from the Islamic perspective, which constitutes the weighted average of the adult literacy rate among Muslims and the enrollment rate in Islamic schools and Islamic universities. The indicator shows the contribution of Muslim and Islamic education in human capital development in Malaysia.

2.3. Islamic Capital (Siasah)

The last indicator in the proposed Islamization index, Islamic capital indicator, comprises of ratios on Islamic banking and finance to total banking and financial market, and Islamic capital to total investment capital. The indicator is a proxy of Islamic economic institutions to indicate the participation of Muslims in the economy through capital accumulation.

Islamic capital in Malaysia comprises of capitals from zakat institutions, hajj management fund (*Tabung Haji*), and *Perbadanan Nasional Berhad* (PNB). The total of these capitals will be compared to the total capital market in Malaysia for the contribution ratio. The zakat rate for wealth and saving is fixed at 2.5 per cent of the total wealth and savings amount that fully complies with *nisab* and saved for one Islamic calendar year.

Table-2. Sources of Data Collection

Descriptions	Variables	Sources of data
Islamic Faith	Total mosque and surau	Dept. of Islamic Development (Jakim) and State Religious Dept.
	Total zakat collection and payers	Zakat collection centres
	Total deposit in Tabung Haji and total depositors	Tabung Haji Annual Reports
Islamic Teaching	Adult literacy rate among Muslims	Department of Statistics
	Enrollment rate in Islamic schools	Ministry of Education
Islamic Capital	Total assets of Islamic banks and takaful	Bank Negara Malaysia
	Net asset value of PNB	PNB Annual Reports
	Net asset value of Islamic fund	Securities Commission
	Malaysia's GDP	Department of Statistics
	Total assets of financial sector in Malaysia	Bank Negara Malaysia

2.4. Data Description and Sources

The sources of data collection are presented in

Table-2. Data on Islamic faith is collected from the Department of Islamic Development (*Jakim*), State Religious Departments and Tabung Haji's annual reports, Islamic teachings from Department of Statistics and the Ministry of Education's annual reports, and Islamic capital from the annual reports published by Bank Negara Malaysia, Perbadanan Nasional Berhad (PNB), Securities Commission and the Department of Statistics.

2.5. The Model

Following Franzini and Harvey (1983), the general autoregressive, AR(p) time series model for the Islamization index, y_t with intercept and time deterministic trend is

$$y_t = \beta_0 + \beta_1 t + \sum_{i=1}^{p} \beta_{\mathrm{i}} y_{t-1} + \varepsilon_t, \qquad \text{for } (\mathrm{t} = 1, \dots, \mathrm{T}) \tag{1}$$

where y_t is the Islamization index in period t, $y_{t-1}$is the Islamization index in lagged period t-1, β_1 is intercept constant or drift, $\beta_2 t$ and β_i are trend parameters, and ε_t is normally distributed white noise disturbance term in period *t* with mean zero and variance σ_ε^2. This time series model can be estimated efficiently by ordinary least square (OLS). The corresponding stochastic model of the Islamization index is

$$y_t = \alpha_t + \varepsilon_t, \qquad (t = 1, \dots, T) \tag{2}$$

where α_t is the deterministic trend component and defined as

$$\alpha_t = \alpha_{t-1} + \beta_{1t-1} + \mu_t, \qquad \beta_{1t} = \beta_{1t-1} + \eta_t, \qquad (t = 1, \dots, T) \tag{3}$$

where μ_t and η_t are normally and independently distributed white noise processes with zero means and variances σ_μ^2 and σ_η^2 respectively. The level of the trend, α_t and its slope, β_{1t} in equation (3) are slowly changing over time.

The hypothesis is $\sigma_\mu^2 = \sigma_\eta^2 = 0$, the trend is time deterministic and the model is equivalent to equation (1). If the equation (1) fails the hypothesis test, then the variable has to be detrended by differencing equation (1) into

$$\Delta y_t = \beta_0 + \beta_1 t + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t, \qquad (t = 1, \dots, T) \tag{4}$$

According to Franzini and Harvey (1983), this detrended model is found to be fit in many time series models remarkably well for trend testing of the variables in the model. For instance, consider a simple AR(1) process of the Islamization index time series,

$$y_t = \beta y_{t-1} + \varepsilon_t, \qquad (t = 1, \dots, T) \tag{5}$$

If $|\beta| \geq 1$, *I* is a non-stationary series and the variance of *y* increases with time and approaches infinity. If $|\beta| < 1$, *y* is a (trend)-stationary time series. Thus, the hypothesis of (trend)-stationarity can be evaluated by testing whether the absolute value of β is strictly less than one.

2.6. Trend Analysis Procedure

The presence of stationary or non-stationary stochastic and deterministic trend in a variable could be conducted by the unit root testing procedure, which assumes that the underlying time series is stationary and its mean and variance do not vary systematically over time. We use three different unit root tests for trend analysis: Augmented Dickey-Fuller (ADF); Phillips-Perron (P-P); and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) tests.

2.6.1. Augmented Dickey-Fuller (ADF) Test

The basic assumption that the underlying time series is stationary and its mean and variance do not vary systematically over time is only valid if the time series is a simple autoregressive process, AR(1). If the series is correlated at higher order lags, then the assumption of mean and white noise disturbances are violated. The Augmented Dickey-Fuller (ADF) test constructs a parametric correction for higher-order correlation by assuming that the I_t series follows an AR(p) process and adds p lagged difference terms of the dependent variable to the right-hand side of the test regression

$$\Delta y_t = \beta_0 + \beta_1 t + \beta_2 \Delta y_{t-1} + \beta_3 \Delta y_{t-2} + \cdots + \beta_p \Delta y_{t-p} + \varepsilon_t \quad (6)$$

A unit root in lagged variable y_t, $\beta(L) = 1 - \beta_1 L - \beta_2 L^2 - \beta_3 L^3 - \cdots - \beta_p L^p$ corresponds to $\beta(1) = 0$. The test is easily performed by rewriting the the model (6),

$$\Delta y_t = \pi y_{t-1} + c_1 \Delta y_{t-1} + c_2 \Delta y_{t-2} + \cdots + c_{p-1} \Delta y_{p-1} + \varepsilon_t \quad (7)$$

where, $\pi = \beta_1 + \beta_2 + \cdots + \beta_p - 1 = -\beta(1)$; $c_1 = -(\beta_2 + \beta_3 + \cdots + \beta_p)$; $c_2 = -(\beta_3 + \cdots + \beta_p)$; and $c_{p-1} = -\beta_p$. The unit root hypothesis $\beta(1) = 0$ again corresponds to $H_0: \pi = 0$ against $H_A: \pi < 0$ using t-statistic in the ADF test. In order to determine the number of lags, p, we can use normal procedures: (a) general-to-specific testing, starting with maximum lags and subsequently deleting the insignificant lags; (b) estimating possible models by using information criteria such as Akaike information criterion (AIC) and Schwarz Bayesian criterion (SBC); and (c) using autocorrelation tests such as likelihood ratio, DW-statistic and Lagrange multiplier to avoid spurious regression. Gujarati (2003) argues that most tests of the ADF on unit root have lower power, namely, they tend to accept the null hypothesis more frequently than is warranted. There are several reasons for this low power: (a) the power depends on the time span of the time series data, the larger the time span is the greater the power; (b) the power is sensitive to the coefficient of the lagged variable, π; (c) this test assumes a single unit root, I(1); and (d) this test cannot catch if there is a structural break in the time series. The Phillips-Perron (P-P) test uses non-parametric statistical methods to overcome some of the low power problems in the ADF test, while Kwiatkowski, Phillips, Schmidt and Shin (KPSS) propose the reversed unit root test to recapture the lost power in the ADF test.

2.6.2. Phillips-Perron (P-P) Test

The P-P test estimates the non-augmented Dickey-Fuller (DF) test in the basic differenced equation, $\Delta y_t = \beta y_{t-1} + \varepsilon_t$, and modifies the t-ratio of the β coefficient so that the serial correlation does not affect the asymptotic distribution of the test statistics. We also have to make two major choices in performing the P-P test: (a) whether to include an intercept, an intercept plus deterministic time trend in the equation, or in the test regression; and (b) to choose a method for estimating the frequency zero spectrum estimation f_0, by either using the kernel sum of covariances or the autoregressive spectral density estimation.

2.6.3. Kwiatkowski, Phillips, Schmidt and Shin (KPSS) Reversed Test

The KPSS test reverses the stationarity test as the null hypothesis, with the assumption that there is no trend in the time series. The point of departure in KPSS is a data-generating programme (DGP) of the form

$$y_t = \zeta_t + \varepsilon_t, \qquad (t = 1, \dots, T) \tag{8}$$

where ε_t is stationary and ζ_t is a random walk, i.e. $\zeta_t = \zeta_{t-1} + \vartheta_t$, and ϑ_t is normally and independently distributed white noise processes with zero means and variances σ_ϑ^2. If the variance is zero, $\sigma_\vartheta^2 = 0$, then $\zeta_t = \zeta_0$ for all t and y_t is stationary. To find the estimated stochastic component, we use a simple regression,

$$y_t = \hat{\mu} + \hat{e_t}, \qquad (t = 1, \dots, T) \tag{9}$$

Under the null, $\hat{e_t}$ is stationary. That observation is used for hypothesis testing: $H_0 : \sigma_\vartheta^2 = 0$ against $H_A : \sigma_\vartheta^2 > 0$. The Lagrange multiplier, LM of KPSS test statistic is given by

$$LM = \frac{1}{T^2} \cdot \frac{\sum_{t=1}^{T} S_t^2}{\hat{\sigma}_\infty^2}, \qquad (t = 1, \dots, T) \tag{10}$$

where $S_t = \sum_{s=1}^{t} \hat{e_s}$ is a partial sum; $\hat{\sigma}_\infty^2$ is an estimator of the residual spectrum at frequency zero (f_0, in the case of Phillips and Perron Test) of the variance of $\hat{e_t}$, that is an LM test for constant parameters against a random walk parameter.

The regression in equation (9) can be augmented with a linear trend with calculated critical values as follows (Kwiatkowski et al., 1992):

Table-3. Critical values for augmented linear trend in KPSS

Deterministic terms in regression (13)	**Critical values**		
	0.10	**0.05**	**0.01**
Intercept or drift	0.347	0.463	0.739
Intercept and trend	0.119	0.146	0.216

The regression can also be employed for confirmatory analysis between Dickey-Fuller (DF) and KPSS tests whether to reject or do not reject I(1) and I(0) respectively:

Table-4. Confirmatory Analysis in KPSS Test

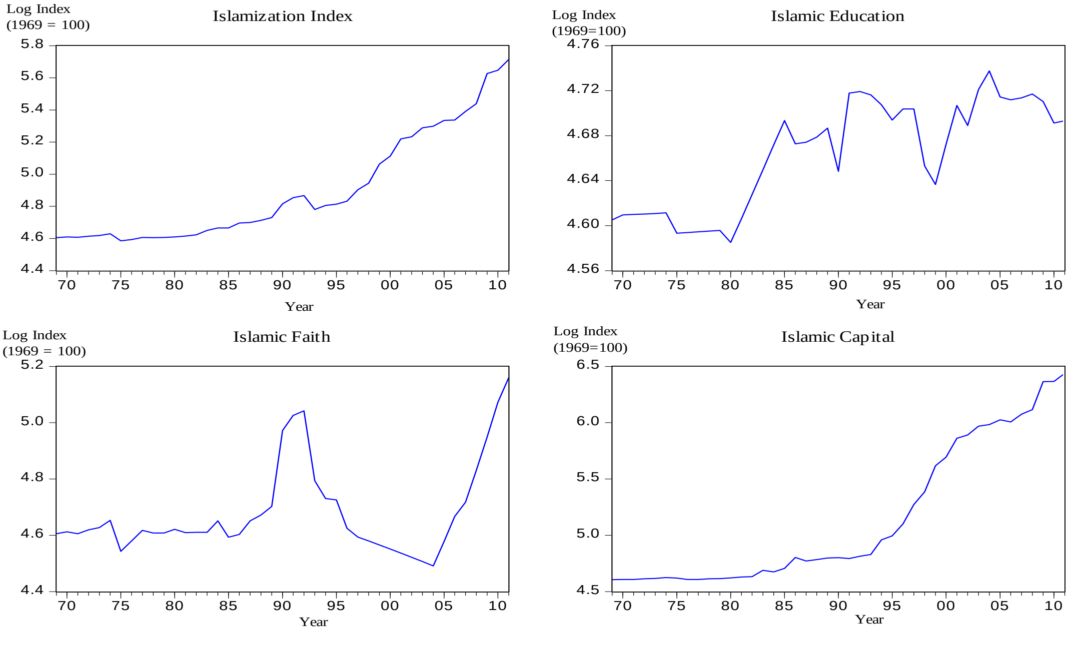
	Confirmatory analysis	KPSS test	
		Reject I(0)	**No reject I(0)**
DF Test	Reject I(1)	?	I(0)
	Do not reject I(1)	I(1)	?

3. EMPIRICAL RESULTS

3.1. Data Preliminaries

We collected 40-years of data on Islamization index and Islamic sub-indices on faith, education and capital in Malaysia from 1969 to 2011. Its log-linear forms are graphically depicted in Figure 1. The base year for the index and sub-indices is 1969, which is considered the beginning of Islamic revival in Malaysia and Islam has been employed as one of the economic policy variables in the economic development planning and process (Ghazali, 1990). The Islamization index in the early sample period is basically flat and very thin until the introduction of Islamic banking and financial system that took place in the 1980's. The index which has exponentially grown from 1990's onwards was largely contributed by the phenomenon growth of Islamic banking, financial services and the *takaful* sector in the economy (as illustrated in the sub-graph on Islamic capital) as a result of the extensive effort undertaken by the government to promote Malaysia as a global Islamic financial hub.

Figure-1. Plots of Islamization Index and Its Sub-indices (1969-2011)



The Islamic faith sub-index has also recorded relatively flat and irregular movements of its sub-index in the first 20-year period from 1969 to 1989 because the total *zakat* collection and the total amount of *Tabung Haji* deposits by the Muslims are still low and insignificant. Zakat collection and total deposit per depositor in *Tabung Haji* (two main components in the Islamic faith sub-index) have no specific trend over the sample period, although in the last five-year period the sub-index showed an exponential increased trend. The total number of Islamic schools in Malaysia in the first 10-year period (1970-1980) experienced a significant decrease as a result of the government policy in converting some private Islamic schools into national schools, thus losing their status as Islamic schools. However, the enrollment of students in Islamic schools significantly increased from 1980 onwards, though the sub-index is rather erratic in nature.

The main contributor to the increased trend in the Islamization index in Malaysia is the Islamic capital market sector in the economy that is indicated by the Islamic capital sub-index (in Figure 1). The Islamic capital market in Malaysia comprises: (a) Islamic banking and *takaful*; (b) *shari'ah* compliant fund management and unit trust including PNB; (c) hajj management fund under *Tabung Haji*; and (d) *zakat* and *bai'tul maal* funds, which in the year 2000 stood at RM83.5 billion or 24.3% of the GDP in current price. The total Islamic capital market in 2011 was estimated at RM497.5 billion or 58.7% of the GDP in current price. The average growth of the Islamic capital market from 2000 to 2011 was 8.3% per annum, surpassing the average growth of the GDP which was 4.4% per annum during the same period. The graphical plots of the Islamization index and its sub-indices revealed that time series data for the proxy of Islam possess the deterministic time trend and intercept properties. Therefore, these suggest, at least initially, that time trend and intercept option need to be included into a regression for unit root or stationary testing that involves the Islamic religion as an economic variable.

3.2. Stationarity Results of Islamization Index

The stationarity test results of the Islamization index and its sub-indices in Islamic faith, Islamic education and Islamic capital time series in log-linear forms are presented in Table 5 based on three different unit root tests: ADF, P-P and KPSS. The tests were conducted using *EViews version 7.1* on different levels and trends. The maximum bandwidths for the P-P and KPSS tests were automatically computed by the system, as with the maximum lag order for the ADF test. Panel-A shows the results on the level form of the variables for the sample period from 1969 to 2011, in which only intercept is included (Panel A1) and both intercept and deterministic time trend are included in the equation (Panel A2). The results of *t*-statistic in ADF, adjusted *t*-statistic in P-P and LM-statistic in the KPSS tests maximum lag order and bandwidth respectively for the level form of variables in Panel A reveal that none of them (whether intercepts and trend or intercept only is included) yields significant result at 90% confidence level or above (see Panel A1 and A2). This suggests that we cannot reject the null hypothesis in the Islamization index and its sub-indices of faith, education and capital time series at their respective levels; meaning that the Islamization index and its sub-indices are basically non-stationary stochastic or random walks time series.

Table-5. Unit Root Test Results Using P-P, KPSS and ADF

$y_t = \beta_0 + \sum_{i=1}^{p} \beta_i y_{t-i} + \mu_t$							$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \mu_t$						
Panel A1: Level – Intercept only							**Panel B1: 1st Difference – Intercept only**						
Variable	**B**	**P-P**	**B**	**KPSS**	**L**	**ADF**	**B**	**P-P**	**B**	**KPSS**	**L**	**ADF**	**I(d)**
Islam	5	3.7012	5	0.7464	3	2.1849	2	-5.1761***	3	0.6822**	2	-3.0327**	I(1)
Faith	3	-0.9695	4	0.1944	1	-1.2418	0	-4.2449***	3	0.1891	0	-4.2449***	I(1)
Education	1	-1.6107	5	0.6601	0	-1.6249	3	-6.7740***	3	0.0859	0	-6.7083***	I(1)
Capital	4	1.7418	5	0.7287	2	0.2388	4	-5.1408***	4	0.5102**	1	-2.1434***	I(1)
$y_t = \beta_0 + \beta_1 t + \sum_{i=1}^{p} \beta_i y_{t-i} + \mu_t$							$\Delta y_t = \beta_0 + \beta_1 t + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \mu_t$						
Panel A2: Level – Intercept + Trend							**Panel B2: 1st Difference – Intercept + Trend**						
Variable	**B**	**P-P**	**B**	**KPSS**	**L**	**ADF**	**B**	**P-P**	**B**	**KPSS**	**L**	**ADF**	**I(d)**
Islam	5	-0.0127	5	0.2144	3	-0.5773	5	-6.7355***	6	0.0742***	2	-4.5239***	I(1)
Faith	3	-1.2608	4	0.0719	1	-1.5177	1	-4.3775***	2	0.1165	0	-4.3929***	I(1)
Education	1	-2.4730	4	0.1162	0	-2.4003	3	-6.7090***	4	0.0623	0	-6.6467***	I(1)
Capital	3	-1.8889	5	0.2041	2	-1.8119	3	-6.1144***	3	0.0752	1	-2.5104	I(1)

Notes: y_t is Islamization index and its sub-indices in log-linear; β_0 is intercept; $\beta_1 t$ is time deterministic trend; B = bandwidth; L = lag order; P-P = Phillips-Perron Test; KPSS = Kwiatkowski, Phillips, Schmidt and Shin Test; ADF = Augmented Dickey-Fuller Test.

Significant test: *** denotes significant at 1%, ** denotes significant at 5%, and * denotes significant at 10%.

Critical values for significant levels 1%, 5% and 10% in ADF, P-P and KPSS tests are automatically computed by *EViews*.

The results for the first difference of the intercept only equation are presented in Panel B1 of Table 5. The Islamization index time series is found to be in stationary after the first difference as indicated by t-statistic of lag order 2 at -3.0327 which is significant at 5%; adjusted t-statistic of P-P test of bandwidth 2 at -5.1761 which is significant at 1%; and LM-statistic of KPSS test of bandwidth 3 at 0.6822 which is significant at 5% significance level. All their test statistics are higher than their respective critical values which are automatically computed by the system. The test results of ADF and P-P for all the Islamization sub-indices are also significant at 1% significance level, except for the KPSS test. If the KPSS test is employed for Islamic faith and education sub-indices time series, they are only significant after the second differencing at 5% significance level.

In Panel B2 of Table 5, when intercept and deterministic time trend are included into the Islamization index equation for first difference unit root testing, the significant result in the null hypothesis is better than the equation without time trend, in all stationarity tests. The test results indicate that t-statistic for lag order 2 at -4.5239 for ADF; adjusted t-statistic of bandwidth 5 at -6.7355 for P-P; and LM-statistic of bandwidth 6 at 0.0742 for KPSS; which are significant at 1% significance level. These clearly suggest that the Islamization index time series is stationary after the first difference and has deterministic time trend and intercept properties. The hypotheses for unit root in Islamic education and capital sub-indices first differencing equations also lead to stationarity existence in both the ADF and P-P tests for the model with intercept and deterministic time trend properties. However, the KPSS tests for Islamic faith, education and capital sub-indices fail to show their stationarity at first difference. Stationarity in the KPSS test is only achieved in the second difference, suggesting that the indices are integrated time series of order 2, or I(2). A comparison of unit root testing in Panels A and B of Table 5 suggest that time series for the Islamization index and its sub-indices (faith, education and capital) in the sample period (1969-2011) are generally random walk in nature and they are generally stationary at first difference. The test of trend with t-statistic using the ADF, P-P and KPSS methods for time series data in level either with the inclusion of intercepts only and intercept plus time deterministic trend has found that all variable of the time series are not significant at the 10% significant level or lower. This result reveals that the Islamization index and its sub-indices on faith, education and capital do not contain unit roots suggesting non-stationarity properties at their levels. The stationarity test at first difference in Panel B1 and B2 shows that all the variables become stationary at their first difference, which is said to exhibit an order of integration of 1 or I(1) at the 10% significance level or lower. This result is consistent with the notion that most of the macroeconomic time series are non-stationary at level but become stationary after first differencing (Nelson and Plosser, 1982). The Islamization index indeed is an observable time series, which is the sum of a non-stationary variable component and a stationary noise component. Then the variable and the noise can be easily separated as a case of a stationary variable (Pollock, 2008).

The inclusion of intercept and deterministic time trend properties in the first difference has yielded a better result in terms of t-statistic or LM-statistic in the ADF, P-P and KPSS tests for Islamization index, Islamic faith, and Islamic education as compared to the intercept only or no trend property (see Panels B1 and B2 in Table 5). In contrast, the results of the unit root test in the first difference with intercept only property for the Islamic capital sub-index time series show better t-statistic and LM-statistic from the ADF, P-P and KPSS tests as compared to time deterministic trend plus intercept properties inclusion in the regression, thus suggesting the intercept only time series model for the Islamic capital sub-index variable. Panel B2 in Table 5 also shows that the KPSS and ADF tests for the Islamic capital sub-index are still not significant despite first difference. The variable is only significant at second difference where at zero lagged, t-statistic in the ADF test based on AIC selection is -14.4902 and at bandwidth of 34, the KPSS test yields LM-statistic at 0.4302, in which both tests are significant at 1% level or lower.

Therefore, from the stationarity tests result we can conclude that the Islamization index is a non-stationary stochastic random walks time series, and becomes an integrated deterministic time trend series with stationarity after first differencing or integrated of order 1, I(1). Islamic faith, education and capital sub-indices are also non-stationary stochastic random walks time series, but become stationary integrated deterministic series without time trend after first differencing. The Islamization index and its sub-indices have passed the unit root test to proceed into diagnostic tests.

3.3. Diagnostic Tests Result

Diagnostic testing on data series provides information regarding how these data might be modelled. When a model is estimated, diagnostic tests can be applied to evaluate model residuals, which also serve as tests of model adequacy. If a time series is serially uncorrelated, no linear function of the lagged variables can account for the behaviour of the variable. The results of the diagnostic tests for autocorrelation, functional form, heteroscedasticity and DW-statistic are presented in Table 6. The Islamization index time series autoregressive model with intercept and deterministic time trend properties at lagged order of 5 is found to have passed all the diagnostic tests on serial autocorrelation, functional form, heteroscedasticity and DW-statistic (see Panel A in Table 6). LM-statistic for serial correlation of residual is 1.7974[.180]; Ramsey's RESET at 1.0536[.305]; heteroscedasticity at 2.3619[.124]; and DW-statistic at 2.017 which is higher than 2.0 to reject autocorrelation in the residuals. The autocorrelation test of lag order 5, yields chi-square for LM-test at 5.6882[.338] and F-statistic of F(5,25) at .90831[.491] which confirms the inexistence of autocorrelation in the Islamization index time series after differencing. The result of the diagnostic test for the Islamization index with the inclusion of deterministic time trend and intercept is better off as compared to the results without the deterministic time trend property in Panel B and Panel C in Table 6. This diagnostic result suggests that the Islamization index time series can be employed as one of the macroeconomic variables that can best be represented as stationary fluctuations around a deterministic trend function.

In the autoregressive model with intercept and deterministic time trend properties, the Islamic capital sub-index time series has failed the autocorrelation test (LM statistic is 4.9176 [.027]), thus we cannot reject the null hypothesis of autocorrelation. However, its DW-statistic is 2.1002, higher than the autocorrelation critical value of 2.0 suggesting no autocorrelated white noise error.

Table-6. Diagnostic Test for Deterministic Trend

Variable	Lag	Serial Correlation LM	Ramsey RESET	Hetero-scedasticity	DW-Stat
Panel A: Intercept + trend, $\Delta y_t = \beta_0 + \beta_1 t + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t$					
Islam	5	1.7974 [.180]*	1.0536 [.305]*	2.3619 [.124]	2.0170*
Faith	5	0.3430 [.558]	0.3769 [.539]*	1.8517 [.174]*	2.0110*
Education	4	2.2685 [.132]	5.7046 [.017]	0.0014 [.970]*	2.0291*
Capital	5	4.9176 [.027]	0.1587 [.690]*	2.2156 [.137]	2.1002*
Panel B: Intercept only, $\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t$					
Islam	5	1.1308 [.288]	0.8745 [.350]	3.0834 [.079]	1.9682
Faith	5	0.1299 [.718]*	0.4141 [.520]	2.8134 [.093]	1.9783
Education	4	0.6714 [.413]*	3.8332 [.050]	0.0297 [.863]	1.9997
Capital	5	4.8591 [.028]	3.9517 [.047]	2.3410 [.126]	2.0773
Panel C: No trend, no intercept; $\Delta y_t = \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t$					
Islam	5	0.0349 [.852]	4.3323 [.037]	2.2429 [.134]*	1.9785
Faith	5	0.4338 [.510]	5.1990 [.023]	4.5079 [.034]	1.9647
Education	4	0.1623 [.687]	2.0970 [.148]*	0.0216 [.883]	1.9737
Capital	5	2.0566 [.152]*	0.6743 [.412]	2.1013 [.147]*	2.0406

Notes: Figures in brackets are probability or p-values. * denotes the highest p-value of all panels.
Diagnostic tests: If p-value is zero, test has failed. DW-stat > 2.0 no autocorrelation in the residuals. Diagnostic tests are conducted using *Microfit 5.0*.

3.4. Hypothesis Results

Hypothesis testing for the Islamization index from equation (8) for lag order 1 using ordinary least square (OLS) method is;

$$\Delta y_t = \beta_0 + \beta_1 t + \beta_2 \Delta y_{t-1} + \varepsilon_t \tag{15}$$

The null hypotheses, $H_0: (\beta_0, \beta_1, \beta_2) = (1,1,1)$ is an integrated by order 1 or I(1) process model with intercept and deterministic time trend; $H_0: (\beta_0, \beta_1, \beta_2) = (0,1,1)$ is an integrated by order 1 or I(1) process model with zero intercept and deterministic time trend; and $H_0: (\beta_0, \beta_1, \beta_2) = (0,0,1)$ is an integrated by order 1 or I(1) process model with zero intercept or drift. The result of OLS estimation for coefficients in the Islamization index regression log-linear form with intercept and trend is

$$\Delta y_t = \underset{(0.20358)}{0.01773} + \underset{(0.00125)}{0.00213t} + \underset{(0.05033)}{0.98535}\, \Delta y_{t-1} + \varepsilon_t \tag{16}$$

The figure in the bracket is the standard error of the estimate and ε_t is the error correction term or white noise. Both coefficients of trend and lagged Islamization index are significant at less than 10% significance level. Hence, we cannot reject the null, $H_0: (\beta_0, \beta_1, \beta_2) = (0,0,1)$ which implies that the Islamization index is an integration of order 1 or I(1) process with zero drift or intercept.

In the second null testing, we remove the deterministic trend (β_1) in the Islamization index model, and the result of OLS estimation for coefficients is

$$\Delta y_t = \underset{(0.10339)}{-0.28464} + \underset{(0.0212)}{1.0638}\, \Delta y_{t-1} + \varepsilon_t \tag{17}$$

Hence, we can reject null of $H_0: (\beta_0, \beta_2) = (0,1)$ which implies that the Islamization index is an integration of order 1 or I(1) process with drift or intercept because β_0 coefficient is less than zero. All coefficients are highly significant at 1% significance level.

In the last hypothesis for the Islamization index regression with deterministic trend, the result of OLS estimation is

$$\Delta y_t = \underset{(0.00061)}{0.00204} + \underset{(0.0048)}{0.98971}\, \Delta y_{t-1} + \varepsilon_t \tag{18}$$

All coefficients are highly significant at the 1% significance level. The result suggests that we do not reject the null hypothesis, $H_0: (\beta_1, \beta_2) = (0,1)$ which implies that the Islamization index time series is an integration of order 1 or I(1) process with deterministic time trend. Based on these three null hypotheses mentioned above, we could conclude that the first differenced log-linear Islamization index sample data in Malaysia for the period 1969 to 2011 are stationary integrated process of order 1 or I(1) with deterministic trend and intercept.

3.5. Discussion and Implication

This paper determines the appropriateness to employ the Islamization index time series as one of the economic variables based on the empirical trend analysis of sample data collected in Malaysia from 1969 to 2011. Time series with deterministic and stochastic trend components have been known as a plausible approach in empirical research to study economic relationship between economic variables as argued by Nelson and Plosser (1982), Dickey and Fuller (1979), Franzini and Harvey (1983), Gujarati (2003), and others. It is important to distinguish between these two important cases. In a stationary process with a deterministic trend, the shocks have transitory effects. In contrast, for a process with a stochastic trend or a unit root, the shocks have permanent effects.

Preliminary data and unit roots test results show that the Islamization index and its sub-indices time series are basically random walks or stochastic trend with drift in nature, like other economic performance variables. They become a stationary process after first differencing with the inclusion of deterministic trend and intercept. The implications from the stationarity test are that the shocks in the Islamization index have transitory effects; and satisfy a strong law of large numbers (SLLN) and suitably standardized sums of elements of the time series obey a central limit theorem (CLT); which are important to prevent the potential risk of misspecification of the data-generating mechanism and exhibiting spurious correlation (Durlauf and Phillips, 1987).

4. CONCLUSION

This paper documents the appropriateness of the Islamization index to be employed as one of the macroeconomic variables time series to overcome the problem of robustness in the study on the effect of religion on economic performance. When deterministic trend and intercept are included in the time series differencing model, the stationarity result is found to be better off as compared to that without deterministic time trend. This suggests that deterministic time trend should be included in the Islamization index and its sub-indices time series model. Stationary or unit root tests on the Islamization index and its sub-indices have revealed that their time series variables are stationary with time deterministic properties at first difference or integrated by the order 1, I(1), which is consistent with the notion that most of the macroeconomic time series are non-stationary at level but become stationary after first differencing.

Diagnostic tests for the various models of the Islamization index and its sub-indices indicate that the autoregressive model with the inclusion of deterministic time trend and intercept yield better passing marks as compared to those without time trend in terms of serial correlation of residuals, Ramsey's RESET test for functional form, heteroscedasticity test, and DW-statistic for autocorrelation. Therefore, the Islamization index as a proxy of Islam can be employed in the empirical study with other economic variables because time series with stationary deterministic and stochastic trend components have been known as a plausible approach in empirical research to study the economic relationship between variables.

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[i] Prophet Muhammad s.a.w (peace be upon him) as narrated by Ibn Umar explains that Islam is based on five pillars: *shahadah, shalat, zakat,* fasting in the month of Ramadhan, and performing *hajj* pilgrimage for those who have the capability at least once in a life time (Shahih al-Bukhari 1:8 and Shahih al-Muslim 1:34).