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Do Islamic Stock Indices Follow the Adaptive Market Hypothesis Using an Artificial Neural Network Approach?

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Abstract

The purpose of this study is to determine the existence of the adaptive market hypothesis (AMH) in Islamic stock indices as a growing substitute to efficient market hypothesis (EMH) by employing monthly returns of Karachi Meezan Index 30 and S&P 500 Shariah are used which cover three main regions of capital investments. To fulfill the purpose, monthly returns from 2010 to 2019 are inspected. Artificial Neural Network Approach and Rolling Window Analysis are applied in this study. Hence, the outcomes show markets' efficiency after some time, which bolsters the AMH in Islamic markets. The essential outcome is that the Islamic stock exchanges accomplished noteworthy cyclical patterns of predictable and non-predictable returns over the period which bolsters the AMH idea. The research outcomes would provide help to brokers and portfolio managers as well as investors to encapsulate valuable returns over Islamic markets.

Discipline: Management Sciences (Finance), Data Science & Deep Learning.

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1 Introduction

Lo (2004) presented the idea of AMH to express efficiency and inefficiency in an intelligently predictable manner. He argued that market efficiency is not an all-or-nothing situation, but rather one that evolves through time. Research studies analyzing the validity of AMH have been administered on main stock indices where the framework of each market is distinctive. The research studies show solid proof of AMH in conventional stock markets. But unlike conventional markets, we come up with an intensive comprehension of return predictability in Islamic stock indices. The ongoing development of this division presently calls for a thorough examination by academicians. This exploration starts by revealing the early investigations of Islamic markets. Hussein (2005) presents those non-conventional markets outflank conventional indices in positively trending markets i.e., bullish market sub-period. The examiner reasoned that the two markets were profoundly associated which opened a scene for the financial investors to broaden their portfolios in any one of the business sectors. Various investigations inspected the weak-form efficient market hypothesis for Islamic indices (El Khamlichi *et al.,* 2014; Rizvi *et al*., 2014; Jawadi *et al.,* 2015; Al-Khazali *et al.,* 2016).

Jawadi *et al.* (2014) discovered that before the crisis, the traditional market beat, and the profits were high for Islamic assets. Manahov and Hudson (2014) present that stock market elements are predictable with the developmental procedure of AMH. Furthermore, Mohammad and Ashraf (2015) demonstrate that Islamic equity indices are statistically different in developing markets from those of developed markets, but the Islamic indices have negative market timing capacity mirroring the traditionalist idea of Islamic equity speculations. Al-Khazali *et al.* (2016) show that Islamic indices of UK, European, and Japanese markets are inefficient, and in Canadian, UK, Asia-Pacific, and European markets both Islamic and conventional indices were found to be efficient during and after the economic meltdown. Hence, an inclination that Islamic indices are more efficient in crises period is not observed (Charles *et al*., 2017). Abdelsalam and El-Komi (2015) note that the surviving research on Islamic finance has been falling behind, and more research and investigation are needed to additionally propel the information in this area.

The common problem in Islamic finance is the return predictability or market efficiency, which is under-researched. This means that whether it is an Islamic market, or a non-Islamic market frequently indicates withdrawal from market efficiency occasionally, which is constant with AMH. The main issue with the past methodology is looking at the efficiency of the market has withdrawn EMH point of view while inspecting the movement of stock prices and whether they pursue RW or not over longer periods (Campbell *et al*., 1997). Kim *et al.* (2011) contend that market efficiency is dynamic after some time considering various economic situations, as per the AMH.

The market dynamic presumption of AMH underlines that the market's efficiency level evolves after some time depending on its members, economic situations, the versatility of its members, and competition level. Hiremath and Narayan (2016) explore that the Indian stock exchange (ISE) is developing towards efficiency.

Islamic market has not attempted significant academic investigation in terms of research studies that could be clarified by their confined histories and by technological challenges because of contrasts in size and industry weighting. El Khamlichi *et al.* (2014) research on Islamic indices, banks, and mutual funds have not been given the elevated level of experimental research because of its limited history. However Islamic funds have demonstrated tremendous development in recent decades (Rana and Akhtar 2015). Researchers have not widely analyzed AMH on Islamic indices. In this study, Artificial Neural Network Approach is used to investigate AMH on Islamic indices of different countries. This is a major contribution to the literature on Islamic finance. This exploration starts by revealing the early investigations of Islamic markets. With limited Islamic indices history, AMH is also new comparatively to related theories such as Random Walk Theory and Efficient Market Hypothesis. The extraordinary growth of Islamic stock indices has raised the attention of researchers in investigating return predictability and their movements.

In this study, we assess the validity of the AMH in Shariah Compliant context by testing for stock return predictability of the KMI 30 and S&P Shariah 500 between 2010 and 2019 using monthly returns with a 36-month rolling window This investigation supplements past research studies concerning the AMH in a worldwide setting by giving knowledge of how the Islamic stock indices have acted generally. We would like to give productive insights to Islamic investors directing them to understand the behavior of predictable stock returns when applying ANN and the rolling window technique by keeping in view that economic conditions drive the predictability behavior of stock returns. This research study endeavored to give a thought to understanding whether AMH is the best fit to clarify the stock return behavior or not. This study also analyzes the time-varying fluctuations of predictability and unpredictability of Islamic market indices through the Artificial Neural Network approach.

2 Literature Review

2.1 AMH in Conventional Markets

A comprehensive audit of observational work on the efficient market hypothesis is presented by Sewell (2014), who pointed out that simply under half of the research studies audited bolster market efficiency with the greater part of the contradictory views on the efficient market hypothesis coming during the 1980s and 1990s. The believers of behavioral finance come up with the most contradicting and convincing research findings that make the validity of the efficient market hypothesis doubtful. Kim et al (2011) give solid proof that return predictability is associated with instability in the stock market and economic fundamentals. Lim and Brooks (2011) clarify that regardless of the conceptual and subjective nature of AMH it offers suggestions for financial issues. Gourishankar S. Hiremath and Kumari (2013) assess whether AMH gives a superior portrayal of the conduct of Indian exchanges and recommend that the Indian financial exchange is still in the principal phase of AMH. Gourishankar. et al (2013) stated that nonlinear returns straight away reject the EMH on account of India, Urquhart, and Hudson (2013) also experimentally study strong nonlinear dependence in developed markets. The testing of the efficiency of the market is tough and if there are changes in economic conditions, a new hypothetical model ought to be formed to contemplate all changes. As a reason, it is essential to proceed with the experimental examinations to determine market efficiency.

The outcomes imply that the returns are predictable in some periods but may not be inconsistent in another period. Shahid and Sattar (2017) tested AMH using five diverse schedule impacts in Pakistan financial exchange.

2.2 AMH in Islamic Markets

Hussein (2005), over the period 1996–2003, presented those profits on non-conventional markets outflank conventional indices positively in bullish market sub-periods as compared to bearish sub-period. The conduct of Islamic indices is by changing economic situations, particularly in the financial crisis (Ho et al. 2014). Jawadi et al. (2014) discovered that before the crisis period, the traditional market beat, and in times of financial crisis the profits were high for Islamic assets. Hull and McGroarty (2014) show alignment with the AMH, Manahov, and Hudson (2014) presented stock market elements are predictable with the developmental procedure of AMH. Islamic finance depends on the use of the old-style Islamic constitution in cash administration, infers restriction of premium, avoidance of interests in arms, high risk, liquor, clubs, gambling, tobacco, erotic entertainment, and pork; and significant regard for social government assistance. As conventional indices, Islamic indices have a similar degree of efficiency (Al Khamlichi, 2014). Islamic finance accessed a brilliant, advanced growth phase, developing subsequently financial crisis as an increasingly equitable and efficient option in contrast to the Western methodology. Although, Abdelsalam and El-Komi (2015) note that, surviving research on Islamic finance has been falling behind, and more research and investigation are needed to additionally propel the information in this area.

One of the problems in Islamic finance is the basic question of return predictability or market efficiency is under review; returns of all markets have been predictable in various periods. This means that whether it is an Islamic market or a non-Islamic market, they frequently indicate withdrawal from market efficiency occasionally, which supports the adaptive market hypothesis (AMH). The main issue in most past research studies looking at the efficiency of the market has withdrawn EMH's point of view while inspecting the movement of stock prices and whether they pursue random walks or not over longer periods. (Campbell et al.1997). Lo (2004) contends that market efficiency is dynamic after some time considering various economic situations, thus supporting adaptive market efficiency. The conception of return predictability and how it changes in a powerful pattern depend on behavioral biases and economic conditions when deciding on active/passive investment(Titan, 2015). Research studies analyzing the validity of AMH have been administered on main stock indices globally according to Lo (2004) where the framework of each market is distinctive, Urquhart and McGoarty (2016) observe that diverse economic situations have diverse implications in various markets. Thus, each market is to be assessed separately depending on special conditions.

3 Method

In this study, the monthly return data of Islamic indices of Karachi Meezan Index (KMI) and S&P 500 Shariah from January 2010 to December 2019 are used which cover three main regions of capital investment.

3.1 Artificial Neural Network Approach

ANNs are generally applied in financial applications to predict stock prices. Human neurons are the essential practical unit of ANNs. These systems can handle problems without prior learning of input/output association, that is why they are known as self-adjusting networks. The unique activation functions are utilized to delineate input and output variables. Furthermore, for the application of the feed-forward artificial neural network model this study will follow the following steps:

Step 1: To properly select the best combination of nodes(Y), layers(X), and the return lag (z) at which the minimum errors (min) are reported the multiple combinations are run first for each country's indices. The feed-forward network for each country at different lag values is given in the following equation:

$$R_{KMI} = G(\alpha_0 + \Sigma_{j=1}^{h} (\alpha_j) F(\beta_{0j} + \beta_{1j} R_{t-1}))$$

$$R_{KMI} = G(\alpha_0 + \Sigma_{j=1}^{h} (\alpha_j) F(\beta_{0j} + \beta_{1j} R_{t-2}))$$

$$R_{KMI} = G(\alpha_0 + \Sigma_{j=1}^{h} (\alpha_j) F(\beta_{0j} + \beta_{1j} R_{t-N})) \quad (1),$$

where α_j, β_{1j} (j=1, 2..., h) are the connection weights, α_0, β_{0j} are the bias terms and F and G are hidden and output layer activation functions, respectively.

$$F(X) = \frac{1}{1+e^{-x}} \quad (2).$$

$$G(X) = X \quad (3).$$

These equations will be analyzed at different combinations of hidden layers and nodes, for the performance accuracy of each country. The performance accuracy of the fitted method can be measured through the error statistic RMSE which is defined below:

$$\text{RMSE}= \sqrt{\frac{1}{N} \Sigma_{t=1}^{N} (R_t - R\hat{}_t)^2} \quad (4),$$

where R_t and $R\hat{}_t$ are actual and forecasted returns and N is the size of the testing dataset.

Step 2: Step two would employ the Rolling window technique by applying the estimation window length of 36 months with one month rolling forward at a time. After the arrangement of the best combination of hidden layers (X), nodes (Y), and lags (z) the point which accounts for a lesser RMSE moving-window would be applied. Following is the equation of ANN for employing a rolling window:

$$R_{KMI} = G(\alpha_0 + (\alpha_{j(m)}) F(\beta_{0j(m)} + \beta_{1j(m)} R_{t-N})) \quad (5).$$

To decide the ideal length of the training window, training periods of a year and two years will be made and examined. Training, Validation, and Testing Sets will be using different combinations.

Step 3: After constructing the best combinations the next step is to calculate the RMSE of subsamples from step 2 and plot a graph.

Step 4: Now error term movements which means efficiency or inefficiency of indices is identified.

4 Result and Discussion

4.1 Results and Discussion of KMI 30

The following tables and figures show the preliminary results of the Artificial Neural Network model. As in Table 1, we can see the minimum RMSE value is 0.03317 at node 3 with a combination set (0.8 training, 0.1 validation dataset, and 0.1 testing dataset) of KMI LAG 1. Similarly, in Table 3 we can see the minimum RMSE value is 0.05685 at node 1 with a combination set (0.75 training, 0.15 validation dataset, and 0.1 testing dataset) of KMI LAG 2.

Table 1: KMI LAG1 RMSE VS increase in hidden neurons

KMI 30 RMSE Lag1 (Combination 80%, 10%, 10%)										
Nodes/	1	2	3	4	5	6	7	8	9	10
RMSE	0.061	0.062	0.034	0.049	0.08	0.108	0.079	0.072	0.142	0.498
Nodes/	11	12	13	14	15	16	17	18	19	20
RMSE	0.398	0.079	0.223	3.102	0.1	0.263	0.231	0.201	0.591	0.749
Nodes/	21	22	23	24	25	26	27	28	29	30
RMSE	0.530	0.290	0.489	0.26	0.49	0.336	0.390	0.228	0.909	1.067
Nodes/	31	32	33	34	35	36	37	38	39	40
RMSE	0.992	0.287	0.592	0.85	0.43	0.525	1.154	0.796	1.264	1.806
Nodes/	41	42	43	44	45	46	47	48	49	50
RMSE	1.257	0.900	1.136	1.38	0.64	0.536	1.422	0.503	0.904	1.083

Table 2: KMI LAG2 RMSE VS increase in hidden neurons

KMI 30 RMSE Lag2 (Combination 75%, 15%, 10%)										
Nodes/	1	2	3	4	5	6	7	8	9	10
RMSE	00.057	0.06	0.058	0.073	0.064	0.061	0.064	0.069	0.224	0.084
Nodes/	11	12	13	14	15	16	17	18	19	20
RMSE	.064	0.06	0.223	0.074	0.073	0.39	0.217	0.427	0.557	0.386
Nodes/	21	22	23	24	25	26	27	28	29	30
RMSE	0.094	0.53	0.422	0.210	0.467	0.375	0.094	0.483	0.501	0.72
Nodes/	31	32	33	34	35	36	37	38	39	40
RMSE	0.433	0.42	0.512	1.756	0.744	0.664	1.248	0.696	0.512	0.463
Nodes/	4	42	43	44	45	46	47	48	49	50
RMSE	0.994	0.48	0.743	0.537	0.607	0.855	0.884	1.038	1.81	1.154

With the increase in neurons RMSE values also go up in the cyclical pattern. In KMI Lag1 highest RMSE 3.101275 is reported at neuron 14 (0.8 training dataset, 0.1 validation dataset, and 0.1 testing dataset). At node 49 RMSE 1.81012 is higher in Lag2 with 0.75 training, 0.15 validation set, and 0.1 testing dataset.

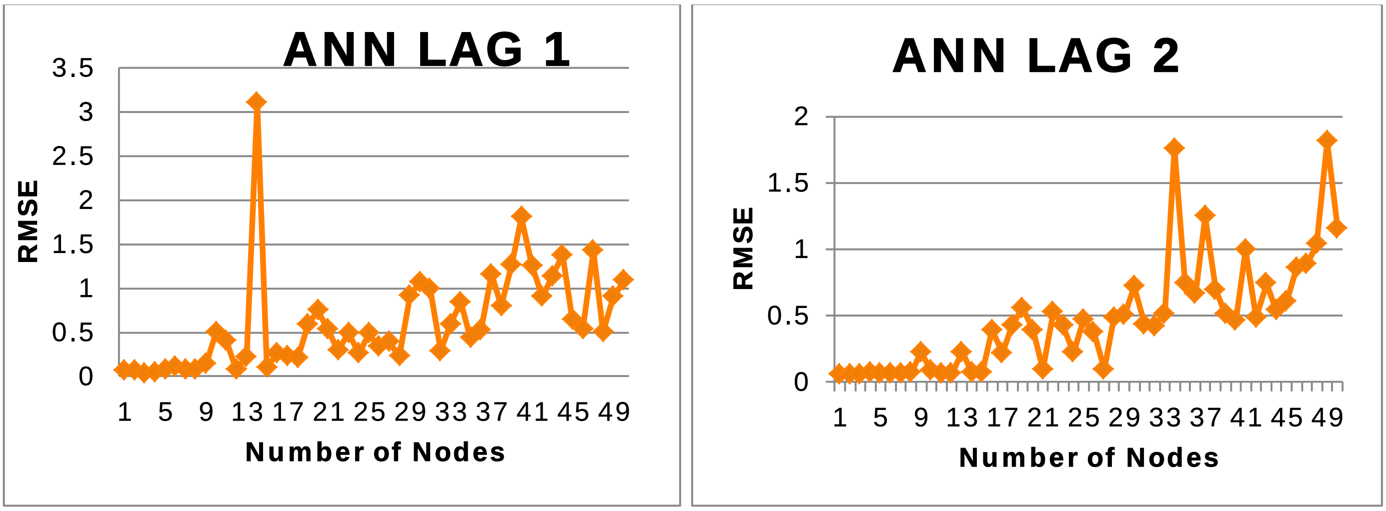

Figure 1: KMI LAGs RMSE Evolution Vs increase in hidden neurons

To evidence evolving efficiency of price movement of KMI 30, a fixed 36-month length window is applied with one month rolling forward in turn, to have a more intensive look at the time-varying trends of the Islamic indices returns. We applied a rolling window at KMI 30 Lag1 with 3 neurons and a combination of 80% training set, 10% validation set, and 10% testing dataset, at Lag 2 with 1 node (training 75%, Validation 15%, testing 10%), and collected RMSE values. Here are some declines and upswings which show inefficiency and efficiency.

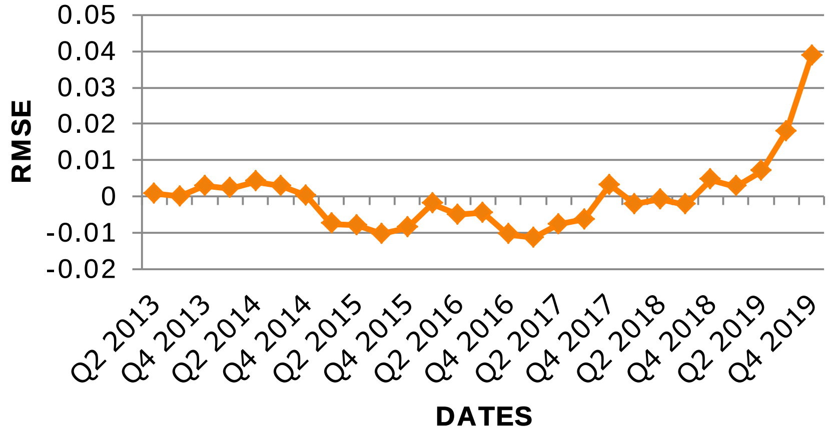

Figure 2: KMI LAG1 Rolling Window (AMH)

For KMI Lag1 Mean value is 0.042 and the standard deviation is 0.001904, by which a benchmark is created for analyzing the graphs. The upper region is 0.04084 and the lower region is 0.044084 the values that lie outside this region are efficient and values that lie on or under this region are considered inefficient. In the period of Q2 & Q3 2013, Q3 2014 and Q2 2018 markets are inefficient. From Q2 2013 to Q1&Q3 2015 market remained efficient, from Q2 to Q4 2015 market is showing efficiency and inefficiency in a way that is conclusive to AMH. 2016 and 2017 also support AMH but in 2018 market is efficient in 2019 market again fluctuates to show adaptability. Our outcomes fulfill our objective that efficiency and inefficiency are related in such a manner that we conclude the results support AMH. All graphs for KMI Lags depict periods of unpredictability as well as predictability. But Lag1 shows the best result as it reports minimum RMSE and the market continues to fluctuate in this manner.

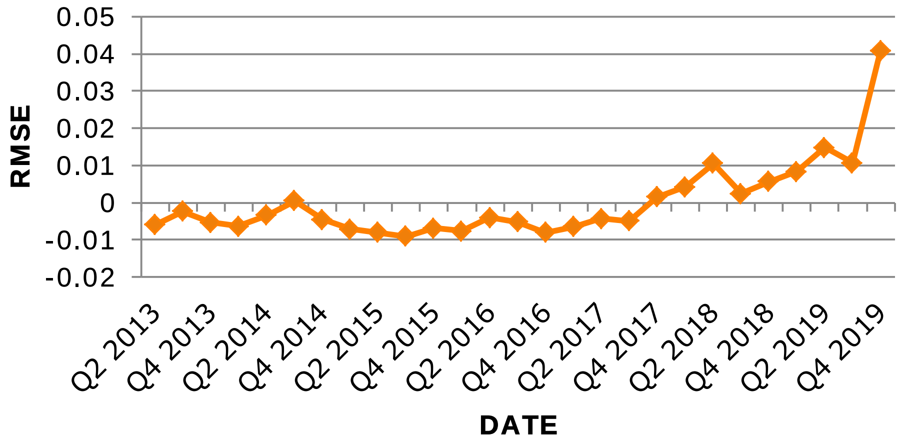

Figure 3: KMI LAG2 Rolling Window (AMH)

Mean value for KMI Lag2 is 0.042, deviation is 0.001 and critical region is (0.040, 0.044). In the above graph of KMI Lag2 from 2013 to 2017 market is efficient, and from 2018 to 2019 market is growing towards AMH behavior.

Table 3 shows the results that support AMH. It means our third objective whether efficiency or inefficiency is related in such a manner that may be conclusive that the market might be adaptive is fulfilled. As it is analyzed from 2015 Q2is efficient, Q3 is inefficient, and then again Q4 is efficient which supports AMH in 2015, 2016 market show adaptability both years have inefficient quarters and from 2017 to 2019 again results are consistent with AMH in 2017 prices fluctuate, in 2018 remains efficient then again in 2019 it shows fluctuations this behavior of market confirms AMH. As we increase Lags the implication of AMH becomes less consistent.

Table 3: KMI All LAGs AMH

Years	KMI 30 LAG1		KMI 30 LAG2	
	EMH	AMH	EMH	AMH
2013-2014	Supported for 2013	Not Supported for 2013-2014	Supported for 2013	Not supported 2013-2014
	Supported for 2014		Supported for 2014	
2015-2016	Not Supported for 2015	Supported for 2015-2016	Supported for 2015	Not Supported for 2015-2016
	Not Supported for 2016		Supported for 2015	
2017-2019	Not Supported for 2017	Supported for 2017 & 2019	Supported for 2017	Supported for 2018-2019
	Supported for 2018		Not Supported for 2018	
	Not Supported for 2019		Supported for 2019	

Broadly, the evidence of swings in inefficiency lends support for the AMH. As we can analyze the cyclical fluctuations, we found AMH. Rolling window analysis confirms the existence of AMH in

KMI 30 in form of time-varying efficiency and inefficiency as observed, some values are above the mean, and some are below the mean. Inefficiency and efficiency are captured in such a manner that is conclusive that the market is adaptive.

4.2 Empirical Results of S&P Shariah 500

The following Tables and Figures show the preliminary results of the Artificial Neural Network model. Table 4 and Figure 4 show the minimum RMSE value is 0.01536 at node 13 with a combination set (0.7 training, 0.2 validation, and 0.1 testing dataset) of S&P Shariah 500 LAG 1. Similarly, in Table 5, we can see the minimum RMSE value is 0.02747 at node 4 with a combination set (0.65 training, 0.15 validation, and 0.2 testing dataset) of S&P Shariah 500 LAG 2.

Table 4: S&P Shariah 500 Lag1 RMSE VS increase in hidden neurons

S&P Europe 350 Lag1 (Combination 70%, 20%, 10%)										
Nodes/	1	2	3	4	5	6	7	8	9	10
RMSE	0.018	0.033	0.025	0.032	0.038	0.025	0.16	0.036	0.032	0.0307
Nodes/	11	12	13	14	15	16	17	18	19	20
RMSE	0.139	0.034	0.016	0.116	0.118	0.043	0.091	0.047	0.053	0.107
Nodes/	21	22	23	24	25	26	27	28	29	30
RMSE	0.128	0.134	0.24	0.108	0.278	0.093	0.149	0.217	0.146	0.15
Nodes/	31	32	33	34	35	36	37	38	39	40
RMSE	0.062	0.211	0.289	0.22	0.194	0.174	0.292	0.253	0.147	0.261
Nodes/R	41	42	43	44	45	46	47	48	49	50
MSE	0.31	0.27	0.27	0.138	0.14	0.29	0.311	0.313	0.22	0.23

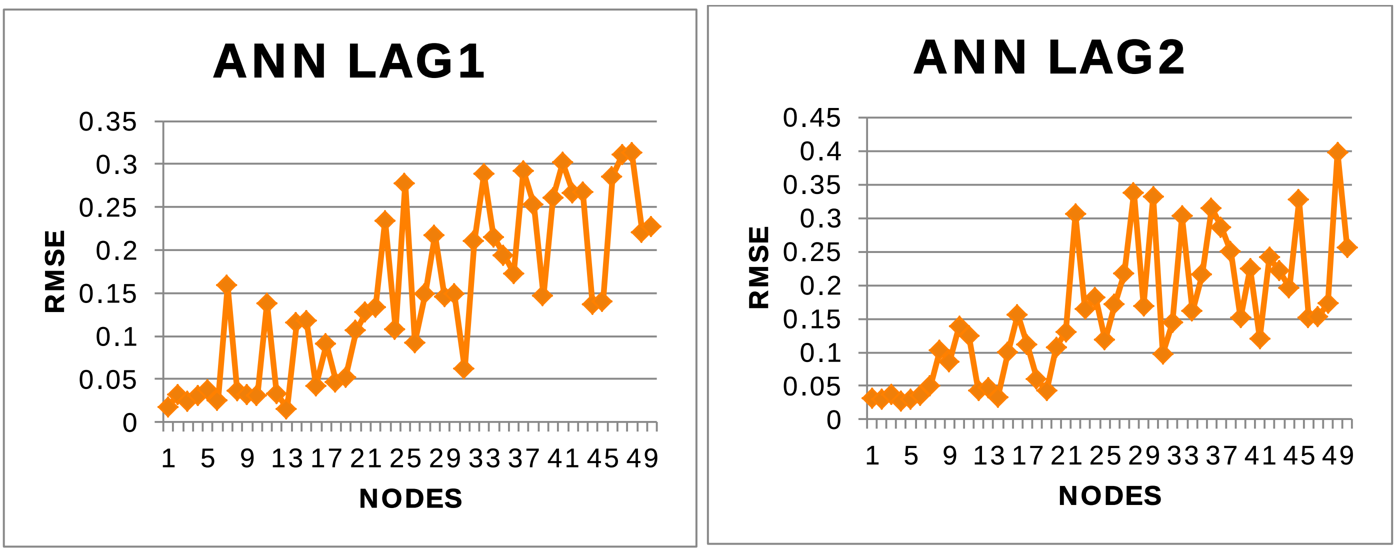

Figure 4: S&P Shariah 500 Lag4 RMSE Evolution Vs increase in hidden neurons

Table 5: S&P Shariah 500 Lag2 RMSE VS increase in hidden neurons

S&P Europe 350 Lag2 (Combination 65%, 15%, 20%)										
Nodes/	1	2	3	4	5	6	7	8	9	10
RMSE	0.031	0.030	0.040	0.027	0.03	0.0354	0.049	0.1	0.086	0.139
Nodes/	11	12	13	14	15	16	17	18	19	20
RMSE	0.1247	0.043	0.05	0.033	0.1	0.1559	0.111	0.06	0.043	0.107
Nodes/	21	22	23	24	25	26	27	28	29	30
RMSE	0.1305	0.306	0.16	0.182	0.118	0.171	0.218	0.34	0.169	0.332
Nodes/	31	32	33	34	35	36	37	38	39	40
RMSE	0.0972	0.144	0.3	0.161	0.215	0.3148	0.286	0.25	0.151	0.225
Nodes/RMSE	41	42	43	44	45	46	47	48	49	50
	0.121	0.241	0.220	0.196	0.327	0.152	0.152	0.17	0.398	0.256

In S&P Shariah 500 Lag1 highest RMSE 0.31274 is reported at neuron 48 (0.70 training, 0.20 validation and 0.1 testing dataset). At node 35 RMSE 0.497 is higher in S&P Shariah 500 Lag2 with 0.6 training, 0.2 validation set and 0.2 testing dataset.

AMH is analyzed as we found cyclical fluctuations in Figures 5 and 6. During the period of Q1 and 2 2014, Q4 2014 to Q3 2015, Q1 2016, Q1 & Q2 2017, and Q1&2 2019 market is inefficient. Rolling window analysis confirms the existence of AMH in S&P Japan 500 in the form of time-varying efficiency and inefficiency. The figure shows in some periods market is inefficient and in other periods, it is efficient which is conclusive that the market is consistent with the implications of AMH.

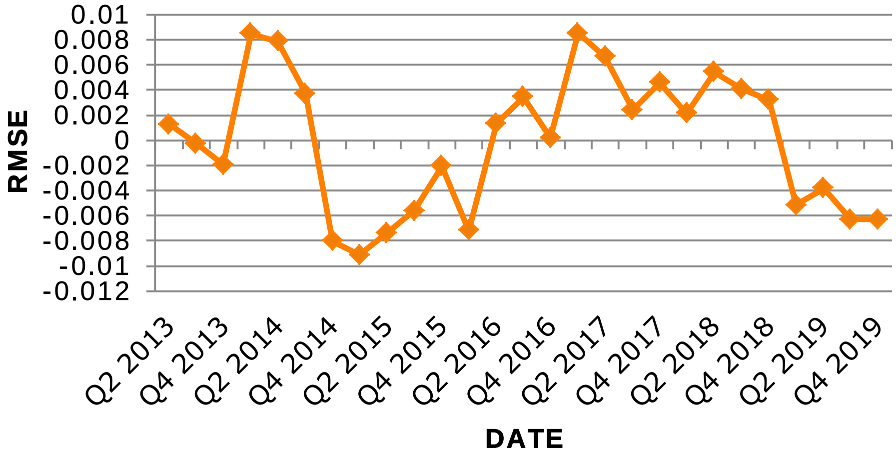

Figure 5: S&P Shariah 500 Lag1 Rolling Window (AMH

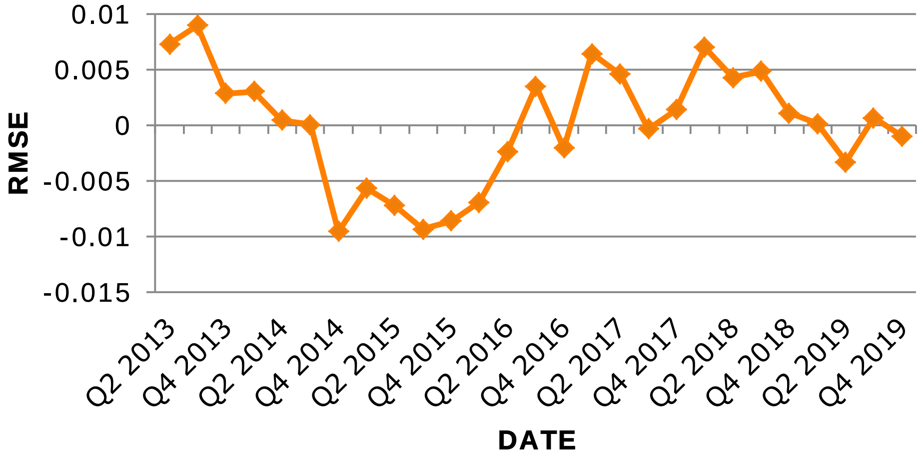

Figure 6: S&P Shariah 500 Lag2 Rolling Window (AMH).

Rolling window analysis confirms the existence of AMH in S&P Shariah 500 in form of time-varying efficiency and inefficiency as cyclical fluctuations/patterns can be observed as some values are above mean and some are below mean. In LAG 1 from 2014 to 2019 results depict support for AMH. In Lag2 2013, 2017, and 2018 bolster AMH. Both lags show variations that confirm that the Islamic market also moves in wave structure as its counterparts.

Table 6: S&P Shariah 500 Lags AMH Results

Years	S&P Shariah 500 LAG1		S&P Shariah 500 LAG2	
	EMH	AMH	EMH	AMH
2013-2014	Supported for 2013 Not Supported for 2014	Not Supported for 2013 Supported for 2014	Not Supported for 2013 Not Supported for 2014	Not Supported for 2013 Supported for 2014
2015-2016	Not Supported for 2015 Not Supported for 2016	Supported for 2015-2016	Not supported for 2015 Supported for 2016	Not Supported for 2015 Not supported for 2016
2017-2019	Not Supported for 2017 Not Supported for 2018 Not Supported for 2019	Supported for 2017-2019	Not Supported for 2017 Not Supported for 2018 Supported for 2019	Supported for 2017-2018 Not supported for 2019

5 Conclusion

Pakistan has a significant level of active/passive investments in stock assets, but there is a need for research on market efficiency mainly and explicitly on stock return predictability in Islamic markets alongside conventional markets. Moreover, every market shows various patterns of predictability of stock prices based on various economic situations; it is exceptionally pertinent to research how the predictability of stock return has changed after some time in a Pakistani setting. Thus, this study fulfills the objective to examine whether ANN can be utilized to predict the returns of Islamic market indices and to ensure efficiency and inefficiency of Islamic market indices by analyzing forecasting outcomes. To test stock return predictability, the ANN approach is used. From the observational outcomes in this research, we discovered that the stock return predictability for the KMI 30, and S&P Shariah 500 varies after some time which follows AMH. This research observes times of high unpredictability compared to the high predictability of stock returns. At long last, our investigation is of significance for financial investors and the overall public in understanding the behavior of Islamic indices concerning time-varying efficiency and benefit choices will rise.

The outcomes of the research will help brokers and portfolio managers as well as investors to encapsulate valuable returns over Islamic markets. Future research includes assessing the cause of explicit historical occasions/events, for example, political crisis and financial crisis, affecting the Islamic markets. This would be a significant supplement to our outcomes. This would additionally expand the comprehension of the AMH in the Pakistani Islamic index context as far as how stock return consistency is identified with these occasions.

6 Availability of Data and Material

Data can be made available by contacting the corresponding author.

7 References

Abdelsalam, O. and El-Komi, M. (2014). Islamic finance: an introduction. *Journal of economic behavior and organization.*, *103*(Supplement), S1-S3.

Al-Khazali, O.M., Leduc, G. and Alsayed, M.S. (2016). A market efficiency comparison of Islamic and non-Islamic stock indices. *Emerging Markets Finance and Trade*, *52*(7), 1587-1605.

Campbell, J.Y., Lo, A. and MacKinlay, C. (1997). *The econometrics of financial markets*. Princeton University Press, Princeton. New Jersey: MacKinlay.

Charles, A., Darné, O. and Kim, J.H. (2017). Adaptive markets hypothesis for Islamic stock indices: Evidence from Dow Jones size and sector-indices. *International Economics*, *151*, 100-112.

El Khamlichi, A., Sarkar, K., Arouri, M. and Teulon, F. (2014). Are Islamic equity indices more efficient than their conventional counterparts? Evidence from major global index families. *Journal of Applied Business Research*, *30*(4), 1137-1150.

Hussein, K. and Omran, M. (2005). Ethical investment revisited: evidence from Dow Jones Islamic indexes. *The Journal of Investing*, *14*(3), 105-126.

Hiremath, G. S., and Kumari, J. (2013). Stock returns predictability and the adaptive market hypothesis in emerging markets: evidence from India. *SpringerPlus*, 3(1), 1-14.

Ho, C.S.F., Abd Rahman, N.A., Yusuf, N.H.M. and Zamzamin, Z. (2014). Performance of global Islamic versus conventional share indices: International evidence. *Pacific-Basin Finance Journal*, *28*, 110-121.

Hull, M. and McGroarty, F. (2014). Do emerging markets become more efficient as they develop? Long memory persistence in equity indices. *Emerging Markets Review*, *18*, 45-61.

Jawadi, F. and Jawadi, N., Idi Cheffou A (2014). Are Islamic Stock Markets Efficient: A Time-Series Analysis. *Appl Econ*, *47*(16), 1686-1697.

Kim, J.H., Shamsuddin, A. and Lim, K.P. (2011). Stock return predictability and the adaptive markets hypothesis: Evidence from century-long US data. *Journal of Empirical Finance*, *18*(5), 868-879.

Lim, K.P. and Hooy, C.W. (2013). Non-Linear Predictability in G7 Stock Index Returns. *The Manchester School*, *81*(4), 620-637.

Lo, A.W. (2004). The adaptive markets hypothesis. *The Journal of Portfolio Management*, *30*(5), 15-29.

Manahov, V. and Hudson, R. (2014). A note on the relationship between market efficiency and adaptability–New evidence from artificial stock markets. *Expert Systems with Applications*, *41*(16), 7436-7454.

Mohammad, N. and Ashraf, D. (2015). The market timing ability and return performance of Islamic equities: An empirical study. *Pacific-Basin Finance Journal*, *34*, 169-183.

Rizvi, S.A.R., Dewandaru, G., Bacha, O.I. and Masih, M. (2014). An analysis of stock market efficiency: Developed vs Islamic stock markets using MF-DFA. *Physica A: Statistical Mechanics and its Applications*, *407*, 86-99.

Rana, M.E. and Akhter, W. (2015). Performance of Islamic and conventional stock indices: empirical evidence from an emerging economy. *Financial Innovations*, *1*(1), 1-17.

Sewell, M. (2014). *Efficient Markets Hypothesis: Joint Hypothesis*.

Shahid, M.N. and Sattar, A. (2017). Behavior of calendar anomalies, market conditions and adaptive market hypothesis: evidence from Pakistan stock exchange. *Pakistan Journal of Commerce and Social Science*, *11*(2), 471-504.

Urquhart, A. and Hudson, R. (2013). Efficient or adaptive markets? Evidence from major stock markets using very long run historic data. *International Review of Financial Analysis*, *28*, 130-142.

Urquhart, A. and McGroarty, F. (2014). Calendar effects, market conditions and the Adaptive Market Hypothesis: Evidence from long-run US data. *International Review of Financial Analysis*, *35*, 154-166.

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