

An Investigation of an Adaptive Neuro-Fuzzy Inference System to Model the Relationship among Natural Resources, Islamicity and Financial Development

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Abstract

Understanding the relations among natural resources, Islamicity and financial development helps economies to formulate policies and develop sources to improve the financial development. The current study aims to apply a novel Adaptive Neuro-Fuzzy Inference System (ANFIS) to explore financial development in 6 Asian economies (Pakistan, Indonesia, Philippines, Qatar, Bahrain and Thailand). It is a model used for prediction that depends on fuzzy guidelines findings in the information and creates a link among criterion and predictor variables. In doing so, the study considers the data from 2005 to 2019 to construct the forecasting framework of financial development in selected Asian economies using two predictor variables (natural resources and Islamicity). The findings of the study show that financial development increases with the decline in natural resources in all the sample countries. The selected countries are similar with respect to natural resources as a predictor versus financial development as criterion. With respect to Islamicity index, the findings are similar in Pakistan, Indonesia and Thailand and alike in Philippines, Qatar and Bahrain. For concern, in Pakistan, Indonesia and Thailand, financial development increases with the decline in Islamicity index while it increases with the increase in Islamicity index in Philippines, Qatar and Bahrain. It is concluded that resource-centered nations have negative relationship with financial development. It seems that the economies with abundant natural resources increases the exports of these resources instead of using them in the process of production. The study concludes that this soft computing approach can be implemented as an efficient and effective tool for predicting financial development for future period based on anticipated targets of rising financial development in Asian economies. Moreover, the method established in this study can be utilized to find out the solutions of different prediction problems in the similar domains.

Keywords: Natural Resources, Islamicity, Financial Development, Adaptive Neuro-Fuzzy Inference System

INTRODUCTION

The resource and financial markets are highly at risk of resource deficiency. Natural resources are the strength for a nation as they lead to economic progress. In the same way, they create a

challenging environment for financial progress under certain circumstances. However, in recent times, different nations, like Africa, Asia, Middle East Asia, and Latin America are the resource abundance nations (Badeeb et al., 2017; Grabara, 2020). The results of existing empirical studies have shown the reduced level of financial progress in most of the resource-abundant economies (Sachs and Warner, 2001; Zhang et al., 2018). The resource curse hypothesis clarifies why the resource-dependent nations are failed

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economically. Countries require an effective financial system in order to stimulate their economic progress and effective use of natural resources (Pradhan et al., 2016).

Financial development is an important factor in achieving substantial economic progress (Nawaz et al., 2019). The effectiveness in the financial indicators can be achieved with the preservation of net interest margins, control over corruption, credit circulation and political stability, which is based on the economic rents of natural resources (Dwumfour and Ntow-Gyamfi, 2018). Natural resources provide input to produce primary goods, and economies gain foreign revenue by exporting these primary goods in the international market. Thus, the abundance of natural resources in developing economies are useful in improving the country's trade deficit and creating economic activities (Kim and Lin, 2017). However, the potential negative effects of abundant reroutes can be alleviated through natural resource rents by reinforcing the economic and organizational arrangements (Boschini et al., 2007). Present study, therefore, concludes that efficient utilization of natural resources are one of the important factor for the financial development of selected Asian Economies.

Asia is one of the world's largest continent which accounts for almost 30 percent of the earth's land. It is also one of the most populous continents, which accounts approximately 60% of the total population. Asia is blessed with natural resources abundances. It reserves almost three fifth of the natural resources. Coal, oil, gold, iron, silver, diamond, natural gas, and fishing are the major natural resources of this region. However, the utilization of its natural resources is highly dependent on numerous factors such as, political and technological factors etc.

However, besides natural resource abundance, Islamicity is another important factor of having significant contributions in the development of financial sector of a nation. Islamicity facilitates Muslims to emphasis on the incontrovertible foundation of their religion that is Quran, which is an uninterrupted indicator of performance for the government and communities. Islamicity also deliver a complete understanding of Islam to the non-Muslim world as well. The Islamicity foundation has grasped the ownership of the Islamicity indices with the aim of supportive passive and optimistic change in Muslim nations. For that reason, the organizational structure of this foundation was reinforced by the Muslim community who appreciates the lessons of Quran.

Researchers believed that Islam do not only influence the personal life of individuals but it also significantly influences the different aspects of humans i.e., social, political, economic and cultural aspects. Mostly, the effect of Islamicity can be perceived in Islamic nations, where a Muslim, as an individual of society, engage in many responsibilities (Nasrabadi, 2006). Platteau (2008) argues that the economy in Islamic religions are highly associated with the religious beliefs and integrity. Islam necessitates the Muslims to follow the right path, the path of kindness, justice, honesty and morality. Zsolnai (2004) specifies that financial progress or economic development are the secondary outcomes in the Islamic nations, first is to follow the right path. Moreover, Islam entails the Muslims to establish their business relations in the harmony of Islamic principles. Guiso et al. (2003) point out that the organizational change is necessary condition for the economic progress in Islamic countries because, there is a significant fault in an Islamic legitimate system, that is "failure to invest paperwork with legal personality". Whereas, the Quran's verses highly emphasized on the importance of writing and recording the credit dealings, such as debit agreements. However, law believed that people can easily interfere in the written dealings i.e., by replacing or changing it. They highly believe on verbal promise, they perceived that verbal words under the shelter of Quran more reliable and having greater worth as compare to the written dealings. Basically, this belief is a serious hurdle to the financial and economic development of Muslim economies. Present study, therefore, perceives the significant contributions of Islamicity to the financial development of selected Asian Nations.

LITERATURE REVIEW

Natural Resources and Financial Development

Existing research showed the positive relationship between natural resources and financial development till 1980s (Balassa, 1980). This positive relationship was first challenged by Sach and Warner (2001) in their "resource curse hypothesis". The hypothesis proposed that resource-centered nations have a negative relationship with financial development. The economies with abundant natural resources increase the exports of these resources instead of using them in the process of production (Dwunfour and Ntow-Gyamfi, 2018). However, the findings of the existing studies on financial development and natural resources nexus are as follows.

Yuxiang and Chen (2011) empirically investigated the relationship between natural resources abundance and financial development. For this purpose, the study utilized the data of China for the period of 1996-2006. Results of the study showed the positive influence of natural resource abundance on the financial development. The study concluded that the rate of financial development for the resource-abundant nations was low as compared to the resource-poor nations. Kurronen (2015) investigated the influence of natural resources on the financial sector of 128 resource dependent economies and found that the resource dependent economies were having small financial sector. Shahbaz et al. (2018) worked on the US economy and found the direct relationship between natural resource abundance and financial development. Their study concluded that the optimal use of natural resources supported the financial markets. Bhattacharyya and Hodler (2014) significantly contributed to the existing debate of natural resource and financial development. The study investigated the role of political institutions in the association between natural resources and financial development. In order to accomplish the research objective, the study gathered the data from 133 nations for the period of 1970 to 2005. Results of the study showed the positive relationship between natural resources and financial development in the nations having strong political institutions. While, the negative relationship was found between natural resources and financial development in the nations having weak political institutions. Gokmenoglu and Rustamov (2019) studied the contributions of natural resource abundance in the development of financial sector of Russia, Turkmenistan, Azerbaijan, and Kazakhstan throughout 1992-2017 and showed the positive role of natural resource abundance in the development of the financial sector of selected economies. Shahbaz et al. (2018) also studied the relationship between natural resource abundance and financial development. For this purpose, the study utilized the data of USA for the period of 1960-2016 and showed the positive relationship between resource abundance and financial development. Dwumfour and Ntow-Gyamfi (2018) studied the relationship between natural resources and financial development in the context of resource curse hypothesis. For this purpose, the study collected the data from 38 African economies over the period of 2000-2012. Results of the study showed that 31% of the African economies were dependent on their natural resources rent ranging from 12.4% (in Zambia) to

51.5% (in Angola). Study further showed an unclear association between natural resources and financial development. Results of the study specified that the natural resource-financial development relationship was highly dependent on the measurement of financial development. Khandelwal et al. (2016) examined the linkage between oil price movements and financial development in the context of GCC economies over the period of 1999-2014. Results showed the significant relationship between oil price movements and financial development in the context of selecting economies. Zaidi et al. (2019) worked on the relationship between natural resources and financial development. For this purpose, they collected the data from a sample of 32 OECD nations. They found positive relationship between natural resources and the financial development. Canh and Thong (2020) studied the association between natural resources and financial development. For achieving this purpose, the study collected the data from 86 emerging economies for the period of 2002-2017. Results of the study showed the bi-directional relationship between these variables. Study concluded that the abundance of natural resources helped to develop the financial sector of a nation. Moreover, financial organizations helped to reduce the rents of natural resources through their financial efficiency. The study further concluded that both, financial institutions and natural resources were important for the economic progress. Guan et al. (2020) believed that a nation requires financial development in order to promote their economic efficiency (Kamarudin et al., 2017; Alaeddin et al., 2018). Therefore, the authors tested the "resource curse hypothesis" in the presence of globalization and economic growth. For this purpose, the study utilized the data of China for the period of 1971-2017. Findings showed a negative relationship between natural resources and financial development in the presence of globalization and economic growth. Result of the study validated the resource curse hypothesis in the context of China. Khan et al. (2020) also tested the validation of "resource curse hypothesis" in the context of China for the period of 1986 to 2017. Study incorporated some additional variables like human capital, technological innovations and trade openness in the finance demand function. Study applied Maki co-integration approach with structural break models in order to get the empirical results of the study. Outputs supported the validation of resource curse hypothesis as the study found negative influence of natural resources on the development

of financial sector. Rongwei and Xiaoying (2020) collected the data from 30 provinces of the China and found a negative relationship between natural resources and financial development. Sun et al. (2020) studied the relationship between natural resource rent and financial development in the context of resource curse hypothesis. For this purpose, the study collected the data from seven emerging economies (E-7) for the period of 1990-2017. Results showed the negative influence of natural resource rent on the financial development of selected economies. Atil et al. (2020) considered natural resources as a blessing for Pakistan and believed that financial sector was the backbone of any economy. Therefore, the study investigated the relationship between natural resources and financial development in the case of Pakistan. For this purpose, study collected the data for the period of 1972 to 2017 and applied ARDL for examining the empirical relation among variables. Findings of the study showed the positive impact of natural resource abundance on the financial development of Pakistan.

After reviewing the above literature, it is concluded that there have been many attempts to investigate the relationship between natural resources and financial development. Some evidences support the validation of resource curse hypothesis (negative influence of natural resources on financial development), while other do not support the validation of resource curse hypothesis (negative influence of natural resources on financial development). Some evidences suggest that the relationship between natural resources and financial development depends on the indicator of financial development, while other evidences suggests that this relationship is based on the role of political institutions. Conclusively, the results of previous studies are conflicting and contradictory in nature. Therefore, present study attempts to re-investigate the natural resource-financial development nexus. Hence, it is proposed that:

H1: There is a significant relationship between natural resources and financial development.

Islamicity and Financial Development

Uddin and Masih (2015) perceived the importance of financial development to the economic growth and human development. The authors believed that the concept of development in Islam has multifaceted. Therefore, the study investigated the empirical relationship between financial development, human development and economic progress in the context of pro-Islamic growth model. The study found the positive

relationship between financial development, economic growth and human development. The study argued that pro-Islamic growth model helped in the eradication of poverty and income inequality in Muslim world. Ayob and Saiyed (2020) done a valuable work and explored the contributions of a country's religious constitution on its financial development. In order to investigate the results empirically, study gathered the data from 88 nations. Findings of their study showed that the development of financial sector of Muslim nations was slow as compare to the non-Muslim nations. This is so because the participation rate of Muslim population in a new business activity was low. Moreover, Muslims usually engaged in a business activity because of their need instead of opportunity. Kim et al. (2020) collected the data from the Muslim countries and investigated the influence of religiosity and social inequality on the financial inclusion. In this regard, author calculated the financial indices. Study showed the significant relationship between religiosity and financial indices. Andraeny and Putri (2017) studied the influence of intellectual capital, Islamic social reporting and Sharia supervisory board on the Islamicity financial performance index. In this regard, the study collected the data from ten Islamic banks of Indonesia for the period of 2011-2015. Study used Islamicity financial performance index as a measure of bank's financial performance. Results of the study showed the positive relationship between intellectual capital, Islamic social reporting and Sharia supervisory board on the Islamicity financial performance index. El Ghoul et al. (2012) investigated the relationship between religiosity and financial development. Results showed that religiosity played a prominent role in the development of the financial sector. Oh, and Shin (2019) studied the effect of religion on the financial development of a nation. For this purpose, the study collected the data from 46 nations for the period of 1996-2015. Study applied co-integration techniques in order to test the long run association among religion and financial development. Findings showed the positive influence of religion on the financial development of the selected economies. Mtiraoui (2020) tested the influence of Islamic financial development on the development of financial sector. For this purpose, the study gathered the data from the MENA economies for the period of 1990-2018 and found a positive effect of Islamic financial development on the development of financial sector in the case of selected economies.

After reviewing the above literature, it is concluded that numerous studies report a significant relationship between religiosity and financial development. Whereas, studies on Islamicity- financial development are lacking in available literature. As far as we know, it is a neglected aspect in previous studies. However, above literature provides a road on Islamicity-financial development nexus. It is, therefore, proposed that:

H2: There is a significant relationship between Islamicity and financial development.

Resource Curse Hypothesis

Neo classical theory proposes that the natural endowments are beneficial for the economic progress of the nation because natural endowments accumulate the natural resource rents which result in the development of financial sector, which in turn promotes the economic progress of a nation. However, historically it seems that natural endowments appear to be a curse, instead of blessings for many nations as the growth rate of resource abundant economies is slow as compare to the resource-poor economies, known as "resource curse hypothesis". The idea of resource curse has emerged in early 1960s. The term of "resource curse" was first used by Richard Auty in 1933. He defined that how the countries with the abundance of natural resources were incompetent to use their wealth to improve their economic progress. Sachs and Warner (2001) were among the economist who reached at the conclusion that resource-centered nations have a negative relationship with financial development. It seems that the economies with abundant natural resources increases the exports of these resources instead of using them in the process of production (Dwunfour and Ntow-Gyamfi, 2018).

DATA AND METHODOLOGY

Data Source and Period

The study considers the data from 2005 to 2019 to construct the forecasting framework of financial development in 6 Asian economies (Pakistan, Indonesia, Philippines, Qatar, Bahrain and Thailand) by using two predictor variables (natural resources and Islamicity). The data of financial development and natural resources are taken from the database of WDI (World Development Indicator). The data of Islamicity index are gathered from Islamicity foundation (<http://islamicity-index.org/wp/>).

Variables

The study uses financial development as outcome variable while Islamicity and natural resources are used as predictor variables. Financial development refers to the improvements in capital distribution, trading expansion, risk management, money supply, and possible investments. It is calculated as the ratio of domestic credit to private sector and is measured as proportionate of GDP. Natural resources refer to the resources which comes from the natural environment i.e., water, coal, oil, iron, air, etcetera. It is measured as the rent of natural resources as proportionate of GDP (Siminică et al., 2020; Paşnicu and Ciucă, 2020; Vuță et al., 2020 and Nițescu and Murgu, 2019). The Islamicity is taken from the Islamicity foundation as Islamicity index which is the sum of four sub-indices i.e., human and political rights, legal and governance, international relations and economy. The indices of Islamicity validate the reflection that Western nations better imitate the Islamic institutions than those nations that confess Islam and also deliver the scope and extent for progress and renewal in Muslim states. This index makes Muslims enable to emphasis on incontrovertible foundation of their religion, "the Qur'an", and is a continuous indicator of performance of their communities, governments, rulers and for themselves. This index also offers an artless tactic to describe Islam to the world of non-Muslim.

Analytical Procedure

The current study applies Adaptive Neuro-Fuzzy Inference System Methodology (ANFISM) to explore financial development in 6 Asian economies (Pakistan, Indonesia, Philippines, Qatar, Bahrain and Thailand). ANFISM is a model used for prediction that depends on fuzzy guidelines findings in the information and creates a link among criterion and predictor variables. In order to build ANFIS model, the study uses three types of information namely "initially by preparing, secondly by checking, and finally by testing". First stage consists of building up framework using preparation group. In second stage, ANFISM uses test and confirms the groups for simplification and justification of the framework and the last stage is testing. Hussain et al. (2020) presents an ANFISM model for generating a forecast model depending on the original information. Five basic layers are there for generating the prediction of framework. These basic layers are shown in Figure 1. ANFISM is alike to the "Takagi-Sugeno-Kang fuzzy guideline-built framework". This system takes the parameters from criterion and predictor variables. The fundamental ANFISM system is shown in Figure 1 in

which this system applies five layers to formulate the information in order to forecast the criterion variable. A "Takagi-Sugeno-Kang fuzzy induction framework" with one criterion variable f , two predictor variables "x" and "y", and two fuzzy logics "IF-THEN" guidelines are performed in Equation 1. In such situation, the fuzzy groups for criterion variables "y" and "z" are considered, individually, by M1, M2 and by N1, N2. Similarly, the criterion elements are described by the j_1 , k_1 , h_1 and the j_2 , k_2 , h_2 restraints.

Rule 1:(x is M1) and (y is N1), then $f_1=j_1 x+ k_1 y+h_1$

Rule 2:(x is M2) and (y is N2), then $f_2=j_2 x+ k_2 y+h_2$
---- (1)

The framework depending on guidelines governs the plotting from independent variable to dependent variable of fuzzy groups. Fuzzification and defuzzification methods are used in order to present the probability of meeting with the framework focusing on two groups of predictor/criterion variables. In the stage of fuzzification, Gaussian membership functions (MFs) are joined to acquire the fuzzy predictor/criterion variables. For rationale links among the fuzzy predictor/criterion variables, the current study uses the instructions by decoding principles using fuzzy operators and logics. The study generates four resulting stages based on fuzzy principles; "predictor fuzzification, group of MFs, removal of the criterion defuzzification, and fuzzy principles". In the stage of fuzzification, MFs are used to predict the level of criterions in each fuzzy group. Oppositely, in the phase of defuzzification, the study uses area centroid (Hellendoorn and Thomas, 1993), which results in returning the central point of area under curve. The construction of ANFISM is shown on Figure 2.

In ANFISM, for predicting the outcome variable, there exists an essential and significant measure called MAE (mean absolute error). The forecasting of MAE of residuals of estimating framework is provided in Equation 2.

$$MAE = \sum (0-1)^n \text{ actual } (o) - \text{ foresight } (o) / n \text{ ---} \\ (2)$$

In equation 2, "actual (o)" represents actual outcome variable, "foresight (o)" represents foresighted outcome variable while n represents total number of observations. The study is basically established for predicting financial development on the basis of two predictors; natural resources and Islamicity in six countries of Asia based on the information available for the period 2005-2019. In order to get this objective, the study established predicting framework using fuzzy principle suggested by ANFISM from original information.

Moreover, the study establishes the associations among predictor and outcome variable ($Z = f(X_1, X_2)$) in a technique to certify prediction with the thrilling accuracy regarding the financial development. X_1 and X_2 indicate predictor variables of natural resources and Islamicity, respectively, while Y denotes the outcome variable of financial development. Three types of data (preparing, checking and testing) are used in ANFISM to establish prediction models.

Analytical Tool

The predictor models are established using MATLAB 7.10 (R2010a) software in 64-bit Microsoft Windows 10 under 4 GB of RAM and 4 GHz of processor. In order to evaluate the framework and analyze the ANFISM's ability to predict the models, the study uses measure of MEA in predicting financial development as output.

RESULTS AND DISCUSSIONS

The analysis begins with the descriptive statistics of variables used in the sample of selected Asian Economies. Results of descriptive statistic are reported in Table 1. Table shows the mean, standard deviation, skewness, and kurtosis, along with minimum and maximum values of the data. Results show that the mean value of financial development (FD) is 41.325 in Pakistan, 62.505 in Philippines, 63.732 in Qatar, 74.587, 33.197 in Indonesia, and 104.067 in Thailand. The mean value of FD ranges from 35.745 to 46.023 in Pakistan, from 48.992 to 75.394 in Philippine, from 41.889 to 92.859 in Qatar, from 53.460 to 89.398 in Bahrain, from 29.038 to 36.465 in Indonesia, and from 84.521 to 122.531 in Thailand. The average value of Islamicity (ISC) and natural resources (NR) is 2.003 and 1.914 in Pakistan with the minimum and maximum values of 0.383, 0.931 and 3.732, 2.840 respectively. In Qatar, the mean value of ISC (3.474) and NR (2.336) ranges from 0.447 to 6.357 and 14.283 to 43.233 respectively. In Bahrain, the average value of ISC is 4.004, ranges from 0.834 to 6.415, while the average value of NR is 6.233, ranges from 3.227 to 9.337. In Indonesia, the value of ISC ranges from 0.586 to 5.361 with an average of 2.769, while the value of NR ranges from 3.058 to 11.943 with an average of 3.070. In Thailand, the average value of ISC is 3.911, and the average value of NR is 0.732. The average value of ISC ranges from 1.873 to 5.893, while the value of NR ranges from 1.273 to 3.785. Jarque-Bera is used to test the normality of residuals. The test is having the null hypothesis of "non-normal residuals". Results of Jarque-Bera signifies the non-normal distribution of

residuals among the selected economies. Results of Jarque-Bera indicates the nonlinear relation among the proposed variables.

Present study uses Augmented Dickey Fuller (ADF) and Phillip Peron (PP) tests for testing the order of integration of variables in Tables 2 and 3. Table 2 reports the results of stationary analysis. Results depicts that all the series are non-stationary at level in both cases i.e., Intercept, and trend. The series become stationary at first difference by rejecting the null hypothesis of “non-stationary series” in both cases i.e., with and without trend. In order to provoke the usage of this new non-linear technique, the present study statistically evaluates the probability (likelihood) of non-linear relations among financial development, Islamicity and natural resources for six Asian economies. To do this, the study adopts Brook et al. (1996) test (currently used by Hussain et al., 2020) on the variable equation’s residuals of VAR (vector autoregressive model). The outputs of nonlinearity of BDS test are displayed in Table 4. In the first row of Table 4, “m” denotes to entrenched dimensions (Rehman and Apergis, 2019). The outputs confirm the rejection of residual’s null hypothesis at 0.01 level of significance across various dimensions. More precisely, the findings confirm nonlinearities in financial development, natural resources and Islamicity for all the selected countries. It may be the cause of broad variations in environmental and economic conditions of Asian countries in which natural resources and financial development & growth behave intermittently.

Table 5 shows the ranges of the Gaussian MFs taken via the ANFISM in context of Asian countries. For the stage of fuzzification, the study takes in to consideration the three phases of dialectal features for the inputs; “Low, Moderate and High”. Table 5 provides generated Gaussian MFs of ANFISM for “natural resources (X1)” and “Islamicity (X2)”. For “Low, Moderate and High”, the ranges of natural resources (X1) are estimated as “[1675, 2503], 2698, 5453] and [3367, 7985]”, respectively. Additionally, the ranges of Islamicity (X2) for “Low, Moderate and High” are estimates as “[1267, 2934], [1324, 3596] and [1587, 4687]”, respectively. To check the robustness of the approaches in enlightening the accuracy and efficiency of prediction of financial development on the basis of the values of fuzzy membership, the recital of proposed method is compared with other available methods, i.e., neural network (NLN), support vector regression (SVRG) and single ANFIS learnings (S-ANFIS) (Hussain et al., 2019; Hussain et al., 2020) . All these methods are compared with MAE-ANFIS.

The results of comparison are displayed in Table 6 which confirms that the ANFIS method performs more accurately and efficiently in predicting financial development as compare to the NLN, SVRG and S-ANFIS methods. The findings of MAE show that this approach of ANFIS provides higher accuracy (MAE $\frac{1}{4}$ 0.037) as compare to SVRG (MAE $\frac{1}{4}$ 0.132), NLN (MAE $\frac{1}{4}$ 0.189) and S-ANFIS learning (MAE $\frac{1}{4}$ 0.117). For the purpose of analysis, the links of criterion variables with outcome variable are given on the basis of surface plots for selected Asian countries. The outcomes of ANFISM with respect to the surface plots are revealed in Figure 3. These plots are described through continuous function of natural resources and Islamicity versus the financial development. The plots are generated by the average values of fuzzy rules mined from the numeric values of natural resources and Islamicity and financial development of the dataset. Moreover, the plots describe that how two predictors natural resources and Islamicity influence the financial development. For concern, Figure 3A shows the prediction of financial development on the basis of fuzzy rules in Pakistan with two indicators (i.e., natural resources and Islamicity). Based on Figure 3A, it is concluded that financial development, on average, decreases with the increase in natural resources and Islamicity. The values of natural resources, Islamicity and financial development range from 0.93 (2016) to 2.84 (2011), 0.38 (2005) to 3.73 (2017) and 35.75 (2011) to 46.02 (2019), respectively. Figure 3B provides the forecasting of financial development in Indonesia with two predictors (i.e., natural resources and Islamicity). Based on Figure 3B, it is also found that financial development, on average, falls with the rise in natural resources and Islamicity. The values of natural resources range between 3.06 (2016) to 11.94 (2008), the values of Islamicity range between 0.59 (2005) to 5.36 (2017) and the values of financial development range between 29.04 (2010) to 36.47 (2005). Figure 3C displays the likelihood of financial development on the rules of fuzzy method in Philippines with two criterion variables of natural resources and Islamicity. From Figure 3C, it is decided that financial development, on average, increases with the decrease in natural resources while it upsurges with the rise in Islamicity index. The values of natural resources, Islamicity and financial development range from 1.21 (2017) to 4.42 (2007), 1.72 (2005) to 5.70 (2018) and 49.00 (2005) to 75.40 (2019), respectively. Figure 3D illustrates the estimation of financial development on the basis of fuzzy rules in Qatar with two independent

variables (natural resources and Islamicity). Based on Figure 3D, it is established that financial development decreases with the increase in natural resources and conversely is true for Islamicity index. The values of natural resources, Islamicity and financial development range from 15.24 (2019) to 43.23 (2005), 0.45 (2005) to 6.36 (2015) and 41.89 (2008) to 91.88 (2019), respectively. Figure 3E exhibits the probability of financial development in Bahrain with two criteria of natural resources and Islamicity. From Figure 3E, it is cleared that financial development, on average, rises with the decline in natural resources while it increases with the increase in Islamicity index. The values of natural resources, Islamicity and financial development range from 3.23 (2016) to 9.34 (2013), 0.83 (2005) to 6.42 (2015) and 53.46 (2005) to 89.40 (2019), respectively. Figure 3F delivers the projection of financial development in Thailand with two predictors of natural resources and Islamicity. On the basis of Figure 3F, it is also concluded that financial development increases with the decline in natural resources and same is true for Islamicity index. The values of natural resources range between 1.27 (2018) to 3.79 (2008), the values of Islamicity range between 1.87 (2005) to 5.89 (2015) and the values of financial development range between 84.52 (2010) to 122.53 (2016).

The Table 7 provides a comparison among selected Asian countries on the basis of surface plots of Figure 3A to Figure 3F for the relations among natural resources, Islamicity and financial development. The Table shows that financial development increases with the decline in natural resources in all the sample countries. The selected countries are similar with respect to natural resources as predictor versus financial development as criterion. With respect to Islamicity index, the findings are similar in Pakistan, Indonesia and Thailand and same in Philippines, Qatar and Bahrain. For concern, in Pakistan, Indonesia and Thailand, financial development increases with the decline in Islamicity index while it increases with the increase in Islamicity index in Philippines, Qatar and Bahrain.

CONCLUSION AND IMPLICATIONS

Asia is one of the world's largest continent which accounts almost 30 percent of the earth's land. It is also one of the most populous continents, which accounts approximately 60% of the total population. Asia is blessed with natural resources abundances. Natural resources are the strength of any nation as they lead towards economic progress.

In the same way, they create a challenging environment for financial progress under certain circumstances. However, in recent times, different nations, like Africa, Asia, Middle East Asia, and Latin America are the resource abundance nations. The resource curse hypothesis clarifies why the resource-dependent nations are failed economically. Countries require an effective financial system in order to stimulate their economic progress and effective use of natural resources. Financial development is an important factor in achieving substantial economic progress. Natural resources provide input to produce primary goods, and economies gain foreign revenue by exporting these primary goods in the international market. Thus, the abundance of natural resources in developing economies are useful in improving the country's financial development. However, besides natural resource abundance, Islamicity is another important factor of having significant contributions in the development of financial sector. Islamicity facilitates Muslims to emphasis on the incontrovertible foundation of their religion that is Quran, which is an uninterrupted indicator of performance for the government and communities. Islam do not only influence the personal life of individuals but it also significantly influences the different aspects of human i.e., social, political, economic and cultural aspects.

The current study therefore applies Adaptive Neuro-Fuzzy Inference System Methodology to explore financial development in 6 Asian economies (Pakistan, Indonesia, Philippines, Qatar, Bahrain and Thailand). It is a model used for prediction that depends on fuzzy guidelines findings in the information and creates a link among criterion and predictor variables. In order to build ANFIS model, the study uses three types of information namely "initially by preparing, secondly by checking, and finally by testing". The predictor models are established using MATLAB 7.10 (R2010a) software. In order to evaluate the framework and analyze the ANFISM's ability to predict the models, the study uses measure of MEA in predicting financial development as output. In doing so, the study considers the data from 2005 to 2019 to construct the forecasting framework of financial development in selected Asian economies by using two predictor variables (natural resources and Islamicity). The data of financial development and natural resources are taken from the database of WDI. The data of Islamicity index are gathered from Islamicity foundation.

The findings of the study show that financial development increases with the decline in natural

resources in all the sample countries. The selected countries are similar with respect to natural resources as a predictor versus financial development as criterion. With respect to Islamicity index, the findings are similar in Pakistan, Indonesia and Thailand and same in Philippines, Qatar and Bahrain. For concern, in Pakistan, Indonesia and Thailand, financial development increases with the decline in Islamicity index while it increases with the increase in Islamicity index in Philippines, Qatar and Bahrain, hence, accepting both hypotheses of the study. The findings are in line with the resource curse hypothesis and neo classical theory. The theory proposes that the natural endowments are beneficial for the economic progress of the nation because natural endowments accumulate the natural resource rents which result in the development of financial sector, which in turn promotes the economic progress. However, historically it seems that natural endowments appear to be a curse, instead of blessings for many nations as the growth rate of resource abundant economies is slow as compare to the resource-poor economies, called "resource curse hypothesis". The hypothesis states that the countries with the abundance of natural resources are incompetent to use their wealth to improve their economic progress. It is therefore concluded that resource-centered nations have negative relationship with financial development. It seems that the economies with abundant natural resources increases the exports of these resources instead of using them in the process of production.

The study suggests government of selected Asian nation focusing on efficient utilization of natural resources for their production process. The study advises that the government should utilize these resources in the production of goods and services instead of exporting them. Second, the study recommends that selected Asian economies necessitate to have an intense political system which is based on the inclusion values and strong policy creations. These political policies will navigate the use of natural resources for a productive purpose, instead of exploitation purpose. Third, the study suggests that the government of selected Asian economies should follow the Islamic system. This does not only help in promoting the financial development, but also helps in maintaining peace and integrity in an economy.

The study concludes that this soft computing approach can be implemented as an efficient and effective tool for predicting financial development for future period based on foreknown targets of

rising financial development in Asian economies. Moreover, the method established in this study can be utilized to find out the solutions of different prediction problems in the similar domains.

REFERENCES

- [1] Alaeddin O., Altounjy, R., Zainudin Z. & Kamarudin, F. (2018). From physical to digital: Investigating consumer behaviour of switching to mobile wallet. *Polish Journal of Management Studies*, 17(2), 18-30.
- [2] Andraeny, D., & Putri, D. D. (2017). Islamicity Financial Performance Index in Indonesian Islamic Banks. *Shirkah: Journal of Economics and Business*, 2(3), 1-48.
- [3] Atil, A., Nawaz, K., Lahiani, A., & Roubaud, D. (2020). Are natural resources a blessing or a curse for financial development in Pakistan? The importance of oil prices, economic growth and economic globalization. *Resources Policy*, 67, 101683.
- [4] Ayob, A. H., & Saiyed, A. A. (2020). Islam, institutions and entrepreneurship: evidence from Muslim populations across nations. *International Journal of Islamic and Middle Eastern Finance and Management*. <https://doi.org/10.1108/IMEFM-11-2019-0472>
- [5] Badeeb, R. A., Lean, H. H., & Clark, J. (2017). The evolution of the natural resource curse thesis: A critical literature survey. *Resources Policy*, 51, 123-134.
- [6] Balassa, B. A. (1980). *The process of industrial development and alternative development strategies* (Vol. 1). Washington, DC: World Bank.
- [7] Bhattacharyya, S., & Hodler, R. (2014). Do natural resource revenues hinder financial development? The role of political institutions. *World Development*, 57, 101-113.
- [8] Boschini, A. D., Pettersson, J., & Roine, J. (2007). Resource curse or not: A question of appropriability. *Scandinavian Journal of Economics*, 109(3), 593-617.
- [9] Broock, W. A., Scheinkman, J. A., Dechert, W. D., & LeBaron, B. (1996). A test for independence based on the correlation dimension. *Econometric reviews*, 15(3), 197-235.
- [10] Canh, N. P., & Thong, N. T. (2020). Nexus between financialisation and natural resources rents: empirical evidence in a global sample. *Resources Policy*, 66, 101590.
- [11] Dwumfour, R. A., & Ntow-Gyamfi, M. (2018). Natural resources, financial development and institutional quality in Africa: Is there a resource curse? *Resources Policy*, 59, 411-426.

- [12] El Ghouli, S., Guedhami, O., Ni, Y., Pittman, J., & Saadi, S. (2012). Does religion matter to equity pricing? *Journal of Business Ethics*, 111(4), 491-518.
- [13] Gokmenoglu, K. K., & Rustamov, B. (2019). Examining the World Bank Group lending and natural resource abundance induced financial development in KART countries. *Resources Policy*, 63, 101433.
- [14] Grabara, J., Hussain, H.I., & Szajt, M. (2020). Sustainable university development through sustainable human resources and corporate entrepreneurship: The role of sustainable innovation and work environment *Amfiteatru Economic*, 22(54), 480-495.
- [15] Guan, J., Kirikkaleli, D., Bibi, A., & Zhang, W. (2020). Natural resources rents nexus with financial development in the presence of globalization: is the "resource curse" exist or myth? *Resources Policy*, 66, 101641.
- [16] Guiso, L., Sapienza, P., & Zingales, L. (2003). People's opium? Religion and economic attitudes. *Journal of monetary economics*, 50(1), 225-282.
- [17] Hellendoorn, H., & Thomas, C. (1993). Defuzzification in fuzzy controllers. *Journal of Intelligent & Fuzzy Systems*, 1(2), 109-123.
- [18] Hussain, H.I., Kamarudin, F., Thaker, H.M.T., & Salem, M.A. (2019). Artificial Neural Network to model managerial timing decision: Non-linear evidence of deviation from target leverage. *International Journal of Computational Intelligence Systems*, 12(2), 1282-1294.
- [19] Hussain, H. I., Slusarczyk, B., Kamarudin, F., Thaker, H. M. T., & Szczepańska-Woszczyzna, K. (2020). An investigation of an adaptive neuro-fuzzy inference system to predict the relationship among energy intensity, globalization, and financial development in major ASEAN economies. *Energies*, 13(4), 850.
- [20] Kamarudin, F., Hue, C. Z., Sufian, F., & Anwar, N. A. M. (2017). Does productivity of Islamic banks endure progress or regress?: Empirical evidence using data envelopment analysis based Malmquist Productivity Index. *Humanomics: The International Journal of Systems and Ethics*, 33(1), 84-118.
- [21] Khan, Z., Hussain, M., Shahbaz, M., Yang, S., & Jiao, Z. (2020). Natural resource abundance, technological innovation, and human capital nexus with financial development: a case study of China. *Resources Policy*, 65, 101585.
- [22] Khandelwal, P., Miyajima, M. K., & Santos, M. A. O. (2016). The impact of oil prices on the banking system in the GCC. *International Monetary Fund*.
- [23] Kim, D. H., & Lin, S. C. (2017). Natural resources and economic development: new panel evidence. *Environmental and resource economics*, 66(2), 363-391.
- [24] Kim, D. W., Yu, J. S., & Hassan, M. K. (2020). The influence of religion and social inequality on financial inclusion. *The Singapore Economic Review*, 65(01), 193-216.
- [25] Kurronen, S. (2015). Financial sector in resource-dependent economies. *Emerging Markets Review*, 23, 208-229.
- [26] Mtiraioui, A. (2020). Islamic financial development between investment and economic growth in the MENA region and The East Asia and the Pacific [Développement financier islamique entre l'investissement et la croissance économique dans la région MENA et l'Asie de l'Est et Pacifique] (No. Hal-02523154).
- [27] Nasrabadi, M. A. (2006). Influential factors in the trust relationships existing between financial analysts and corporate managers in Iran. <https://ro.uow.edu.au/theses>.
- [28] Nawaz, K., Lahiani, A., & Roubaud, D. (2019). Natural resources as blessings and finance-growth nexus: A bootstrap ARDL approach in an emerging economy. *Resources Policy*, 60, 277-287.
- [29] Nițescu, D.C. & Murgu, V. (2019). The economic growth catalyzers at the European level, in the context of the 2008 financial crisis. *Amfiteatru Economic*, 21(50), 241-257.
- [30] Oh, F. D., & Shin, D. (2019). Religion and Financial Development and Structure. *한국재무학회 학술대회*, 435-496.
- [31] Pașnicu, D. & Ciucă, V. (2020). Green procurement implications on the labor market in the context of the transition to the green economy. *Amfiteatru Economic*, 22(53), 28-41
- [32] Platteau, J. P. (2008). Religion, politics, and development: Lessons from the lands of Islam. *Journal of Economic Behavior & Organization*, 68(2), 329-351.
- [33] Pradhan, R. P., Arvin, M. B., Hall, J. H., & Nair, M. (2016). Innovation, financial development and economic growth in Eurozone countries. *Applied Economics Letters*, 23(16), 1141-1144.
- [34] Rehman, M. U., & Apergis, N. (2019). Determining the predictive power between cryptocurrencies and real time commodity futures: Evidence from quantile causality tests. *Resources Policy*, 61, 603-616.

- [35] Rongwei, X., & Xiaoying, Z. (2020). Is financial development hampering or improving the resource curse? New evidence from China. *Resources Policy*, 67, 101676.
- [36] Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. *European economic review*, 45(4-6), 827-838.
- [37] Shahbaz, M., Naeem, M., Ahad, M., & Tahir, I. (2018). Is natural resource abundance a stimulus for financial development in the USA? *Resources Policy*, 55, 223-232.
- [38] Shahbaz, M., Nasir, M. A., & Roubaud, D. (2018). Environmental degradation in France: the effects of FDI, financial development, and energy innovations. *Energy Economics*, 74, 843-857.
- [39] Siminică, M., Avram, M., Popescu, L. & Avram, R.L.(2020). The adoption of national green procurement plans from the perspective of circular economy. *Amfiteatru Economic*, 22(53), 15-27. (GDP)
- [40] Sun, Y., Ak, A., Serener, B., & Xiong, D. (2020). Natural resource abundance and financial development: A case study of emerging seven (E- 7) economies. *Resources Policy*, 67, 101660.
- [41] Uddin, M. A., & Masih, M. (2015). Finance, growth and human development: An Islamic economic development perspective. Online at <https://mpa.ub.uni-muenchen.de/65818/>
- [42] Vuță, M., Vuță. M., Enciu, A. & Cioacă, S.I. (2018). Assessment of the circular economy's impact in the EU economic growth. *Amfiteatru Economic*, 20(48), 248-261
- [43] Yuxiang, K., & Chen, Z. (2011). Resource abundance and financial development: Evidence from China. *Resources Policy*, 36(1), 72-79.
- [44] Zaidi, S. A. H., Wei, Z., Gedikli, A., Zafar, M. W., Hou, F., & Iftikhar, Y. (2019). The impact of globalization, natural resources abundance, and human capital on financial development: Evidence from thirty-one OECD countries. *Resources Policy*, 64, 101476.
- [45] Zhang, W., Du, J., & Tian, X. (2018). Finding a promising venture capital project with TODIM under probabilistic hesitant fuzzy circumstance. arXiv preprint arXiv:1809.00128. <https://arxiv.org/ftp/arxiv/papers/1809/1809.00128.pdf>
- [46] Zsolnai, L. (2004). Honesty and trust in economic relationships. *Management Research News*, 27(7), 57-62.

Table 1. Descriptive Statistics

Variables	N	Mean	SD	Minimum	Maximum	Skewness	Kurtosis	Jarque-Bera
<i>Pakistan</i>								
FD	15	41.325	3.150	46.023	35.745	-0.164	1.757	4.033 *
ISC	15	2.003	1.064	0.383	3.732	-0.056	2.157	5.451 *
NR	15	1.914	0.660	0.931	2.840	-0.339	1.640	6.442 *
<i>Philippine</i>								
FD	15	62.505	9.548	48.992	75.394	0.102	1.569	7.305 *
ISC	15	3.474	1.332	1.723	5.700	0.227	1.659	3.252 *
NR	15	2.336	1.073	1.298	1.208	0.663	2.372	3.347 *
<i>Qatar</i>								
FD	15	63.732	20.774	41.889	92.857	0.469	1.492	4.970 *
ISC	15	3.923	1.908	0.447	6.357	-0.418	1.986	4.079 *
NR	15	29.597	10.220	14.283	43.233	-0.412	2.627	6.603 *
<i>Bahrain</i>								
FD	15	74.587	12.027	53.460	89.398	-0.478	2.044	2.783 *
ISC	15	4.004	1.729	0.834	6.415	-0.469	2.029	3.723 *
NR	15	6.233	2.137	3.227	9.337	-0.215	1.768	4.834 *
<i>Indonesia</i>								
FD	15	33.197	2.113	29.038	36.465	-0.462	2.444	2.678 *
ISC	15	2.769	1.692	0.586	5.361	0.126	1.606	2.170 *
NR	15	6.9623	3.070	3.058	11.943	0.077	1.706	2.990 *
<i>Thailand</i>								
FD	15	104.067	13.694	84.521	122.531	0.238	1.514	4.520 *
ISC	15	3.911	1.047	1.873	5.893	0.036	2.495	4.162 *
NR	15	2.481	0.732	1.273	3.785	-0.287	2.173	4.633 *

Note: “* indicates that the values of Jarque-Bera are significant, FD: Financial Development, ISC: Islamicity and NR: Natural Resources”

Table 2. Stationary Analysis (Augmented Dickey Fuller Test)

Variables	Level		First difference		Decision
	Intercept	Trend	Intercept	Trend	
<i>Pakistan</i>					
FD	-1.256	-0.273	-4.788 ***	-5.873 ***	I (1)
ISC	-2.238	-1.733	-3.745 ***	-3.384 ***	I (1)
NR	-1.936	-1.834	-2.985 **	-4.337 ***	I (1)
<i>Philippine</i>					
FD	-0.725	-0.623	-6.763 ***	-5.376 ***	I (1)
ISC	-1.936	-1.873	-4.753 ***	-4.945 ***	I (1)
NR	-1.836	-0.834	-5.634 ***	-6.873 ***	I (1)
<i>Qatar</i>					
FD	-1.234	-1.753	-3.643 ***	-4.086 ***	I (1)
ISC	-1.267	-0.734	-2.764 **	-3.834 ***	I (1)
NR	-1.676		-3.322 ***	-3.993 ***	I (1)
<i>Bahrain</i>					
FD	-1.872	-1.763	-5.734 ***	-6.735 ***	I (1)
ISC	-0.984	-0.623	-2.385 ***	-3.845 ***	I (1)
NR	-0.124	-1.622	-4.387 ***	-5.734 ***	I (1)
<i>Indonesia</i>					
FD	-1.873	-0.923	-2.002 *	-3.119 ***	I (1)
ISC	-1.223	-1.754	-3.764 ***	-4.873 ***	I (1)
NR	-0.872	-1.245	-4.623 ***	-5.002 ***	I (1)
<i>Thailand</i>					
FD	-1.663	-0.976	-3.633 ***	-4.723 ***	I (1)
ISC	-1.753	-0.423	-4.634 ***	-5.732 ***	I (1)
NR	-0.735	-0.984	-4.222 ***	-6.735 ***	I (1)

Note: “*, ** and *** shows the level of significance at 1%, 5% and 10%, respectively, FD: Financial Development, ISC: Islamicity and NR: Natural Resources”

Table 3. Stationary Analysis (Phillip Peron Test)

Variables	Level		First difference		Decision
	Intercept	Trend	Intercept	Trend	
<i>Pakistan</i>					
FD	-1.656	-1.634	-2.433 **	-3.734 ***	I (1)
ISC	-0.734	-1.612	-2.387 **	-3.967 ***	I (1)
NR	-0.623	-0.2873	-3.458 ***	-4.734 ***	I (1)
<i>Philippine</i>					
FD	-1.734	-0.936	-4.311 ***	-5.726 ***	I (1)
ISC	-1.883	-1.724	-5.634 ***	-6.524 ***	I (1)
NR	-1.974	-0.952	-4.034 ***	-5.724 ***	I (1)
<i>Qatar</i>					
FD	-0.6723	-1.735	-3.734 ***	-4.523 ***	I (1)
ISC	-0.921	-1.700	-2.734 **	-3.725 ***	I (1)
NR	-1.983	-0.113	-3.873 **	-4.724 ***	I (1)
<i>Bahrain</i>					
FD	-0.254	-1.962	-4.367 ***	-5.423 ***	I (1)
ISC	-1.736	-1.834	-3.454 ***	-6.935 ***	I (1)
NR	-1.332	-1.083	-2.873 **	-4.762 ***	I (1)
<i>Indonesia</i>					
FD	-0.982	-1.118	-2.984 ***	-3.624 ***	I (1)
ISC	-1.734	-0.952	-3.873 ***	-4.114 ***	I (1)
NR	-1.521	-1.624	-4.322 ***	-6.624 ***	I (1)
<i>Thailand</i>					
FD	-0.826	-0.524	-3.387 ***	-1.952 ***	I (1)
ISC	-1.742	-1.734	-4.942 ***	-6.902 ***	I (1)
NR	-0.624	-1.374	-5.734 ***	-5.974 ***	I (1)

Note: “* , ** and *** shows the level of significance at 1%, 5% and 10%, respectively, FD: Financial Development, ISC: Islamicity and NR: Natural Resources”

Table 4. BDS Test Outputs of Nonlinearity

Country	m = 2	m = 3	m = 4	m = 5	m = 6
<i>Residual of Financial Development</i>					
Pakistan	11.6547 *	13.3645 *	13.9354 *	15.3798 *	17.6824 *
Indonesia	16.3497 *	20.4967 *	23.3487 *	27.3142 *	29.3124 *
Philippines	20.3845 *	23.9348 *	25.3715 *	31.4827 *	34.281 *
Qatar	42.3784 *	42.9347 *	43.6345 *	44.3641 *	46.634 *
Bahrain	23.6485 *	24.5891 *	27.3482 *	29.3145 *	31.489 *
Thailand	18.3467 *	22.3486 *	25.3461 *	27.3284 *	28.3587 *
<i>Residuals of Islamicity</i>					
Pakistan	16.3145 *	17.2597 *	18.3247 *	21.3745 *	22.4827 *
Indonesia	13.6578 *	15.3246 *	18.3254 *	20.3578 *	23.2222 *
Philippines	26.3579 *	28.3657 *	31.5478 *	37.8117 *	41.2579 *
Qatar	51.2798 *	53.3648 *	55.2497 *	56.3278 *	61.2486 *
Bahrain	31.2548 *	34.6274 *	34.9234 *	35.2487 *	35.9999 *
Thailand	10.2348 *	11.2497	13.2478	14.2417 *	16.3247 *
<i>Residuals of Natural Resources</i>					
Pakistan	14.3258 *	15.2975 *	16.3289 *	18.3258 *	21.2522 *
Indonesia	09.3245 8	10.3487 *	11.2489 *	13.4872 *	14.2550 *
Philippines	29.3148 *	29.8217 *	30.2715 *	32.1480 *	33.0027 *
Qatar	52.3547 *	53.2852 *	54.3667 *	55.32489 *	57.2511 *
Bahrain	22.3541 *	23.3254 *	23.8517 *	24.5471 *	27.2813 *
Thailand	15.3247 *	15.5384 *	15.8631 *	16.3057 *	17.0578 *

Note: "*" indicates that the values are significant"

Table 5. Generated Gaussian MFs of ANFISM for Predicting Financial Development

Factor (Input)	Type	Low	Moderate	High
NR (X1)	Gaussian	"[1675, 2503]"	"[2698, 5423]"	"[3367, 7985]"
ISC (X2)	Gaussian	"[1267, 2934]"	"[1324, 3596]"	"[1587, 4687]"

Note: NR: Natural Resources and ISC: Islamicity.

Table 6. Comparing the Findings of MAE Value with Existing Methods Values

Method	MAE
Neural Network (NLN)	0.189
Support Vector Regression (SVRG)	0.132
Single ANFIS Learning (S-ANFIS-L)	0.117
ANFIS	0.037

Table 7. Comparison among Selected Asian Countries on the Basis of Figure 3A to Figure 3F

Country	NR → FD	ISC → FD
Pakistan	FD increases with the decrease in NR.	FD increases with the decrease in ISC index.
Indonesia	FD increases with the decrease in NR.	FD increases with the decrease in ISC index.
Philippines	FD increases with the decrease in NR.	FD increases with the increase in ISC index.
Qatar	FD increases with the decrease in NR.	FD increases with the increase in ISC index.
Bahrain	FD increases with the decrease in NR.	FD increases with the increase in ISC index.
Thailand	FD increases with the decrease in NR.	FD increases with the decrease in ISC index.

Note: FD: Financial Development, ISC: Islamicity and NR: Natural Resources.

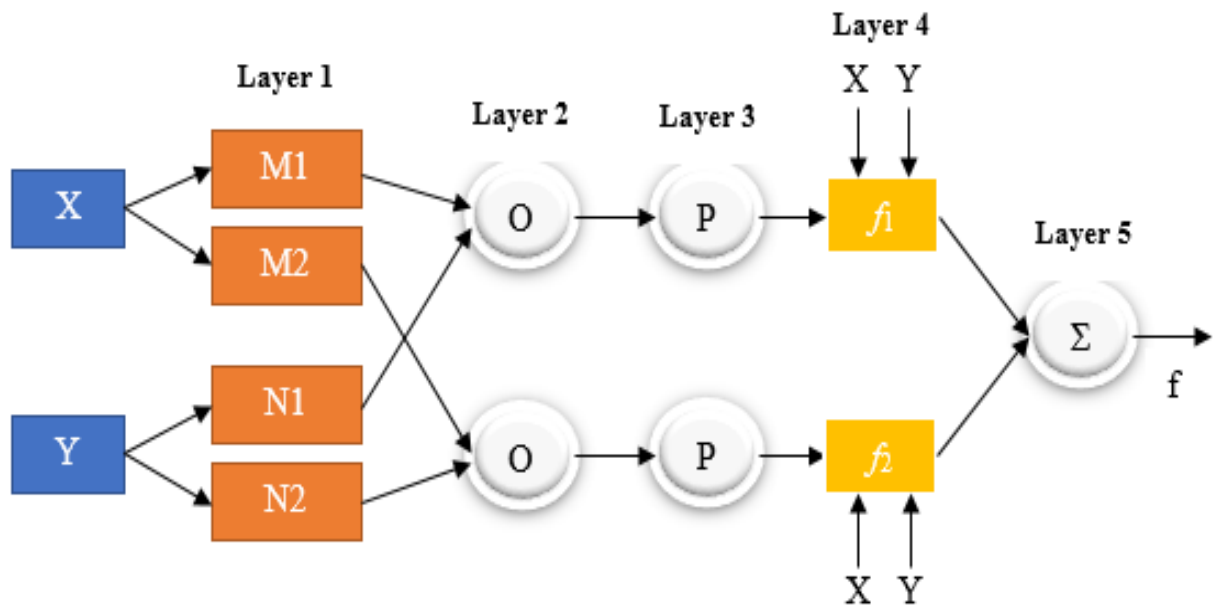


Figure 1. Fundamental Model of Adaptive Neuro-Fuzzy Inference System

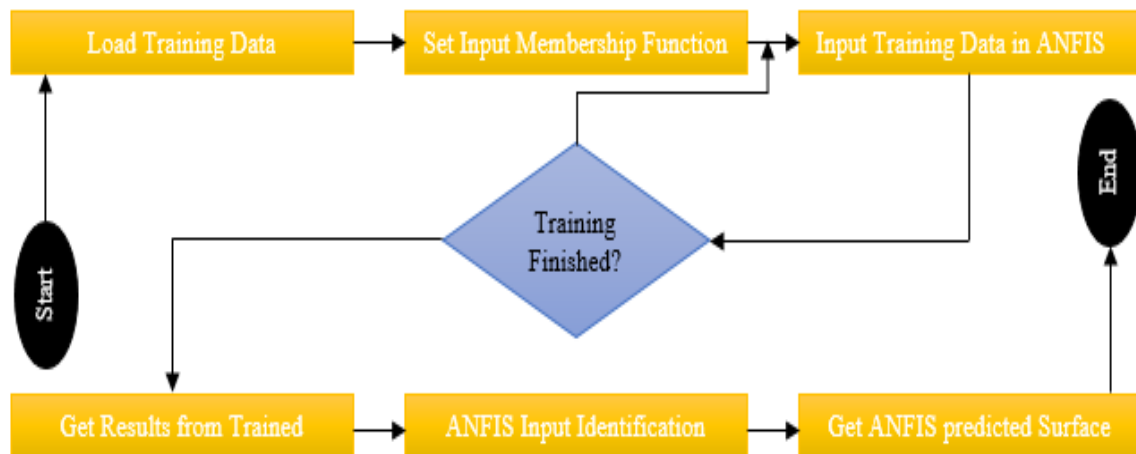


Figure 2. The Construction of ANFISM

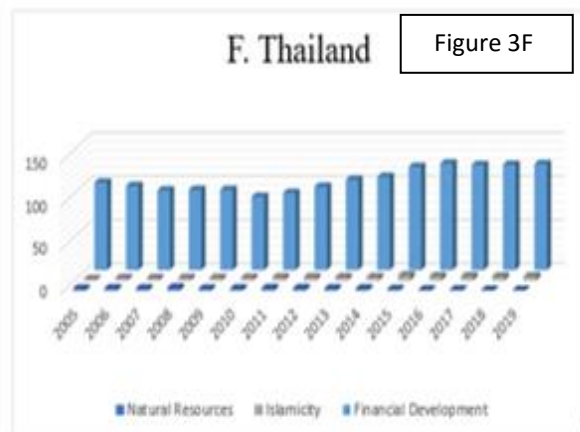
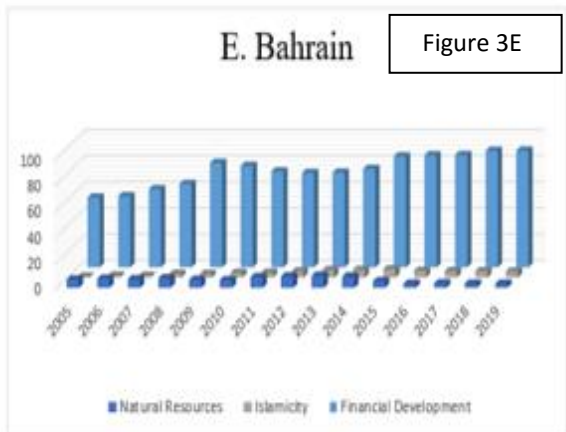
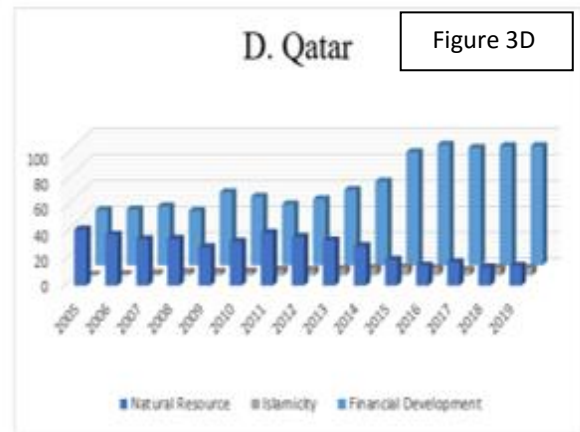
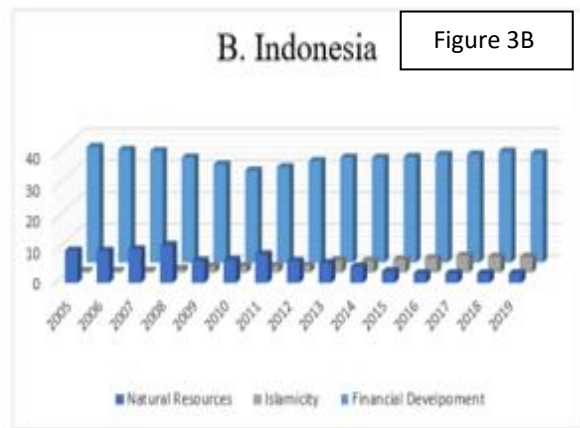
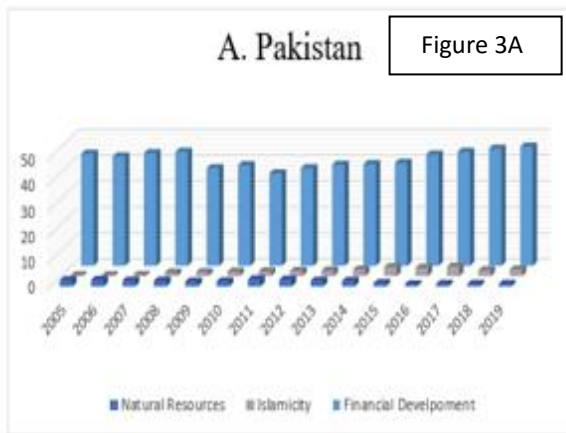


Figure 3. Prediction of Financial Development based on Natural Resources and Islamicity of Six Selected Asian Nations