ACTA SCIENTIFIC AGRICULTURE (ISSN: 2581-365X)

Volume 3 Issue 3 March 2019

Research Article

Prediction of Iran's GDP By Using Autoregressive Moving Average Model

Karim MH*

Associate Professor in Agricultural Economics, Kharazmi University, Tehran, Iran

***Corresponding Author:** Karim MH, Associate Professor in Agricultural Economics, Kharazmi University, Tehran, Iran.

Received: December 29, 2018; **Published:** February 21, 2019

Abstract

One of the important matters in economy is prediction of GDP. Since proper prediction of economic growth has vital effects on economic plans and policies made by the government, and plus making grounds for developing new prediction methods, may assist policy makers in their future decision making, this article aims at predicting Iran's GDP using autoregressive-moving-average model. The data used in this study includes annual GDP from 1977 till 2016. The results were compared by minimum root mean square error and mean absolute percentage error. The results indicated that GDP would increase in the future; therefore, planning may play a very significant role in this regard.

Keywords: Prediction of Iran's GDP; Autoregressive-Moving-Average Model; Planning

Introduction

Change in GDP is considered as economic growth; in other words, it is indicative of economic development trend and enlargement of national economy during this period. GDP means sum of goods production and final transacted services within one year, and the word "gross" is replaced with "net" when items such as amortization is deducted from the accounts [1]. Therefore, GDP may be used to compare the position of countries in terms of economy. Moreover, this variable is a criterion that shows economic growth of a country. Economic growth of every country indicates constant growth of production which is often accompanied by infrastructure changes and population growth [2]. Today, economic growth is favorable because of the following: 1) it has remarkably improved livelihood, welfare and consumption of a great number of people in a way that today people have better nutrition, means, cloths and educational materials and more goods. 2) Growth brings with it more options for humans particularly women and children, to choose from among jobs, lifestyles and values. 3) Development of technology makes millions of people free from hard labor, saves time and puts nature under relative control of human. 4) Growth will result in flourish of talents, use of innovation and imagination in different areas of science such as organization of social, political and economic relations and establishment of the related institutes, ruling of law and public participation in political arenas. 5) It causes increasing positive mutual dependence in the world in a way that the world has become like a small village and all of the world will be aware of whatever happens in a small deserted place, and such a thing arises from long-term economic growth. 6) Political and military power of the country will increase nationally and globally [3].

Hence, the main question this research poses is "Is neural network approach more accurate than autoregressive methods?" Based on this question the following hypothesis is formulated "neural network has more predictive power compared to autoregressive methods".

Review of the Related Literature

Growth model proposed by Adam Smith is based on three factors of labor, land and capital. Like Hume, he considered free trade as the engine of the economic growth. The most important thing Smith did was entering "increasing returns based on division of labor" in economy. The growth (development) model proposed by Smith starts from accumulation of capital created by the resources of industry, and like all other classic models, the dynamic power in investment is the amount of profit [4]. Economists such as Thomas Malthus and David Ricardo, who were from among pessimist economists, offered new perspectives on economic growth. Malthus considered accumulation of capital, soil fertility and innovations as factors of growth. He emphasized more on the effect of population growth rate on economic growth. However, Ricardo examined economic growth from wealth distribution perspective. He believed that increasing or diminishing returns had an essential role in long-term economic growth. John Stuart Mill offered his economic growth model based on factors like land, labor, capital, amount of returns and factors affecting each of them in his book "Principles of

Political Economy". Karl Marx is one of the other classic theoreticians in economic growth area, who in his well-known book "capital" (1867) predicted collapse of capitalism. However, he considered capital surplus as the source of capital accumulation and main motive for growth [4]. After Marx, neoclassic economists such as Marshal, in his book namely "Principles of Economics" (1890) proposed his growth model emphasizing factors determining income distribution and variables of savings rate and rate of increase in quality and quantity of labor. Arthur Pigou, Leon Valras, Vilferdo Parto and Irving Fisher were from other theoreticians in neoclassic growth, who played important roles in development of economic growth. Walt Witman Rostow, John Maynard Keynes (1936) and Joseph Schumpeter (1934) apart from neoclassic economists worked on growth theory, particularly Schumpeter who had an insight into growth theory and emphasizing innovation and invention, considered these factors as the main ones in economic growth [4]. Schumpeter considered acquisition of profit from among factors causing innovation and invention, which in turn resulted in increase of production, employment of labor and improvement in production conditions and methods in long run. These classic economists accompanied by Frank Ramsey (1928), Elian Yang (1928), Frank Kant (1944) and Joseph Schumpeter (1934) named many of the main factors in modern theories on economic growth. These theories include the main perspectives like competitive behavior and dynamic equilibrium, diminishing returns rule and its relation with physical and human capital accumulation, the interaction between investment income ratio and population growth rate, technical development effects in different forms like increase in labor's expertise, discovery of new products and production methods, and monopoly power law which has been like a motive for advanced technology (Baro, Salai Martin, 1995).

Background of Research

Much research has been done on prediction using neural network and autoregressive models several of which are presented herein below.

Azadeh., *et al*. (2008) in a study entitled "Prediction of Monthly Electricity Consumption Using Algorithm Simulated Based on Neural Network" compared prediction accuracy of neural network and autoregressive method; the results of this study showed that neural network method outperformed the other. Henry Vebosarnges (2007) examined prediction of Thai rice export using autoregressive-moving-average model (ARIMA) and neural network. They compared the results from these two models and found that neural network model compared to autoregressive-moving-average model predicted and fitted the data of export rice very well. Hashyav and Tinpav (2006) in a study entitled "Comparison of Linear and Non-linear Methods in Relation with Use of Electricity" compared linear and non-linear (neural networks) methods in order to examine the effect of four factors including economy, national income, population, GDP and consumer price index on use of electricity. The results of the two methods indicated that population and national income had effect on use of electricity in Taiwan. Harouri., *et al*. (2004) taking into account limited number of research in prediction of economic variables in Europe, compared the ability of neural network with an autoregressive process (AR) in prediction of industrial productions in three European countries namely Germany, France and England. To this end, RMSE was used. The results indicated that in time periods shorter than 12 months, neural network had less prediction error compared to autoregressive method. These researchers believed that neural networks outperformed other methods in predicting path of variables. Farough Malek and Mahdi Nasereddin (2002) in an article entitled "Prediction of Output with Oil Price Using Neural Network" predicted the U.S. GDP by a typical neural network, (CS) neural network and autoregressive model, and the results showed the least prediction error for CS network. Takz (2001) in a study entitled "Prediction of Canada's GDP Using Neural Network" compared accuracy of prediction of GDP using neural network and autoregressive model, and the results showed that the neural network outperformed the other method in predicting GDP. Portugal (1995) compared the accuracy of prediction of GDP in industry sector in Brazil using neural network methods, non-visible component model and ARIMA. The results of the study showed that ARIMA outperformed the neural network model. Chatfield (1993) compared classic statistical methods for prediction with artificial neural method and found that neural networks method may be used as a non-linear regression method. Marzban., *et al*. (2005) tested and analyzed artificial neural network models and some of the prevalent models in prediction of hard currency rate. The results obtained from direct comparison of structural econometric models performance and time series with neural networks regarding prediction of foreign exchange rate clearly enjoyed more strength. Sinaei., *et al*. [6] dealt with prediction of Tehran securities by using neural networks and ARIMA the results obtained from this study showed that neural networks have better performance than autoregressive models. Roshan [7] dealt with Iran's inflation forecasts by using ARIMA, GHARCH and ARCH models and neural networks and comparison of the mentioned model efficiency and the result showed the model best performance in comparison to the mentioned models. Ghadimi (2002) in investigation of modeling and economic growth forecast in Iran compared a neural network with a regression linear model to predict Iran's economic growth. His study showed that the neural networks model enjoys high efficiency in predicting Iran's economic growth rate.

Methods

According to definition, prediction of future conditions and events is called forecasting. The predictors prepare a model extendable for future by information gathered from the last years, experiences and analysis of these data. This basic method is used by assuming model extension in future in most of the prediction methods. There are different methods for prediction of time series variables.

Autoregressive heteroskedasticity model (ARCH) was proposed for the first time by Engel and then it was generalized to GHARCH models by Boulercello. In theoretical literature the ARCH and GARCH technics called auto regression under the terms of the variance anisotropy are used for investigation of shock and prediction of a variable. Using ARCH and GARCH models is so popular in the experimental works since by using these models, we can estimate variance of a set of data in any certain point of time. In the GARCH models, such as GHARCH (1, 1), the conditional variance equation in addition to squares q of the previous returns of total P interval from itself is as the distributive variables. That is it is stated in the form of an ARMA process.

Where N_i is the standardized values, X_i is the real values and X_{max} is the maximum real value. The above mentioned relation standardizes the input between 0.1 and 0.9 and its advantage is the better possibilities out of the data limitation values of the training course. After completion of the prediction and obtaining the value, different criteria is used for comparing the prediction power and choosing the best method that in this study, Criteria of mean square error:

$$MSE = \frac{\sum (\hat{y}_t - y_t)^2}{n}$$

And mean square error will be as follows:

$$RMSE = \sqrt{\frac{\sum (\hat{y}_t - y_t)^2}{n}}$$

Similarly, the mean absolute deviation;

$$MAPE = \frac{\sum \left| \frac{\hat{y}_t - y_t}{y_t} \right|}{n}$$

Results and Discussions

In order to determine the variables statics, the generalized Dickey - Fuller Test (ADF) is used. Unit root test showed that GDP variables become static with one difference making. To estimate average model of auto regression is the first level of stability of time series that it was showed that GDP variable is static with one difference making. The next level is recognition in which the model non-deterministic identification, the initial determination of p, d and q values, is dealt with. With consideration of the fact that by using AC and Partial autocorrelation (PAC), we can determine p and q values and according to GDP kilogram diagram in points close together enjoy high correlation and this variable in the time points with much distance is approximately uncorrelated that it was observed for degree of autocorrelation P that there is more than 50 percent up to one delay course among remainders. Therefore, the part of AR (1) is at first imported to the model and then it is observed that the coefficient of AR (1) in this model in the reliability level 95% is meaningful statistically.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	570.434	548.227	1.3658	0.0831
AR (1)	5.23642	1.356710	3.8795	0.0032

Table 1: Recognition of degree of autocorrelation P.

Source: Research findings.

Then, according to the partial autocorrelation diagram, the amount of correlation is more than 50% up to two delay courses among the remainders. Therefore, in this level, MA (1) and MA (2) are added to the model and the estimation is done.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	541.543	451.440	8.795651	0.0000
AR (1)	2.17349	0.12547	10.281223	0.0000
MA (1)	-0.14587	0.125478	3.7632629	0.07621
MA (2)	-1.45874	0.45897	8.668221	0.0000

Table 2: Recognition of partial autocorrelation q by adding MA (1) and MA (2).

Source: Research findings.

According to Box - Jenkins methodology, the interval relating to the most meaningless coefficient is omitted. Therefore, MA (1) is omitted and the model is estimated again. According to the results, it can be observed that the variables are statistically meaningful 95% in the reliability level.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	587.836	145.659	0.25478	0.3261
AR (1)	2.14587	0.098725	13.60668	0.0000
MA (2)	-0.597354	0.25478	-14.76370	0.0000

Table 3: Re-estimation after omission MA (1).

Source: Research findings.

Therefore, ARIMA (1, 1, 2) model was selected as the final model of GDP prediction in this method. The generalized auto regression model was used under the terms of heteroskedasticity (GARCH). In the first level of study, ARCHLM test was conducted which implies the existence of heteroskedasticity effects. The zero assumption of this test include sameness of residual variance that with consideration to the test result, according of two statistic F and multiple of the number of observations and the coefficient of determination, the zero assumption is rejected and the first assumption based on existence of heteroskedasticity in the remainders is accepted. GHARCH consists of two parts: remainders auto-description and conditional variance that both parts appear with interval in the model which determine the intervals between model grades. Therefore, Akaike and Schwarz Bayesian statistics are considered as criterion and the result of GARCH (1,1) model estimation import to the relation (6):

$$h_t^2 = 0.01 + 0.46\varepsilon_{t-1}^2 + 0.44h_{t-1}^2$$

t(2.23) t(1.99)

Where ε_{t-1}^2 is remainder and h_{t-1}^2 is conditional variance and the numbers between parentheses show the meaningful relation of these variables. By using the above mentioned equation, GDP is estimated through GARCH.

Therefore, ANN output according to the table 4 is observed that GDP has an increasing trend from 2014 till 2019.

Year	2014	2015	2016	2017	2018	2019
Prediction value	2587965	3385034	3585174	3775036	3791034	3802586

Table 4: Prediction results of GDP.

Source: Research findings.

Recent economic developments

Following two years of recession, the Iranian economy recovered during the 2014, as the administration led by new government has taken place and a partial lifting of sanctions was enacted under the Joint Plan of Action (JPA) [8]. This sanctions relief included the partial removal of constraints on Iran's oil exports, and the supply chain in key sectors of the economy-such as in the automobiles industry-and on international and domestic banks' international transactions. The economy expanded by 3% in 2014, on the heels of annual economic contractions of -6.6% and -1.9% in 2012 and 2013, respectively. As of August, 2015, the official and parallel market rates were trading at 29,797 Iranian Rials per U.S. dollar and 33,400 Iranian rials per U.S. dollar, respectively, thereby representing a difference of about 13%, down from roughly 190% in the second quarter of 2012 when sanctions were tightened. The inflation rate declined from a year-on-year peak of 45.1% in 2012 to 15.6% in June 2015 in line with the lifting of sanctions and the tightening of monetary policy by the Central Bank of Iran.

The unemployment rate has remained stubbornly high and rose slightly in 2014. The unemployment rate reached 11.4% in 2014, up from 10.4% in 2013. The unemployment rate was much more elevated among women (20.3% for women against 8.7% for men), among the population between the ages of 15 and 29 (17.9% for men and 39% for women in this age cohort) and in urban areas (11.7% in urban areas and 7.4% in rural areas). This weak labor market performance took place within a context of a subdued and declining labor force participation rate with only 37.2% of the country's population being economically active in 2014, down from 37.6% in 2013 (62.9% for men and 11.8% for women). The incidence of underemployment has also become more prevalent, with an estimated 9.5% of workers being considered underemployed (10.3% for men and 4.8% for women). Underemployment is largely concentrated among the youth population.

Stimulating private sector growth and job creation is a mounting challenge for the new government considering the number of workers who should enter the labor market in the coming years, including women and youth. Weak labor market conditions are exacerbated by the large number of youth entering the labor market and low female labor force participation rate. This trend is expected to be maintained in line with the evolving socio-economic profile with

the demographics of the country characterized by a disproportionately high youth population with over 60% of Iran's population of 77 million individuals estimated to be under the age of 30 in 2013. The government estimated that 8.5 million jobs should be created in the following two years to reduce the unemployment rate to 7% by 2016. Tackling youth unemployment in particular is a pressing policy issue [9,10].

Conclusion

Prediction of GDP was fulfilled by autoregressive-moving-average model and the output of this method showed that GDP has increasing trend during future years. That is we can increase the production by increasing the scientific and technical capacities, manpower efficiency in the sectors, facilities, governmental and private credits and increase of export subsequently leads to increase in GDP in the country and then economic growth.

Bibliography

1. Asna Ashari Hajar., *et al*. "Prediction of employment in the agriculture sector in Iran". Economic and agriculture development (Agriculture Science and Industry) No. 22 (2013).

2. Kuznets S. "Modern Economic Growth". Morteza Gharebaghian. Tehran. Ministry of Islamic Culture and Guidance (1993): 11.

3. Jahanian Nasser. "Islam and justice-oriented growth". Tehran. Institute of Islamic Culture and Thought. 1st edition (2009).

4. TeerelWall AP., *et al*. "Growth and development referring to developing countries". Tehran. Ministry of Islamic Culture and Guidance. Publishing Organization (1999).

5. Rostow., *et al*. "Economic growth theorists". Volume 1. Tehran. Shahid Beheshti University Publishing Centre (1993).

6. Sinaei Hassanali., *et al*. "Tehran Stock Exchange index forecasting using an artificial network". *Journal of Review of Accounting and Auditing* 41 (2005).

7. Roshan Reza. "Iran's inflation forecasts by using ARIMA, GHARCH and ARCH models and neural networks and comparison of the mentioned model efficiency". Master's thesis. Faculty of Economic-Administrative Sciences. University of Zahedan (2004).

8. Iran Statistical centers, Statistical Hand book, Iran -Tehran (2014).

9. Nofarasti Mohammad. "Unit root and co-integration in econometrics". Rasa Cultural services institute. 1st edition (1999).

10. Todaro M. "Economic development in third world, Gholamali Farjadi, Tehran". Institute for Research in Planning and Development. 8th edition (1999): 117.

Volume 3 Issue 3 March 2019