Projecting the Labor Participation Rate in Iran Using the Neural Network for the Period 2018-2028

Nasibeh Esmaeili (*Email*: n.esmaeli@gmail.com)
Hossein Mahmoudian
Paper: 347

Introduction

Human labor force is believed to be one of the main factors contributing to economic growth and development and can be examined from two different aspects of supply and demand in the labor market. These two aspects of the labor market, like the market for other goods and services, may be affected by different factors: determinants of supply (such as population growth, participation rate, working hours at time unit etc.) and factors influencing demand (such as production capacity, investments and production capacity development, new technology, global economy etc.). Iran is in a period of population window and about 72% of the population is in working age (15-64 years old).

Due to the importance of labor force supply and the participation rate of the active population in Iran, the present report predicts the ten-year (2018-2028) active population participation rate in Iran. The data used in this article were taken from WHO International Data. These data are available from 1995-2017. Based on a robust neural network, a ten-year prediction (2018-2028) was carried out. This prediction was accomplished in three stages by constructing three models.

In the first stage, the first neural network model was developed using longitudinal data from 1995-2017 on the population of working-age women. The second model was based on data of the population of working-age men. In the third stage, data of the total population (15-64 years old) in the period 1995-2017 was the basis for the production of the third neural network model. We needed several steps to build and produce these three models. The first step is the input data section to the neural network used to train the network. These data must be longitudinal and large enough to train the neural network. In the second step, the model is constructed using first step data for neural network training. This stage is one of the most sensitive steps in modeling. Highlights in this section are the number of layers in the neural network, the number of neurons, and the training functions in MATLAB software. After specifying the characteristics of the working model, the training is performed by input and output data. The third

Modeling process

Initially, data are imported from the excel environment into MATLAB, which is done using the instructions in the software. Secondly, the data are sorted by software and prepared for neural network training. In the third step, we design a structure for the neural network. In the fourth step, the data prepared in the second step by the model obtained in the third step are used to train the neural network.

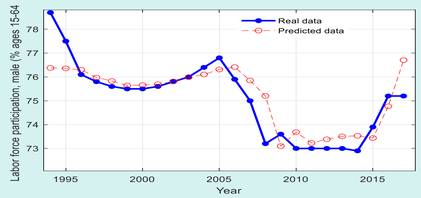
From the mathematical point of view at this stage, the model parameters are estimated according to the available data. Then, the program enters the fifth step. In this section, the program generates outputs with the data available by the model and allows us to evaluate the model. In this step, the generated data are sent to the fifth step along with the actual data to compare and evaluate the model. In the sixth step, the model error is obtained and compared with the criterion for the error. If the error is acceptable, the prediction stage (stage 7) is stepped into and the prediction for a 10-year interval is done. Otherwise, we will return to stages 3 and 4 for model reconstruction and neural network retraining.

Result

Part One: Results for Men (15-64 years)

In this section two diagrams are drawn. In Figures 1 and 2, the accuracy of model and the 10-year prediction of the participation rate of men aged 15-64 were carried out respectively.

Figure 1: Comparison and Prediction of Men's Participation Rate between 1995 and 2017



As Figure 2 shows, a trained neural network based on the data of 28 years was able to follow well the curve of changes in male labor force participation rates (in percentage). At sharp points where there are jumps in the data, the trained model followed the real data with the least error. This step shows the validity of the model. Therefore, this model can be used for prediction. As the distance between the red and blue curves shows, the error between the actual values plotted with solid circles is negligible compared to the values obtained by the trained model known as the modeling error.

Predicting is done using the neural network or the trained model. As can be seen, the participation rate of the active population of 15-64 year olds will rise from about 74.5% in 2018 to 76% in 2020 and in 2022 we will see a decline in the rate of active male population participation reaching 73% and incresing to 73.5% in 2028. In general terms, the participation rate of active male population, with small changes, ranges from 74.5% in 2018 to 73.5% in 2028.

Figure 2. Prediction of participation rate of active population of men 15 to 64 years olf from 2018 to 2028

Part II: Results for Women (15-64 years).

In this section, we draw two diagrams. In Figures 3 and 4, the accuracy of model and 10-year prediction of female participation rates are evaluated respectively.

Figure 3: Comparison and prediction of female labor force participation rates between 1995 and 2017

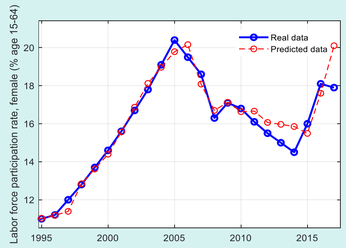


Figure 3 compares and predicts the participate rate of the working-age females. The blue and red curves show the real data in times series and data estimated by neural network model respectively. As clearly seen, the estimated data by neural network can follow the real data well with the least error, indicating the model validity.

As Figure 4 shows, the rate of working-age female participation is initially increasing, reaching from 26% in 2018 to about 26% in 2018. The trend is followed by a sharp decline to reach 18% in 2020 and is expected to continue to decline to around 16% in 2028.

Part III: Results for total population (15-64 years)

Part III: Results for total population (15-64 years)

In this section, as in the previous two sections, we first demonstrate the validity of the model by comparing the actual data available from 1995 to 2017, and then predicted data by neural network and in the second phase we predict male and female active population participation rates of 15-64 years from 2018 to 2028.

Figure 4. Prediction of participation rate of active population of women aged 15-64 between 2018 and 2028

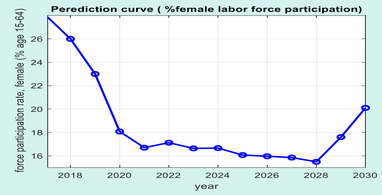
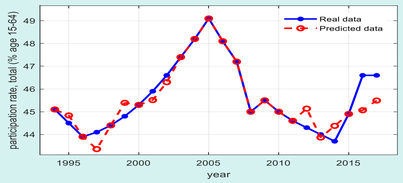


Figure 5 compares and predicts the participation rates of men and women aged 15 to 64 years. The actual data in the time series and the red curve correspond to the data estimated by the neural network model. A trained neural network, based on the data of 28 years, was able to follow well the curve of changes in the rate of participation of men and women of working age (in percentage). At sharp points where there are jumps in the data, the trained model followed the real data with the least error. As shown in the previous graphs, this step demonstrates the validity of the model. Therefore, this model can be used for prediction. As the distance between the red and blue curves shows, the error between the actual values plotted with solid circles is negligible compared to the values obtained by the trained model known as the modeling error. The following can be predicted based on the model trained.

Figure 5: Comparison and prediction of total labor force participation rates between 1995 and 2017



As Figure 6 shows, the participation rate of the active population of 15-64 years of age increases mildly from 46% in 2018 to 47.5% in 2020. Following with some fluctuations, it declines to less than 44 in 2026. With a following increase, it reaches to 45 in 2028.

Figure 6: Prediction the participation rate of active men and women aged 15-64 between 2018 and 2028

Conclusion

Human labor force is believed to be one of the main factors of production which plays an important role in economic growth and development. Based on ILO data, this paper focused on labor force supply and projected active population participation rates and predicted the participation rate of Iranian men and women over the ten-year period 2018 to 2028. The results show that the participation rate of the Iranian active population will not change very much. The participation rate of the active Iranian male population, with a one percent decrease, will decrease from about 74.5 in 2018 to 73.5 in 2028. The female participation rate in economic activity falls from 18 to 16. The rate of overall participation of the working-age population of men and women is expected to decrease from 46 in 2018 to 45 in 2028.