



Analyzing of economic growth based on electricity consumption from different sources



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HIGHLIGHTS

- Economic growth prediction based on the electricity consumption.
- Gross domestic product (GDP) as economic growth indicator.
- Coal, hydroelectric, natural gas, nuclear, oil and renewable sources.
- Renewable sources has the highest influence on the GDP growth rate prediction.

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ABSTRACT

Economic growth could be influenced by different factors. In this study was analyzed the economic growth based on the electricity consumption from different sources. As economic growth indicator gross domestic product (GDP) was used. ANFIS (adaptive neuro fuzzy inference system) methodology was applied to determine the most important factors from the given set for the GDP growth prediction. Six inputs were used: electricity production from coal, hydroelectric, natural gas, nuclear, oil and renewable sources. Results shown that the electricity consumption from renewable sources has the highest impact on the economic or GDP growth prediction.

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1. Introduction

Electrical energy plays an important role in economic, human and social improvements which are essential inputs to achieve sustainable development especially in developing countries. Consumption of energy in developing countries is growing rapidly in response to rapid economic growth, population growth and industrialization. There has been a great deal of attention devoted towards the importance of energy (electricity) in the economy. Hence, several researches have been conducted to study the relationship between electricity consumption and economic growth.

As one of the major components of energy consumption, the importance of electricity to economic growth has been recognized not only by economists, but also by businessmen, engineering, energy and government agencies. The growth of Gross Domestic Product (GDP) is one of the most important factor for good economy.

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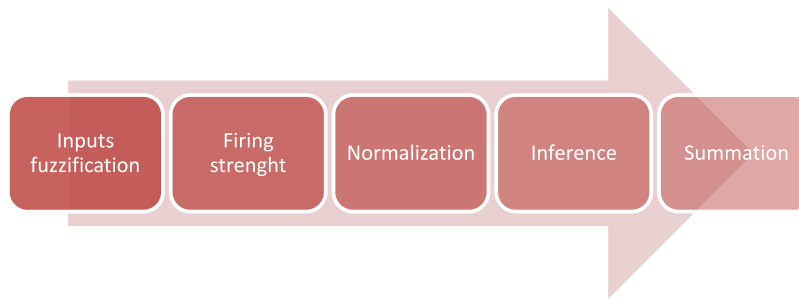


Fig. 1. ANFIS structure.

Some studies have been focused on carbon dioxide emissions and its consequences on economic growth while some others have investigated whether electricity consumption increases output or not. In the relationship between economic growth, electricity consumption, urbanization and environmental degradation was explored in [1] where results shown electricity consumption has negative impact on carbon dioxide emissions. The effect of renewable and non-renewable electricity consumption on economic growth was explored in investigation [2] in Latin American countries and it was recommended that the investigated countries should increase their investment on renewable energy projects to increase the role of electricity consumption from renewable sources. In addition, it is essential that these countries should reduce their non-renewable electricity consumption by increasing their energy efficiency and implementing energy saving projects. In study [3] was suggested that the government authorities have to explore new sources of energy to achieve sustainable economic development for the long run. Study [4] was shown that there is a limited support for the electricity-led growth hypothesis. Based on the results in investigation [5] with artificial neural network (ANN) method, a forecasting system of economic growth was proposed and software with related applications was developed. The ANN method achieved better results in performance and efficiency compared to conventional methods. In paper [6] was analyzed the performance of GDP growth and inflation forecasts for 25 transition countries between 1994 and 2007 and the empirical results were shown that there is a positive correlation between the number of forecasters covering a given country and the forecast accuracy.

In order to determine the most important factors for the GDP growth prediction in this study was applied a soft computing methodology, adaptive neuro-fuzzy inference system (ANFIS) [7]. Six inputs were considered: electricity production from coal, hydroelectric, natural gas, nuclear, oil and renewable sources. The main aim was to determine the inputs impact on the GDP growth.

2. Energy consumption data

In this study energy consumption parameters were used and inputs for the GDP analyzing. All of the parameters represent the percentage of the energy consumption based on the total produced electricity. The World Bank database was used for European Union and the following inputs were analyzed:

1. The first input represents coal sources of electricity. The coal refers to all coal and brown coal, both primary and derived fuels. Peat is also included in this category.
2. The second input represents hydropower sources of electricity. The hydropower refers to electricity produced by hydroelectric power plants.
3. The third input represents natural gas sources of electricity. The gas refers to natural gas but excludes natural gas liquids.
4. The fourth input represents nuclear sources of electricity. The nuclear power refers to electricity produced by nuclear power plants.
5. The fifth input represents oil sources of electricity. The oil refers to crude oil and petroleum products.
6. The sixth input represents electricity production from renewable sources, excluding hydroelectric, includes geothermal, solar, tides, wind, biomass, and biofuels.

3. ANFIS structure

ANFIS structure has 5 layers as it shown in Fig. 1. Fuzzy inference system is the main core of the ANFIS structure. ANFIS layers have the specific task in the training process of the ANFIS network. The inputs were fuzzified in the first layer by defined membership function. Here in this study bell shaped function was used since it is highly suitable function for nonlinear data. ANFIS structure operate with the fuzzy values but the final layer provides the crisp outputs.

In this study root means square error (RMSE) was used and the indicator ANFIS prediction accuracy estimation.

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