

# Identifying the Best Type of Wavelet in Economic Research: A Case Study of Business Cycles in Iran

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## Abstract:

Theoretical studies show that the wavelet method is a suitable mathematical tool for analyzing signals and displaying them at different levels. At the same time, the wavelet method includes the order of waves and different tools for smoothing the series. Studies have shown that orthogonal wavelets including Haar, Daubechies, Symmelets, Coiflets, and Biorthogonal are the best types of wavelets. On the other hand, each type of wavelet is divided into different orders, which is defined once for Haar wavelet, nine times for Daubechies wavelet, seven times for Symmelets wavelet, five times for Coiflets wavelet, fifteen times for Biorthogonal wavelet. Given that each of wavelet orders can be considered as a single wavelet, for orthogonal wavelets alone, thirty-seven wavelet types can be selected. On the other hand, for each type of wavelet, up to ten levels of decomposition can be performed, and each level of decomposition shows the process of economic trend in a different way, which means that a series can be decomposed into three hundred and seventy series. Economically, this means that 370 types of economic cycle formulas could be defined to examine a time series such as Gross Domestic Product (GDP), each of which would certainly have different results and interpretations. This is very sensitive in short-term and long-term economic planning.

Given that no research has been done on the superiority of the wavelet type in economic projects, many studies have been erroneous due to a lack of attention to the following questions, though valuable.

- 1- What is the definition of process and cycle?
- 2- What is the most suitable type of wavelet?

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- 3- Which wavelet order is more suitable?
- 4- Which wavelet level is more suitable?

To answer these questions using the method of orthogonal wavelets of Haar, Daubechies, Symmelets, Coiflets, and Biorthogonal with a maximum of 5 levels, the best type, order, and level of the wavelets are investigated in order to smooth the business cycles in Iran during the seasonal period of 1367-1397 by applying retrospective simulation (ex-post) method and correlation analysis using MATLAB software. The results show that bior 2.2 wavelet has the highest quality in the analysis and smoothing of business cycles in Iran. Based on these results, the seasonal GDP logarithm series, decomposed using the bior 1.1 wavelet at level 2, has the highest quality of all wavelets in analyzing and smoothing economic data. The wavelets bior 2.2\_14, bior 2.2\_11, bior 3.1\_14, bior 2.2\_13, and bior 3.1\_15 are ranked second to sixth. Moreover, regardless of the type of wavelet, level 4 has the highest repetition in all levels and in this respect, it is considered the best level of analysis. Therefore, it is recommended to select the low selective wavelet level (maximum 3) when using annual data, and the high wavelet level (minimum more than 4) if the data is monthly or seasonal. Moreover, the estimation of Iran's business cycles shows that in the research period, there were 16 business cycles, which were the most consecutive years of recession related to the years 1380-82, 1387-89, and 1391-93.

**JEL** classification: E32, C22, C61

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