Business cycle analysis is one of the key aspects of conducting monetary and fiscal policies for every economy. A business cycle is an economic activity fluctuation displaying some periodic (cyclical) features. Four business cycle states (phases) are typically distinguished: expansion, slowdown, recession and recovery. Identification of current and prediction of future business cycle phases of the world's economies is performed by central banks, governmental institutions and other economic monitor agencies, who draw heavily on observation of key economic activity indicators, such as GDP and industrial production index (and their components) and many others. However, business cycles analysis (either based on experts' diagnosis or those produced by means of econometric models) display a great deal of uncertainty, attributable to some morphological features of economic activity fluctuations. For example, duration of each individual cycle phase is noticeably time-variable, and thereby difficult to predict. In addition, the deepness of expansion or recession strongly depends on many macroeconomic factors (difficult to quantify), which further adds to the uncertainty.

The aim of this project is to construct new econometric tools for business cycle analysis, drawing on ideas from, among others, exponential smoothing models, which are a special case of unobserved component models. This class of models is extremely intuitive, decomposing observable time-series data into their constituent components, including trend, level and seasonality, with the dynamics of each being described by a separate equation. So far, however, no exponential smoothing model has been developed for capturing (via a separate equation) also business cycle fluctuations. In this project we plan to fill this gap and design such a cyclic component, which would take into account the typical (found in the literature) morphological features of business cycles, including time-varying length of individual business cycle phases, time-varying amplitude of economic activity fluctuations, outliers (during Covid-19 pandemic), cycle asymmetry, or (not highlighted in the literature as yet) coexisting (overlapping) cycles of different lengths (so-called Kitchin, Juglar, Kuznets and Kondratiev cycle). Allowing for these features (specifically the latter) in a business cycle models is admittedly far from straightforward, which is largely due to additional difficulties of theoretical nature as well as effort of designing efficient algorithms of estimation of the resulting model specifications.

We plan to investigate both univariate and multivariate model specifications, corresponding to either an individual macroeconomic aggregate or several aggregates simultaneously. The business cycle models constructed in this way will also be subjected to a comparison procedure (in the Bayesian approach) in order to optimally use the knowledge derived from individual econometric models.

The major result of the project will be a fully functional system for the business cycle analysis. It will be possible to model the business cycle in a fully probabilistic approach (using Bayesian approach), which seems necessary given the experience of the recent global crisis and Covid-19 pandemic.

Despite intricate theoretical and methodological foundations of the models to be developed in the project, the key results from individual (univariate and multivariate) models will be handled in an intuitive and communicable manner, using, among others, some popular and widely-recognized measures and visualizations. This, in turn, would ensure that the all business cycle models of our design be available and fully operative for all kinds of professionals and practitioners in the area of business cycle analysis (and short-term forecasting).