

In the 30's Keynes presented the beauty contest game. In this competition entrants are asked to choose few faces out of many which they reckon are the most appealing. One, who voted for most popular face wins. Although the rules of the game are simple they present complex phenomenon present in economics. The winning face don't have to be the most pretty one – entrant while choosing faces (hence it's strategy) is maximizing his chances to win, therefore he will take into consideration the strategy and tastes of other entrants. The inclusion of payoff and strategy expectation was since then widely discussed in terms of both theoretical and applied methods. The major problem of solving this kind of problems is existence of multiple equilibria in those models, which might make them cumbersome to even impossible to solve.

Significant insight to the discussion was added by Morris and Shin (2000), where they argue that multiple equilibria approach and inclusion of expectation of other agent's strategy is an unnecessary extension as it is hard to evaluate one's beliefs. In 2001 they propose an approach, which focus on uncertainty of the fundamentals. Using a global game approach the problem can be represented as unique equilibrium. In 2013 Angeletos claim the hypothesis, which brings back the discussion of multiple equilibria back on track. He stated that sentiments plays crucial role in business cycle and can solely identify the equilibrium in which economy is. He assumed that sentiments influences the expectations over other's information sets and other's strategies. Thanks to this approach sentiments can identify the equilibrium and economy analysis, which is based solely on macroeconomic fundamentals, might end up with multiple equilibria. In 2015 Schaal calibrated model of US economy in the period 2005-2015 using the Angeletos idea. Results were consistent with the historical data observed in that period. Moreover it was shown that sentiments are responsible for up to 40% of business cycle variance.

In a computing fields of this discipline worth mentioning are works of Datta, Reffett and Woźny (Datta, Reffett (2003), Reffett, Woźny (2017)). They have described the conditions, which have to be fulfilled in order to get and identify the equilibrium. Moreover, Benhabib (2017) presented the modelling approach in which both production and employment are driven by sentiments and multiple equilibria are present. Above-mentioned articles creates solid basis for the research.

The described research extends the literature. If a shock in sentiments are driven by an disturbances in the information agents possess and sentiments have significant impact on an economy then it is assumed that sentiment's impact should be trackable in historical data. Additionally, there is a forth industrial revolution going on, known as Industry 4.0. More and more data are being generated therefore broader analysis is possible to be conducted. Nowadays, there are much greater capabilities which were not available at the beginning of 21<sup>st</sup> century, when Morris and Shin published their work.

The research consists of three steps. Firstly, it will focus on extraction of sentiments out of historical data in form of time series, which enables econometric estimation monetary and fiscal policies. Next, the reseach will shift to Newkeynsian and RBC models in order to model the relations between macroeconomic factors when second-ordered beliefs are taken into account. Additionally, it will analyze causes and effects of crises in years 2007 and 2010 for European economies. The last step of the research elaborates on cointegration of results established in previous steps. With artificial intelligence methods such as neural networks model will capture important signals in Internet activity and passes further to economic model. The real-time analysis enables to create a tool, which warn the user of upcoming economy downturns or crises.

Presented research will provide significant insight to the literature concerning economic modelling with multiple equilibria. It combines such disciplines as econometrics, economic modelling and artificial intelligence in an innovative way in order to explain phenomena in European markets. Article based on this research have a solid chance to be published in well-established journals. The preliminary results of the first step are presented on *37th International Symposium on Forecasting*