Measure inflation expectations by incorporating linguistic term evolving perception within a fuzzy environment

Aleksandra Rutkowska[1*]

[1*]Department of Applied Mathematics, Poznan University of Economics and Business, al. Niepodległości 10, Poznań, 61-875, Poland.

Corresponding author(s). E-mail(s): aleksandra.rutkowska@ue.poznan.pl;

Abstract

Inflation expectations crucial for central banks' monetary policy, shaping consumer and business outlooks. Deviations from central bank targets complicate price control. In current methods we can distinguish between the probabilistic approaches pioneered by Theil [1], Carlson and Parkin [2], and regression approaches pioneered by Anderson Jr [3], Pesaran [4]. The probability method uses perceived inflation as a scaling factor to the function of percentages of responses to the survey question. In contrast, the regression method exploits the empirical relation between qualitative data on perceived inflation and actual inflation to quantify inflation expectations based on qualitative opinions. An extensive comparison of the empirical results of existing methods in this stream is presented in Rutkowska et al. [5]. Among the disadvantages of mainstream methods, the authors listed unrealistic assumptions and difficulties regarding the empirical application of the technique. They also noticed that the most common use of the procedure assumes constant model coefficients even if the inflation dynamic varies over time. Consumers' qualitative inflation perceptions and expectations have tended to broadly co-move with actual inflation, so they differ on time. The source of inflation perception and expectation is The Business and Consumers Surveys (BCS). BCS is one of the regular harmonized surveys the Directorate General for Economic and Financial Affairs conducted for different European economies. The BCS contains among others two questions considering inflation: [Q1] Question about the inflation perception: *How do you think that consumer prices have developed over the last 12 months?* (with answers: risen a lot, risen moderately, risen slightly, stayed about the same, fallen, don't know) and [Q2] Question about the expected change of the prices: *By comparison with the past 12 months, how do you expect consumer prices will develop in the next 12 months?*

(with answers: increase more rapidly, increase at the same rate, increase at a slower rate, stay about the same, fall, don't know).
In this study we introduce two different fuzzy approaches to quantify inflation expectation with changing inflation perception: The first one is extending the fuzzy system approach presented in Rutkowska and Szyszko [6] by scaling factor. The second approach is an algorithm mapping survey responses on inflation using fuzzy interval sets. We calculate the membership function according to Q1 answers. In the next step based on Q2 answers, determine expectations for future inflation. As the answers are related to uncertainty, for modelling we use interval fuzzy sets. The two models are compared and demonstrated using real data as an example.

Keywords: linguistic terms, interval fuzzy sets, fuzzy systems, inflation expectation, survey analysis

Acknowledgement

This work is supported by the National Science Centre, Poland; grant No. 2020/37/B/HS4/02611

References

[1] Theil, H.: On the time shape of economic microvariables and the munich business test. Revue de l'Institut International de Statistique, 105–120 (1952)

[2] Carlson, J.A., Parkin, M.: Inflation expectations. Economica **42**(166), 123–138 (1975)

[3] Anderson Jr, O.: The business test of the ifo-institute for economic research, munich, and its theoretical model. Revue de l'Institut International de Statistique, 1–17 (1952)

[4] Pesaran, M.H.: Expectations Formations and Macroeconometrics Modelling. University of Cambridge, Department of Applied Economics, ??? (1985)

[5] Rutkowska, A., Szyszko, M., Pietrzak, M.B.: When all we have is not enough: a search for the optimal method of quantifying inflation expectations. Economic research-Ekonomska istraživanja **36**(1), 977–996 (2023)

[6] Rutkowska, A., Szyszko, M.: Inflation expectations quantification with fuzzy control system. Soft Computing **25**(12), 7803–7812 (2021)