

Estimating nationwide impacts using an input-output model with fuzzy parameters

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Abstract. A oft-forgotten feature of input-output models (IO models) is the inherent incompleteness and inaccuracy of the underlying survey data that are used to build them. Many different techniques have been applied to resolve these data issues. Here we introduce an approach based on the fuzzy set theory. To do so, we articulate the lack of reliability of technical coefficient values, assuming the qualities themselves are equivalently expressed as a finite set of discrete values. The discrete values reflect domains coefficient sizes. The domains are defined by quantitative (membership) functions—quasi-probability density membership functions—that parallel density functions of cell values. The relative sizes of the domains of the fuzzy components suggest the relative reliabilities when bi-proportionally adjusting the I-O accounts, given known exogenous factors. The membership functions enable the use of a quasi-stochastic programming model to estimate fuzzy impacts of changes in final demand. Results of the fuzzy model are compared to results estimated via classically created IO model.

In this paper, we estimate impact of different elements of the final demand on the US economy. Gaussian membership functions are employed to describe the technical coefficients. The domains for the functions are defined via cluster analyses of data in the US Make and Use tables. The impacts derived from both absolute and relative changes in the final demand for separate industries and the group of independent industries on the gross output for 60 industries of the national economy are subsequently estimated via I-O model with the fuzzy matrix of technical coefficients.

We next extend the initial model by also fuzzifying different components of final demand: investment and international trade flows. After adding fuzzified versions of these components of national accounts, the technical coefficients are even further fuzzified. The known final demands on the US economy are re-estimated, now with fuzzified technical coefficients, investment, and trade. We still find the estimated difference between the fuzzy and classical results to be fairly small; this suggests that the fuzzy approach may be a promising way to update and reconcile input-output data.