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Procedia Economics and Finance 24 (2015) 550 – 556

Procedia Economics and Finance

www.elsevier.com/locate/procedia

International Conference on Applied Economics, ICOAE 2015, 2-4 July 2015, Kazan, Russia

Parameter estimation of the Engel curve using the method of fuzzy regression to assess the level of welfare in the Republic of Tatarstan.

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Abstract

This article proposes the estimating method of a quality indicator of "population welfare in the region" based on the theory of fuzzy sets. For welfare analysis there are estimated the parameters of Engel curves using the method of fuzzy regression. The resulting model parameters are triangular fuzzy numbers whose cofactor is the fuzzy evaluation of the welfare population in the region. For defazzification of obtained fuzzy number, there is calculated the area of the intersection of fuzzy numbers of the actual wealth level and the possible linguistic terms from "absolute poverty" to "a high level of well-being". These obtained results suggest that the population of the Republic of Tatarstan has a good and a high level of well-being. The proposed methodology provides an analysis on the short time series and takes account of incomplete or inaccurate information.

Selection and/or peer-review under responsibility of the Organizing Committee of ICOAE 2015.

Keywords: Engel curves; Tornqvist functions; welfare; food availability; food security; fuzzy sets; fuzzy regression

1. Introduction

The economic security refers to a state of food infrastructure when the population of the region are able to purchase food in the required volume, range, amounts of not less than rational norms of food consumption needed for an active and healthy lifestyle, without compromising the quality and quantity of non-food products and services (Lewbel, Pendakur, 2008; Blisard & Blaylock, 1991).

Consumption is a complex process: on the one hand it is necessary to analyze the income and the structure of their expenditure, on the other hand it is necessary to analyze the market environment and the availability of the physical capacity of the population to buy foodstuffs.

The analysis of population income and expenditure patterns gives an indication of the level of the population welfare (Larsen, 2007; Ibragimov M.J. et al., 2014). Ernst Engel has revealed the relationship between the cost of certain groups of goods and income level of population (Engel, J; Kneip, A, 1996). The higher the level of welfare, the less the share of expenditure on food and more share of spending on high-technology products and luxury goods (Crawford, I et.al, 2003).

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Selection and/or peer-review under responsibility of the Organizing Committee of ICOAE 2015.
doi:10.1016/S2212-5671(15)00631-0

2. Methodology

Disposable resources of households increase annually. However, to judge the adequacy of income of the population is only possible with an analysis of costs. The results of the study by Ernst Engel show that the growth of real income of the consumer, the consumption of secondary benefits increases faster than essentials benefits (Chai & Moneta, 2012; Moneta & Chai, 2014). Engel curves is a graph showing the dependence of consumption goods volume on the level of income of the consumer. Swedish economist L. Tornqvist offered special kinds of demand functions (Tornquist functions) for the three product groups: essentials, the second necessary, luxuries (Wan, 1996; Hufnagel, 1994). Graphical form of data of Engel functions (depending the cost of the various groups of goods and services on revenues) is shown in Fig. 1.

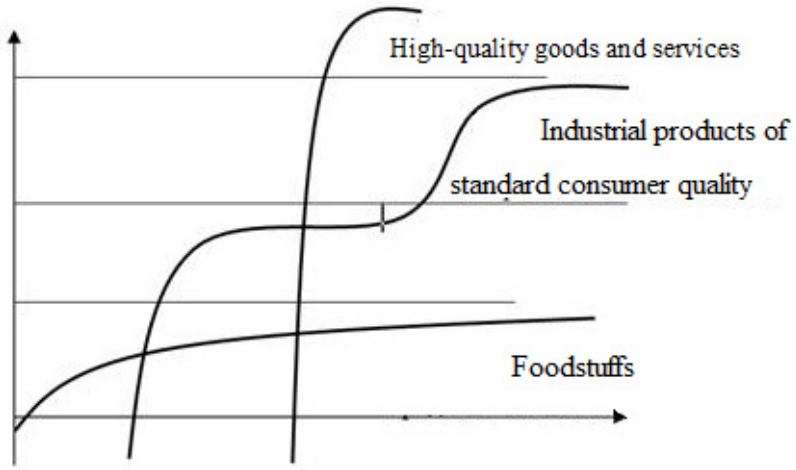

Fig. 1. Engel curves in the interpretation of Tornqvist.

Tornqvist function for food products is as follows:

$$Q = \frac{aI}{I + b} \tag{1}$$

where Q is consumer expenditures on food products, I is Per capita income;
a, b are the parameters of the model.

Here are calculated the parameters of the Tornqvist function for the Republic of Tatarstan for the period of 2007-2012. To do this, we transform the function into a linear form (Larsen, 2009):

$$Q^{-1} = c + d * I^{-1} \tag{2}$$

Where *c,d* are the parameters of the model.

Table 1. Correlation and regression analysis of income and consumption