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The use of functional differential equations in the model of the meat market with supply delay

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Abstract

In economic applications, we have to make the assumption that relations between the variables vary with time. One of the possible ways of incorporating the process dynamics into the model is to describe the model by functional equations. The paper is based on the assumption that the balance between the demand and supply can be successfully expressed by a model described by differential equations, even if the goods are supplied with a certain delay.
The equation is solved by modern theory. Theoretical results are illustrated by an example, with concrete results presented in graphical form. The solution is presented by modern computer simulation and the Maple system is used.
The authors come to the conclusion that a delay in the supply of goods can cause an oscillation in the price. On the other hand, it is possible to define conditions under which the solution is monotonous.

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Introduction

One of the typical characteristics of contemporary economic development in the world is the growing interdependence and interconnection of the markets of the national economies and the multinational groups, which is sometimes called the globalization process. Information and the ability to handle information effectively are the source of wealth and power. It is information which plays a decisive role in the success of every individual and

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organization. The changing world needs information to survive and markets and stock-exchanges are the main driving force of the economy. The entry into the unified market and harmonization of the legal framework have a decisive effect on the economic position of households and companies. To make this effect less costly and socially unacceptable, suitable instruments for examining the effects of the corresponding measures must be used in constructing the strategies of economic development and forecasting. One of the questions most frequently discussed in connection with further economic development and planning is the question of future development of the markets.

A company owner who wants to be successful needs to have information on the environment and the current trends. Such information may protect him in the future against sales problems, sales decline, or profit decreases. The speed of evaluating information, acquisition of new resources, effective communication, and collaboration among people are some of the factors which are essential to a successful economic situation. Agricultural development, for instance, influences to some extent all sectors of industrial production which follow the production of agricultural commodities, and therefore it is essential for users of agricultural products to be able to foresee its future movements. This paper focuses on demonstrating how functional differential equations with delayed argument can be used to model market relations in the poultry meat market in the Czech Republic. The aim of the study is to analyze the behavior of the model from the point of view of oscillatoricity in the case of a change in the input parameter. In the applications section, we show how the model is constructed and how it may be solved in a particular case. The model behavior is presented using computer simulation and the Maple System is utilized in representing the results graphically.

1. Walras´s Model

The idea of market equilibrium, intuitively introduced by Adam Smith, was worked out as a self-contained theory of general equilibrium by Leon Walras. One of Walras´s contributions consisted in the inclusion of the household sector. As a founder of the general equilibrium theory, Walras was followed by other authors, who worked out his theory into a form in which it may be applied to analyzing economic policies.

Leon Walras´s scientific contribution to the development of economics was not fully appreciated until after his death, in particular after World War II, owing to J. R. Hicks and J. Fisher. In the 1930s and 40s, certain economists, such as G. Cassel, F. Hahn, or T. Triffin, inspired by Walras´s theory, connected the model with imperfect competition. J. L. Neumann created a dynamic equilibrium model and a great Walras enthusiast, J. R. Hicks applied Walras´s methodology at the macro-level. After World War II, this concept was further expanded, particularly thanks to G. Debreu and K. J. Arrow. These authors "confirmed the consistency of the general equilibrium theory, including the definition of existence conditions". Under certain strict conditions, they gave a theoretical mathematical proof of Walras´s conjecture which says that adaptation processes will finally lead to a stable equilibrium.

Recently, a number of papers has appeared which study Walrasian dynamics in experimental markets (Plott, 2000; Anderson et al., 2003; Crocket et al., 2011; Hirota et al., 2005). Other studies deal with the economic equilibrium (Anello et al., 2010; Donato et al., 2014; Jofre et al., 2005).

Walras´s model represents a more complex approach to micro-economic analysis as compared with the partial equilibrium methodology represented by the Cambridge School. However, due to its apparent complexity, the model is not often presented in contemporary medium-level textbooks of microeconomics. Various ways of solving the model are studied, for instance, in Danielle (2006) and Anello et al. (2010) books. In the latter, we can find a number of problems which have a background in economics or finance and are formulated in terms of Lebesgue spaces.

An analysis of the dynamics of prices, production and consumption, especially in the case of commodities, can be based on the assumption of the Walrasian theory which says that relative change in the price $p(t)$ in time t is governed by the equation of equilibrium between the demand $D(p(t))$ and $S(p(t))$. The dynamic formalization of this relationship is as follows: $p' = f(D(p) - S(p))$ (1)

Further, we assume that $xf(x) > 0$ pro $x \neq 0$.