

Preface

Problems of macroeconomic analysis and the participation of the state in control of market economic development were critically revealed by the latest global economic crisis in 2007–2009.

This work presents the elements of parametric control theory, as well as some results in the context of the aforementioned problems based on AD-AS, IS, LM, IS–LM, IS–LM–BP mathematical models and the models of Keynes all-economic equilibrium, open economy of a small country, market cycles, and computable models of general equilibrium.

The materials of this book to a certain extent allow estimating the versions of recommendations on stabilizing acyclic economic policy and choosing state policy in the area of economic growth.

Chapter 1 is devoted to a presentation of parametric control theory. This chapter includes the following:

- Components of parametric control theory.
- Methods of analysis of the structural stability of mathematical models of a national economic system.
- Statements of variational calculus problems of choosing optimal sets of parametric control laws for continuous- and discrete-time dynamical systems. In these variational calculus problems, the objective functions express some (global, intermediate, or tactical) goals of economic development. The phase constraints and constraints in admissible form are presented by the mathematical models of the economic systems. The considered variational calculus problems of choosing optimal laws of parametric control in the environment of a given finite set of algorithms differ from those considered earlier in the theory of extremal problems [18] and are characterized by computationally acceptable applications.
- A solution existence theorem of the variational calculus problem of choosing the optimal set of parametric control laws in the environment of a given finite set of algorithms for continuous- and discrete-time systems.

- Defining the bifurcational points of extremals of the variational calculus problem of choosing the optimal set of parametric control laws in the environment of a given finite set of algorithms.
- A theorem establishing sufficient conditions for the existence of bifurcation points. The presented results differ from similar well-known results of parametric disturbance analysis in the variational calculus problems considered in [18], where parametric disturbance is used for obtaining sufficient extremum conditions via construction of respective S -functions and using the constraint-removing principle. The presented results also differ from the results of [42] examining stability conditions for solutions of variational calculus problems (Ulam problem). Research on this problem is reduced to finding the regularity conditions under which the objective function of the disturbed problem has a minimum point close to that of the objective function of the undisturbed problem. Also, [13] offers a theorem stating existence conditions for the bifurcation point of the variational calculus problem with the objective function considered in the Sobolev space $W_p^0(\Omega)$ ($2 \leq p < \infty$) and depending on some scalar parameter $\lambda \in [0, 1]$.

The remainder of the chapter presents an algorithm for the application of parametric control theory and examples of its application based on a number of mathematical models of economic systems.

Chapter 2 presents economic estimates of functions obtained on the basis of statistical information on the national economy of Kazakhstan that characterizes the state of the national economy. A number of mathematical models including AD–AS, IS, LM, IS–LM, IS–LM–BP, Keynesian general economic equilibrium models (constructed on the basis of economic functions), as well as the model of open economy of a small country are described. The results of analysis of influence of economic instruments on the equilibrium solutions in the context of the aforementioned mathematical models of economic equilibrium of the national economy are presented.

Based on mathematical models of general economic equilibrium and open economy, problems of estimation of optimal values of economic instruments in the sense of certain criteria are stated and solved. Results on the dependence of the optimal criteria values on the set of uncontrolled economic parameters given in the respective ranges are described.

The main sources of inflation in the economy of Kazakhstan are revealed. It is proved that prediction of inflation rates can be accomplished on the basis of approaches of both the rational and adaptive expectation theories.

Chapter 3 is devoted to the development of the market cycle theory. It contains the results of the analysis of structural stability of the Kondratiev and Goodwin mathematical models of cycles and the solution of parametric control problems on the basis of the aforementioned mathematical models.

Chapter 4 presents results on the parametric control of economic growth based on computable models of general equilibrium. This chapter describes the proposed algorithm of model parametric identification, taking into consideration the characteristic features of the macroeconomic models with high dimensions and facilitating the discovery of the global extremum of a function depending on a large number of variables (more than a thousand). The algorithm uses two objective functions (two criteria of identification, main and additional). This allows the withdrawal of the values of identified parameters from neighborhoods of local (and nonglobal) extreme points concurrently, maintaining the conditions of coordinated motion to the global extreme point.

This chapter includes statements and solutions of parametric control problems of economic growth on the basis of computable models with a sector of knowledge of economic branches, as well as with the shady sector.

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