

Agents' capital as invariants of trajectories of intertemporal equilibrium: theory, technology of modeling and applications

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In 1975 in Computer Center of Russian Academy of Science under leadership of academician A.A. Petrov we opened a new direction of researches: system analysis of developing economy [1] in which the methodology of mathematical modeling of the complex systems, advanced in natural sciences, was synthesized with achievements of the modern economic theory. Models were similar to so called computable general equilibrium models, that became popular in the nineties. But our models pay more attention to specific features of economic mechanisms of the system under consideration. With the help of models it was possible to understand internal logic of seemingly paradoxical economic processes. It is possible to tell that our works turn out the whole "annals" of the Russian economic reforms expressed in language of mathematical models.

Here we present results of a new stage of our research. Investigations of intertemporal equilibrium revealed a dynamic characteristic of rational behavior of an agent which unifies accepted estimations of price of firm: cost of net assets, capitalization and expected discounted profit. We refer to this quantity as capital. Especially useful it appears in homogeneous models. From mathematical point of view capital occurs to be straight analogy of invariants of movement of Hamiltonian systems, connected with symmetries. We suggest to take this quantity as a base of descriptions of interaction between firm and its proprietor. To reveal this quantity we propose new description of Arrow-Debreu intertemporal equilibrium as a dynamic process end of which is also equilibrium in the same model with new initial conditions. We show that consumer and producer may be described uniformly as agents maximizing their own capitalization. Putting additional institutional constraints on the dynamics of financial instruments, we can move from a model of an ideal market to more realistic models. The report briefly discusses the general scheme of the model, we called

the canonical form [2]. This form covers all Computable general equilibrium models, and many more. To work with models in canonical form we have developed a special system EKOMOD [2], implemented in the computer algebra Maple. The system controls the correctness of the model and automate many phases of its analytical studies, and also allows the calculation of direct recording in a standard mathematical notation of the model. The report discusses the general form of the canonical homogeneous model of behavior of agent maximizing her capitalization. Boundary conditions of capital growth open new approach to solving an old problem of the "natural" conditions at the end of the planning horizon [2]. The developed approach was applied in constructing a model of modern economy of Russia, executed by order of the Federal Tax Service [2]. With only 15 configuration parameters the model perfectly reproduces quarterly dynamics of about 20 main macroeconomic indicators, including the rate of inflation over the 20 quarters of 2000-2004 and gives a plausible estimate the size of shadow turnover and capital flight.

References

- [1] A.A. Petrov, I.G.Pospelov, A.A. Shananin, *From Gosplan to ineffective market: Mathematical analysis of the evolution of Russian economic structures* The Edwin Mellen Press, Lewiston - Queenston-Lampeter, NY, 1999. 393p.
- [2] M.Yu. Andreyev, I.G. Pospelov, I.I. Pospelova, M.A. Khokhlov, *Technology of economic modeling and the model of the modern economy of Russia*. M.: MEPhI, 2007, 262p.