

The Growth and Marcescence of *SOFE*: “System for Optimal Functioning of the (Socialist) Economy”

Politekonomia and Mathematical Methods

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Economic Knowledge in Soviet Union

Politekonomia and Bolshevik Planning

- Political Economy: Modes of Production and their Dialectic
 - The Laws of History & Economic Development; the Laws of Socialism (for the Socialist Mode of Production)
 - An historic-philosophic science
 - Labor Theory of Value
 - NO theory of economic policy or management of the economy!
- (Stalinist) “real Bolshevik planning” — Voznesenskii’s “technocratic approach” with focus on:
 - mobilizing resources
 - enlarging bottlenecks
 - enforcing ‘discipline’

'Practical' Economic Knowledge in Soviet Union

Subordinate to *Politekonomia* and Central directive Planning

- Applied economy and management (*khozyastvovanie*)
 - Planning as a guided collective social process, not a 'technical' problem
 - Planning practice and implementation:
 - practical application in each sector and branch of the economy
 - including 'functional', coordinating activities: planning, finance, supply and materials allocation, labor, investment, etc.
- From the late 1950s, practical, technical tools developed:
 - Economic Cybernetics and Mathematical Methods
 - to be applied as needed in the planning and directing/managing of the economy.
 - But opening the door to new, if constrained, thinking about how the economy functions.

Background of SOFE

Arose from Two Mutually Interacting Stimuli: 'Ideational' and Practical

- Ideational: Intellectual ferment, an opening to new ideas:
 - Death of Stalin and ebbing of 'terror';
 - 20th Party Congress, and subsequent "*Ottepel'* "
 - Acceptance of cybernetics/systems analysis as a science
 - Growing acceptance (slow!) of applied mathematical methods in support of economic planning and management,
 - but only for helping to solve purely technical problems.
- Practical: Growing economic 'dislocation' with growing economic complexity;
 - Khrushchev's *SOVNARKHOZ* reform, and growing chaos from its 'decentralizations'.
 - Evidently growing economic problems for which *Politekonomiia* and socialist *Khoziastvovanya* offered no answers;
 - But a "political economy" justification required for application of mathematical/systems analyses to the economy.

The Economic Problem

Issues, with growing impact, for which '*Politekonomia*' had no answers

- Failure to complete plans in time;
- The place of Ministries in the planning & plan implementation process;
 - both essential (?) and disruptive;
- Incomplete/incoherent plans and implementation shortfalls;
 - The aggregation problem, distorting critical information;
 - The 'success indicator' problem, distorting implementor behavior;
- Growing coordination problems in both 'branch' and territorial hierarchies;
 - The problem of incentives – suboptimization;
 - The problem of prices distorting aggregation and evaluation;
- Low and declining efficiency of investment, with diminishing impact on output;
- Loss of control over materials flows, wages and incomes.

First Steps in Economics towards SOFE

- L.V. Kantorovich and the 'plywood trust assortment problem'
 - Developed by Kantorovich as a mathematical analysis of production planning (1939), and
 - Generalized as an "optimizing approach" to planning (1942);
 - 'single-factory' vision; blueprint for an optimal socialist economy.
- V.V. Novozhilov proposed using LP to improve planning (1940s).
 - Focused on the dual 'valuation' problem:
 - *ob'ektivno obuslovlennye otsenki* — o-o-o;
 - Indirect centralization, rather than direct
 - Introduced "opportunity cost" and the need for "market feedback."
- V.S. Nemchinov (1957, 1960) advocated the enhanced use of *khozraschët* to strengthen the role of planning in the economy:
 - reduce number of plan indicators, and establish long run stable norms;
 - have enterprises 'bid' for "plan-orders";
 - use interenterprise contracting for materials and product flows;
 - allow "dual price system" for sales of "above plan-order" output.
 - Introduced von Neuman growth model (1962)

New Institutional Structures

- Seminar on Cybernetics at MGU (1956) at which suppressed ideas about the place of mathematics in managing the economy were laid out; Kantorovich – “Mathematical Methods in Economic Planning”
 - AN SSSR Scientific Council on Cybernetics (1958) established under A.I Berg to manage the development of cybernetics, computerization, and mathematical methods for economy, its planning/ management;
 - In 1958 AN SSSR Economic-Mathematical Laboratory established by Nemchinov.
- All Union Conference on Computer Technology and Mathematics (1959) on the development of systems, networks, and software for applications in the economy;
 - MGU Laboratory for Mathematical Methods (1962) → *Kafedra MMAE*, established as a research and training center;
 - *TsEMI* (CEMI) formed in 1963 under N.P. Fedorenko as the primary center for advanced research into methods for improving the functioning of economic mechanisms; it was the home of *SOFE*;
 - Journal *Ekonomika i Matematicheskie Metody* [EMM] founded in 1965.

The system of the optimal functioning of the socialist economy is understood as a single unified (tselostnaya) system consisting of both development of optimal plans for all links in the national economy and the optimization of the processes for realizing these plans. (Fedorenko, 1972, p. 3).

- Provide a socialist, mathematical-scientific basis for guiding and managing the development of the Socialist economy;
- Evolved from modeling and optimizing the “single factory” model of the socialist economy (Kantorovich), toward
 - ‘indirect centralization’ making use of ‘market instruments/levers’ to guide delegated decisions of enterprises in pursuit of State socio-economic objectives.
 - State ownership of productive property;
 - operational ‘decentralization’ subject to strict monitoring/*kontrol*’ with assigned production ‘profile’ and economic connections;
 - prices and money in an instrumental role, furthering guidance and control;

Policy Recommendations

- Accepted 4 early ideas of Academician Nemchinov:
 - (i) *Stable norms* with limited plan indicators; (ii) enterprises 'bid' for *plan-orders*; (iii) *interenterprise contracting* ("wholesale trade"); (iv) *negotiated prices* ('contract' prices) for 'above-plan' sales/orders;
- and extended/enhanced them:
 - New planning processes: based on scientific/mathematical methods; interactive iterative development of plans; 'rolling plans';
 - Use of information systems [*SOOI* – System for Optimal Information Processing, a nationwide computer system with mathematical processing software];
 - *SOFE* as the software of an all-union computer system for gathering, processing, and using (in optimizing calculations) economic information required for the optimal development;
 - Use of "shadow prices" (*o-o-o*) in planning and plan implementation;
 - Critically dependent on 'optimality criterion';
 - Use of economic contracts for implementing plan allocations;
 - *Khozraschët* throughout the economic hierarchy (not just in enterprises), with credit in place of financing grants.

Some Basic Models

Derived within/from the all-encompassing SOFE (integrated system) framework

- Models of Social Objective Function and Economic Optimum
 - maximizing production (minimizing costs) given politically determined targets/structure (Kantorovich, Katsenelenboigen);
 - maximizing objective function built on 'rational, scientifically based norms' (Nemchinov);
 - Maximizing objective function based on 'user demand', market-like feedback (Volkonskii);
- Models of the Process of Optimal Plan Creation
 - Multilevel models of iterative plan formation;
- Models of Plan Implementation using *Khozraschët*
 - Models of 'norms'/'prices' and material incentives and 'profits' to insure implementation;
- Dynamic/simulation models of long-run optimal growth;
 - von Neuman and I-O models of growth and capital formation;
- 'State of the Art' reflected in Cave, et. al. (1982),
 - emphasizing the dependence on and integration with *OGAS*, *ASUx*.

Some Inherent Problems

Arising from practical administrative necessities:

- Many more goods than balances, leaving the allocation/distribution of most goods, and most subcategories of centrally balanced goods, unplanned and uncoordinated outside of the specific allocating authority;
- Scattered production among numerous administrative structures (e.g. ministries), but unitary central planning, implying only about 60% of many critical, balanced goods were accounted for in the official balances;
- There were no systematic, uniform aggregation procedures creating inconsistencies in the way balances were calculated by different organizations at different levels (e.g. 'value' vs. 'physical' units of measurement, differing dimensions of aggregation, etc.)
- The mind-set, understanding of the mathematical approach, of practical workers/ economists/administrators in the planning and economic administrative apparatus.

Some Inherent Problems

For applying systematic mathematical optimization

- Technical coefficients were based on "progressive aggregate norms" for 'average' commodity aggregates, due to lack of necessary information, implying:
 - unrealistic, overly optimistic coefficients, in part to impose pressure on implementors to perform;
 - serious aggregation problems from product mix and 'unit of measurement' conflicts across organizations and hierarchical structures;
- Coefficients/norms were subject to arbitrary (from the perspective of both allocators and implementors, if not planners) changes, and were too numerous to be taken seriously [over 400×10^6 primary norms!]
- The 'true' technical coefficients (material production norms) were continually changing, in ways that can't be known at the center, due to the specifics of local activity and circumstances;
- Manageable (\approx simplistic), largely linear, formulations \implies precise, optimal solutions to an incorrect/irrelevant problem.

The Rise of SOFE

“Software” of OGAS – automated systems of information, planning, management, etc.

● Political Foundations

- 1966 Decree of Central Committee and Council of Ministers
 - assigned responsibility for developing automated management systems;
- 1971 the 24th Congress of CPSU specifically authorized
 - application of science-based methods (mathematical and system analytic) to enhance/improve planning;
 - ordered development of *OGAS*, dozens of *ASUs*, linking *GOSPLAN*, Ministries, and enterprises, using *SOFE* models and programs (*ASPR*);
- 1965 – 1968: *CEMI* flowering of intellectual ferment, reform ideas:
 - Proposals for a “constructive political economy” [Fedorenko, 1966]
 - Improving development of central plans: realize the laws of socialism
 - A set of integrated optimization problems
 - Improving the implementation of central plans through the use of incentives and ‘valuation’/price guidance
 - Using the mathematical dual for guiding ‘norms’ and incentives.
 - Debate over appropriate socialist “objective function” for optimization.

Application and Experimentation

- Computer applications in planning and supply management expanded in the late 1960s and 1970s;
 - Almost 4,000 automated management systems installed, mostly in enterprises (1,200), technological production processes (over 1,300), and territorial organizations (almost 900) from 1966 to 1978;
 - For 'Perspective' 1976-90 Plan, *GOSPLAN* developed an 18 sector I-O model, broken into a 260x260 interproduct table at end of each 5-year period; never integrated results into an actual plan.
- Models and recommendations of *SOFE* never received wide application, despite substantial *CEMI* & other R&D funding;
 - Many ideas tried out in 'economic experiments', partial reforms, e.g.:
 - Optimization of location of cement industry in Central Asia;
 - Use of financial measures, profit proxies, in planning directives and evaluating enterprise performance;
 - Marginal changes in pricing rules, reflecting some arguments of *SOFE*-ists.
- Never accepted by practical planners or managers!

Impact on Planning and the Economy

- *SOFE* 'optimal' plans rejected by *GOSPLAN* as at best iterated forecasts, lacking the necessary 'directive' nature of plans:
 - "... fails to recognize the decisive significance of conscious applications of objective economic laws in scientific planning ... in economic management."
 - Computers used for information processing to the extent possible, but mathematical optimization results only used in preliminary discussions and failed to influence actual planning decisions and assignment;
- 'Improvements' in procedures, norms, and guidelines, and their application in associated 'economic experiments', yielded anticipated results in "hothouse" conditions, but also unleashed massive unintended consequences; Hence
- Liberalizing, decentralizing (using indirect controls) reforms rejected by economic administrators as threatening control over economic activity, development;
 - Shut down for (unintended) distributional consequences, and/or disruption of the surrounding planned economy;

Disillusion and Hope

- Early disappointment in the failure of the Kosygin reforms to more fully introduce *SOFE*-ist ideas;
 - Recentralization of administration, new enterprise incentives, wholesale price reform, but
 - no change in the economic goals or nature of the system; work of planners and administrators remained unchanged.
 - Degenerated into fragmented '*sovershenstvovaniya*' of procedures, norms and normatives, recommended from some mathematical models, and introduction of disparate computerized information systems.
- Continued experimentation with increasingly decentralized, market-like, settings and incentives, culminating in 6-Ministry "Large Scale Experiment" pushed by Y. Andropov, beginning in 1984.
 - Driven by deteriorating performance: macroeconomic stagnation and growing microeconomic disorganization and deviation from 'plan';
 - But themselves contributing to further disruption, unintended distributional consequences.
- V.L. Makarov (IM SO AN SSSR) replaces Federenko in 1985

Afterlife in Perestroika

An intellectual foundation for radical, decentralizing (Socialist) economic reform

- Economic *Perestroika* comprised a state-guided, indirectly centralized market socialism, which appears based substantially on:
 - remembered/reconstructed experience with NEP
 - ideas and analyses of *SOFE*, and
 - experience with piece-meal implementation after 1967.
- Like *SOFE*, *Perestroika* came to rescue socialism;
 - Unlike *SOFE*, it was allowed to go too far, destroying Soviet socialism.
- Many of the leading economists associated with *Perestroika* were actively involved in the debates about, and work on, *SOFE*:
 - Aganbegyan, Petrakov, Shatalin, Bogomolov, Abalkin, etc.
- The key economic components of *Perestroika* can all be found in *SOFE*,
 - as much of its institutional structure can be found in *NEP*.
- *SOFE* withered away as *Perestroika* crumbled into chaos, both to be replaced by radical marketizing (Capitalist!) reform.