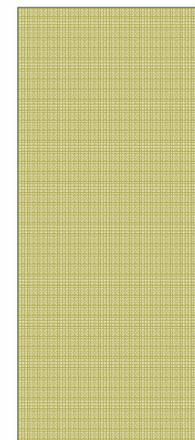


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**THE HISTORY OF RUSSIAN ECONOMIC
AND MATHEMATICAL THOUGHT THROUGH 1928
AND ITS MARK IN MODERN ECONOMICS**

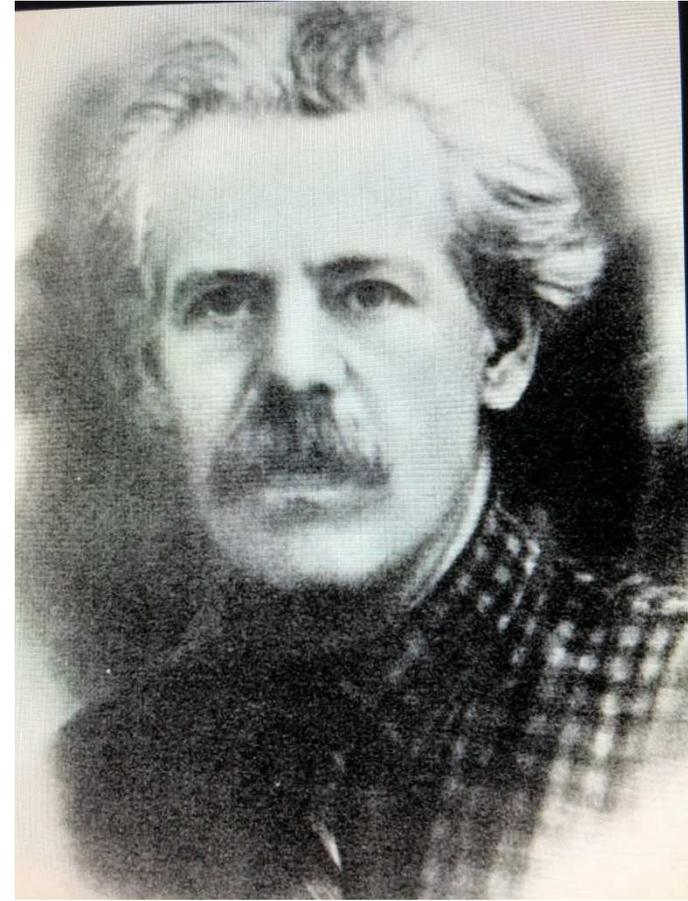
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WAS THE RUSSIAN THEORY OF CYCLES A MATHEMATICAL THEORY?



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SUMMARY

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RECURRING CRISES SINCE THE EARLY 19TH CENTURY

- Wars and revolutions have a profound influence on the course of development.
- Wars arose during periods of increasing economic activity.

- Russia was an agrarian country at the beginning of the 20th century: 85% of the population lived in villages.
- World competition for new markets (in particular financial and technological) led to the aggravation of diplomatic relations between Russia and a number of countries, and finally to Russia's involvement in the First World War.
- The destruction and impoverishment of the rural population as a result of military action led to social protests and ultimately to the revolutions of 1917.
- Russia pulled out of WWI in March 1918, plunging into civil war. Its economy was destroyed over a seven-year period: from 1914 to 1921.

ECONOMIC POLICY

- During the first post-revolutionary years, the country's economy continued to be governed by the principle of “war communism”.
- For the needs of the army and industrial revival, the so-called “prodrazverstka” was carried out in rural areas. Peasants were required to provide the State with all their “surplus” food.
- The peasants revolted, refusing to deliver the largest portion of their crops to the Soviet proletarian State.

- The government introduced the **NEW ECONOMIC POLICY (NEP)** in 1921.
- The main task of the agrarian section of the policy was to incite peasants to produce more.
- To that end, the following market mechanisms were put in place:
 - new fiscal policy: the “**prodnalog**” tax was collected in agricultural products or in money;
 - price policy (in order to favor industrial development);
 - monetary policy:
 - ✓ “tsarist” money and “Soviet” money for budget purposes;
 - ✓ “tchervonets” for credit policy, convertible to gold and to foreign currency;
 - ✓ foreign currency.
- The NEP was carried out for five years only.

- During the NEP period, the scientific theoretical foundations of the socialist development – planning – were elaborated by new establishments:
- - the Moscow Institute of Economic Trends, created in 1920
 - the Gosplan, created in 1921.

PLANNING

- The planning aimed at analysing the ways (means) to organize investment and production during the period of industrialization to avoid economic crises observed in Europe during the 19th century.
- The role of the Moscow Institute of Economic Trends, headed by N.D. Kondratiev between 1923 and 1928, was to analyse past trends and to forecast future developments.
- The Gosplan had to elaborate the optimal trajectory of development for different time periods, each having precise objectives.

PHILOSOPHICAL STREAMS

- Two philosophical streams challenged each other during the time period that the planning conception started:
 - one was called “genetic” (descriptive status of economic theory, useful for forecasting), and
 - the other “teleological” (normative status of economic theory, useful for the plan’s construction).

- The economists of the “genetic school”, N. Kondratiev, V. Bazarov, and V. Groman, advocated for the approach of a scrupulous analysis of random processes, the revelation of their regularity, and the study of current economic trends.
- According to them, economic theory was not able to explain completely the economic processes, since each process is a combination of many factors.
- Planning should not *impose* the dynamic of the factors, but should *favor* their evolution “towards regular patterns deduced by empirical analysis, what Groman called “the empirical laws”.

- The “teleological” doctrine emphasizes that the final objectives of the plan influence the sequence of the process. The originators of the “teleological school” – G. Krjijanovsky and S. Strumilin – put forward the elaboration of plan objectives and insisted on the use of directive methods for their realization.
- Their ideas have widely influenced the practice of Soviet planning. According to their concepts, the national economy is conceived on the basis of a national plan that takes into consideration all technological and environmental constraints.
- Since the economy is considered as a single and entire organization, trade and money are not required. Products are no longer merchandise; they are goods distributed according to the plan.

ECONOMIC TRENDS AND CYCLES

- Kondratiev's Institute collected data describing the main economic indicators of Germany, France, England and the United States from the late 18th century until 1920: the average level of prices, the rate of securities (interest on capital), wages, foreign trade turnover, coal mining and consumption, iron and lead production.
- The analysis of these data made it possible to establish two characteristics for understanding the nature of crises: their periodicity and the fact that they are inherent to capitalism.
- The crisis is only one phase of the whole cycle of overproduction, consisting of phases of recovery, crisis and depression. On this basis, Kondratiev studied the entire cycle (known principally as the theory of the long economic cycles).

- N.D. Kondratiev analysed the dynamics of economic evolution and equilibrium.
- In empirical analyses, he defined two groups of processes:
 - the reversible one, whose evolution has the form of waves,
 - the irreversible one, presenting trends.

- The reversible processes had different periodicities: annual (seasonal variations), every 3.5 years, every 7 to 11 years (business cycles), and long waves, every 50-60 years.
- Long oscillations are regular and specific to a set of socioeconomic processes. The latter have a joint endogenous evolution, and technical and scientific progress would be part of those processes.

- N. Kondratiev already showed in 1926 that long oscillations are linked to inventions, their diffusion and applications (innovation and technical progress). Scientific and technical progress, along with the process of capital accumulation, is *not regular*.
- The transformation of the technological structure of production is saltatory (discontinuous).
- The conditions of money turnover deeply modify the economic reproduction process and also the involvement of new countries in the capitalist system.

- The critics of Kondratiev's studies (D.I. Oparine, among others) pointed out the logical discrepancy between Kondratiev's empirical analysis and Marx's theoretical conclusions.
- For Marx, capitalistic competition leads ineluctably to the decrease in the rate of return on invested capital, in long historical perspective, signifying the disappearance of capitalism as a production system.
- On the contrary, Kondratiev insisted on the cyclical movement of capitalist countries with an increasing growth trend in the long run.

- In Kondratiev's 1926 and 1927 works on the methods of short-run forecasting, he introduced the distinction between direct and indirect prognostics.
- The indirect prognostic signifies that one knows in advance what will happen, but does not know the intensity of the event: for example, the prognostic of the harvest level of different agricultural products and of their prices.
- The exactness of the forecasting depends, in this case, on the force of correlation between the phenomenon to be foreseen and its symptoms.
- The direct prognostic consists in using the data series themselves, which can be cyclical and repetitive.

SLUTSKY'S ANALYSIS OF RANDOM EVENTS ON ECONOMIC ACTIVITY

- In 1915, the economist Evgeny Slutsky studied shifts in demand for goods by looking at income and at substitution effects of price changes.
- The Slutsky equation says that the total change in demand is composed of an income and a substitution effect and that the two effects together must equal the total change in demand.

- In 1926, Slutsky joined the Moscow Institute of (Konjunktura) Economic Trends and studied, with Kondratiev, the apparent cycles in economic time series.
- Reflecting on the paper by George Udny Yule on “nonsense correlations in time series”, Slutsky found specific drivers of economic cycles (or fairly regular oscillations in activity) – random events.
- In 1927, Slutsky published, “The summation of random causes as a source of cyclic processes” in *Voprosy Conjuncture*. In this article (published in English in 1937 in *Econometrica*), Slutsky asked the question: Could the laws of probability account for the recurrent spikes and dips seen in time series?

- Instead of coming up with a business-cycle idea, used to explain historical observations, Slutsky created an artificial data set to see what picture emerged.
- Thus, Slutsky did not introduce the initial hypothesis of economic dependence among the variables, but created a theory after examining *mathematical facts*.
- Using the moving summation process on completely random numbers (data from the State lottery), the Slutsky model forged connections among these numbers.

- In statistical terms, the numbers became serially correlated:
 - The value of each sum is associated with (but not identical to) the values of previous sums.
 - The effect of a single random number persists in the chain of moving summations.
 - Over time, this process causes the sum values to oscillate – the statistical equivalent of a seesaw.
- *“Serial correlation” describes the relationship between observations of the same variable over a specific period of time. If a variable’s serial correlation is measured to be zero, then it means that there is no correlation, and each of the observations are independent of one another.*
- *Conversely, if a variable’s serial correlation skews towards one, it means that the observations are serially correlated, and that future observations are affected by past values.*

- Slutsky concluded: random events, such as inventions, natural disasters, conflicts..., lead to the wave rhythms of the real economy.
- In 1928, when the Moscow Institute of (Konjunktura) Economic Trends closed its doors, Slutsky left economics and devoted himself to mathematics.

TIME-SERIES MODELLING

Adjustment models

$y(t) = f(t, u(t))$, where $u(t)$ – zero mean random variable

Models are used to reveal regularity, trend = medium-term movement, which is approximately constant.

Autopredictive models

$$y(t) = f(y(t - 1), y(t - 2), \dots, u(t))$$

For example, the ARIMA model (Box–Jenkins method) allows for the selection of the optimal forecasting method from a large set of possibilities.

It is used:

- to answer causality-related problems;
- to distinguish between short- and long-term;
- to analyse agents' expectation behaviour.

Explanatory models

$$y(t) = f(x(t), u(t))$$

where $x(t)$ – exogenous variables, which may be deterministic or random

$u(t)$ – random disturbance

TELEOLOGICAL PRINCIPAL OF PLANNING: *MODELLING, OPTIMIZATION AND SIMULATION*

- Russian economists in the early 20th century pointed out the defects of the short-term vision of profit-seeking economies and proposed the “teleological” principal of planning.
- Scholars were interested in the consequences of intentional effort and control on observable processes.
- Gleb Krjijanovsky, the first president of Gosplan, suggested two predicted trends of development: a minimal set of numbers and a maximal one.
- The first had to define the level of sufficient capacities for the continuous functioning of the economy. The outlay numbers close to the values of the minimal set had to signal potential “dangers” and provoke the appropriate interventions.
- The maximal set corresponded to the plan called “optimum”.

MODELLING FOR PLANNING IN RUSSIA

- The theoretical background was inspired by Karl Marx's schemes:
 - one concerned the simple reproduction of the national economy;
 - the other an enlarged reproduction of the national economy.
- The latter was, in a sense, the “final aim” of the planning.

- Alexandre Bogdanov [1912], creator of the systemic approach to science (monumental work “Tektologie”), developed the concept of the equilibrium of systems and introduced the “law of the minimalists”. According to this concept, the weak link of the system determines the viability of the entire system.
- On this basis of Marx’s scheme of simple reproduction and Bogdanov’s “law of the minimalists”, Vassily Leontief elaborated his “input–output” model.
- Since that time, Leontief’s “input–output” tables have been at the heart of all macro-models.

- The Gosplan estimated the proportionality indicators between the reciprocal offers of the sectors for the Russian economy for 1923–1924.
- Leontief participated in this work of estimation and in the elaboration of the first annual plan. The estimation of the price and wage was derived from **Marxist axioms**, as a function of the average values of the production of goods in each given sector (**socially necessary norms**).

- This practice was challenged by the theory of *optimal prices*, completely corresponding to the “teleological” ideas. Indeed, in the 1930s and 1940s, the “normative” theories were developed by Leonid Kantorovich [1939], Viktor Novojilov [1926, 1967], Maurice Allais [1943] and Marcel Boiteux [1949].
- Some of them demonstrated that the efficient functioning of the entire economy is possible only through an optimal price calculation in a context of rational behaviour of economic agents.
- An optimal price balances the supply and demand of a good and corresponds to the *marginal cost* in a sample.

- The mathematical method proposed by L. Kantorovich to find the optimal conditions of resource allocation was based on the iterative calculation of the “Lagrange multipliers” (a method known since the beginning of the 19th century thanks to the work of Jean-Batiste Fournier).
- The Lagrange multipliers make it possible to obtain the optimal solution. Kantorovich’s innovation consisted in interpreting the Lagrange multipliers as the values of produced goods, called the *shadow prices* (fictitious) of goods.
- The **shadow price** shows how much the profit (of the enterprise) will increase due to the production of a complementary unit of the good. It is a subjective value and has nothing to do with the price of the good at the time of sale. In particular, if there is an excess of a given resource (factor of production), its fictitious price is equal to zero, according to such mathematical models.

CLOSING REMARKS

1. Planning in the 21st century

- While we have discussed the mistrust of planning failures in Russia and the theoretical failures of the planning theories, in general, it should be noted that planning intensifies over time and has acquired new tools in the 21st century.
- One sphere of planning is the **big global company** with all its networks, production modules, suppliers and outlets.
- The other is the **financial authority** that scrutinizes the activity of companies of all sizes and seeks to regulate the entire production system in order to avoid serial failures.

- In the first area, planning is akin to quantitative and qualitative strategic management without resorting systematically to monetary signals or prices (Beffa, 2002).
- Operational research and “normative” planning methods are widely used for task scheduling.
- In the second case, the ability of the planner lies in his capacity to direct cash flows in the sensitive areas of the economy in order to set the whole economic system on its true course.

2. Scenarios using prognostic methods

- The most significant problems of the future development path are related to demography and the ageing of the population. In order to envisage viable social security, retirement programs and medical expenditures, economists are developing **prognostic scenarios**.
- The association with new technologies and scientific provisions of information management (financial, in particular) have opened the way to **new projects that are more focused on ecological objectives**.

3. Marks of the 1920's Moscow "genetic" and "teleological" theories of planning

- The prediction and strategic planning practices were developed from the "genetic" and "teleological" theories of the 1920s and have been strengthened by the adoption of the tools proposed by the normative theories of the 1950s and later.

Some methods used by the Moscow Institute of (Konjunktura) Economic Trends in the 1920s are applied today, with a slight modernization:

- the direct prognostics: extrapolation, prognostic by aggregation of revealed short-run trends, and experts' predictions;
- the synthetic index of economic trends, representing the aggregate of simple indices, is a variant of a model of leading (advanced) factors used to detect regime changes;
- the indirect prognostics: the models of exogenous factors.

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