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# SOCIALISM, CAPITALISM AND ECONOMIC GROWTH

ESSAYS PRESENTED TO  
MAURICE DOBB

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## EDITOR'S PREFACE

One of the pleasures of editing this Festschrift for Maurice Dobb has been the warmth of the response—from so many people, in so many parts of the world—to all my requests for contributions, advice and assistance. I have had the invaluable co-operation of the Editorial Board and of Piero Sraffa in the planning of this volume; Ezra Bennathan, Ruth Feinstein, Michele Salvati and Bob Rowthorn have helped me with translations from German, Russian, Italian and matrix algebra; and Jennifer Warren did most of the work for the compilation of the bibliography.

C. H. F.

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## CONTENTS

Editor's Preface	page v
Maurice Dobb. <i>Eric Hobsbawm</i>	I
I. PROBLEMS IN THE THEORY OF ECONOMIC GROWTH	
A Classical Model of Economic Growth. <i>Leif Johansen</i>	13
The Interest Rate and Transition between Techniques. <i>Robert M. Solow</i>	30
Terminal Capital and Optimum Savings. <i>Amartya K. Sen</i>	40
A Growth Cycle. <i>R. M. Goodwin</i>	54
The Application of Marx's Model of Expanded Reproduction to Trade Cycle Theory. <i>Péter Erdős</i>	59
On the Tendency for the Rate of Profit to Fall. <i>A. A. Konüs</i>	72
II. PLANNING AND THE MARKET	
The Curve of Production and the Evaluation of the Efficiency of Investment in a Socialist Economy. <i>Michal Kalecki</i>	87
A Model for the Planning of Prices. <i>O. Kryn, B. Sekerka and L. Hejl</i>	101
Some Suggestions on a Modern Theory of the Optimum Regime. <i>Jan Tinbergen</i>	125
Socialist Market Relations and Planning. <i>Ota Šik</i>	133
The Computer and the Market. <i>Oskar Lange</i>	158
Socialism, Planning, Economic Growth. <i>Kurt W. Rothschild</i>	162
Socialist Affluence. <i>Joan Robinson</i>	176
III. PROBLEMS OF ECONOMIC DEVELOPMENT	
Obstacles to Economic Development. <i>Paul M. Sweezy</i>	191
Capitalism, Science and Technology. <i>Josef Steindl</i>	198
On the Political Compulsions of Economic Growth. <i>Theodor Prager</i>	206

Role of the 'Machine-Tools Sector' in Economic Growth. <i>K. N. Raj</i>	page 227
National Economy Planning and the Development of the Natural Sciences. <i>Sh. Ya. Turetsky</i>	217
On the Possibility of Constructing a Model of the Transition to Socialism in Italy. <i>Antonio Pesenti</i>	240
IV. ECONOMIC GROWTH IN HISTORICAL PERSPECTIVE	
World Economy in Transition (1850-2060). <i>Surendra J. Patel</i>	255
Some Random Reflections on Soviet Industrialization. <i>E. H. Carr</i>	271
Aspects of Soviet Investment Policy in the 1920s. <i>R. W. Davies</i>	285
The Historical Setting of Socialist Planning in the U.S.S.R. <i>Rudolf Schlesinger</i>	308
Some Problems of Urban Real Property in the Middle Ages. <i>R. H. Hilton</i>	326
Pottage for Freeborn Englishmen: Attitudes to Wage Labour in the Sixteenth and Seventeenth Centuries. <i>Christopher Hill</i>	338
V. A BIBLIOGRAPHY OF WORKS BY MAURICE DOBB	351
Index	361

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# THE COMPUTER AND THE MARKET

OSKAR LANGE

## I

Not quite 30 years ago I published an essay *On the Economic Theory of Socialism*.<sup>†</sup> Pareto and Barone had shown that the conditions of economic equilibrium in a socialist economy could be expressed by a system of simultaneous equations. The prices resulting from these equations furnish a basis for rational economic accounting under socialism (only the static equilibrium aspect of the accounting problem was under consideration at that time). At a later date Hayek and Robbins maintained that the Pareto-Barone equations were of no practical consequence. The solution of a system of thousands or more simultaneous equations was in practice impossible and, consequently, the practical problem of economic accounting under socialism remained unsolvable.

In my essay I refuted the Hayek-Robbins argument by showing how a market mechanism could be established in a socialist economy which would lead to the solution of the simultaneous equations by means of an empirical procedure of trial and error. Starting with an arbitrary set of prices, the price is raised whenever demand exceeds supply and lowered whenever the opposite is the case. Through such a process of *tâtonnements*, first described by Walras, the final equilibrium prices are gradually reached. These are the prices satisfying the system of simultaneous equations. It was assumed without question that the *tâtonnement* process in fact converges to the system of equilibrium prices.

Were I to rewrite my essay today my task would be much simpler. My answer to Hayek and Robbins would be: so what's the trouble? Let us put the simultaneous equations on an electronic computer and we shall obtain the solution in less than a second. The market process with its cumbersome *tâtonnements* appears old-fashioned. Indeed, it may be considered as a computing device of the pre-electronic age.

## II

The market mechanism and trial and error procedure proposed in my essay really played the role of a computing device for solving a system of simultaneous equations. The solution was found by a process of

<sup>†</sup> The Review of Economic Studies, London 1936 and 1937. Reprinted in O. Lange and F. M. Taylor, *On the Economic Theory of Socialism*, edited by B. E. Lippincott, Minneapolis 1938.

iteration which was assumed to be convergent. The iterations were based on a feedback principle operating so as to gradually eliminate deviations from equilibrium. It was envisaged that the process would operate like a servo-mechanism, which, through feedback action, automatically eliminates disturbances.<sup>†</sup>

The same process can be implemented by an electronic analogue machine which simulates the iteration process implied in the *tâtonnements* of the market mechanism. Such an electronic analogue (servo-mechanism) simulates the working of the market. This statement, however, may be reversed: the market simulates the electronic analogue computer. In other words, the market may be considered as a computer *sui generis* which serves to solve a system of simultaneous equations. It operates like an analogue machine: a servo-mechanism based on the feedback principle. The market may be considered as one of the oldest historical devices for solving simultaneous equations. The interesting thing is that the solving mechanism operates not via a physical but via a social process. It turns out that the social processes as well may serve as a basis for the operation of feedback devices leading to the solution of equations by iteration.

## III

Managers of socialist economies today have two instruments of economic accounting. One is the electronic computer (digital or analogue), the other is the market. In capitalist countries too, the electronic computer is to a certain extent used as an instrument of economic accounting. Experience shows that for a very large number of problems linear approximation suffices; hence the wide-spread use of linear programming techniques. In a socialist economy such techniques have an even wider scope for application: they can be applied to the national economy as a whole.

It may be interesting to compare the relative merits of the market and of the computer in a socialist economy. The computer has the undoubted advantage of much greater speed. The market is a cumbersome and slow-working servo-mechanism. Its iteration process operates with considerable time-lags and oscillations and may not be convergent at all. This is shown by cobweb cycles, inventory and other reinvestment cycles as well as by the general business cycle. Thus the Walrasian *tâtonnements* are full of unpleasant fluctuations and may also prove to be divergent. In this respect the electronic computer shows an unchallenged superiority. It works with enormous speed, does not produce

<sup>†</sup> Cf. Josef Steindl, 'Servo-mechanisms and Controllers in Economic Theory and Policy', in *On Political Economy and Econometrics, Essays in Honour of Oskar Lange*, Warsaw 1964, pp. 552-554 in particular.

fluctuations in real economic processes and the convergence of its iterations is assured by its very construction.

Another disadvantage of the market as a servo-mechanism is that its iterations cause income effects. Any change in prices causes gains and losses to various groups of people. To the management of a socialist economy this creates various social problems connected with these gains and losses. Furthermore, it may mobilise conservative resistance to the iteration process involved in the use of the market as a servo-mechanism.

#### IV

All this, however, does not mean that the market has not its relative merits. First of all, even the most powerful electronic computers have a limited capacity. There may be (and there are) economic processes so complex in terms of the number of commodities and the type of equations involved that no computer can tackle them. Or it may be too costly to construct computers of such large capacity. In such cases nothing remains but to use the old-fashioned market servo-mechanism which has a much broader working capacity.

Secondly, the market is institutionally embodied in the present socialist economy. In all socialist countries (with the exception of certain periods when rationing was used) consumers' goods are distributed to the population by means of the market. Here, the market is an existing social institution and it is useless to apply an alternative accounting device. The electronic computer can be applied for purposes of prognostication but the computed forecasts have later to be confirmed by the actual working of the market.

An important limitation of the market is that it treats the accounting problem only in static terms, i.e. as an equilibrium problem. It does not provide a sufficient foundation for the solution of growth and development problems. In particular, it does not provide an adequate basis for long-term economic planning. For planning economic development long-term investments have to be taken out of the market mechanism and based on judgement of developmental economic policy. This is because present prices reflect present data, whereas investment changes data by creating new incomes, new technical conditions of production and frequently also by creating new wants (the creation of a television industry creates the demand for television sets, not the other way round). In other words, investment changes the conditions of supply and demand which determine equilibrium prices. This holds for capitalism as well as for socialism.

For the reasons indicated, planning of long-term economic development as a rule is based on overall considerations of economic policy

rather than upon calculations based on current prices. However, the theory and practice of mathematical (linear and non-linear) programming makes it possible to introduce strict economic accounting into this process. After setting up an objective function (for instance, maximising the increase of national income over a certain period) and certain constraints, future shadow prices can be calculated. These shadow prices serve as an instrument of economic accounting in long-term development plans. Actual market equilibrium prices do not suffice here, knowledge of the programmed future shadow prices is needed.

Mathematical programming turns out to be to an essential instrument of *optimal* long-term economic planning. In so far as this involves the solution of large numbers of equations and inequalities the electronic computer is indispensable. Mathematical programming assisted by electronic computers becomes the fundamental instrument of long-term economic planning, as well as of solving dynamic economic problems of a more limited scope. Here, the electronic computer does not replace the market. It fulfils a function which the market never was able to perform.