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The Structure of Economic Development (II)

—Economies of Scale and Indivisibility—

by Iwao Ozaki
Masahiko Shimizu

In the previous study, "The Structure of Economic Development (I)" [Ozaki (1979)], we attempted to build a dynamic model that incorporates the effects of structural change. In this model, we emphasized the effects of economies of scale on changes over time in the capital input coefficient matrix, B^{t+1}. The model was built on the basis of the empirical results of the study of production function using the input-output data for each sector on time-series analysis.

The main purpose of this study is to determine, statistically, stable input-output relationship for the production process of each commodity. The results of our experiments all showed the statistical validity for the existence of indivisibility of plant (individual production units) based on the effects of economies of scale, for the sectors with technology of large-scale processing; Iron & Steel, Petro chemical products, Cement, Pulp and Paper etc. These results bring us to support statistically the hypothesis that the effects of economies of scale is a dominant factor in structural change.

Fixed Point Theorems in Nonlinear Functional Analysis

by Wataru Takahashi

Let X be a given set and consider a mapping T of X into X. Then a point x such that $Tx=x$ is called a fixed point of T. Furthermore consider a mapping T of X into 2^X (the set of all subsets of X), then a fixed point for T is a point x such that $x \in Tx$. A fixed point

exists under suitable conditions on T and X. The theorems concerning fixed points are the so-called fixed point theorems and they have many applications in various fields. Particularly, many existence theorems can be treated as special cases of suitable fixed point theorems.

Our purpose in this article is to prove some fixed point theorems and to illustrate the usefulness of them by giving various applications. In Section 1, we state fixed point theorems for nonexpansive mappings in Hilbert spaces. In Section 2, we prove two theorems which are concerned with nonlinear ergodic theorems. The first nonlinear ergodic theorem was proved by Baillon in 1975. The nonlinear ergodic theory constitutes now one topic of nonlinear functional analysis. Section 3 is related to the theory of nonlinear monotone operators. In Section 4, we discuss fixed point theorems for families of nonexpansive mappings by using the theory of maximal monotone operators. In Section 5, we deal with theorems concerning convex functions. The subdifferential ∂f of a proper convex lower semicontinuous function f is a maximal monotone operator and the relation $0 \in \partial f(x)$ means that $f(x) = \min f$. The problem of finding such an x is an important instance of the nonlinear ergodic theory. In Section 6, we prove a very useful existence theorem by making use of Brouwer's fixed point theorem and a partition of unity and then we obtain Fan's useful existence theorem concerning systems of convex inequalities in topological vector spaces. In section 7, we first generalize Tychonoff's fixed point theorem and Schauder's fixed point theorem. Furthermore we prove minimax theorems and existence theorems by using fixed point theorems for multi-valued mappings. Section 8 is related to the theory of variational inequalities and the nonlinear complementarity problem. We solve nonlinear variational inequalities for multi-valued mappings on closed convex subsets in topological vector spaces. Then the results are applied to the nonlinear complementarity problem. In Section 9, we discuss necessary and sufficient conditions for the non-emptiness of the core of a convex game by using Fan's theorem concerning systems of convex inequalities.

On the Positive Operators

by Ryuichi Watanabe

In the well known economic model of von Neumann, the production technology is expressed by a polyhedral convex cone K in $R^n \times R^n$. An element of (x, y) in K is interpreted as meaning that the economic state represented by the vector x can be transformed in an unit time period into the state represented by y. Rockafellar approaches to this problem by regarding the cone K as the graph of a multi-valued mapping called the convex process.

In this paper we extend, by using the theory of Krein spaces, the concept of positive operators to the case of multi-valued mappings and generalized the convex process of Rockafellar.

Oscillation in Dynamic Kaldorian Model

by Kunio Kawamata

We first study the nature of the dynamic system

(1) $\dot{Y}(t) = k(I(Y(t), K(t)) - S(Y(t)))$

(2) $\dot{K}(t) = I(Y(t), K(t)) - \delta K(t)$

where t denotes the time and the other symbols are defined as follows:

Y: gross national product

K: capital stock

k: a positive constant representing the adjustment speed of Y

δ: a positive constant representing the rate of depreciation

$I(Y, K)$: investment function

$S(Y)$: saving function

It is shown that under Kaldorian assumptions of saving and investment functions, there exists a limit cycle of the system if k is sufficiently large. We also give sufficient conditions under which the system converges to a stationally point.

We next consider the behavior of system (1)～(2) when the saving function is replaced by

$$S(Y,\ t)=S(Y)+\beta(t)$$

where $\beta(t)$ is a periodic function. It is established that the modefied system has a periodic solution under suitable conditions on functions and parameters of the model.

Theory of Measurable Correspondences

——Mathematical Foundations and its Applications——

by Toru Maruyama

The existence theorem of measurable selections for certain correspondences (i.e. multi-valued mappings), the first successful proof of which was obtained by J. von Neumann, has gradually been acquiring a wider range of applications. The proof of this theorem is based upon a deep insight into the topological properties of Polish or Souslin spaces. Although the idea involved in the proof deserves close attentions on its own, the theorem also provides indispensable foundations for certain problems in functional analysis and optimization theory.

In this paper, I am going to give a systematic exposition of the recent developments in this field, including the results of my own. The topics included are the measurability criteria of correspondences, the existence theorem of measurable selections, the Castaing's representation theorem, the projection theorem, the measurable implicit function theorem, the integration theory of correspondences and so on. In the last section, the applications to the existence proof of the optimal solutions for certain variational problems will be shown.