Contribution to the Discussion of Professor Leontief's Paper on "Recent Developments in the Study of Inter-Industrial Relationships."

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I shall confine my remarks to points of contact between the models developed by Professor Leontief and certain sections of current economic theory. I shall thus not be concerned with the difficulty of finding data that correspond to the theoretical concepts. In particular, I need not question the assumption of constant input-output ratios, because conceptually such constancy can be produced by a sufficiently fine breakdown of production into elementary reproduceable activities. Since Leontief's model and its presentation are influenced by a concern with measurement, my remarks are to be regarded as supplementary rather than critical.

However, some criticism seems in order of Leontief's use of certain terms in meanings different from those usually attached to them in economic theory. "Supply and demand equations" are usually conceived as relationships expressing by what quantity suppliers and consumers respond to a given price. The same term should not be used for the identity (or equilibrium condition) which says that, in the absence of changes in stocks of a commodity, the quantity supplied equals the quantity demanded.

Likewise, I feel that the designation "general equilibrium analysis" for the model under discussion is inappropriate. This term usually connotes analysis of the process whereby the exercise of optimizing choice by each of a number of individuals or firms brings about determinate prices and quantities. In the model that has been presented there is no study of choice. Even in its open version the model is mechanical in the

sense that specification of the final bill-of-goods uniquely determines the rate of output of all industrial activities.

It may be useful to draw a distinction between planning models designed to study and guide optimum allocation of resources toward some stated objective, and models intended as a description of economic behavior in reality. Reference to this distinction will clarify apparent contradictions. For instance, the acceleration principle, declared dead yesterday by Professor Haberler, is very much alive today in Professor Leontief's presentation. The contradiction is resolved if we realize that the acceleration principle is dead as an explanation of actual investment fluctuations during business cycles, but makes very good sense in a model designed to plan investments over a period in order to attain levels of production increasing in a pre-assigned manner. Similarly, the use of technological information stressed by Leontief seems adequate for a planning model, but the attempt to develop a dynamic model of actual behavior including such matters as investment in inventories and in productive equipment is likely to reintroduce the difficulties of statistical inference from time series which he has been hoping to avoid.

The remainder of my remarks is concerned with the use of the model under discussion for the theory of allocation of resources. Let us define primary inputs, not in a manner dependent on where the model is "cut open," but as those inputs of which the amount is subject to limitations beyond the influence of the planning body. Such essentially limited inputs comprise, for practical purposes, the maximum labor force, the amounts of land of various grades in existence, mineral resources, and, in dynamic models, the initial amounts of capital equipment of various kinds. Now, as was remarked by Professor Herbert Simon in another meeting, the mechanical

nature of the model entails that if a given bill-of-goods just absorbs the total amount of labor available, it may either fail to utilize all, or require more than, the land or the capital equipment available. This unrealistic feature of the model can be avoided by placing more columns in the coefficient matrix than rows, that is, by introducing more ways of producing things than things to be produced. Choice between alternative combinations of industrial processes can then be directed to utilizing to the limit of availability all primary inputs, and to maximizing the composite output in the sense that a position is sought in which any further increase in the output of one commodity necessitates a decrease in the output of at least one other commodity.

If such a position is attained, one can evaluate the technological ratios in which individual outputs are substituted for each other (by changing the relative weights of processes in the combination applied). By interpreting these ratios as imputed (relative) prices, and by extending this system of imputed prices to primary inputs and to such intermediate products as may be introduced, a model is obtained which is a special formulation of the theory of allocation of resources developed* by Meade, Lange, Lerner, and others. To the extent that perfect competition exists, ordinary market processes bring about the establishment of such price ratios. Where due to monopoly or oligopoly, or due to price control in a war economy, money prices lose their usefulness as guides to allocation because they fail to express the relative scarcity of the commodities involved, explicit evaluation of imputed prices by means of a model of production as here considered is an important tool toward optimum use of available resources.

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* J. E. Meade and C. Hitch, Introduction to Economic Analysis and Policy.

O. Lange and F. Taylor, On the Economic Theory of Socialism, Minneapolis, 1938.

A. Lerner, The Economics of Control, New York, 1944.