THE PLAN AND THE MARKET: THE MODELS OF OSKAR LANGE

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The terms "plan" and "market" have been central concepts in the study of economic systems, but they have not always been treated with the necessary rigour. Some very important aspects of these two coordination mechanisms can be illuminated by means of a decision-theoretic approach to economic systems.[1]

It is not possible to present the full panoply of models in which the market, the plan, or a combination of the two are present. I shall concentrate on a comparison of three models. These models are based on those presented by Oskar Lange in his famous essay in the 1930s, which constituted a key part of the "socialist controversy" literature of the 1930s.[2] The comparison of these models[3] lends itself to examining some of the key distinctions between the plan and the market, as well as permitting us to analyze the relationship of these two mechanisms to the "price system."

Lange's essay was in response to the gauntlet flung at socialists by Ludwig von Mises, who argued that it was impossible to find an efficient way to organize the allocation of resources under socialism; one essential feature of socialism, social ownership of the means of production, prevented the creation of a rational economic system.[4]

Lange I Model

The Lange model (let us call it Lange I) showing that a system simulating perfect competition is feasible even without a true market for the means of production, is well known and we need only outline it in its bare essentials.

A Central Planning Board (CPB) sets the prices of all goods and services, including the interest rate for capital. The managers of enterprises, appointed by the CPB, are given two rules to follow: (1) equate marginal cost to the price set by the CPB in order to produce at the optimal scale of output, and (2) combine factors of production until the marginal productivity of a dollar's worth of each factor is equal, in order to assure the least cost combination of productive resources. These two rules duplicate the behavior of the perfectly competitive firm. With every enterprise manager following these rules, the CPB need merely alter prices whenever there exists excess demand or supply in the market for any good or productive resource. These price changes form part of a trial and error process converging toward a short-run equilibrium situation where demand and supply are equal in all markets. This equilibrium would be achieved by the substitution of the central price-setting board for the invisible hand of the market.

The CPB also appoints managers in each industry and instructs them to expand the capacity of the industry whenever the marginal cost in their industry is below the price set by the CPB and contract capacity when the marginal cost is above the price. This provides a substitute for the free entry and exit of firms in perfect competition, but no detail was provided on how new firms were to be established.[5]

This model assumes consumer sovereignty and the CPB merely reacts passively to changes in consumer demands and changes in costs of production, i.e., the CPB simulates the freely formed prices in perfectly competitive markets.

In addition to this function of setting prices in response to excess demands or supplies in each commodity or resource market, the CPB serves two other important functions which differentiate this model from the perfectly competitive one. The CPB determines the overall saving rate and distributes a social dividend among all the participants in the economic process. The saving rate is determined by the planners' and not consumers' preferences. The social dividend becomes available since the return to capital and land is kept by the state instead of going to private owners of capital and land. It must be distributed in such a way as to minimize the effect on the allocation of resources.

Let us explore this model in terms of our decision-theoretic approach. Lange provides a careful description of the "decision-making structure" in his model.[6] The decision on the rate of saving and investment and the decision on how to distribute the social dividend are completely centralized in the hands of the CPB. The preferences of the planners with respect to the time shape of the income streams, rather than those of the consumers, will be dominant. Thus, the preference ordering or objective function of the CPB members will partially determine the rate of growth in output by setting the saving and investment rate, and through this and the social dividend it will influence the distribution of income over time and at each period of time. All of the other decisions are delegated to the industrial and enterprise managers and the consumers. The inter-

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action between the consumers trying to maximize the satisfaction from their incomes (wages plus social dividend) and the managers following the rules and responding to changes in prices, determines the allocation of resources.

Lange has little to say, on the other hand, about the "information structure"[7] or the "motivation structure."[8] The essence of the motivation process consists of the CPB giving the rules to the managers, and if there exists "organizational unity" i.e., all decision agents share a common objective function and operate as a team,"[9] the motivation problem is solved.

The model appears to place relatively modest burdens on the information structure. The CPB requires no information on the internal workings of the enterprises or industries as long as the Board can assume that the managers are loyally following the rules. In this case, all it needs to know is whether there is an excess or deficit of each commodity; that is, it requires information on inventories. It does not need any information on the price elasticities of supply or demand, any more than does the invisible hand of the competitive market. Of course, to the extent that the CPB has some knowledge of these elasticities, it can achieve a convergence to equilibrium in each market more rapidly.

A key critic of Lange's model, Friedrich Hayek, questions the notion that the Lange model is informationally equivalent to the perfectly competitive model.[10] He argues that the seemingly easy task assigned to the information structure depends on the assumptions that the economy is changing very slowly and that the number of commodities and productive resources is relatively small. If economic conditions change rapidly, the CPB will be faced with the problem of how often to change the prices. If it wishes to change them very frequently, then it will need a very efficient system of communication for both incoming and outgoing messages, while less frequent changes will impair the quality of the prices as resource allocation signals. If most commodities and resources are not homogeneous, then the Board would have to monitor, modify, and communicate to agents changes in such a large number of items that the job would no longer be a simple one. The CPB would have to face a difficult problem in having to define all commodities and resources in sufficient detail to be able to set a price for each of them. This is essential if the buyers and sellers are to understand each other when they are engaged in a transaction. Thus, there exists a linguistic problem,[11] but it does not represent a crucial weakness of the Lange model. Even if the common language[12] of the CPB and all buyers and sellers is not utility-perfect,[13] the consequences of this are much less serious than they would be under a Soviet-type planned system. Abuses of imperfections in the definition of a commodity are limited by the fact that both partners to the transaction are able to refuse the deal.

While the informational efficiency of the Lange model is open to some question, the really serious problem rests with the assumptions underlying the motivation structure. The model is based on the implicit assumption of complete organizational unity. Once this is questioned, a Pandora's box is opened. If the objective functions of the industrial and enterprise managers do not correspond fully to those of the Board, then it is necessary to explain how the Board will make sure that everyone follows the rules. No such assumption is necessary in the perfectly competitive model. There, the self-interest of each enterprise owner and competition among them impels each to act in such a way as to maximize profits (minimize costs), and there is no need to impose or enforce any rules. In the Lange model without organizational unity, the CPB must establish an information structure sufficient to provide it with information on the degree to which everyone follows the rules. This is essential since some managers might find it easier not to obey the rules fully. For example, the rule that factors must be combined in such a way as to equalize the marginal productivity of a dollar's worth of each factor of production, requires considerable effort on the part of the manager. Unless he believes in the CPB's objectives or some incentive is provided for him to follow the rule, he may prefer to give it mere lip service. After all, if technology and/or the prices set by the CPB change frequently, it takes considerable time and effort to change the input combinations in such a way as to follow continually the dictate of this rule. If following the rule requires in some cases the reduction in the labor force, it may be easier for the manager to disobey the rule than to face the unpleasant task of firing part of his workers.

Thus, the Board would have to accept lower efficiency, provide incentives to managers to follow rules, and/or invest more heavily in the information structure in an attempt to study the internal operation of the enterprise to discover such flouting of the rules. If the Board chooses to operate on the motivation structure, it may substitute profit maximization for the rules.[14] Each manager could be told that his rewards will be tied to the amount of profit his firm or industry is able to achieve. If the enterprise is very small compared to the market in which it sells, then the enterprise managers will find it in their self-interest to choose the same actions as would be required by the two rules, or as would be the case

for perfect competitors. However, if the enterprise is large in relation to its market, then neither the Lange managers nor the perfect competitors would act to maximize social welfare. In this case, the Lange manager would find it in his self-interest to produce an output below the level at which marginal cost equals the price set by the CPB. This would create a shortage in the market, at the existing price, thereby forcing the CPB to raise the price. At the new higher price, the enterprise would make larger profits as long as its costs do not rise sharply with increased output.

The problem of assuring that industrial managers follow the rule set for them is even more difficult. In this case, it would not be possible to provide them with short-term incentives and the stress would have to be on improving the information structure so the CPB can obtain information on their performance and provide some long-term rewards, such as promotions.

One of the key differences between the Lange model and the perfectly competitive or centrally planned models results from differences in the behavior of industrial and enterprise managers of Lange as compared to decision agents in the other models. The Lange managers may have different objective functions than those in the other models and different information at their disposal. Lange himself has argued that one of the most damaging criticisms of his model is that it is likely that his managers will act as bureaucrats and not be willing to take risks.[15]

The reason for this is the probable asymmetry in the rewards for succeeding in a risky venture and the penalties for failing. Thus, unless the managers share to a significant degree in the profits accruing to their industry or enterprise, or their promotion depends on success in risky ventures, they are justified in structuring their subjective probabilities of the consequences in such a way as to make the payoffs appear lower than the payoffs from a less risky venture. The Lange industrial managers are likely to have much better information on the set of investment options that are feasible, and on the probable consequences of such investments than would private enterpreneurs, but less information than central planners. The Lange managers would know what investment decisions are being taken in their own industry, while central planners would also have information on actions to be taken in other industries.

Assuming away the informational and motivational problems, Lange argues that all the benefits of the perfectly competitive model can be obtained when the means of production are owned by society. He goes further and argues that his model is superior to the perfectly competitive model since it is likely to perform better in achieving certain goals, such as greater equality in income distribution, greater stability in output, and prevention of unemployment. He also argues that the CPB will be in a position to internalize some of the externalities in the production process and set prices in such a way as to include social costs and benefits of any activity. It is beyond the scope of this paper to analyze these claims in detail. Suffice it to say that there is no consensus on this, and that it is not self-evident that Lange's model will perform better than the perfectly competitive model.

Lange II and III Models

The Lange I model is well known to students in the field of comparative economic systems. Less attention has been paid to two variants of this model, one presented by Lange in the same essay, and the other a logical alternative to this model. Both of these variants assume that the CPB imposes its own preferences and does not merely play the role of the hypothetical Walrasian auctioneer reacting to the revealed preferences of the consumers, as was the case in Lange I.

Not surprisingly, this single modification results in a significantly different model. The two major changes are the replacement of a highly decentralized goal decision-making structure with a highly centralized one, and the need for a heavier investment in, and greater centralization of, the information structure.[16]

Instead of consumer sovereignty, with the allocation process being determined primarily by the preferences of the myriad of consumers, this system exhibits consumer free choice, where planners determine the allocation of resources and consumers are only free to choose among the goods presented to them by the planners, as is the case in the Soviet system. This change in the goal decision-making structure is likely to be reflected in the prevailing norm,[17] since this norm will now represent the objective functions of the planners and not the consumers.

Each individual consumer in Lange I requires knowledge of the characteristics of only those goods and services which have some positive probability of entering into his consumption set. Once the CPB decides to impose its own preferences, it must obtain information on characteristics of all goods and services entering into its decision set, which is much larger than that of the consumer. This information is necessary to make it possible for the CPB to preference order all possible commodity bundles in the n dimensional commodity space. If the CPB does not consist of one single decision agent, there is the additional problem of communication among the members of the

CPB and the possibility of intransitive orderings arising in such a process.

Once the CPB defines its objective function, it can approach the remaining information problem in two ways.

One approach, which I shall call Lange II, is for the CPB to use a double price system, with one price facing the producers and another price facing the consumers. The CPB would then alter these two sets of prices by trial and error until the final bill of goods corresponds to the one desired by the Board.

The second approach, Lange III, involves the centralization of the information structure in an attempt to obtain as much information as possible about the capacities, supplies of labor and materials and technology in enterprises, and the elasticities of consumer demands for various commodities. Given this information on all the feasible commodity bundles, on the expected consumer demands, and on the CPB's preference ordering of the feasible bundles, the CPB could formulate directly the prices facing the consumers and those facing the producers which will lead to the final bill of goods desired by the CPB.

The advantage of Lange III over Lange II is that the optimal solution can be reached more rapidly, thereby avoiding a waste of resources and the possibility of disequilibriating dynamic processes leading to divergence rather than convergence. The disadvantage of Lange III is the heavy resource cost of obtaining the information. In reality, of course, the CPB would probably choose a model intermediate between II and III, obtaining sufficient information to avoid starting the trial and error process in a position of extreme disequilibrium, but without attempting to obtain all the necessary information.

As I shall argue in the next section, Lange I should be considered a market system and Lange III a planned system. Lange II could be thought of as a planned system, if the nature of the goal decision-making structure is the key criterion for differentiating between the plan and the market or a market system if the nature of the information structure is the criterion.

The Plan and the Market as Coordination Mechanisms

The Lange models were contributions to the still unresolved controversy over the superiority and feasibility of coordination via plan or market. They are also extremely useful in helping to analyze the distinction between these two mechanisms. What are these distinctions?

A pure market system may be said to exist when the following conditions are met: (1) resource allocation is guided by consumer sovereignty, i.e., the utility maximizing consumers, interacting with utility (profit) maximizing producers, determine the final bill of goods (they are the goal decision-makers); (2) information is communicated along horizontal channels[18] between buyers and sellers and the content of the message is limited to prices and quantities; (3) each agent must make his decision on the basis of his best forecast of the actions of other agents based on the pattern of prices; (4) the coordination of his decisions with those of others takes place *ex post*, i.e., after all actions have been executed; (5) agents can motivate each other solely by means of offering positive material incentives, i.e., they can manipulate the consequences of choices among various acts, but cannot limit the set of feasible acts; (6) one corollary of this is that the transactions must be voluntary and cannot be imposed by one agent on another; and (7) the other corollary is that consumers and/or producers will compete with each other in the process of attempting to maximize their utility.

A pure plan may be said to exist when: (1) some central decision-making agent or organization develops its own blueprint of the desired future final bill of goods, or more generally, a desired future state of the economy; (2) information is communicated along vertical channels of communication between this central organization and other agents in the economy, and the content of this communication is not limited to any particular type of message; (3) the central decision-making agents attempt to achieve *ex ante* coordination of all decisions in the plan-formation or "informing" stage, i.e., they attempt to attain a feasible, consistent plan that fulfills their objectives, before moving onto the plan-implementation or "action" stage; (4) they can motivate others by means of manipulating the consequences of their choice of action, as in the market, but also by limiting their set of feasible acts; (5) the transactions need no longer be limited to voluntary ones; and (6) competition may exist, but does not have to exist.

Having outlined the key features of the pure models of the market and the plan, we may analyze the three Lange models and determine their place on the spectrum between the plan and the market. Lange I meets most, but not all of the conditions for the existence of a pure market system. It differs from the pure market by having information move through vertical channels between the CPB and buyers and sellers, with the content of the messages consisting of the rules and levels of inventories, as well as prices, and the CPB acting to limit the feasible set of acts by setting rules that must be followed. Except for these three differences[19] the Lange I model is

identical with the pure market model, and we may consider it as fitting into the family of market models.

Lange II contains these three differences from the pure market model, but in addition, resource allocation is guided by planner and not consumer preferences, and the CPB must develop its own blueprint of the desired future state of the economy. This represents a very significant shift from the market toward the plan, and if we concentrate on the goal decision-making structure, we may classify Lange II as a plan model.

When we move from Lange II to Lange III we depart even further from the pure market and approach the pure plan. The key difference here may be found in the change in the information structure. As indicated earlier, Lange III requires considerably more information and a much greater information processing activity at the center. In addition, the CPB will attempt to obtain enough information to be able to determine the probable supplies and demands for all goods and resources, thereby working toward the achievement of *ex ante* coordination of decisions in the plan-formation stage, a most important aspect of the plan models. Thus, Lange III might be considered a member of the family of planning models, whether we concentrate on the goal decision-making or the information structure; it satisfies all of the necessary conditions for the existence of a plan.

We might note that even in a market system the decision units (firms, households, and sellers of resources) generally utilize a planned system internally, and the market only operates in inter-unit transactions. By contrast, economies utilizing planned systems internally, generally interact with other planned or nonplanned economies on international markets. Thus, the level of aggregation at which our analysis is conducted will be a key determinant in the choice of plan or market.

The Two Roles of the "Price System"

The systematic comparison of the "plan" and the "market" makes it possible to examine more carefully the notion of a "price system" or "price mechanism." Generally, the terms price system and market system are used interchangeably in economic theory. This is permissible as long as the theory is limited to a specific subset of economic systems, but ceases to be permissible when the complete panoply of economic systems is considered.

In a market system, the price mechanism constitutes the essence of the information and motivation structures; it both informs and motivates the agents and thereby provides the mechanism for coordinating their decisions and allocating economic resources.

If the market system and the price system were merely synonyms, then the price system could not form part of a planning system. Our discussion of Lange III indicates that even a system with planner sovereignty, vertical channels of information, and an attempt at *ex ante* coordination, i.e., a planned system, can still utilize the price mechanism. In this case, the price system does not coordinate decisions or guide the allocation of resources since this task is performed by the central plan. The price mechanism is used, instead, to implement the plan by informing and motivating the enterprise and industrial managers to fulfill the wishes of the planners.

Along the same lines, we might ask whether the operation of a Pigovian central agency, engaged in corrective, but not substantive intervention,[20] constitutes a market or a planned system? I would argue that this represents a variant of Lange I, where consumer sovereignty is still honored and the CPB is merely attempting to remove market imperfections resulting from externalities. On the other hand, if the Pigovian CPB attempted to obtain all the necessary information to set its taxes and subsidies at the optimal level, without having to depend on a trial and error process, we would have a case analogous to Lange III, but with consumer sovereignty. In this case we could classify it as a market if we concentrated on the decision-making structure, and as a plan if we stressed the information structure.

The important lesson from this exercise is not the classification of the various models into market or plan models, but rather the analysis of the important features of economic systems. It also shows clearly that the price system is not a system-bound concept. It represents merely one possible combination of information and motivation structures, and this combination is feasible both in market systems and some very special types of planned systems, i.e., in those planned systems where the planners choose to implement the plan by manipulating the consequences of the actions of producers and consumers rather than by limiting their set of feasible actions.

Concluding Comments

The foregoing has only scratched the surface of the problem. We hope that it has convinced the reader that the *Weltanschauung* presented in this paper provides an alternative, and hopefully illuminating, approach to the analysis of the coordination problem in economic systems. Its two key virtues are: the possibility of introducing new developments in various fields of economic theory such as information theory, decision-making under uncertainty, welfare economics *et al.* into the field of comparative economic systems, and the ability

to decompose the plan and the market into its component parts and thereby analyze their variants in a more rigorous manner.

FOOTNOTES

1. Fuller treatments of the decision-theoretic approach may be found in Egon Neuberger and William J. Duffy, *Comparative Economic Systems: A Decision-Making Approach*, Boston; Allyn & Bacon, forthcoming; William J. Duffy and Egon Neuberger, "Toward a Decision-Theoretic Approach to Economic Systems," *Jahrbuch der Wirtschaft Osteuropas*, Munich, Band 3, 1972; Egon Neuberger and Estelle James, "The Yugoslav Self-Managed Enterprise: A Systemic Approach," in M. Bornstein, editor, *Plan and Market: Economic Reforms in Eastern Europe*, New Haven: Yale University Press, forthcoming; and Egon Neuberger, "Comparative Economic Systems," in A. A. Brown, E. Neuberger, and M. Palmatier, editors, *Perspectives in Economics: Economists Look at Their Fields of Study*, New York: McGraw-Hill Publishing Company, 1971. The present paper represents a revised version of Chapter 8 in the Neuberger-Duffy book.
2. Oskar Lange, "On the Economic Theory of Socialism," in B. E. Lippincott, editor, *On the Economic Theory of Socialism*, Minneapolis: University of Minnesota Press, 1938; originally published in *Review of Economic Studies*, 1936 and 1937.
3. Oskar Lange contributed other models after World War II, e.g., in his *The Political Economy of Socialism*, The Hague: Van Keulen, 1958. However, his postwar models deal with centrally planned economic systems or systems combining the plan and the market and are not used in this paper.
4. Ludwig von Mises, "Economic Calculation in Socialism," in M. Bornstein, editor, *Comparative Economic Systems: Models and Cases*, Homewood, Illinois: Richard D. Irwin, 1969. The original work was *Die Gemeinwirtschaft*, published in 1922.
5. It is beyond the scope of this paper to analyze the very difficult problem that the CPB would face in trying to determine what constitutes an "industry"; would it use technological or functional similarly, cross elasticities of demand or some other criterion?
6. The decision-making structure describes the socially established allocation of decision-making authority among agents, and the source of this authority.
7. The information structure describes the mechanisms and channels for the collection, transmission, processing, storage, retrieval and analysis of economic data.
8. The motivation structure describes the ways in which one agent can motivate another agent to act in accordance with his wishes. Agent B can influence the decision of agent A by limiting his set of feasible acts, by manipulating the events that will determine the consequences of A's acts, and by attempting to alter A's objective or preference function. If B influences A's choice by limiting his set of feasible acts, we call this "administrative decentralization." If he does not limit the set of feasible acts, but operates on the events affecting the consequences (this is usually called the incentive structure), we call it "manipulative decentralization."
9. Organizational unity exists when all members of an organization share a common objective function; in this case they act as a "team."
10. Friedrich Hayek, "Socialist Calculation: The Competitive 'solution'," *Economica* New Series, May 1940, pp. 125-149.
11. Our discussion of the linguistic problem is based on Pavel Pelikan, "Language as a Limiting Factor for Centralization," *American Economic Review*, September 1969, pp. 625-31. The essence of the linguistic problem consists of the difficulty of describing commodities or resources in sufficient detail and sufficiently clearly so that no ambiguity is possible.
12. Each organization is assumed to have an "internal language" for communication within the organization, and an "external language," which may or may not be the same as the internal language, for communication with others. When a message means the same thing to two or more organizations it is said to belong to their "common language."
13. A "utility perfect common language" exists when every item is described in sufficient detail to assure that each agent regards any two items having the *same* name in the common language as equally desirable.
14. For an excellent discussion of this, as well as other, aspects of the "socialist controversy" the reader is referred to Abram Bergson, "Market Socialism Revisited," *Journal of Political Economy*, October 1967, and Benjamin N. Ward, *The Socialist Economy: A Study of Organizational Alternatives*, New York: Random House, 1967, Chapter 2.
15. Lange, *op. cit.*, p. 109.
16. For a discussion of various approaches to centralization in decision-making and information structures, see Neuberger-Duffy, *op. cit.*, Chs. 4, 5, and Appendix to Ch. 5. For the purposes of this paper we may think of centralization in decision-making as representing a situation in which the CPB has the authority to make the key economic decisions, and centralization in information as signifying that the CPB has information on everyone's environment and prospective actions (we follow Leonid Hurwicz's approach to informationally centralized and non-centralized adjustment processes in his "Centralization and Decentralization in Economic Processes," in *Comparison of Economic Systems, op. cit.*, p. 96.)
17. Tjalling C. Koopmans and John Michael Montias discuss the alternative norms by which the success of an economy can be judged in their "On the Description and Comparison of Economic Systems," in Alexander Eckstein, editor, *Comparison of Economic Systems: Theoretical and Methodological Approaches*, Berkeley: University of California Press, 1971, pp. 34-35 and 41-48. The prevailing norm is the norm of central decision agents that is accepted by or imposed on the remaining agents.
18. Horizontal channels connect two agents neither of whom is hierarchically superior to the other. Vertical channels connect two agents at different levels in the hierarchy.
19. The other differences are connected with the control over the saving/investment decision and the social dividend, discussed earlier.
20. For a discussion of these two types of government interventions see Abba P. Lerner, "Microeconomics," in *Perspectives in Economics, op. cit.*