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Economic Development as Coordination Problems*

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Abstract

The economics of coordination failures is widely interpreted, both by its advocates and by its critics alike, as a call for more active government interventions in economic development. The goal of this paper is to explain that, contrary to the common perception, the logic of coordination failures does not justify policy activism, any greater role of the government in coordination.

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1. Introduction.

The major challenge for the theory of economic development is to explain divergent economic performances across economies. In recent years, this problem has motivated a large number of studies in the so-called "new growth theory."[1] One strand of this literature approaches economic development as a coordination problem and portrays underdevelopment as a state of equilibria, in which the economy fails to achieve necessary coordination among complementary activities.[2] The task assigned to me in writing this chapter is to reexamine the logic of coordination failures in the context of economic development and to draw some implications concerning the role of government in facilitating coordination.

Some economists believe that this literature provides a theoretical justification for active roles of the government, and try to support it empirically by collecting anecdotal evidence, in which the government seems to have improved the efficiency through coordination activities. The critics, skeptical of the government's ability to coordinate actions when the private sector fails to do so, *also* believe that this literature tries to justify more interventionist policies. In their effort to refute such a conclusion, the critics question the prevalence of coordination failures in practice and offer anecdotal evidence, in which the private sector seems to have succeeded in coordination without any government guidance.

I do not attempt in this paper to review these arguments and to find out the "right" side of this debate. Instead, I intend to explain that this debate is fundamentally misguided as it is based on

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[1]Lucas (1988, 1993), Romer (1986,1990), Grossman and Helpman (1992), and many others. Of course, not everyone would agree. Barro and Sala-i-Martin (1995), for example, stress the continuity from the previous growth literature by focusing on, using their terminology, "conditional" convergence; they seem to think that "absolute" divergence is outside the scope of growth theory.

[2]Murphy, Shleifer, and Vishny (1989), Azariadis and Drazen (1990), Rodriguez-Claire (1993), Matsuyama (1991, 1992), Ciccone and Matsuyama (1992), Rodrik (1993). The idea of coordination failures first gained its popularity in macroeconomics in the context of business cycles; see, Cooper and John (1988). For a broad survey, see Matsuyama (1995), whose section 5 also addresses some of the issues discussed here.

a wrong presumption; contrary to the common perception, the logic of coordination failures does *not* justify policy activism.

The task of any allocation mechanism requires coordination of a large number of activities, performed by a large number of people, each equipped with what Hayek (1945) called "the knowledge of the particular circumstances of time and place." The major part of this problem is to find out which combination of activities should be coordinated. This problem--not unlike the problem of hundreds of people, scattered in a dense, foggy forest, trying to locate one another--, is of such fundamental difficulty that no algorithm can solve it. What the economics of coordination failures tries to show is that *even* the market mechanism cannot solve the problem. More precisely, it projects the view of the world that economic development is a continuous process of system change, in which society tries to discover a better way of coordinating economic activities, and yet, due to the fundamental complexity of coordination problems, there are equilibrating tendencies in which society is evolved into one of a large number of inefficient states. From this perspective, even the most advanced economies fail in coordination. What differentiates the rich from the poor is simply a matter of degree; the former has been *relatively* more successful in coordination than the latter. In this sense, all countries are still developing. And a series of historical accidents, including coordinating efforts of entrepreneurs and of the government, determine the performance of the economy, by pushing it from one state into another in an unpredictable matter, which in turn explain diverse performances across economies, as well as the diversity of the manners in which different economies cope with coordination.

If there are significant coordination failures, then the economy necessarily operates at a position far away from the Pareto frontier. So, it is possible that, after some shocks, society may accidentally discover a better way of coordinating activities. This helps us explain, among other things, why we can find much anecdotal evidence, in which government intervention seems to have

played an important role in improving coordination. But, it is one thing to say that something is improvable, and another to say that we know how to improve it. If the coordination problem were simple enough that even the outsider, such as the economist and the bureaucrat, would know how to solve it, it would have been taken care of long time ago by those directly involved with the problem.

If there are significant coordination failures, then it is not surprising, and indeed very likely, that we can find some isolated instances in which some entrepreneurs, those lucky enough to stumble upon unexploited opportunities, succeed in solving coordination problems; business sections are full of such stories. But, this does not refute the prevalence of coordination failures in practice. Quite the contrary, the very fact that these innovators become fabulously rich by doing so and yet such innovations are introduced year after year suggest that a large number of coordination problems are yet to be solved, or even identified.

This is not to deny the value of studying how government policies had permanent impacts on the way we coordinate our economic activities, or the value of studying how entrepreneurs succeeded in enhancing efficiency through their coordination efforts without any government guidance. It is through accumulation of such evidence that we can acquire better understanding of how our society is organized. However, the sheer abundance of such evidence neither support nor refute the benefits of policy activism. It merely suggests the prevalence of coordination failures in our society.

Pointing out that the market mechanism fails in coordination problems does not mean that the government should intervene. In fact, we do great injustice to the achievement of the market if we judge it by an ideal standard there is no way of achieving. But this is different from saying, as mainstream economists are often inclined to do, that the market allocation is constrained efficient. Such a statement, by arguing that we were seemingly in the best of all possible worlds, does not sit comfortably with the apparent lack of progress in the third world and the conspicuous roles played

by the government in some rapidly growing economies in East Asia. The economics of coordination failures, by arguing that we are far from being efficient, questions the validity of efficiency as the criterion by which we judge economic performances, and hence suggests that the mere evidence of improvement by government interventions does not justify a policy activism.[3]

Then, what are the policy lessons of the economics of coordination failures? This literature does not intend to argue that there is a single, easily identifiable, source of failure that is waiting to be solved. Rather, it argues that coordination problems are inherently difficult; coordination failures are everywhere; whatever coordination mechanism is put in place, they are so pervasive that there are plenty of room for improvement. The only way to sustain continuous improvement is thus to keep searching for a better system. That is why it is essential to maintain the freedom to pursue and experiment a new way of coordinating economic activities, such as the freedom to form new business enterprises. This is not to deny that the government can sometimes improve coordination. Indeed, the coercive power of the state is the effective means for establishing a particular coordination mechanism. However, precisely because of its coercive power, the state-led coordination inevitably leads to a tighter enforcement, which limits experiments for further improvement in coordination, thereby making it hard to sustain continuous progress.[4] Freer systems have their own problems, but they are at least open to the discovery of new ways of solving them.

It is worth pointing out that recent studies of coordination failures in economic development attempt to formalize the old idea which dates back to Allyn Young (1928), Paul Rosenstein-Rodan

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[3]Winston Churchill once said of democracy that it is the worst system of government known to man, except for all the others. The point of emphasizing market failures is simply to explain why things can often go wrong, not to condemn the market system.

[4]As pointed out by Sachs (1994), state-led industrialization programs in developing and socialist countries often achieved a spectacular success in an early phase, only to be followed by a slowdown, stagnation, and then, eventual collapse. The problem of centrally planned economies is not so much that they never experience rapid growth, but rather that they suffer from the lack of inventiveness, and become "prematurely grey."

(1943), Ragnar Nurkse (1953), Tibor Scitovsky (1954), Albert Hirschman (1957), and Gunnar Myrdal (1958). This early literature, after it enjoyed wide popularity in the fifties and sixties, lost much of its intellectual force in the subsequent decades. The reason was not because the sources of coordination failures pointed out by these authors proved to be empirically insignificant, but rather because many economists, including some of the authors themselves, had drawn wrong policy lessons; they have misinterpreted it as a call for a "big push" industrialization, i.e., a synchronized expansion of industries, deliberately coordinated by the central planning board. The eventual collapse of such state-led industrialization programs in many countries diverted away the profession's attention from what nevertheless remains one of the important sources of development failures discovered by the early writers.

It is my ultimate goal in this paper to discuss the fundamental difficulty of coordination problems in the context of economic development (in section 3) and some implications that follow (in sections 4 and 5). Before embarking on this task, it is worth pondering why the economics of coordination failures is widely misinterpreted as a call for more active government interventions (with my sincere apologies if my own writing in this area had been responsible for such misunderstanding). In section 2, I will point out some possible reasons by using an abstract coordination game, devoid of any economic content. I hope that clarifying common fallacies and discussing closely connected methodological issues at the outset will help us avoid unnecessary confusion in the discussions to follow.

2. The Economics of Coordination Failures: Misconceptions.

The paradoxical nature of the economics of coordination failures is that any attempt to model it necessarily runs the risk of trivializing the difficulty of coordination problems. The theorist naturally tries to come up with a *simple* model of coordination problems, so that the reader can *easily*

see how the agents living in the model environment may be stuck in a Pareto-dominated equilibrium. The significant part of expositional effort hence has to be spent on demonstrating the existence of other, and better, equilibria. But, such a demonstration itself makes coordination problems look easy and trivial to the reader. Having seen how a better equilibrium can be achieved, some may think that there are obvious things the government can do. Other may find it hard to believe that the private agents miss such obvious gains from coordination. But if so, they are making two kinds of errors. One is the failure to make a distinction between the main results of the model and the mere artifacts of its simplifying assumptions. The other is the failure to make a clear distinction between what is known to the agents living in the model environment and what is known to us (that is, the theorist, the creator of this artificial world, and the reader, who is given the opportunity to take a look at the structure of the model).

For example, let us look at Figure 1, which shows a simple coordination game. It is widely used as the simplest set-up in which one can talk about coordination failures. The game is played by a representative agent against the rest of the agents in society. There are two strategies, *I* and *II*, and two equilibria. In one equilibrium, every agent selects *I*, and in the other, every agent selects *II*. Although the former is Pareto dominated by the latter, *I* is an optimal strategy for each agent given that the other agents also select *I*; an unilateral deviation does not improve his/her payoff. In order to escape from the dominated equilibrium, the agents somehow need to coordinate the complementary changes in their strategies. They are stuck in the dominated equilibrium because of their failure to coordinate. In the context of economic development, an additional interpretation is given in order to explain divergent performances across economies. That is, some societies, "the underdeveloped", play the dominated equilibrium, while other societies, "the developed", play a better equilibrium (in this case, every agent playing *II*). This simple game captures the economics of coordination failures in its essentials. And it is a useful one, as long as we do not forget that the

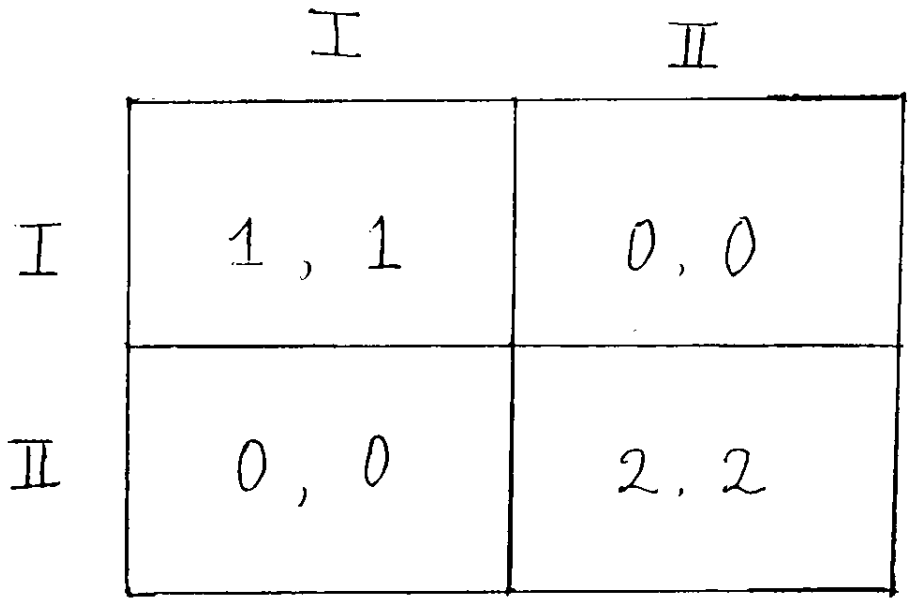

Figure 1

game is meant only for an illustration. Here are some cautionary remarks in interpreting Figure 1.

By showing that some societies, "the underdeveloped," play a dominated equilibrium, this game is not trying to argue that these societies fail in coordination completely. In Figure 1, every agent playing *I* happens to be the worst equilibrium outcome, but this is a mere artifact of the two-ness of the game. In general, one can easily imagine that society plays a dominated equilibrium, which in turn dominates other equilibria. This may at first appear obvious, but has at least three consequences that are not appreciated sufficiently. First, pointing out some real world examples of successful coordination does not refute the prevalence of coordination failures in practice, because even the most primitive society has achieved a certain degree of coordination. (Otherwise, it would hardly deserve to be called "society.") Second, improving coordination means not only setting up a new system of coordination, but it may also mean tearing down the old system of coordination. A steady progress in coordination can be achieved only through the process of "creative destruction." Third, society may be worse off by an attempt to move to another equilibrium by coordinating changes in strategies. For example, coordination failures are sometimes interpreted as a problem of expectations; that is, the agents play a bad equilibrium when plagued by the pessimism, while a good equilibrium is associated with optimistic expectations. This interpretation helps us understand why governments occasionally try to generate optimism by preaching the "Economics of Euphoria."[5] And it may work, and there is nothing to lose from attempting to do so if society is in the worst possible equilibrium, as in Figure 1. But, generally, such an attempt may backlash and society may find itself in an even worse equilibrium. When the president gives a speech like "the only thing we have to fear

[5]Arguably, the announcement of the famous "Doubling National Income Plan" in 1961 by the Ikeda administration helped to generate optimistic expectations of growth potential of the Japanese economy, and led to simultaneous expansions of a wide range of industries. For a more recent example, Lau (this volume) argues that the visit of Deng Xiao Ping to Southern China in early 1992 has the effect of coordinating optimistic expectations. "The announcement of his visit to the public almost three months afterward stimulated an economic boom that continued even today."

is the fear itself," it may indeed help to generate euphoria, but it could also be taken as a sign of despair (particularly when it is not supported by any tangible act of government commitment), and end up making the mood of the nation even more pessimistic. One can never predict how the "market" interprets and reacts to statements made by public officials.[6]

Similarly, by showing that some societies, "the developed," play a better equilibrium than others, this game is not trying to argue that these societies have already succeeded in solving the coordination problem. In Figure 1, every agent playing *II* happens to be Pareto optimal, but, in a more general game, the equilibrium played by the most successful societies can be dominated by other equilibria. Again, the Pareto optimality of *II* is a mere artifact of the two-ness of the game in Figure 1. Unfortunately, this tends to trivialize the difficulty of coordination--if somebody else has solved the problem, it cannot be that hard--, and also to generate the false impression that one simply has to imitate practices in more advanced societies.

By pointing out that the agents are stuck in the dominated equilibrium due to their failure to coordinate complementary changes in their strategies, this game does not intend to argue that, in order to escape from a low level equilibrium, it is necessary to force a large number of agents to start moving in the same direction simultaneously. In Figure 1, all agents are identical and have only one alternative, so that such a "Big Push," or "Great Leap Forward," solution to the coordination problem could work. But again, this is an artifact of the two-ness of the game, and the symmetry of the game (another simplifying assumption). In a more general game, with different agents having different sets of strategies and different payoffs, such a bold move may lead to even a bigger failure. Furthermore, society may be able to escape from a low level equilibrium, even when a small number of agents

[6]History of financial markets is rich in examples, where the official use of "cheap talks" to build market confidence ended up precipitating crises. Indeed, there was a joke, during the Bretton Woods era, that the public assurance by a finance minister that there will be no devaluation is the best signal for an imminent devaluation.

succeeds in coordinating changes in their strategies. This is because, in the presence of complementarity, the small change initiated by a small group of agents could start a long process of chain reaction, in which the change in one strategy is continuously supported by changes in complementary strategies.

More importantly, the logic of coordination failures does not require that the agents playing this game, or any agent living in the model environment (e.g., the economist and the bureaucrat), has the full knowledge of the structure of the game (that is, the payoffs, the strategy spaces, or even the set of opponents). In short, they may not know which game they are playing. For example, when all agents play *I* in Figure 1, they may be unaware of the existence of another equilibrium. In order to make *I* an equilibrium strategy, all the agents need to know is that a deviation from *I* does not improve their payoffs. Even if they are sure of the existence of a better equilibrium (e.g., by observing that other societies seem to be doing better), they may not know which combination of strategies constitutes an equilibrium. Of course, in a two-by-two symmetric game, like the one given in Figure 1, this would be easy to figure out; one could deduce from the two-ness of the game that all agents must be playing *II* in a second equilibrium. But, again, there is nothing special about "two", except that it happens to be the smallest integer larger than one. More generally, with N different agents, each of whom has access to M different strategies, there are M^N boxes in a payoff matrix, each contains an N-dimensional payoff vector. Then, just figuring out which box corresponds to an equilibrium alone becomes a formidable task even when the agents have the full knowledge, let alone when they have only partial knowledge of the game. And even if society accidentally discovers a better equilibrium and succeed in reaching it, this newly attained equilibrium is almost surely dominated by other unknown (at least to the agents living in the model environment) equilibria.

That the agents have only partial knowledge of the game makes an attempt to learn from the experiences of other societies and to imitate those more successful problematic, as others may not

be playing exactly the same game. It is indeed more natural to expect that each society is different in its own way. And it takes only a small change in payoffs to render a particular strategy profile unqualified for equilibrium. Such sensitive dependence on small (and perhaps imperceptible) differences raises the question of replicability of the experiences of others.

When interpreting a model of coordination failures, such as the one given in Figure 1, it is important to keep in mind the enormous complexity of coordination problems each society has to deal with in the real world. Each of us, including the economist and the bureaucrat, possesses only very partial knowledge of the situation. Any model of coordination failures should thus be interpreted as an abstraction of the complex reality, and thinking about policy lessons of this literature requires the intuitive combination of several such models. The trouble begins when we start taking a particular model literally, treating it as a complete description of the real world, and assuming that everybody agrees that everybody agrees that it is a complete description of the real world. It is the approach that Coase (1988, p.19) termed "blackboard economics." It is the approach in which "The policy under consideration is one which is implemented on the blackboard. All the information needed is assumed to be available and the teacher plays all the parts.... In the back of the teacher's mind (and sometimes in the front of it) there is, no doubt, the thought that in the real world the government would fill the role he plays." But, of course, "there is no counterpart to the teacher within the real economic system." There is no one who has access to all the information the teacher has on his blackboard.

Of course, some economists, particularly those familiar with Hayek's work, fully understand that the main difficulty of formulating economic policies lies in that we have to cope with uncertainty, about which everybody disagrees with one another. But, blackboard economics has become the dominant approach in the profession since the seventies, with the rational expectations revolutions in macroeconomics and the increasing popularity of game theory throughout almost all areas of

economics. It has become almost mandatory to treat a formal model as if it were a complete description of the real world, which includes not only the physical environment, but also the information structure, and to assume that the agents agree on the true structure of the model.[7] Such a modelling exercise undoubtedly requires great intellectual ability and may play a role in developing the skills of an economist. But, it has the danger of misdirecting our attention when thinking about economic policy.

In the next two sections, I will intentionally adopt an approach different from "blackboard economics" in my discussion of economic development as coordination problems. In particular, I will try to describe the complexity of development processes as it is; I will consider the implications from the fact that the agents have to cope with considerable uncertainty, by thinking about the possibility that there are substantial discrepancies between the true structure of the model and the subjective knowledge possessed by the agents living in the model environment, including the government. I hope that this rather nonstandard approach will be more effective in conveying the fundamental difficulty of coordination problems.

3. Fundamental Difficulty of Coordination Problems.

Economies grow and our standards of living rise not so much because we are becoming better at doing the same activities, but because we continuously develop and add new activities to the list of those we are already engaged in. Economic development is also a process of structural change; productivity growth is achieved through the evolution of a highly complex system of activities,

[7]I should mention that there are several important strands of literature, which attempt to move away from this dominant approach. In game theory, there are already a large literature on evolutive or learning models of games. See also the recent paper by Kalai and Lehrer (1993) on subjective games, which allow discrepancies between the true structure of the model and the players' perception of it. In macroeconomics, there is the bounded rationality literature, surveyed by Sargent (1993). However, it seems fair to say that these studies have not yet made much impact on the policy analysis.

generally associated with an ever greater indirectness in the production process and an ever increasing degree of the division of labor. Why have certain countries been more successful in developing such a complex economic system than others? And why does the process of system change proceed at different rates in different countries?

By an activity, I mean all sorts of jobs, tasks, works, services, goods, and products that have potential economic value and are costly to perform and to produce.[8] By an economic system, I mean a combination of highly complementary economic activities (that is, tasks, services, goods, etc), which, when taken together, make a coherent whole. The development of a sophisticated economic system requires a high degree of coordination among these diverse activities, performed by a diverse set of agents, each of whom may possess the unique knowledge and technical expertise concerning these activities.

It should be noted that the problem is not merely of coordinating day-to-day operations of a fixed set of activities. Since there are innumerably many activities, any economic system inevitably has to choose the range of activities that are actually introduced. The major part of this problem is to figure out which set of activities should be activated. It is the problem of discovering a combination that brings about a better outcome for the economy as a whole. Economic progress may thus be regarded as an outcome of an continuous process of adding a new set of activities, while dropping others. This problem would be relatively simple if the value of introducing each activity

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[8]Some readers may object the fuzziness of my definition of "activity," but this is intentional, because my main concern is to describe a process of system change. An activity, which is performed only as a "task" in a production line under one economic system, can be a "service" readily available in the marketplace under another. I have chosen to use "activity" instead of other terms, as it is most generic in meanings. Indeed, coordination of a certain range of activities itself could be another "activity." I deliberately use this term in a fuzzy way, so that it would not be interpreted in any concrete fashion, which assumes a particular form of economic, political, and social organization. For the same reason, I also make frequent use of "agents." Unlike "consumers," "producers," or "workers," this generic term does not assume a particular pattern of the division of labor prevailing in an economy. "An agent" could also mean all sorts of actors, not only an individual, but also a group of individuals, such as teams, firms, committees, unions, etc.

could be assessed independently of other activities. If this were true in reality, we could achieve steady progress by routinely experimenting, and determining to adopt or to reject, one activity after another. The problem arises, however, because of the inherent complementarity across activities.

The following metaphor may be apt here. Think of the physical world we live in as a network. It consists of a large number of nodes and a larger number of branches connecting a pair of nodes. Travelling through a node takes a certain amount of time, but this information is available only to the agents living in the node. Our goal is to discover the quickest route from node S (START) to node F (FINISH). According to this metaphor, each node corresponds to a particular activity; each route corresponds to a particular economic system; a set of nodes that belong to the same route corresponds to a set of complementary activities.[9]

Finding the efficient route would be relatively easy, if we know that every route contains a single node. Then, even when there are thousands of possible routes, one can steadily discover a better one by trying one after another. And once a better route is discovered, one can eliminate old ones without any loss. The problem would be much harder, if routes contain multiple branches, and they are all interconnecting with each other. In this case, whether one should visit a particular node cannot be determined solely on the traveling time across the node; one has to evaluate the total traveling time across an entire itinerary along all possible routes that contain this node. And yet, the number of all possible routes grow exponentially with the number of nodes. This is a difficult problem to solve, as anyone who has tackled with the travelling salesman problem in a puzzle book, can testify. The catch is the interconnectedness. Due to the large number of possibilities, it is practically impossible to check all possible routes, but there is no way of reducing the entire problem into a number of separate problems of a manageable size.

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[9]One minor disadvantage of this metaphor is that all activities in a particular system have to be perfectly complementary to one another. This, of course, helps to simplify the discussion below, but the conclusion does not require perfect complementarity across activities.

Our problem of finding the best route, or the problem of discovering the efficient economic system, is much harder than the travelling salesman problem, which is already very difficult. There are two additional obstacles. One is that the information concerning the traveling time across each node is widely dispersed in a society, so that we somehow need to collect the information. It is as if the traveling salesman first had to make a phone call to obtain the information concerning each node, although he knows for sure that he would never visit most nodes. And he may not even know who to call. This is the difficulty that has been pointed out before by many economists, most eloquently and persistently by Hayek (1945, 1974), and yet it is probably worthwhile repeating, as it tends to be forgotten whenever theory is applied to the real world problems.

There is another, and in my opinion more serious, obstacle. Unlike the traveling salesman, we do not have a map of the network. It is as if the traveling salesman had to go through a maze. If you have ever tried to escape from a real maze (as opposed to solving a maze in a puzzle book, in which case you are given the diagram of a maze), or if you have ever got lost in a dense, foggy forest and tried to escape from it, then you know that this means that there is no way of knowing all feasible routes; the only way to discover a feasible route is to try one, of which there are so many. This means that there is no way of verifying that the route (or the economic system) discovered is indeed the efficient one. The best one can hope is to assure that taking a detour here and there along the route would not cut down the traveling time (that is, to verify that it is locally optimal). Even if we are sure as a matter of conviction that there must be somewhere a route better than the current route, it is not even clear where to start a search process.

No algorithm, or no rule of thumb, can guide us "intelligently" through untrod regions of the maze. Likewise, no mechanism can help us discover the efficient economic system. The price mechanism, or the Invisible Hand, is no exception. This is not to deny that the price mechanism may be the most superior means of utilizing information diversely held in a society, relative to any other

mechanisms that ever existed in the human history. However, this is different from saying that the price mechanism can solve the kind of coordination problems we have to deal with in designing an economic system.

In rebuttal, one might argue that the Invisible Hand Theorem, or the first fundamental theorem of welfare economics, demonstrates the efficiency of the price mechanism as a coordination mechanism, and that this theorem does not rule out the possibility of complementarity across goods. But let us read carefully what this theorem has to say. It states that, if there are complete competitive markets, market allocation is efficient; hence, all we have to do is to price all potential activities (competitively). In other words, this theorem claims that there would be no coordination failure, *if* we can make a list of *all* activities we may conceivably be interested in coordinating. But, how can we make such a list, when the knowledge concerning the feasibility of each activity, as well as the knowledge concerning possible complementarities across activities, are diversely held in a society?

In the Invisible Hand Theorem, the coordination problem is artificially resolved by the Walrasian auctioneer, who quotes the prices for all potential activities, to which agents can communicate demand and supply simultaneously. But, there is no way of knowing whether the list held by the Walrasian auctioneer indeed includes everything. This is like saying that we know how to discover the most efficient route if all the feasible routes are drawn in your map of the network, when there is no way of knowing whether any feasible route, possibly the most efficient one, is missing in your map. And this is not the end of the problem. Even if one succeeded in making the list of everything, it would be impossible to open markets for all: even with very small costs of setting up markets, all the resources in the economy would be absorbed that nothing would be left over to be used in performing these activities. Hence, one must somehow decide for which combination of activities markets should be set up.

We have thus come back to our original problem of finding the efficient economic system. The paradox is that we need to open all markets in order to collect necessary information to know which markets to open. Of course, in reality, nobody ever designed a system of markets. It has somehow evolved over time. If there are potential gains from trade a particular good, independently of those that are already available in the marketplace, then one may hope that the market for that good would eventually come to exist. However, there is no reason to expect that the markets for a complementary set of goods would ever be developed. (See the appendix for simple models, illustrating this point.)

Of course, the Visible Hand, by entrepreneurs, managers, or bureaucrats, could fill some of the gaps left by the Invisible Hand of the price mechanism. Entrepreneurs in particular, have advantage in solving isolated coordination problems with their localized knowledge, through the formation of new organizations, thereby creating the "islands of conscious power in the ocean of unconscious cooperation."[10] However, it is optimistic to suppose that such coordination efforts of entrepreneurs, managers, and bureaucrats can solve coordination problems altogether. Furthermore, precisely due to the localized nature of their knowledge, they are powerless in tackling with a global coordination. Even worse, their successes in local coordination may indeed block the possibility of achieving a better way of coordinating at a global level.

4. The Economics of Coordination Failures: Implications.

Due to the fundamental difficulty of the coordination problem, it is inevitable that any mechanism, including the Invisible Hand of the price mechanism, supplemented by the Visible Hand of entrepreneurs and of bureaucrats, cannot find the efficient economic system. Each society,

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[10]This statement is true almost by definition, as I would define "an entrepreneur" as an agent who designs and experiments a new organization in order to facilitate coordination, and "a manager" and "a bureaucrat" as those who conduct day-to-day coordination within a given organizational framework.

whatever mechanism is used, has evolved into a particular economic system, and adopted a particular combination of activities, which are at best locally optimal.

Figure 2 schematically illustrates this view of the world. The horizontal axis represents the space of all possible combination of activities, or all possible economic systems. The dimensionality of this space indeed is a very big one (it is an M-dimensional lattice, where M is a number of all potential activities), although it has to be shrunk down to one dimension here. The graph represents the performance of economic systems. The rugged nature of the graph captures the inherent complementarity of activities in each system; the performance of an economy can change drastically by a small change in selection of activities. (Building only one barrier along a route can turn it to the driver's nightmare.) There are a large number of locally optimal systems, and each society has evolved into one of them. There is no way for society to search in a systematic way for the global optimum, or other local optima that are more efficient. And a series of accidents, such as coordination efforts of entrepreneurs and of the governments, pushes society out of one local optimum to another. As an illustration of the economics of coordination failures in the context of economic development, Figure 2 has several advantages relative to the simple coordination game given in Figure 1.

For example, it does not give the impression that developed countries have already succeeded in solving coordination problems, and that developing countries fail in coordination completely. Instead, it shows that even the most advanced economies fail in coordination, and even the least developed economies have achieved a certain degree of coordination. What differentiates the rich from the poor is simply a matter of degree; the former has been relatively more successful in coordination than the latter. In this sense, all countries are still developing.[11] This helps us

[11]Future archaeologists will surely find the way we organize our society, even in the most advanced one, very primitive relative to theirs, just as we find the organization of the Roman Empire very primitive relative to ours.

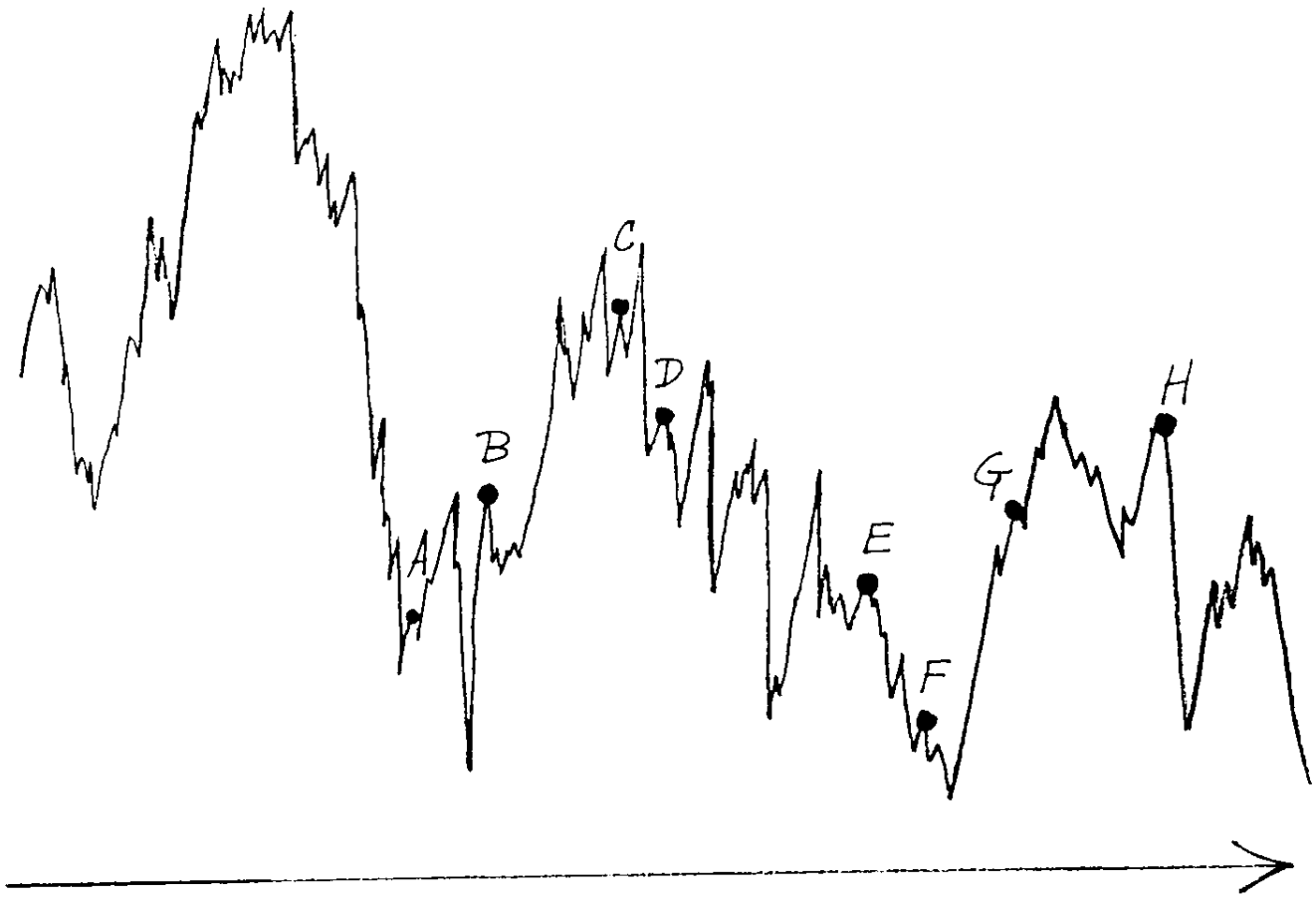

Figure 2

understand why it is so difficult to find empirically any systematic relation between the growth performance of the economies and their initial levels of development.

Figure 2 also implies that, even after one controls for the stages of economic development, there may be a great variety to the manners in which different economies cope with the coordination problem. This is a direct consequence of the prevalence of coordination failures; there is only one way of being perfect, but there are millions of ways of being imperfect. This helps us to understand large systemic differences across national economies, in financial markets, in labor markets, as well as in the organization of industry. For example, it has been pointed out that some of the human resource management practices, such as the seniority system, corporate union, lifetime employment, firm-specific on-the-job training, frequent rotations in job assignments, and bonus payment are far more prevalent in Japan than in the United States. The same can be said about the interfirm relationship, such as an extensive use of subcontractors and more bank-oriented corporate governance mechanisms. Recent advances in the comparative institutional analysis indicate that there are significant complementarities across these practices, which explain the relative homogeneity of practices adopted within each national economy and the variety of systemic attributes across national economies.[12]

Figure 2 tells us more than just the observed diversity of national economic systems. There may be even more diversity to potentially coherent economic systems; the very fact that we observe many variations of capitalism, say American, British, French, German, Japanese, Scandinavian, etc., indeed suggests that there may be more. Most of such viable systems have not been discovered, but a few of them may be accidentally discovered by some economies in the future. And such an evolutionary process of an economic system may be path-dependent; after some external shocks, an economy may experience fundamental structural changes, develop a new system, and never return

[12]See Aoki and Dore (1994) for a most assertive statement of this view.

to the original one. For example, an increasingly large number of historical studies show that the Japanese economy before the WWII was fundamentally similar in character to the Western European and American economies; much of the practices mentioned above, often viewed as uniquely and culturally Japanese, became widespread only after the WWII, and that their origins can be traced back to a variety of attempts by the government as well as by the private sector to secure access to critical supplies during the turbulent periods of wartime planning and of the postwar recovery: see Nakamura (1989) and Okazaki (1994).

One can also read many implications from the rugged nature of the graph in Figure 2. For example, combining two economic systems does not make a new coherent system. Due to the fundamental complementarity of a system, one cannot simply pick and choose different parts from different systems without sacrificing their effectiveness. The ruggedness is also highly suggestive of the sensitivity of an economic system, as a small shift of the graph can be shown to have a big effect on the performance. Not only the effectiveness of an economic system may be greatly undermined by small errors in selection of activities; it is also highly sensitive to the environment in which the system is applied. These properties of the complementarity all indicate the difficulty of adopting any system that has proved to be successful in other economies, and help us understand why an attempt to transplant foreign technologies or practices to underdeveloped economies often meets a disaster.

The economics of coordination failures is widely interpreted as a call for policy activism. But, the view of the world expressed above, and portrayed in Figure 2, suggests a more prudent approach. Because of the prevalence of coordination failures, it is not surprising to find some cases where government policies played an important role in improving the way we coordinate our economic activities. Of course, this does not mean the government knew how to improve coordination and to design a new system. Rather, it could have been that the disturbances created by the government had forced the private agents to come up with and experiment a new way of conducting their

businesses, and as a result, they happened to discover a better system. For example, one may be able to point out with the benefit of hindsight that many policies taken by the Japanese government during the WWII turned out to be critical in the evolution of the postwar Japanese economic system. Yet, it is clear that these policies were adopted as a part of the war efforts, not as a part of any grand design to rebuild the postwar Japanese economy. It was what Aoki (this volume) calls "Unintended Fit." Going back to one of the earlier metaphors, imagine that for travelling between the two locations in a maze, people have been using a particular route, meandering and yet the quickest among the routes known to them. If somebody builds a wall along this route, they are forced to try alternatives, and may very well end up discovering a short cut. Does this mean we should build another wall? Of course not.

Even if one can establish, as convincingly as Okazaki's study (this volume) on the post WWII Japan and Rodrik's study (1994) on Korea and Taiwan, that government policies sometimes appear to have succeeded in coordination in an intended way, it does not follow that the government was essential in achieving coordination in such instances. The private initiatives could have achieved the same, or even better, results.[13] Furthermore, the sensitive dependence of a solution to the specific nature of the coordination problem raises the question of the replicability. Each industry, each region, each country is unique in its own way. Without detailed knowledge of the environment, the effects of policy interventions are extremely difficult to predict, and even small differences in the environment, or small errors in designing policy packages, can render the policy ineffective. In the worst case, such a policy mistake could lead to a major disaster by undermining the entire system.

The very diversity of the manners in which different developed economies cope with

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[13]Okazaki's study stresses the role of government councils in facilitating coordination between shipbuilding and steel industries. But, one can also point out a story of Eiichi Shibusawa, a private entrepreneur, who achieved to coordinate between cotton textile and ocean shipping industries in Meiji Japan.

coordination also imposes a problem for underdeveloped economies if they try to learn from the experiences of more successful economies. They cannot pick and choose different parts from different systems, because of the complementarity inherent in any system. They somehow need to decide from whom to learn. In the context of transition from the communist regime in Central and Eastern Europe, there is an ongoing debate, concerning the choice of a corporate governance mechanism, whether it should be based on the Anglo-American system, which relies heavily on the stock market, or on the French-German-Japanese system, where banks play more significant roles. No doubt that we can gain many insights from the debate, but it is unlikely that any consensus could ever be reached in time on what to do about, say, the financial system of Lithuania.

Even if we could decide which system to adopt among all the systems currently known, and then replicate the system completely, it is not at all clear whether this is a desirable thing to do. If the view of the world portrayed in Figure 2 is correct, even the most developed economies fail in coordination. All the systems the human society has developed constitute a very small subset of all the potentially coherent systems, many of which would perform much better. The very attempt to replicate the best known system, if successful, would lead to a more uniformity, thereby reducing the possibility that some economies accidentally discover a new, and better system. This point is illustrated in Figure 2, where an economy sitting at A performs more poorly than others, and yet this economy has better chance of discovering a new system, which could be far better than any existing system, than other economies.

This is the most fundamental paradox of the coordination problem. Any conscious effort to coordinate a certain set of activities would pose the greatest danger of interfering with our attempt to discover an even better way of coordination, particularly when the effort has succeeded. More generally, this is the critical trade-off that the human being, not being omniscient, has to face in our quest for better knowledge; the dissemination of knowledge leads to a uniformity in our thinking,

which hinders the creation of new knowledge. When the World Bank sponsors an interdisciplinary forum like this, inviting scholars from many different fields, it gives us a great opportunity to exchange our ideas, and may enrich our understanding of the real world. But if an attempt to reach a consensus has any effect of making us all think alike, such exchanges of ideas would impede the creation of new and possibly better ideas. Similarly, we may miss the great chance of discovering a new economic system, when a group of economists visits some developing economies or former communist countries, and try to "educate" --or "indoctrinate" if you prefer-- them how to conduct their businesses, and if they were effective in doing so.

And this seems to be the most important case against a collective approach to coordination problems; the virtue of keeping diversity in coping with uncertainty.[14] Admittedly, the coercive power of the state is useful if it is easy to figure out what should be done, so that coordination failures are caused solely by the inability of the private agents to move in harmony. Very few people deny that the government can play a critical role in establishing and enforcing standards of measurement, traffic rules, property rights, etc.[15] But, the sources of coordination failures in

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[14]One may wonder why the diversity in national economic systems can be of any use if you cannot, or should not, replicate the successful experiences of others. At least two reasons may be given. First, an example of others can give you a starting point for a new search: you can learn a lot from your own failure of replicating the successes of others. So, you may want to try replicating others experimentally, even if you don't want to replicate them completely. Second, observing successes of others make you aware that you may not be doing as well as you could, which help to inspire a search for better alternatives. For major innovations to organizations tend to occur only after the current system has become demonstrably inferior to others, as the military history amply illustrates: McNeill (1983).

[15]It is worth pointing out another important feature of coordination problems that makes the government better suited than private agents in solving them. For certain cases, even a small degree of noncompliance can greatly undermine the effectiveness of a coordination mechanism. We feel safe to cross intersections with green lights, because we are confident that nearly everyone agrees that "green" means "go" and "red" means "stop." We would not feel safe if we suspected that even 1% of the population might not know the traffic rule. In such a case, the government's enforcement is effective in achieving coordination by making compliance almost universal. The same argument could be made to justify government-led coordination in defense against external attacks and in rescue operations after disasters. The argument may even be extended to support other coordination roles

economic development are more likely to come from the difficulties of finding out, or reaching any agreement on, what ought to be done and which activities should be coordinated. Precisely because of its coercive power, government-led coordination limits the diversity and experimentation, which reduces the chance that society continues to discover a better coordination.

Economic development is an eternal process of innovation, in which economies make progress as they discover a better combination of activities, or a better system of coordination. The discovery of any new system, by its nature, cannot be designed nor even anticipated; all we can do is to design a better search mechanism, or discovery procedure. But an attempt to write down such a procedure itself has the danger of conditioning us into certain prescribed patterns of thinking, with stifling effects on innovation. And nothing can be more dangerous than an attempt to design such a mechanism in a collective way, and to put into the straightjacket of a bureaucratic framework, as any attempts to organize, categorize, and even classify search efforts would restrict the directions of search, and slow down the pace of innovations. Indeed, any major innovation, by its nature, inevitably cuts across any existing categories; as we know, any industry or job classification, designed by government bureaucrats, can get quickly outdated in a fast growing economy.

Going back to the problem of finding a quicker route in a maze, imagine that we can build a robot and program a particular search algorithm. There is good chance we can continuously come up with short-cuts if we endlessly build new robots, each given a new algorithm, and let them search. But any single robot, sooner or later, will get trapped into the blind alley and stop discovering a short-cut, no matter how sophisticated its algorithm is.

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of the government, such as establishing and maintaining standards of measurement, judicial systems, or even monetary systems (mainly through its certification activities like coinage). However, much of coordination problems discussed in the economic development literature does not have this feature.

5. Concluding Remarks.

The economics of coordination failures argues that coordination failures are everywhere; they are so pervasive that we can always find room for improvement, and that it is therefore important to encourage coordination experiments. The economics of coordination failures does not argue that such an experiment has to be conducted from above (i.e., the government); a better coordination can, and is more likely to, come from below (i.e., the private sector) by means of innovations. After all, Toyota Motors has improved productivity by introducing a new way of coordinating its subcontractors, and many developers have succeeded in capitalizing on complementarities across firms and shops by means of industrial parks and shopping malls. An attempt to coordinate from above, while effective in enforcing a particular coordination mechanism, would inevitably restrict such coordination experiments from below, and make it difficult to achieve sustainable improvement in coordination.

The logic of coordination failure does not justify policy activism, any greater role of the government in coordination. However, the argument presented above should not be viewed as a case for a smaller government, either. After all, the prevalence of coordination failures suggests the importance of coordination experiments; there should also be experiments in centralized allocation mechanisms, *as long as such centralization experiments are done in a decentralized way*. The free enterprise system can be viewed as one way of encouraging such experiments, where new methods of centralized coordination are tested within independent enterprises. Likewise, it could be argued that the government in each regional, or even national, economy should be allowed to pursue experiments in its roles of coordination.[16] If no economy has succeeded, as I have argued, in coming even close to the discovery of the ideal economic system, then such experiments, by creating

[16]Montinola, Qian and Weingast (1994) and Qian and Weingast (this volume), argue that the key for understanding recent economic success in China, where, unlike former communist countries in Eastern Europe, political freedom of individuals are still suppressed, is the greater autonomy of local governments, "Federalism, Chinese Style," which leads to more experimentation by local authorities.

and maintaining the diversity of economic systems, are valuable for discovering better systems. It is thus essential to maintain the political autonomy in which each economy has the freedom to experiment a new economic system. This is indeed a familiar theme in the writings of economic history. Great mercantile expansions in the Mediterranean, as Hicks (1969) points out, were associated with a system of city states, with their political autonomy. Many historians who ask why Western Europe became the first region in the world to industrialize, most notably Jones (1981) and Rosenberg and Birdzell (1986), attribute the "Rise of the West" to its political fragmentation. As Eric Jones (1981, p.124) argued, "The multi-cell system possessed a built-in ability to replace its local losses ... and was more than the sum of its parts." From this point of view, advocating "levelling playing fields" is misplaced and can be counterproductive, if it means that the organization of society, including its business relations as well the public policies regulating them, should be everywhere alike, as in the American public rhetoric usually means, even when the intention is to reduce restrictive practices by foreign governments.[17]

At the same time, any example of successful government interventions in coordination, even when they are convincingly demonstrated, should not be interpreted that other governments should intervene in the same way. According to the logic of coordination failures, as I have been trying to explain, it is not surprising that many such examples can be found, and yet they are extremely difficult to replicate. Instead, such an example, or rather the abundance of such examples, should be interpreted as evidence that we are far from having discovered the ideal mechanism, that there are still plenty of room for improvement, that another coordination experiment has succeeded, and hence

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[17]Mokyr(1992), in his 1990 Davidson Lecture, argues that "pluralism, diversity , and openness to foreign influences are almost always important elements in technological creativity. If different societies follow divergent technological paths, it will always be possible to follow the one that turns out to be the most successful." and "From this point of view the breaking up of the Soviet Union may be good news, where as the proposed European unification of 1992 may have unexpected long-term negative consequences."

it is important to encourage further experiments.

Recently, an increasingly large number of work has attempted to look at the experiences of the Japanese economy from new perspectives. The older literature, with its neoclassical perspective, tended to portray Japanese business organizations and practices as signs of the backwardness, destined to fade away as the Japanese economy develops. The new literature, exemplified by Aoki (1988), Komiya, Okuno, and Suzumura (1988), Teranishi and Kosai (1993), Aoki and Dore (1994), and Aoki, Patrick, and Sheard (1994), tries to understand the logic, or the internal consistency, of the Japanese economic system. In my view, these studies are important, not because they demonstrate that the Japanese version of capitalism may offer a better role model for developing and transforming economies than the American version of capitalism (as argued by some, but not all, of these authors), but because they keep reminding us that the American system is not the sole model of capitalism. After all, the success of capitalism depends not so much on a particular set of institutions, as on its ability to maintain the environment that encourages open experimentation, by preserving the freedom to form new institutions, and letting the existing institutions to be constantly replaced by those more successful. Likewise, the papers presented at this conference, many of which offer interesting case studies of rapidly growing economies in East Asia, are useful, not because they suggest the birth of a "New Asian Paradigm," but rather because they demonstrate the enormous diversity in which different societies deal with the organization of their economies. And the diversity, just like the freedom to pursue something new, is essential for generating sustainable economic progress.

Appendix.

To understand the inherent difficulty of coordination problems in the presence of complementary activities, let us consider the following example.

There are one final consumption good, and one type of the primary source, whose total supply is given by L. Let us call it labor. There are three activities: 1, 2, and 3. Activity 1 transforms c_1 units of labor into one unit of the consumption good. Activity 2 transforms c_2 units of labor into one unit of an intermediate good, which itself has no consumption value. Activity 3 transforms one unit of the intermediate goods into one unit of the consumption good by using c_3 units of labor. Figure A.1. represents the structure of this economy. Note that this economy can choose between two alternative systems, or two alternative routes from S to F. The first system, $X = \{1\}$, uses Activity 1 only, while the other, $Y = \{2,3\}$, uses the complementary activities, 2 and 3. The optimal allocation can be defined as the solution to the following optimization problem: Choose $z_1 , z_2 , z_3 \geq 0$, to maximize,

$$U \equiv z_1 + \text{Min } \{ z_2 , z_3\}, \text{ s.t. } c_1z_1 + c_2z_2 + c_3z_3 \leq L.$$

It is easy to see that, if $c_1 \leq c_2 + c_3$, the solution is $z_1 = L/c_1$, $z_2 = z_3 = 0$, hence $X = \{1\}$ is the efficient economic system. If $c_1 \geq c_2 + c_3$, then $Y = \{2,3\}$ is the efficient economic system. Our question is whether the agents living in this environment, which of course include the government, can discover the efficient economic system.

The standard neoclassical theory argues that they can solve this problem by making use of the price mechanism. All they have to do is to appoint an auctioneer and let him quote the prices and adjust them until the equilibrium prices are found. Taking labor as numeraire, the auctioneer publicly quotes a price vector, (p_1, p_2, p_3). Then, there is a positive demand for 2 and 3 if and only if $p_1 \geq$

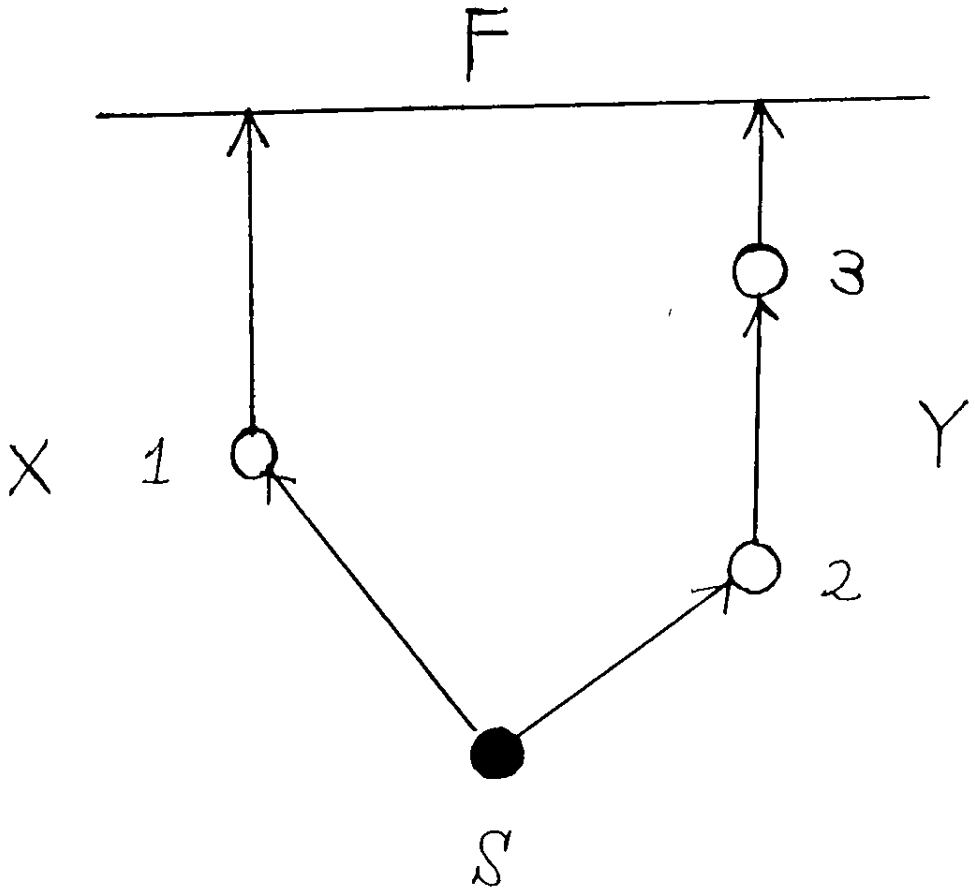
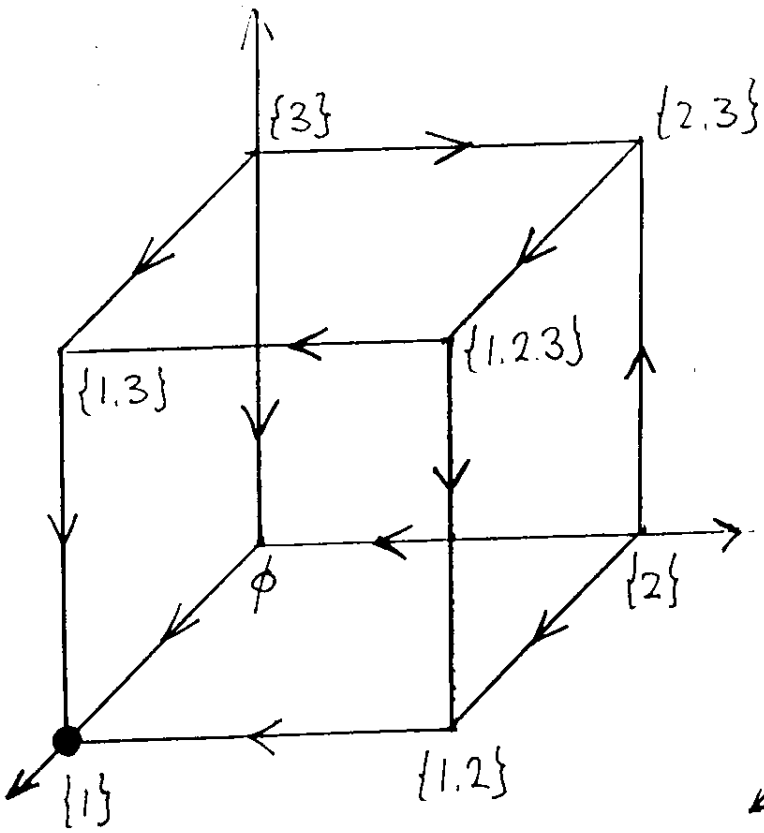


Figure A.1

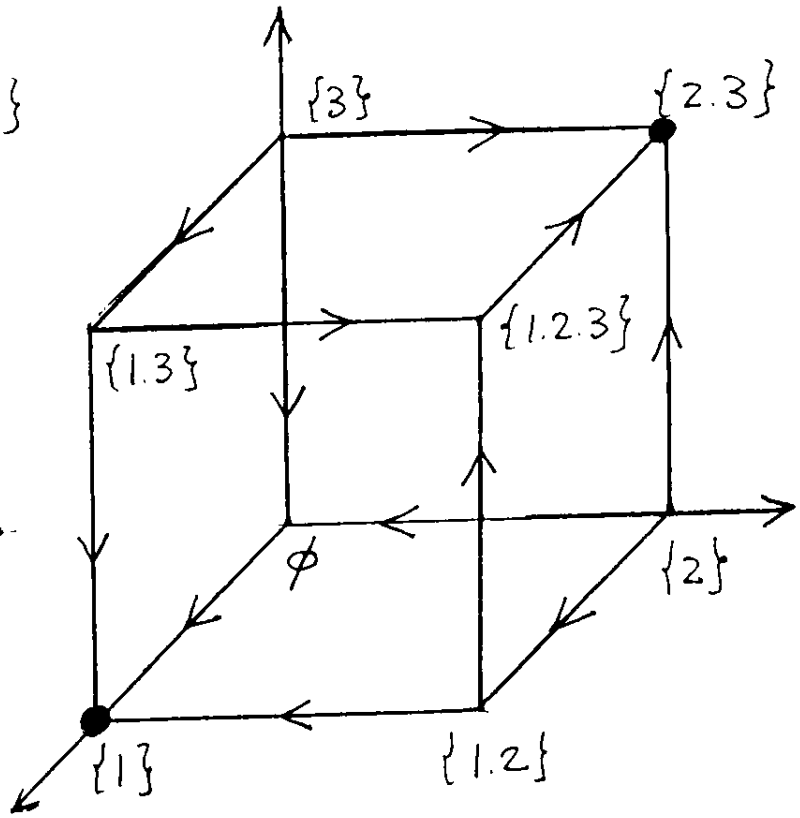
$p_2 + p_3$, and the agents who have access to Activity j are willing to perform it, if and only if $p_j \geq c_j$. Thus, Y is adopted in equilibrium if and only if the equilibrium price vector satisfies $p_1 \geq p_2 + p_3$, $p_1 \leq c_1$, $p_2 \geq c_2$, and $p_3 \geq c_3$. It is easy to check that this occurs if and only if $c_1 \geq c_2 + c_3$; that is, Y is adopted if and only if it is the efficient system. The price mechanism hence can help the economy discover the efficient system.

The trouble with this approach is that it assumes the existence of the market for all three activities. One cannot defend this assumption by saying that the government, or any other agent living in this environment, can design the complete system of markets, as that would assume the significant amount of objective knowledge on the part of the designer. In particular, it assumes that the designer of the system of the markets already know in advance that Figure A.1 represents the true structure of the economy, and hence the three activities are only potential activities in this economy. To put it another way, the neoclassical theory is not a theory of market formations, but rather a theory of market prices under the assumed existence of markets.

To see whether there is any tendency for the efficient system of markets to develop, suppose that there is a small cost of keeping an open market for any activity, and the government sequentially experiments a new system of markets, by adding one market to the set of the existing markets or by dropping one market from it. Figure A.2. illustrates such a search process. With three activities, there are 2^3 = eight possible market systems, represented by eight vertices of the unit cube. The government can search only along the edges of the cube. (Note that each vertex is connected to three others, which means that, from any system of markets, the government can experiment three alternative systems; it can either add a market that does not exist, or drop a market that exists.) Arrows represent the direction of increasing efficiency. For example, suppose that, initially, only the market for Activity 1 exists, {1}, and the government experiments setting up the market for Activity 2, {1,2}. Then, for any price vector (p_1, p_2), demand for Activity 2 is equal to zero, and the



$c_1 < c_2 + c_3$



$c_1 > c_2 + c_3$

Figure A.2.

government shuts down the market for 2. Similarly, the government does not see any need for the market for Activity 3.

If $c_1 \leq c_2 + c_3$, the case shown in the left, $X = \{1\}$ is the efficient system and having only the market for 1 open is optimal, and this search process can find it, no matter where the search begins. On the other hand, if $c_1 \geq c_2 + c_3$, the case shown in the right, there are two local optima, $X = \{1\}$ and $Y = \{2,3\}$, of which Y is the efficient system. But the search process may choose system X instead. For example, if the search begins from the origin, $\varnothing$, the state in which there is no market, Y cannot be found. In order to discover the efficient system, one needs to coordinate setting up the two markets simultaneously. This example also suggests that the discovery of a sophisticated system may be stalled by the discovery of a less sophisticated one, where the sophistication can be measured by the number of activities involved.

Here's a slightly more complicated example. There are four activities, and $2^4 = 16$ possible market systems. The unit cost of Activity i, measured in labor unit is c_i, and the value of these activities is given by $U(z_1,z_2,z_3,z_4)$, where z_i is the scale of activity i. Suppose that this value function turns out to be

$$U(z_1,z_2,z_3,z_4) = (z_1z_2)^{1/2} + (z_3z_4)^{1/2} + 2(z_1z_2z_3z_4)^{1/4} .$$

In this case, the efficient system of markets is $\{1,2,3,4\}$. But, there are three more locally optimal systems, $\varnothing$, $\{1,2\}$, and $\{3,4\}$, as shown in Figure A.3, where 16 systems of markets are represented by the vertices of a four dimensional hypercube. Again, the government can search along the edges, which connect each vertex with four others.[18]

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[18]Matsuyama (1995) discusses in more detail the fundamental complexity of market formation problems. The examples presented there are indeed more subtle in that, unlike in the examples presented here, every activity is of some economic value even when used in isolation, and yet

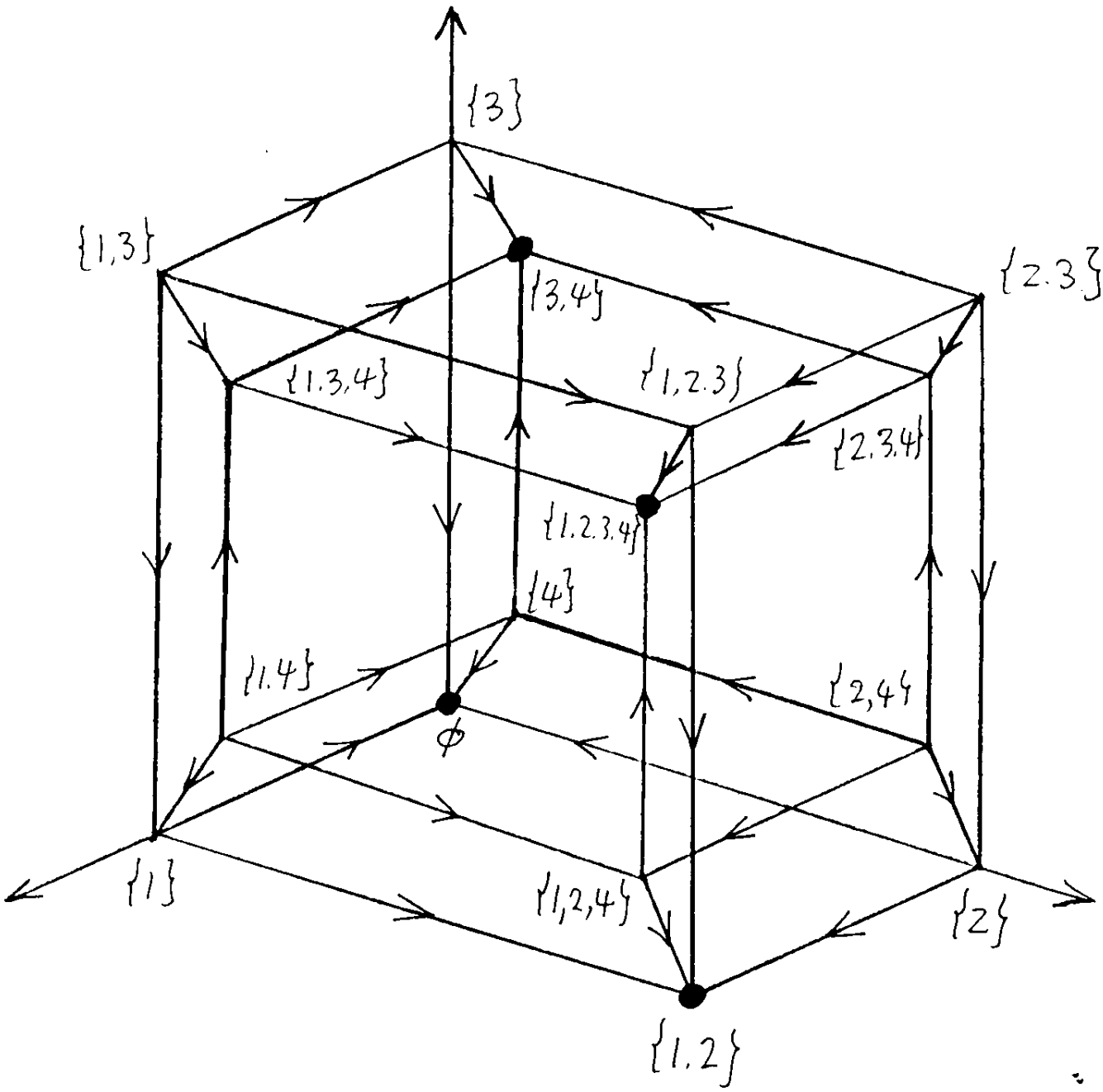

Figure A.3.

Even these examples grossly understate the complexity of the coordination problem of setting up a system of markets. As the number of activities get large, the number of systems of markets, as well as the number of locally optimal systems, grow exponentially. Imagine that, every year, we can conceive and may add only 60 (a very small number!) new activities to the list of millions of activities we are already engaged in. Even if these new, potential activities do not affect the values of the existing activities (a very unrealistic assumption!), we would still have to check all the combination of the 60 activities in order to discover the optimal set of new activities. But, this would mean that, even if we could check the performance of each combination every second, we need 2^{60} seconds, that is, more than 10 billion years, about the age of our universe. This simple calculation suggests the inadequacy of any coordination mechanism, including the price mechanism, and the prevalence of coordination failures.

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complementarities across activities arise through general equilibrium interactions.

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