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New Goods, Market Formations, and Pitfalls of System Design

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Abstract

The standard practice in economic theory is to assume that all the relevant variables (e.g., the space of all the goods of potential economic value) and all the relevant constraints are known to the policymaker or to the designer of an economic system. This often unstated assumption (or the belief implicitly embodied in it) inadvertently creates an illusion about our ability to design an economic system and control the process of resouce allocation. In this paper, a series of examples is developed to illustrate that this modelling approach has the danger of misdirecting our attention when evaluating alternative forms of economic system. Some implications for reforms in the former socialist economies are also drawn.

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1. Introduction.

Economies grow and our standards of living rise not so much because we are becoming better at doing the same set of activities, but because we continuously develop new activities to the list of those we are already engaged in. Economic progress is also a process of structural change; productivity growth is achieved through the evolution of a highly complex system of activities, generally associated with an ever greater indirectness in the production process and an ever increasing degree of division of labor. The development of such a complex system requires a high degree of coordination among the diverse set of activities, performed by a diverse set of agents, each of whom possesses the unique knowledge and technical expertise. The problem of how to facilitate such a coordination should be central to any discussion in comparative economic system and to any debate concerning the reform processes in the former socialist economies.

It should be emphasized that the problem is not merely of coordinating day-to-day operations of a fixed set of activities. Since there are innumerably many products and services, any economic system inevitably has to choose the range of activities that are actually introduced. One major dimension of the coordination 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 a continuous process of adding a new set of activities, while dropping others.

This is one of the critical dimensions along which the socialist experiment has failed. Most economists now agree that the failure of the Soviet-type economies is in no small measure due to their inability to sustain innovation. This is not to deny that the government bureaucracy can sometimes direct R&D activities, as demonstrated by the major achievement of the Soviet Union and China in certain areas of military-related research. When there is a well-defined goal, such as building a nuclear bomb, the central authority could collect and process the information necessary

to mobilize resources and direct them in an effective way. But the information necessary for introducing thousands of new products and services every year, the kind of incremental innovations essential for increasing labor productivity and improving quality of life, is widely dispersed in a society and cannot be made available to the central planning authority. Indeed, it is logically inconsistent to think that the central authority can anticipate and plan on collecting the information about genuinely new products and services that most people, including the authority, are even unaware of. It is here that Hayek's (1945,1974) criticism of central planning --in any deliberate organization, only the knowledge of the planner can enter the design of an organization--becomes most relevant. The success of free market economies in promoting innovations, on the other hand, can be attributed to the fact that many new ideas can be tested in a decentralized way, and markets for new products and services are created, not as an outcome of any deliberate human design, but as an outcome of an evolutionary process, or that of a spontaneous order, to use Hayek's terminology.

The standard approach in economic theory, which assumes that the list of all activities that are conceivably useful is already known to the designer of an economic system, cannot properly deal with this aspect of decentralization.[1] In the standard approach, the model is assumed to be a complete description of the environment, including all the relevant variables and all the relevant constraints. Then, the equilibrium allocation of resources is computed. If the equilibrium allocation is shown to be inefficient, policy measures are proposed to remove the inefficiency. In some cases, the optimal allocation is computed directly and implementation mechanisms are proposed.[2] Any

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[1]Indeed, its inability to address this aspect of decentralization lead to a change in the meaning of the word; in the standard approach, "decentralization" has become synonymous with "incentive compatibility."

[2]The most advanced form of this approach is the theory of Bayesian implementation in the mechanism design literature, in which the designer knows the true game form, including the information structure with a common prior, and implements allocation in a Bayesian-Nash equilibrium, after taking into account all the incentive compatibility constraints.

policy proposal based on this mode of analysis is misleading, as it relies on the implicit and unjustifiable assumption that we know (or at least we can eventually obtain) a correct description of the world we live in.

The point is not simply that policy proposals based on a misspecified model can do more harm than good. Such an interpretation, by attributing any policy failure to the problem of a particular model, would only encourage a mere repetition of the same approach. That is, a "new and improved" model, which incorporates previously overlooked variables and constraints, is constructed and used to formulate new policy proposals under the assumption that the revised model represents a complete description of the environment.

The point is rather that the correctly specified model of the world is unobtainable, and that we have to keep in mind that the main difficulty of designing economic systems is how to deal with our ignorance. What is at issue in the analysis of how the economy should organize itself is much more than implementing a solution to a complex constrained maximization problem. Given the complexity of the resource allocation problem, no economic system can be expected to achieve efficiency; upon any close examination, any system in place would reveal some degree of inefficiency. Hence, a mere demonstration of inefficiency does not warrant a case for reform, as the policy introduced to solve one problem is almost surely going to be the source of another.

Our ignorance seems nowhere greater than the economic values of potential activities, which can be, but have not been, brought into existence. In the rest of this paper, I attempt to show how the often unstated assumption of the standard approach, the assumption that the designer of an economic system knows the list of all the activities that are potentially useful, has the danger of misdirecting our attention when evaluating alternative forms of economic system. For this purpose, I use a series of models in which many new activities can be introduced into an economy. These activities are genuinely new in the sense that their very existence may be unknown to the economist,

the bureaucrat, or more generally the designer of a system, or even if they are known to exist, their values are unknown until they are introduced. Section 2 tells a story of an economist, whose failure to appreciate the possibility that many potential goods of economic value have not been brought into existence makes him easily preoccupied with the allocative distortions across the existing goods and convinced with the superiority of market socialism over monopoly capitalism. Section 3 shows that, even if the architect of market socialism is fully aware of the possibility, there is an inherent difficulty of setting up markets for them, due to the possibility of complementarity across new activities. Although my discussion mainly focuses on (a particular version of) market socialism, the logic can be equally applied to any deliberate attempt to design a centralized allocation mechanism. It is argued that decentralized mechanisms, while unable to achieve efficient allocation, can be expected to perform much better in searching for new activities, because they allow for more independent experimentation. Section 4 offers some concluding remarks, and draws some broader implications, particularly in the context of the problem of the former socialist countries in transition.

2. Monopoly Capitalism versus Market Socialism.

One reason for the intellectual appeal of socialism was that public ownership and the central planning were considered as the effective means of controlling large-scale industrial enterprises. Many believed that monopoly would become inevitable under private ownership, with increasing significance of technological economies of scale in modern industries. They never judged socialism against the competitive market system, the "ideal" that they believed could be found only in the writings by the classical economists, but rather against the "reality" of monopoly capitalism.[3] Indeed, the classical view of competitive markets did much to inspire Lange to develop his vision of market

[3]Even in the eighties, reform-minded communists were still concerned with the danger of freeing up prices in monopolistic settings. Their failure to initiate rapid price liberalization led to widespread shortage. Many Western economists also view monopoly as the major cost of immediate price liberalization; see, for example, Blanchard et. al. (1991).

socialism (Persky 1991). This section tells a story of an economist, whose failure to incorporate what he does not observe into his model, i.e., new goods, makes him preoccupied with the monopoly distortion and convinced of the superiority of market socialism over monopoly capitalism.

2.A. The Basic Model.

Consider an economy endowed with L units of the primary resource, labor, which is the only factor of production. There is a (huge) set of goods that can be potentially produced, denoted by Ω, and its element is indexed by i. Producing x_i units of i requires $h_i(x_i)$ units of labor. The set of goods that are currently "known" in this economy (i.e., their existence is a part of the public information), N, constitutes a very "small" finite subset of Ω. With some abuse of notations, I also use N to denote the cardinality of the set N. In this section, I further assume that there is a countable subset of Ω, Ω_0, such that $N \subset \Omega_0 \subset \Omega$ and $h_i(x_i) = h(x_i)$ for all $i \in \Omega_0$, where $h(x) = 0$ if $x = 0$ and $h(x) = f + ax$ if $x > 0$. That is, f represents the fixed cost and a the marginal labor requirement. For goods in $\Omega \backslash \Omega_0$, it is assumed $h_i(x_i) = \infty$. This is to say that Ω_0 represents the set of "feasible goods." The key assumption is that whether a particular good in $\Omega \backslash N$ belongs to $\Omega_0 \backslash N$ or to $\Omega \backslash \Omega_0$ is not a part of public information.

Agents in this economy share the identical homothetic preferences, the assumption that allows me to express aggregate consumption as the solution to the utility maximization problem of a single fictitious agent, called the representative agent. Preferences can be generally described by $U = U(\{c_i\}_{i \in \Omega}, H)$, where c_i denotes consumption of i ($c_i = 0$ for all $i \in \Omega \backslash N$), and H the amount of leisure. In this section, I adopt, for the sake of analytical convenience, a functional form with a strong symmetry across all elements in Ω. That is,

$$U = \alpha \log C + (1 - \alpha) \log H, \quad \alpha \in (0, 1), \tag{1}$$

where C is the quantity index of consumption, defined by

$$C = \left[\sum_{i \in \Omega} c_i^{\rho} \right]^{\frac{1}{\rho}} = \left[\sum_{i \in N} c_i^{\rho} \right]^{\frac{1}{\rho}}, \qquad \rho \in (0, 1) \quad . \tag{2}$$

Note $\rho > 0$ ensures that preferences are well-defined at $\{c_i\}_{i \in \Omega}$, all but a finite number of whose elements are equal to zero, while $\rho < 1$ ensures that preferences are strictly quasi-concave.

Let us first examine the performance of monopoly capitalism in this environment. Each good in N is produced by a single firm. Each firm, as a monopolist, sets its output price, p_i, to maximize its profit. However, its action has negligible impacts on the aggregate economy. (The set of all the known goods, N, although very small relative to Ω_0, is assumed to be large. Indeed, I assume that it is large enough that the integer constraints can be ignored in the following analysis.) In particular, each firm ignores any strategic interactions with other firms and acts as a price-taker in the labor market. It is well-known from the literature of monopolistic competition that, under the assumed specification, all monopolists set the same price, $p_i = p$; that they operate at the same scale (hence all goods in N are consumed by the same amount), $c_i = c = x = x_i$; and that the pricing rule is given by

$$p = \frac{aw}{\rho} \quad . \tag{3}$$

The representative agent spends α fraction of the total income on the goods in N and the rest on leisure, which implies

$$\frac{\alpha}{1-\alpha} = \frac{Npc}{wH} = \frac{pQ}{wH} = \frac{a}{\rho} \frac{Q}{H} \quad , \tag{4}$$

where $Q = Nc = Nx$ denotes the volume of consumption as well as the aggregate output of this economy. The resource constraint is described by

$$L = H + (ax + f) N = H + aQ + fN \quad . \tag{5}$$

This condition states that labor is used either in the home activity, H, in the manufacturing, aQ, or

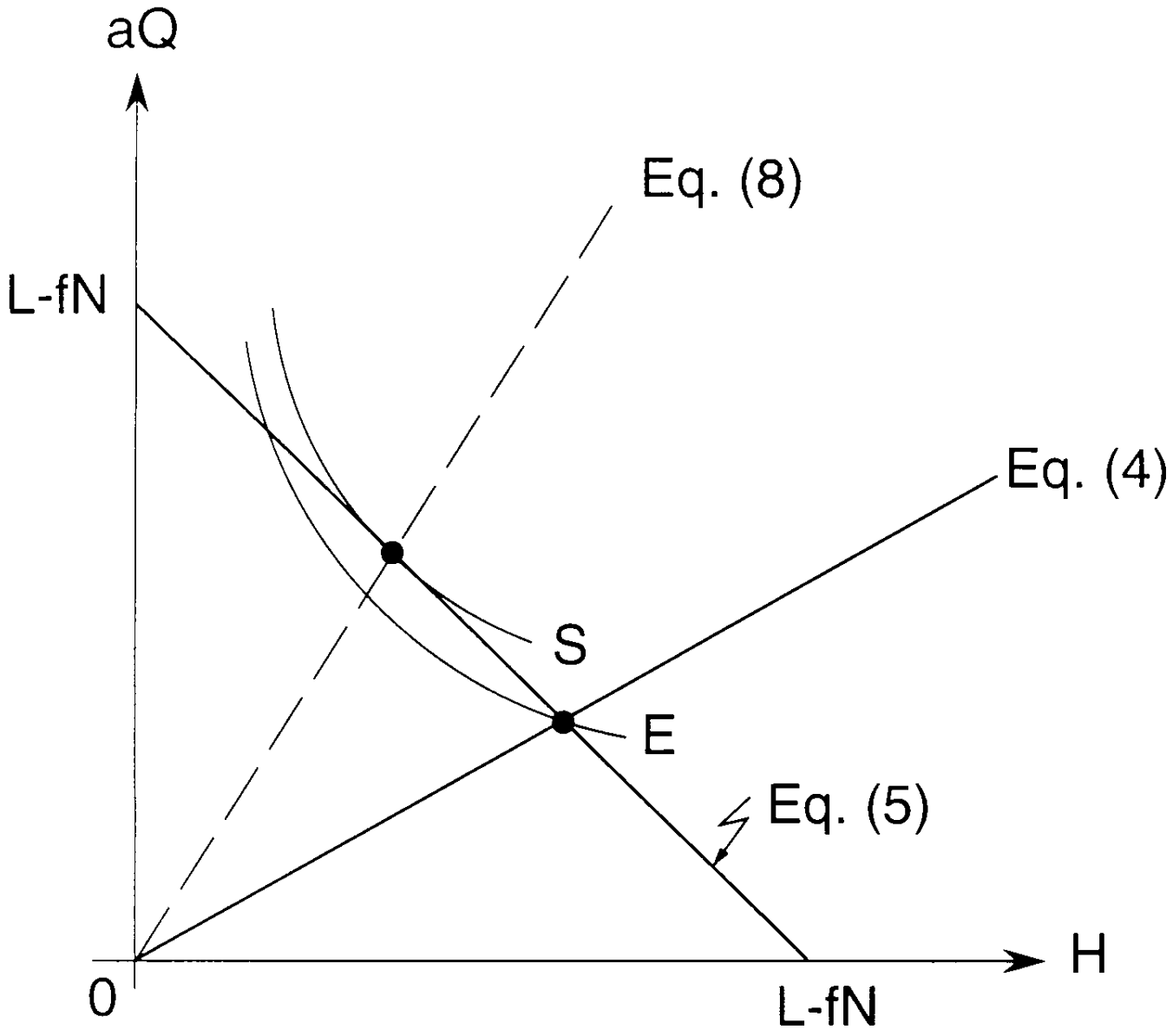

Figure 1

in the maintenance operation, fN. The equilibrium allocation under monopoly capitalism for a given N is the intersection of (4) and (5), depicted at E in Figure 1. The profit earned by each monopolist is

$$\frac{\pi}{w} = \frac{p}{w}x - (ax+f) = \left(\frac{1}{\rho}-1\right)\frac{aQ}{N} - f \ . \tag{6}$$

Finally, the welfare index of this economy can be obtained by rewriting preferences, given by (1)-(2), using $c_i = c$ and $Q = Nc$:

$$\begin{aligned} U &= \frac{\alpha}{\rho}\log N + \alpha \log c + (1-\alpha)\log H \\ &= \alpha\left(\frac{1}{\rho}-1\right)\log N + \alpha \log Q + (1-\alpha)\log H \ . \end{aligned} \tag{7}$$

With a fixed N, the iso-welfare map can also be drawn in Figure 1. According to this figure, the equilibrium allocation is not optimal under monopoly capitalism, due to the monopoly distortion. If all firms set their prices equal to the marginal cost, $p = aw$, then we would have, instead of (4)

$$\frac{\alpha}{1-\alpha} = \frac{pQ}{wH} = a\frac{Q}{H} \ , \tag{8}$$

so that the allocation would be now given at S, the intersection of (5) and (8), the optimal allocation with a fixed N. In equilibrium, the price is too high and the output of each good too low.

Now imagine that the economist living in this environment sets out to evaluate the performance of this economy. He writes down a model of monopoly capitalism, identical to the one shown above, with one exception. In his model, he assumes that there are only N goods, and fails to think of the possibility that the set of goods he observes in this economy, N, may constitute only a very small subset of all useful goods, Ω_0. Or, maybe, his scientific training makes him reluctant to model anything that are empirically unrefutable. Being a fine empiricist, he tests his model and found that all the evidence supports his model. (His data show no sign of goods in $\Omega_0 \backslash N$.) His welfare

analysis suggests that the problem of this economy can be entirely attributed to the monopoly power of the producers, or their attempts to restrict production and to raise prices. Confident in the accuracy of his model, he now sets out to formulate a blue-print for the economic reform, a way of eliminating the source of all the evils, the monopoly power, thereby achieving the optimal allocation, S. One possible option would be antitrust policies. However, he notes that splitting firms has obvious disadvantage in the presence of economies of scale. (Like many Stalinist economists, he believes in the industrial gigantism.) Having read Lange (1938), he proposes market socialism. According to his plan, each good is produced by a single firm to take advantage of economies of scale, and each firm is supervised by a ministry, responsible for setting the price of the good equal to the marginal cost and monitoring the firm. The price adjustment by N ministries is coordinated by the central authority, which assumes the role of the Walrasian auctioneer. The economist simulates his proposal in his model and demonstrates that the economy can achieve the optimal allocation, S, if his proposal is adopted. Alternatively, he could simply point to the proof of the first fundamental theorem of welfare economics in Debreu (1959) and comment that the theorem does not rule out the nonconvexity of the production set. Once his proposal has been implemented, the economy moves from E to S; the total output, Q, increases and the real wage, w/p, rises from ρ/a to $1/a$. Everything seems to be working perfectly.

Neither the economist nor the government that adopted his proposal realize one major drawback of his proposal; market socialism cannot easily accommodate the introduction of new goods. If someone in this economy stumbles upon the idea of a new product, there is no easy way of obtaining necessary resources. The potential innovator has to convince the central authority that some of the inputs should be diverted away from the existing firms at the cost of reducing their productivity. The establishing new firm may also require a reorganization of the entire planning mechanism. Thus, for a new good to be introduced, it does not suffice that someone is convinced

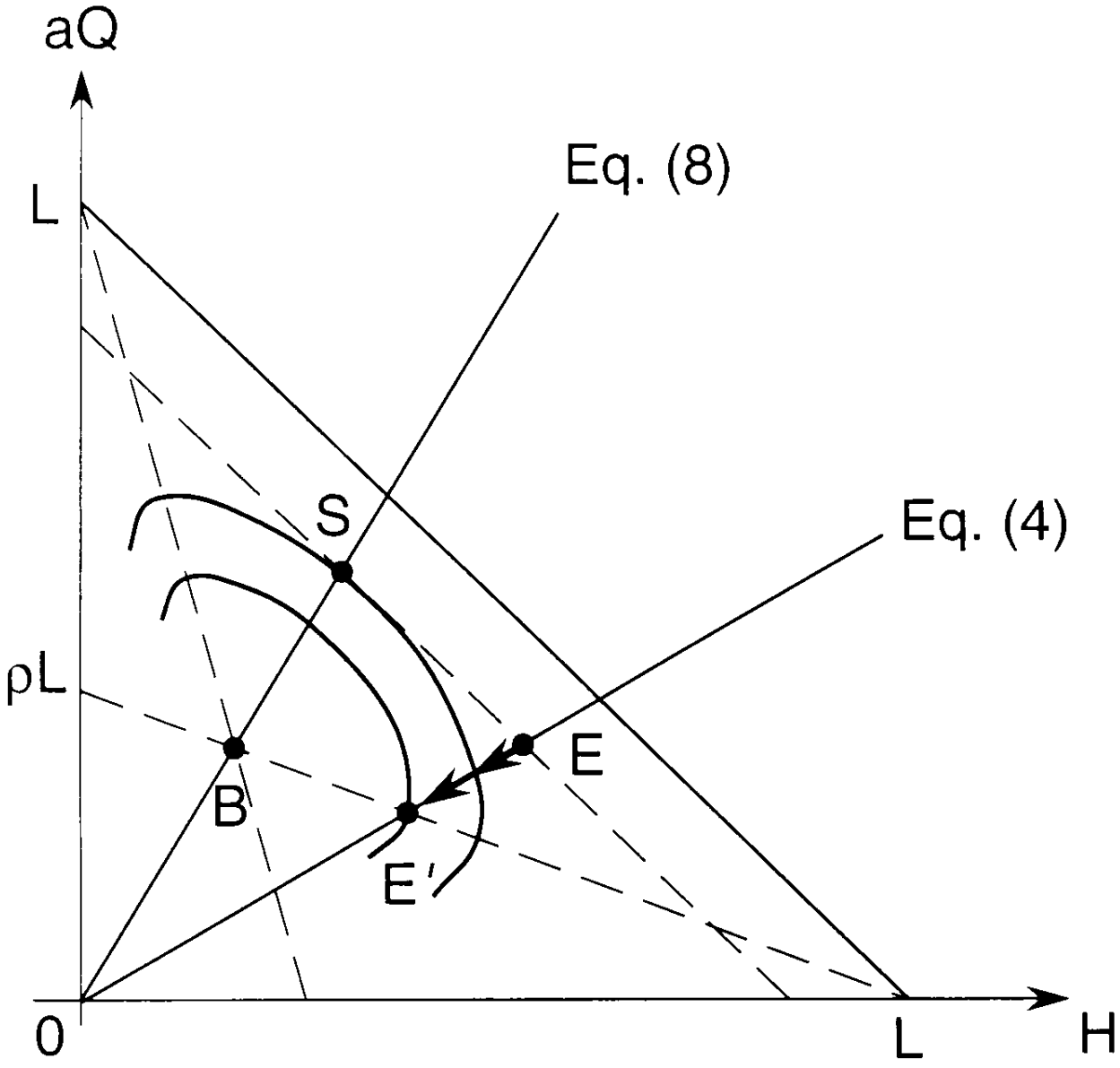

Figure 2

of the value of the good; the central authority also has to be convinced. But the innovator does not have a strong incentive to convince others, since he would not be rewarded by the profit the new good can make.

Figure 2 illustrates how much market socialism can lose from ignoring new goods. With a variable N, the resource allocation satisfying the constraint (5) can be anywhere inside the triangle. The welfare index is now given by, from (5) and (7),

$$U = \alpha\left(\frac{1}{\rho}-1\right)\log(L-aQ-H) + \alpha\log Q + (1-\alpha)\log H + const. \qquad (9)$$

The iso-welfare map is now given by a family of closed curves centered around the bliss point, B, depicted in Figure 2. Note that an iso-welfare curve is tangent to the resource constraint (or perceived as such by our market socialist) at S. Hence, market socialism, by shifting the resource allocation from E to S, may be optimal conditional on the belief that all economically useful goods have already introduced. But, such a belief may cost the economy a large welfare loss by ruling out the introduction of new goods. Indeed, the welfare gain from E to S is of the second-order magnitude, while potential losses associated with the failure of accommodating innovation is of the first order magnitude. The failure of taking into account this "critical dimension" in designing the socialist system can be very costly. Furthermore, their belief could become self-fulfilling. Market socialism, once implemented, discourages potential innovators so that neither the economist nor the central authority would ever realize that their belief that all the necessary goods have been introduced are wrong. They would not see anything wrong about their experiments, unless they observe that other economies seem to be performing better.

But suppose that there are other economies in the world, whose physical environment is described by the present model, and yet, not all of them have adopted market socialism; some stay under monopoly capitalism. In such economies, potential innovators, when they stumble upon the

idea of new goods, do not have to convince any authority, since nobody is in charge of allocating resources. They can simply hire labor, set up operations, and sell their goods, just as the current monopolists.[4] They also have an incentive to do so, as long as the profit is positive; that is, from (5) and (6), the condition for $\pi \geq 0$ is given by

$$aQ + \rho H \geq \rho L .$$

Hence, under monopoly capitalism, the economy can be expected to evolve from E toward E'. If the range of goods known in this economy at E is sufficiently small, then monopoly capitalism eventually outperforms market socialism.

Three points deserve emphasis here. First, the working of market socialism in this story is highly idealized. It does not intend to portray the way actual socialist economies had worked. Market socialism in practice was, of course, characterized by many kinds of problems not found in this story, such as rationing, the lack of managerial incentives, soft-budget constraints, etc. Some economists attempt to rejuvenate market socialism by addressing these problems: see, e.g., Bardhan and Roemer (1992). However, such a "new and improved" version of market socialism is also subject to the same problem. The point of the story is not to explain why market socialism failed in practice. Rather, any deliberate centralized allocation mechanism cannot sustain innovation, even if it worked exactly as intended, because the designer of a system cannot anticipate what is truly new, or what he

[4]If they lack in their own financial resources, potential innovators of course have to convince investors to finance their projects. Nevertheless, the difference between the difficulty of convincing a particular authority and that of convincing some investors would be huge. Furthermore, once succeeded in getting their projects financed, they cannot be prevented from bidding the resources away from the current monopolists.

is unaware of.[5]

Second, by demonstrating the possibility that monopoly capitalism eventually outperforms market socialism, this story is not meant to argue that monopoly capitalism is an ideal economic system and should be preserved as it is. The equilibrium allocation under monopoly capitalism is inefficient due to monopoly price distortions. Our hero/the economist was absolutely right on this point. His mistake is that he fails to anticipate that his solution for the existing inefficiency can be the source of another. This is not to say that he should not have proposed anything. But, if he had been aware of his ignorance about possible side effects, he could have proposed that a variety of alternative solutions be tested experimentally.

Third, according to this story, the failure of market socialism becomes apparent only because other economic systems perform better. If the entire world had adopted market socialism, there would be no evidence for the failure. New goods that are not introduced can be easily overlooked as the dog that did not bark. This suggests a virtue of maintaining diversity in economic systems, when there is significant amount of ignorance. Indeed, the failure of the communist bloc may be partially attributed to the lack of diversity within the bloc, which precludes experimentation. I will come back to this point later.

The above analysis will undoubtedly raise several objections. In what follows, I will try to offer counterarguments, anticipating some of these objections.[6] Before proceeding, however, let me briefly consider a kind of reverse thought experiment. Starting from S, what would happen if the

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[5]My criticism of market socialism is hence different from Shleifer and Vishny, who argue that any version of market socialism, including Bardhan and Roemer (1992), is unworkable because of the fundamental conflict between the government's objectives and the efficiency. See the exchange between Shleifer and Vishny (1994) and Bardhan and Roemer (1994).

[6]I should emphasize that I can anticipate only "some" objections. Just as it is impossible for the designer to anticipate "all" potential activities, it is impossible for me, being a human being, to anticipate "all" possible objections.

government decides to abandon market socialism, decentralizing its economy, and letting the firms set their prices? After the price liberalization, the economy jumps from S to E; the real wage falls, and the total output, Q, declines. The standard-of-living also declines. But, afterward, the economy evolves from E to E'. The profit motive leads to a formation of new businesses, and the introduction of new goods. As a result, the standard-of-living eventually rises. The total output continues to decline, but it should be reminded that the output is not a good measure of the standard-of-living, particularly when the range of goods produced in the economy can vary.[7] [8]

2.B. A Model with Unbounded Innovations.

One possible objection to the above analysis that market socialism can perform better than monopoly capitalism, once the process of innovation stops. In Figure 2, market socialism, if implemented after the economy reaches E', is welfare-improving; all we need to do is to wait until the innovation process peters out. One practical problem with this strategy is that there is no way of knowing when all possible innovations had been done. But, there is another problem; the process of innovation may never stop. Capitalist economies may never reach the stage of maturity in which no new goods would be added. Even casual empiricism suggests that there is no sign of slowdown in innovative activities, even in most advanced economies. In this section, I modify the basic model, so that the introduction of new goods never stops under monopoly capitalism.

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[7]This is roughly consistent with the experiences of East European countries during the initial phases of their transition processes. For example, Sachs (1993, ch.2) notes, for the case of Poland, a sharp fall of the real wage and the output, but a decline in employment in the old industries is offset by an increase in employment in the new sectors, where hundreds of thousands of businesses are formed. He also argues that the standard of living has risen during this period, despite the decline in the real wage, mainly due to improved access to a wide range of products in Poland.

[8]Indeed, the government can easily boost the total output and labor productivity, by reducing the number of goods produced, imposing the price control, and concentrating the resources in this model. This may give a partial explanation why the command economy seems to work better than the free market economy during the wartime if one simply looks at the aggregate data.

The only modification is in technology. As before, manufacturing x_i units of $i \in \Omega_0$ requires that ax_i units of labor, while the fixed cost now requires the use of goods, instead of labor. More specifically, operating a firm, regardless of the scale of operation, requires f units of the composite of goods, defined by

$$f = \left[\sum_{i \in \Omega} f_i^{\rho} \right]^{\frac{1}{\rho}} = \left[\sum_{i \in N} f_i^{\rho} \right]^{\frac{1}{\rho}}, \qquad \rho \in (0, 1) \tag{10}$$

where f_i represents the amount of i used in the maintenance operation. This specification implies that different goods are imperfect substitutes to one another. This in turn means that the fixed cost of a firm declines as the range of activities available in the economy gets larger. It is meant to capture in a simple way the idea that a new generation of computers helps scientists to design new products, the availability of specialized service activities helps the industrial firms operate more efficiently, etc.[9] This specification of technology thus introduces some positive feedback and the possibility of cumulative processes; an economy with a broader range of supporting industries can support more industries.[10]

Another feature of (10) is that the composite, f, has the same functional form with C, defined in (2). This implies that the firm's demand curve has the same price elasticity with the consumer demand. The pricing rule is hence unaffected and given by (3). As all goods have the same price, they are all consumed by the same amount, $c_i = c$, and each firm purchases $fN^{-1/\rho}$ units of each good as an input. Since there are N firms, the total investment demand for each good is given by $fN^{1-1/\rho}$, and its output satisfies

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[9]The small service sector, particularly in communication and distribution services, has been pointed out as one of the major causes of low productivity in the socialist economies, where many of these functions had to be carried out within the industrial firms and without the gains from specialization.

[10]This specification is one of many ways in which cumulative phenomena can be modelled in monopolistic competition. See Matsuyama (1995) for a survey.

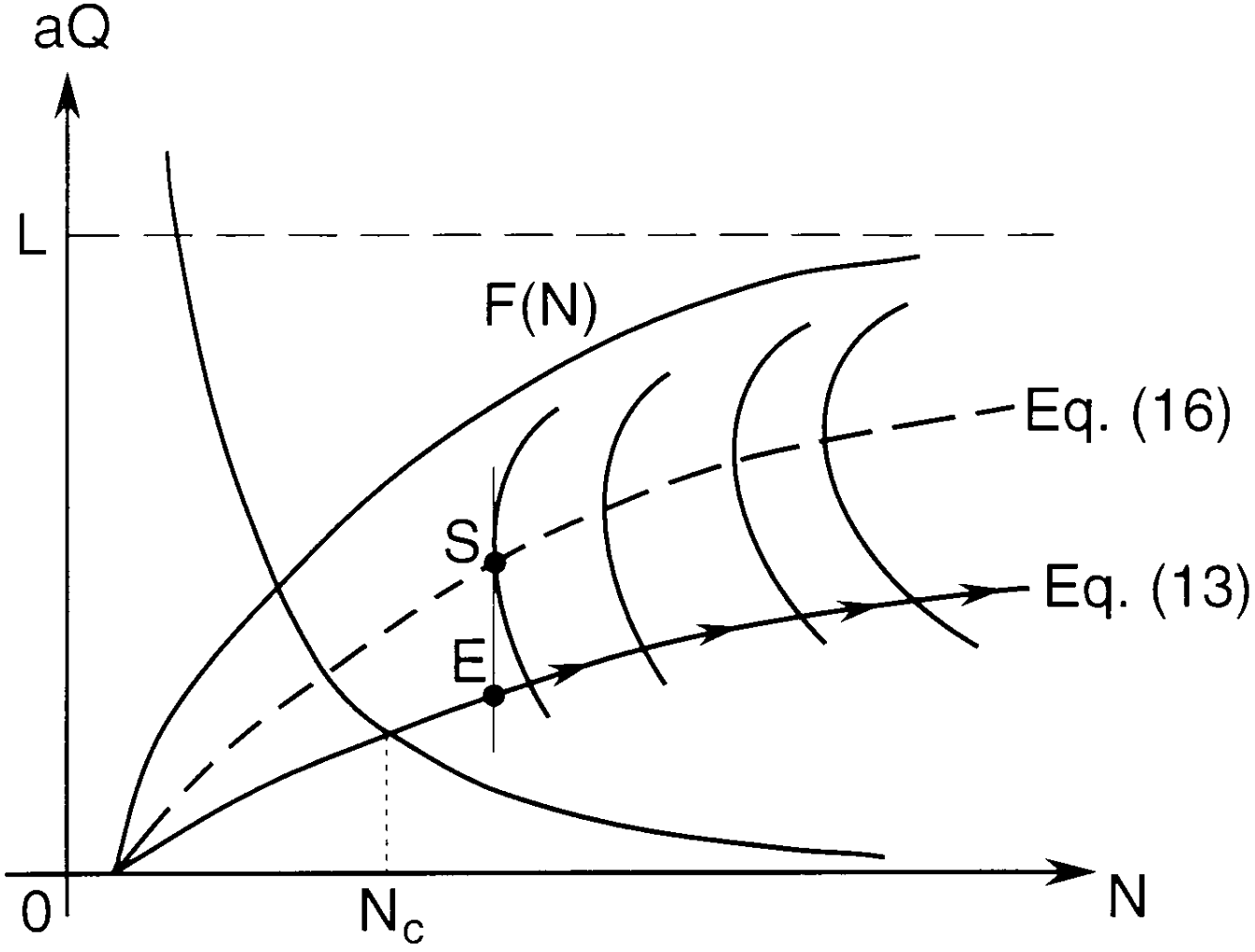

Figure 3

$$x = c + fN^{1-\frac{1}{\rho}} . \tag{11}$$

Since labor is now used only in the home activities or in the manufacturing, the resource constraint is now equal to L = H + Nax. Or using (11),

$$H + aQ = H + aNc = L - afN^{2-\frac{1}{\rho}} \equiv F(N) , \tag{12}$$

where Q = Nc is the volume of consumption (but no longer equal to the total output). From (4) and (12), the equilibrium value of Q under monopoly capitalism satisfies

$$aQ = \frac{\rho\alpha}{1-\alpha+\rho\alpha} F(N) , \tag{13}$$

and the profit earned by each monopolist is equal to

$$\frac{\pi}{w} = \frac{px - wax - NpfN^{-\frac{1}{\rho}}}{w} = \frac{a}{N}\left[\left(\frac{1}{\rho}-1\right)Q - fN^{2-\frac{1}{\rho}}\right] , \tag{14}$$

where use has been made of (3) and (11).

Figure 3 illustrates the case of $\rho < 1/2$, which implies F(N) is increasing in N. The equilibrium allocation under monopoly capitalism for a fixed N is depicted by point E in Figure 3. The iso-welfare map is also drawn in this figure, using

$$U = \alpha\left(\frac{1}{\rho}-1\right)\log N + \alpha \log Q + (1-\alpha)\log(F(N) - aQ) , \tag{15}$$

from (7) and (12). As before, this allocation is not optimal for a fixed N, due to the monopoly distortion; the optimal allocation is given by

$$aQ = \alpha F(N) . \tag{16}$$

The economist, if unaware of the possibility of new goods, may propose market socialism, which moves the economy from E to S. As a result, the total output, the volume of consumption, the real wage, the standard-of-living all go up, but at the cost of stifling innovative activities.

Under monopoly capitalism, on the other hand, new goods continue to be introduced as people stumble upon them, as long as the profit remains positive. From (14), this condition holds if

$$\left(\frac{\rho}{1-\rho}\right) a f N^{2-\frac{1}{\rho}} \leq aQ = \frac{\alpha}{\rho(1-\alpha)+\alpha} F(N) ,$$

or

$$N \geq N_c \equiv \left[\frac{\{\rho^2(1-\alpha)+\alpha\} af}{\alpha(1-\rho)L}\right]^{\frac{\rho}{1-2\rho}} .$$

Thus, if the economy already has a sufficiently wide range of goods produced at E, innovations can continue without bound.

According to this model, the economist's failure of taking into account the critical dimension, N, in his model turns out to be disastrous. After a short period of success, socialist economies fail to achieve any improvement in their standard-of-living.[11] On the other hand, capitalist economies can continue to increase their standard-of-living forever.[12] They continue to introduce new goods and never become mature enough to be ready for socialism.

3. The Fundamental Complexity of Market Formations.

Another possible objection to the above analysis is that the extreme form of bounded rationality--i.e., the economist is completely unaware of new goods--, is assumed. Even though he

[11]As pointed out by Sachs (1994), state-led industrialization programs in socialist countries often achieved a spectacular success in an early phrase, 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."

[12]In this model, the total output has to decline as N increases. This is because manufacturing activities do not benefit from new goods. At the cost of notations, however, the model can be modified so that the total output also rise without bound.

may be ignorant of potential values of goods yet to be introduced, he should be at least aware of his ignorance and can design his proposal of market socialism accordingly. In the previous models, for example, if the central authority had quoted the prices for all goods in Ω, not only for those in N, then the first fundamental theorem of welfare economics assures us the Pareto-efficiency of the equilibrium allocation under market socialism. All the government has to do is to set up a competitive market for each of all conceivable goods, both present and potential. Then, the price signal reveals the information necessary for determining which set of goods should be introduced, despite that the central authority has no knowledge of preferences and technologies.

A couple of responses can be made to this kind of objection. First, the central authority has no way of knowing whether it has the list of everything, as the knowledge concerning the technological feasibility of each activity is dispersely held in a society. Second, even if the authority had ever succeeded in constructing the list of everything, it would be impossible to open markets for all of them. Even with very small costs for establishing a market, so much of the economy's resources would be absorbed if there were markets for each of the billions of potential goods, and nothing would be left over to be used in producing these goods. Hence, we cannot avoid the problem of deciding for which combination of activities markets should be created. Somehow, out of the enormous set of possible new goods, a very small (relatively speaking!) number must be selected and introduced. The paradox is that we need to open all markets in order to collect necessary information to know which markets to open.

In the previous models, the failure to solve this selection problem would be insignificant, as all feasible goods, both present and potential, enter symmetrically. But, this assumption, made for the sake of analytical convenience, is not a realistic feature of the models. (Even if the symmetry assumption turned out to be true, it would be no use, unless the central authority knew it.) If we drop the symmetry assumption in the model of Section 2.A., the problem can be written in a general

form,

$$Max \;\; U\left(\{x_i\}_{i\in\Omega}, H\right) \qquad s.t. \quad \sum_{i\in\Omega} h_i(x_i) \le L ,$$

where the output can be positive only for a finite number of activities, due to an (arbitrarily small) cost of maintaining a market for each good. The question is then; can the architect of market socialism ever find out which markets to open and which ones to shut down without the knowledge of preferences and technologies? To put it differently, can he continuously discover a better combination of activities to be selected through the process of market formations? If preferences and technologies are such that the value of each new activity could be assessed independently, then one may hope that market socialism might achieve steady improvement by discovering valuable activities. With the possibility of complementarities across activities, however, this problem of market formations becomes so complex that any attempt to search for new activities can fail. Although any simple example inevitably runs the risk of trivializing the complexity of the problem, I hope that the following examples help to show "tips of the iceberg".

Example A:

Consider that there are four goods, i = 1, 2, 3, and 4, with $h_i(x_i) = a_i x_i$, and the value function is given by

$$U(x_1, x_2, x_3, x_4, H) = x_1 + \left[x_2^{\rho} + x_3^{\rho}\right]^{\frac{1}{\rho}} + H , \qquad \rho \in (0, 1) . \tag{17}$$

One interpretation would be that there is one consumption good, four intermediate goods, and three alternative systems of (constant returns to scale) production. The first system, Y = {1}, uses Good

1 only, while the second, Z = {2,3}, uses Goods, 2 and 3.[13] The third, ∅, simply converts one unit of labor into the consumption good, without any intermediate good. Good 4 is not used at all. In what follows, it is assumed, in order to avoid taxonomical analyses, that the cost parameters satisfy

$$a_1 < 1 < Min \{ a_2 , a_3 \} .$$

This is to say that Y = {1} is more efficient than ∅, which in turn is more efficient than {2} and {3}. Hence, either Y = {1} or Z = {2,3} is the efficient system of production.

The optimal allocation is given by the solution to the following optimization problem: Choose $x_1 , x_2 , x_3, x_4, H \geq 0$, to maximize

$$U = x_1 + \left[x_2^{\rho} + x_3^{\rho} \right]^{\frac{1}{\rho}} + H \quad s.t. \quad a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 + H \leq L .$$

It is easy to see that Y = {1} is the efficient system of production --i.e, it is optimal to allocate all the resource in Good 1: $x_1 = L/a_1$, $x_2 = x_3 = x_4 = H = 0$,--if

$$a_1 \leq \left[a_2^{\frac{\rho}{\rho-1}} + a_3^{\frac{\rho}{\rho-1}} \right]^{\frac{\rho-1}{\rho}} , \tag{18}$$

where the right hand side of the inequality can be interpreted as the unit production cost of Z = {2,3}, when both inputs, 2 and 3, are available at the marginal costs, measured in units of labor. On the other hand, Z = {2,3} is the efficient (i.e., $x_1 = x_4 = H = 0$), if

$$a_1 > \left[a_2^{\frac{\rho}{\rho-1}} + a_3^{\frac{\rho}{\rho-1}} \right]^{\frac{\rho-1}{\rho}} . \tag{19}$$

The question is whether the central authority can ever discover the efficient system of production.

The neoclassical theory of competitive markets, which did much to inspire market socialism, argues that the central authority can solve this problem by making use of the price mechanism. All

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[13]Since $\rho > 0$, it is feasible to produce the consumption good from Good 2 only, {2}, but it is always less efficient than Z = {2,3} when both Goods 2 and 3 are available. Similarly, {3} is a feasible system of production, but dominated by Z = {2,3}.

it has to do is to quote the prices and adjust them until the equilibrium prices are found. Taking labor as numeraire, the authority publicly quotes a price vector, (p_1, p_2, p_3, p_4). Then, the agents who have access to technology of producing Good j are willing to supply it, if and only if $p_j \geq a_j$, and there is a positive demand for 2 and 3 if and only if

$$Min \{ p_1 , 1 \} > \left[p_2^{\frac{\rho}{\rho-1}} + p_3^{\frac{\rho}{\rho-1}} \right]^{\frac{\rho-1}{\rho}} . \qquad (20)$$

Thus, Z is adopted in equilibrium if and only if the equilibrium price vector satisfies $p_1 \leq a_1$, $p_2 \geq a_2$, $p_3 \geq a_3$, and (20). It is easy to check that this occurs if and only if (19) holds; that is, when Z is the efficient system. Likewise, Y is adopted if and only if it is efficient. The price mechanism hence can help the central authority discover the efficient system.

The trouble with this approach is that it assumes the existence of the market for all four activities. One cannot defend this assumption by saying that the authority, or any other agent living in this environment, can design a complete system of markets, as that would assume the significant amount of objective knowledge. In particular, it assumes that the authority already knows in advance that the four activities are only potential activities in this economy. To put it another way, the neoclassical theory of competitive markets, is merely a theory of market prices under the assumed existence of markets, not a theory of market formations, hence incapable of offering any guide to the market socialist in designing of a system of markets.

To see whether market socialism can improve its performance by developing a system of markets for new goods, suppose that the central authority 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. Furthermore, assume that there is a cost of maintaining an open market for any good, f, which is

taken to be arbitrarily small.[14] For example, imagine that, initially, only the market for Good 1 exists, $Y = \{1\}$, and the government experiments setting up a market for Good 4, $\{1,4\}$. Then, for any price vector (p_1, p_4), demand for 4 is zero, and the government shuts down the market for 4. When the government experiments with a market for 2, it discovers that there is no trade of Good 2 in equilibrium (because $a_2 > 1 > a_1$), so that the government shuts down the market. Similarly, the government does not see any need for the market for 3. Thus, the process of search, if it starts at $Y = \{1\}$, does not reveal any need for forming markets for new goods. This does not imply any loss if $Y = \{1\}$ is the efficient system of production. However, when the cost parameters satisfy (19), the central authority fails to find out the efficient system, $Z = \{2,3\}$.

Figures 4 and 5 illustrate the global dynamics of the search process. With four goods, there are $2^4 = 16$ possible market systems, represented by the sixteen vertices of a four dimensional hypercube. The numbers in the bracket given at each vertex indicate the goods for which markets exist. The government can search only along the edges of the hypercube. (Note that each vertex is connected to four others, which means that, starting from any system of markets, the government can experiment four 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. In Figure 4, which shows the case of (18), $Y = \{1\}$ is the only optimum and the search process can lead to this optimal system of market no matter where the search begins.[15] On the other hand, in Figure 5, the case in which (19) holds, there are two local optima, $Y = \{1\}$ and $Z = \{2,3\}$, of which Z is the global optimum.

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[14]Alternatively, one could think of f as the fixed cost of production as in the previous section: $h_i(x_i) = f + a_i x_i$. The only reason why f is taken to be arbitrarily small is to keep the task of ranking different systems of markets simple. When the two systems of markets perform equally well, an arbitrary small f allows the system with a smaller number of open markets to be chosen, as the tie-breaking rule. One can go through the same exercise with any positive f, at the cost of algebra.

[15]Figure 4 is drawn with an additional assumption that $Z = \{2,3\}$ outperforms $\emptyset$, but the search dynamics remains qualitatively the same even if it is assumed that $\emptyset$ outperforms Z.

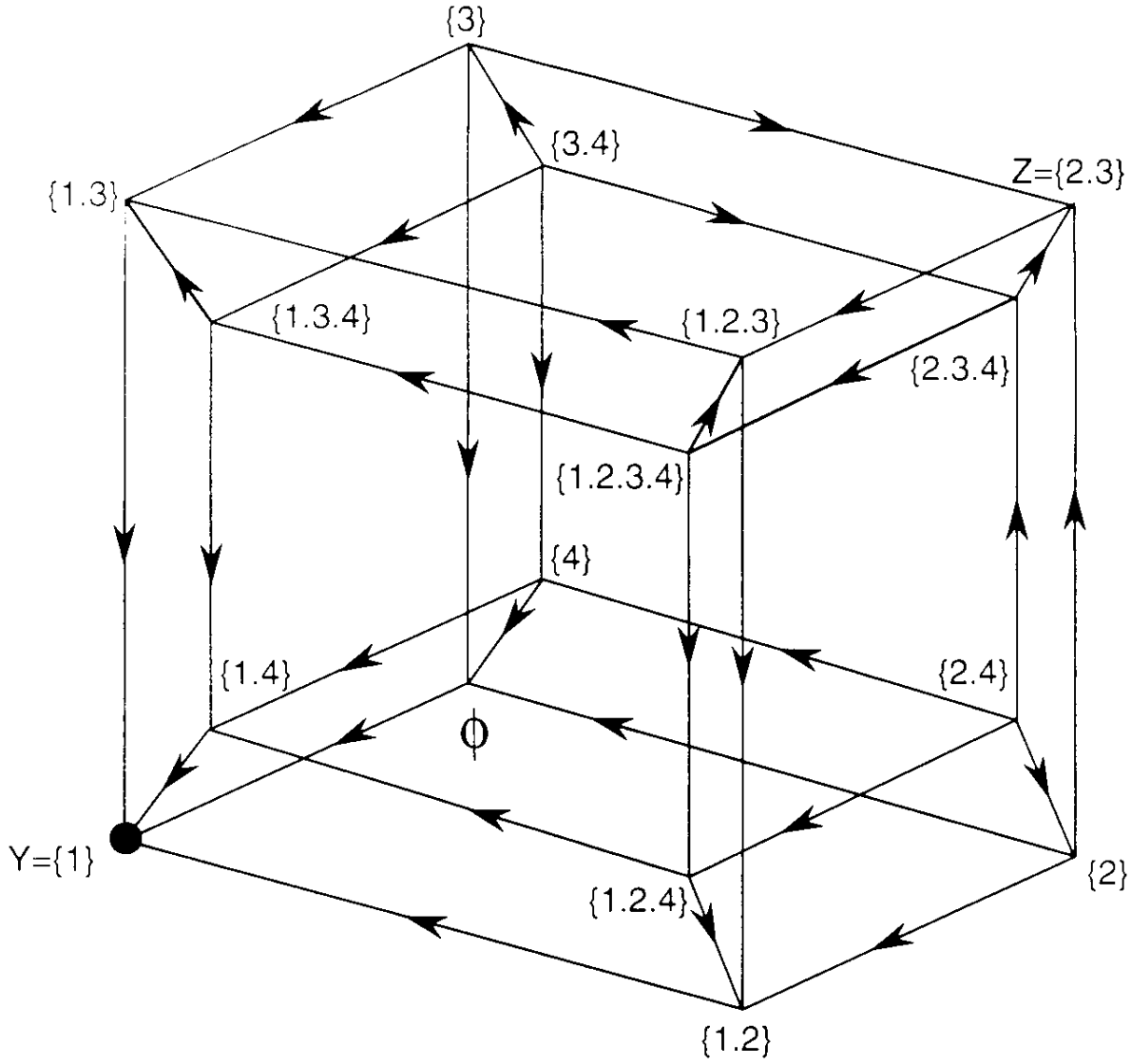

Figure 4

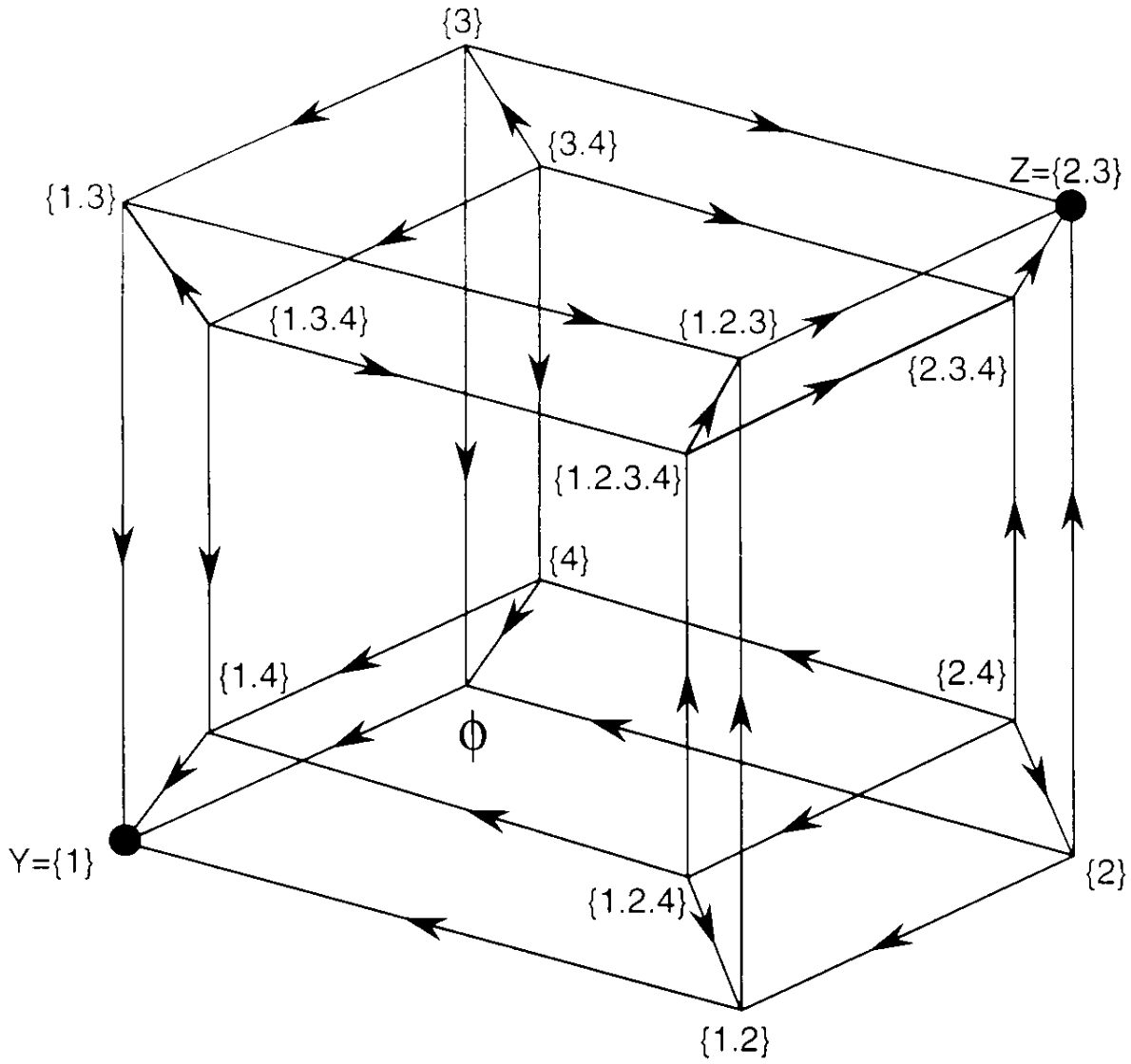

Figure 5

But the search process may choose Y instead. For example, if the search begins from the origin, ø, the state in which there is no market, Z cannot be found. In order to discover the efficient system, it is necessary to set up the markets for two complementary goods, 2 and 3, simultaneously.

It is worth noting that, although Good 2 and 3 are complements, they are not like "nuts and bolts." This example works in spite of $\rho > 0$. Indeed, for any ρ less than one, one can generate the situation given in Figure 5, by choosing the cost paramters appropriately. In this example, Goods 2 and 3 become complements because of general equilibrium interactions (by driving out Good 1). Hence, if markets for 2 and 3 are not open simultaneously, even those who know the technology of assembling 2 and 3 into the consumption good may not notice that they are complements to each other.

Example B:

This is a slight extension of Example A. The only difference is that the objective function is now given by

$$U(x_1, x_2, x_3, x_4, H) = x_1 + \left[x_2^{\rho} + x_3^{\rho} + (\delta x_4)^{\rho}\right]^{\frac{1}{\rho}} + H, \quad \delta \geq 0 .$$

Note that $\delta = 0$ reduces this to (17). Indeed, if there is no market for Good 4, hence $x_4 = 0$, this economy is observationally equivalent to the economy in the previous example. One interpretation would be that a new system of production, $Z^* = \{2,3,4\}$, which makes use of Good 4, in combination of 2 and 3, is invented by engineers. Let us also assume

$$G(\delta) = \left[a_2^{\frac{\rho}{\rho-1}} + a_3^{\frac{\rho}{\rho-1}} + (a_4/\delta)^{\frac{\rho}{\rho-1}}\right]^{\frac{\rho-1}{\rho}} < a_1 < G(0) = \left[a_2^{\frac{\rho}{\rho-1}} + a_3^{\frac{\rho}{\rho-1}}\right]^{\frac{\rho-1}{\rho}},$$

where $G(\delta)$ is the unit production cost of $Z^* = \{2,3,4\}$, when all these inputs are available at the marginal costs. These inequalities imply that, before the technical change, $Y = \{1\}$ is the efficient system, outperforming $Z = \{2,3\}$, but after the change, $Z^* = \{2,3,4\}$ outperforms $Y = \{1\}$.

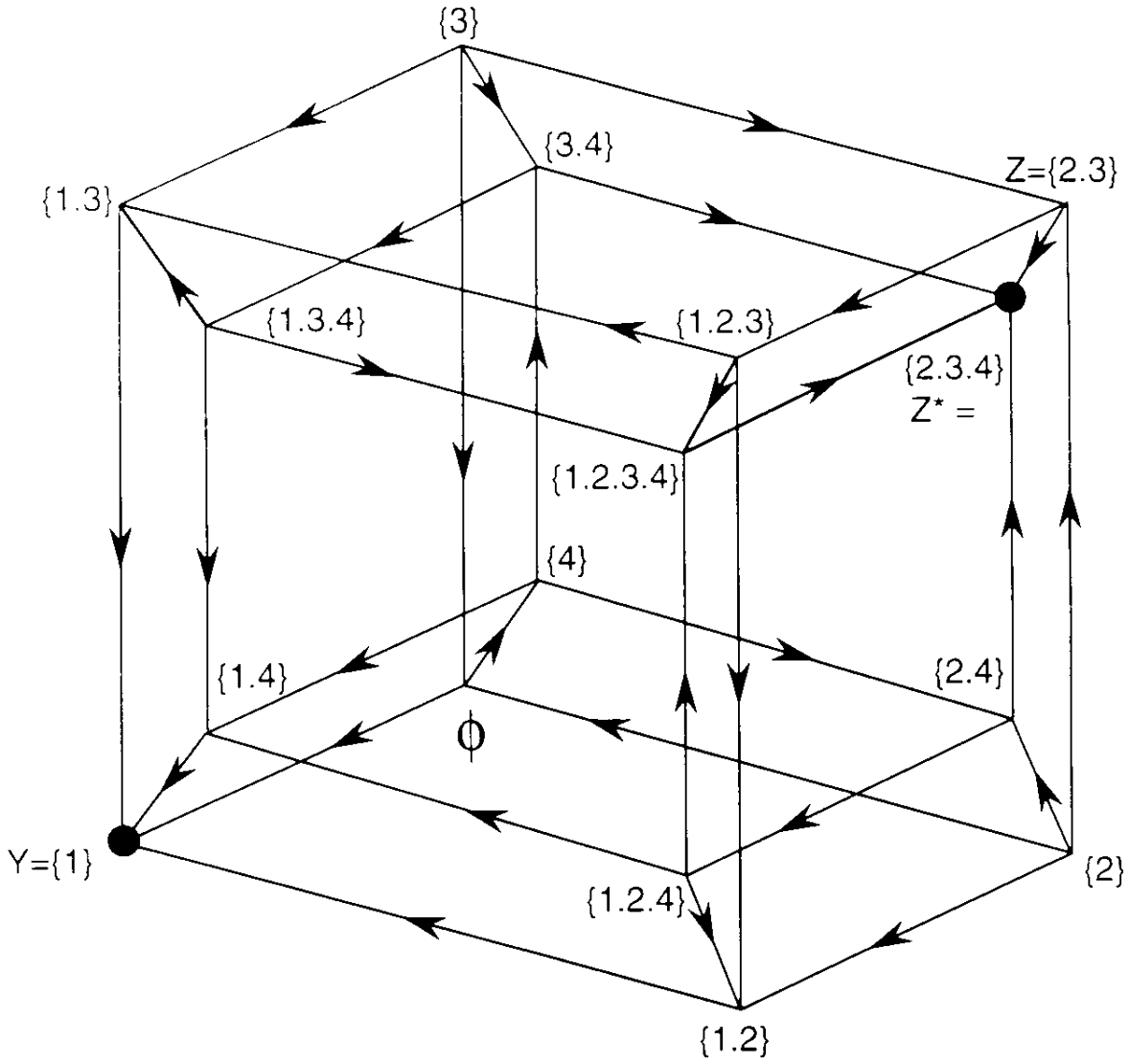

Figure 6

Imagine that, before the change takes place, the government conducted a global search along the edges of the hypercube, given in Figure 4, and found the Y = {1} was globally optimal. Then, the technology condition has changed and Z^* becomes superior to Y. The directions of increasing efficiency may now be indicated on the arrows in Figure 6, drawn with additional assumptions that $a_4 < \delta$ (i.e., {4} dominates ø), and that Y dominates all but Z^*. In this case, unless the government conducts its global search again, it does not see any evidence that Y is dominated by Z^*.[16]

This example illustrates that the central authority has to conduct a global search routinely, in order to detect any change in technology that turns useless goods to useful ones. It is also worth noting that the very success of the central authority in discovering the system Y in the past prevents it from discovering a better system. If the search starts from ø and experiments {4} first, it may succeed in discovering Z^* even with the localized search process.

Example C:

Again, the only difference is in technology. There are four constant-returns-to-scale production functions. They are

$$Y_1 = \left\{ x_{11}^{\rho} + x_{21}^{\rho} \right\}^{\frac{1}{\rho}}$$

$$Y_2 = \left\{ x_{32}^{\rho} + x_{42}^{\rho} \right\}^{\frac{1}{\rho}}$$

$$Y_3 = \gamma\left\{ x_{13}^{\rho} + x_{23}^{\rho} + x_{33}^{\rho} + x_{43}^{\rho} \right\}^{\frac{1}{\rho}}$$

$$Y_4 = H ,$$

where x_{ij} is the amount of input i used in technology j = 1, 2, 3, and the optimal allocation is given by the solution to the problem: Choose $\{x_{ij}\}$ and H to maximize:

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[16]Since δ appears only in the form of a_4/δ and Figure 4 imposes no restriction on a_4, any value of δ can be made consistent with the change in the search dynamics from Figure 4 to Figure 6, by adjusting a_4. This implies in particular that, when Good 4 is cheap to produce (a small a_4), even a small technical change (a small δ) would suffice.

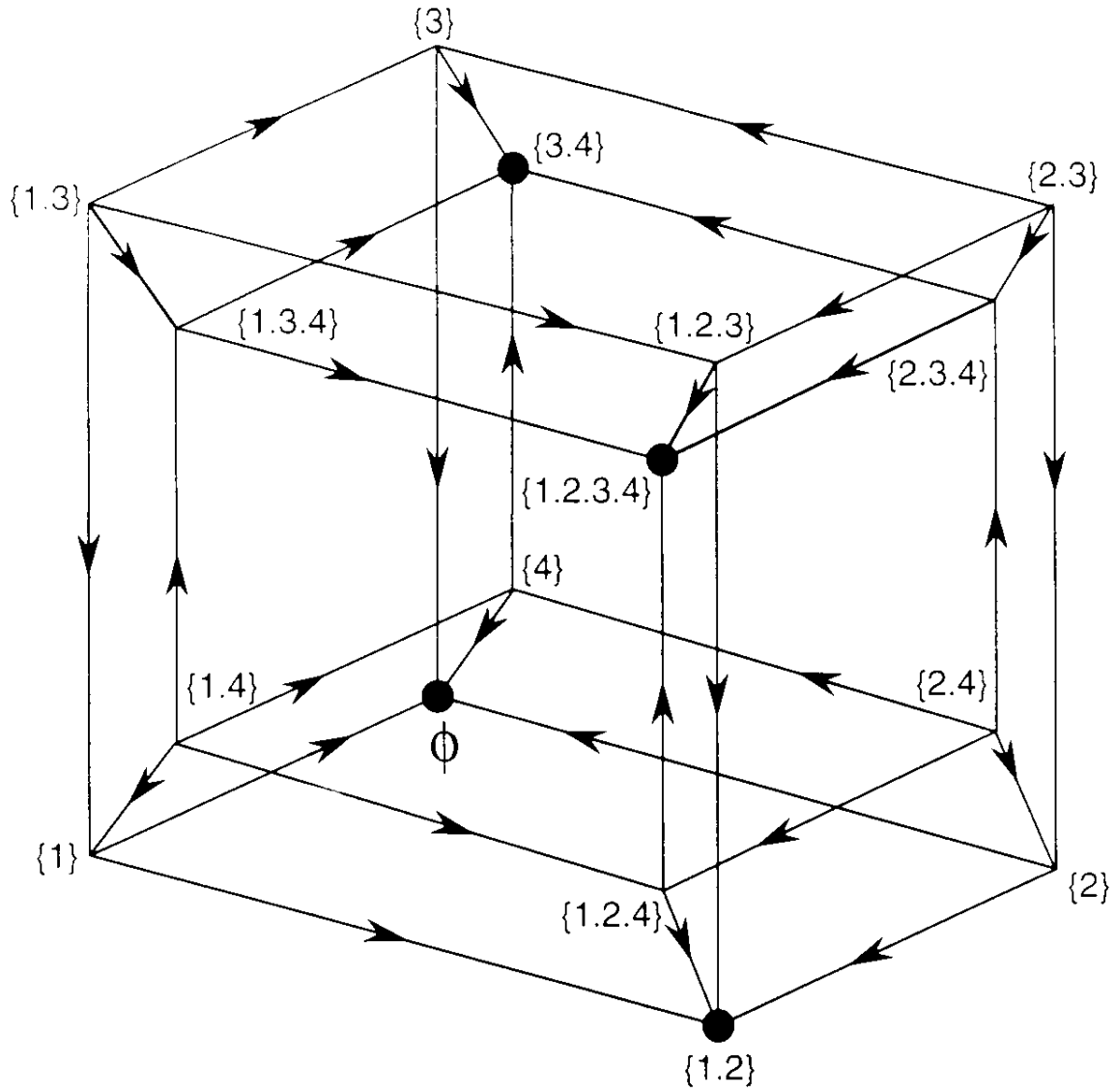

Figure 7

$$U = \left\{ x_{11}^{\rho} + x_{21}^{\rho} \right\}^{\frac{1}{\rho}} + \left\{ x_{32}^{\rho} + x_{42}^{\rho} \right\}^{\frac{1}{\rho}} + \gamma \left\{ x_{13}^{\rho} + x_{23}^{\rho} + x_{33}^{\rho} + x_{43}^{\rho} \right\}^{\frac{1}{\rho}} + H ,$$

subject to the resource constraint:

$$\sum_{i=1}^{4} a_i \left(\sum_{j=1}^{3} x_{ij} \right) + H = L .$$

To simplify the analysis, suppose that $a_i = a$ for all i. Furthermore, let us focus on the case with

$$\left(\frac{1}{2} \right)^{\frac{1-\rho}{\rho}} < \gamma < \left(\frac{2}{3} \right)^{\frac{1-\rho}{\rho}} .$$

The first inequality implies that the third technology is more efficient than the first two, when all four inputs are available at the marginal costs. The second inequality implies that the third technology is less efficient than one of the first two, when only three out of the four inputs are available at the marginal costs. Even with these restrictions, there are still four cases be distinguished, depending on the value of a.

I. If $a > 4^{(1-\rho)/\rho}$, then ø is the only (and hence global) optimum.

II. If $2^{(1-\rho)/\rho} < a < 4^{(1-\rho)/\rho}$, then ø and {1,2,3,4} are local optima, of which {1,2,3,4} is globally optimal.

III. If $1 < a < 2^{(1-\rho)/\rho}$, then ø, {1,2}, {3,4} and {1,2,3,4} are local optima, of which {1,2,3,4} is globally optimal.

IV. If $a < 1$, then {1,2}, {3,4} and {1,2,3,4} are local optima, of which {1,2,3,4} is globally optimal.

Figure 7 depicts the search dynamics for Case III.

Now consider the following thought experiment. Initially, a is high and Case I holds; the economy has the system, ø. Then, a begins to decline over time, and see how the central authority develops, or fails to develop, a better system of markets. As a becomes smaller than $4^{(1-\rho)/\rho}$, it becomes optimal to introduce {1,2,3,4}, but the central authority would not notice it. If a continues

to decline until a < 1, ø is no longer locally optimal. Through its search process, the authority discovers a better system of markets, either {1,2} or {3,4}. If it discovers {1,2}, the authority will never realize that Goods 3 and 4 should be introduced. Likewise, if it discovers {3,4}, the authority will never realize the values of producing Goods 1 and 2. In any event, it will never develop the most efficient system, {1,2,3,4}.

But now suppose that there are many countries in the communist bloc, and the central authority of each country experiments with its allocation mechanism independently. Then, as a becomes less than one, there are good chance that some countries develop {1,2}, while others discover {3,4}. Then, from observing each other, the communist bloc as a whole can discover the efficient system, {1,2,3,4}.

This example thus suggests two points. First, even with a small number of potential goods, there can be many local optima, which stops the process of search, before the authority discovers the global optimum. Second, this problem can be partially solved, if the search process is decentralized and independent experiments are allowed for. There is a virtue of keeping diversity in coping with ignorance.

Even these three examples grossly understate the complexity of the central authority's problem of setting up a system of markets. As the number of potential activities get large, the number of systems of markets, as well as the number of locally optimal systems, grow exponentially. Imagine that, every year, one can conceive and may add only 60 (a very small number!) new activities to the list of millions of activities that are already engaged in. Even if these new, potential activities do not affect the values of the existing activities (a very unrealistic assumption!), the central authority 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 it 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 combinatorial calculation suggests that the problem of market formations is of such fundamental difficulty that, no matter how the central authority attempts to establish markets for new goods, it is inevitable that it fails to introduce a vast number of potential goods of significant economic value. The standard assumption in the theory of competitive markets, i.e., the set of all relevant commodities is known, assumes away the intractable problem of market formation, by far the most significant obstacle for using the price signals to collect the information necessary for allocating resources. This modeling approach, as a result, can inadvertently contribute to creating an illusion of the workability of market socialism.

4. Concluding Remarks: Broader Implications.

In a highly thought-provoking article, Romer (1994, p.17) wrote that "(m)any educated people are contemptuous of creationists who claim that there is a supreme being that created all existing forms of life according to a master plan and who deny the possibility that different forms of life emerged by chance and will continue to do so. We also ridicule the turn of the century head of the patent office who recommended the abolition of the patent system because everything had already been invented. Yet in their everyday approach to economic problems, most economists adopt a modeling strategy that reflects an implicit belief closely related to that of the patent clerk and the creationist."

In this paper, a series of models has been developed to show how misleading this modeling approach (or the belief implicitly embodied in it) can be when evaluating alternative forms of economic systems. The failure to appreciate the possibility that many new activities of potential values have not been introduced into the economy, ignoring the fundamental difficulty of selecting a relatively small number of activities out of all the possibilities, could make us preoccupied with the allocative distortions across the existing uses. As a consequence, it could make us more supportive of a centralized allocation mechanism designed to remedy such distortions (e.g., market socialism)

without being aware of the significant welfare losses associated with the failure to promote innovation.

This paper can also be read as a critique of the neoclassical theory of competitive markets, exemplified by Debreu (1959) and Arrow and Hahn (1971), or at least as a critique of the manner in which the theory is typically interpreted and applied. According to the standard interpretation of the Arrow-Debreu paradigm, there are markets for all possible goods, distinguished not only by their physical characteristics, but also by the location, the time, and the state in which they are made available. A more appropriate interpretation would be that, in the Arrow-Debreu world, the goods available in the marketplace have already been selected from the huge set of all possible goods, and that the theory is only concerned with the remaining problem of allocating resources between a fixed set of existing goods. The twin theorems of welfare economics should then be interpreted as the statements concerning the efficiency of competitive equilibrium conditional on the set of goods available in the marketplace. Once interpreted this way, it would be easier to understand why market socialism, even if it had worked exactly as intended, could have lagged behind the private enterprise system, as the welfare losses associated with the allocative distortions between the existing goods can be of secondary importance, compared to the welfare losses associated with the failure of selecting a better combination of goods.

Although the discussion has mainly focused on (a particular version of) market socialism, the logic can be equally applied to any deliberate attempt to design a centralized allocation mechanism. As the hypercube diagrams presented in the previous section suggest, the problem of finding out a better combination of activities is akin to the problem of discovering a better room in an enormously complicated labyrinth with billions of rooms, each of which is connected to thousands of others via secret doors. This problem is of such difficulty that any single search algorithm, no matter how sophisticated it might be, would sooner or later stop discovering a better solution. On the other

hand, there is good chance that we can continuously come up with better solutions, if we endlessly design new algorithms and let them search independently. As Example C suggests, even the socialist system, if a greater autonomy had been given in each country and in each region and in each enterprise, could have performed better in search for new activities, by encouraging more experiments.[17] While a single search would inevitably lead to the blind alley, the parallel search could generally generate much satisfactory results when exploring the uncharted regions of the labyrinth. This is probably the most significant advantage of decentralization that cannot be replicated by centralization. One reason why the private enterprise system has been more successful in sustaining innovation is that the search for new activities has not been organized deliberately by the government, but rather, it has been pursued independently by a large number of private entrepreneurs.

Of course, this should not be interpreted as saying that the free market enterprise system can "solve" the problem of discovering and implementing the "efficient" or "optimal" selection of the activities. No system can be expected to achieve such a formidable task.[18] The relevant question here is rather the "relative" performance of search procedures. That is, under which mechanism can society be expected to have better chance of sustaining a steady improvement of its economic performance, by continuously discovering a better way of organizing the economies?

The typical advice of the visiting Western economist making a hurried trip to the former

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[17]The case of China is highly suggestive in this regard, where local governments are given semi-autonomous power and the driving force behind rapid growth comes largely from local initiatives, exemplified by the expansion of township and village enterprises, and not from an intentional design of a reform program by the central government. One possible reason for China's success is that decentralization led to more experiments. (Another possible reason, formalized by Qian and Roland (1994), is that the greater autonomy of local governments, by redistributing the bargaining power between the public enterprises and the governments, eased the soft-budget constraint problem.)

[18]Matsuyama (1994) discusses in more detail the "impossibility" of attaining the optimal allocation and its implications for the problems of economic development.

socialist countries is to emphasize the virtue of market competition. But, it is important to understand the reasons why market economies have outperformed socialist economies in the past. The argument presented in this paper suggests that they may have little to do with the textbook explanation of how markets work, such as, the role of price signals in coordinating the existing activities and the equalization of the marginal costs and marginal benefits. Rather, they have more to do with the very complexity of coordination problems, which defies any deliberate allocation scheme. The superior performances of market economies can be largely attributed to the fact that there are few systematic attempts to control the process of resource allocation, thereby allowing greater scope for open experimentation, which is the most effective way of coping with ignorance. Freer systems has their own problems, but they are at least open to the discovery of new ways of solving them.[19]

If so, the most important lesson of the collapse of the Soviet-type system, should be to resist the urge to design and control and thus to allow economic outcomes to arise naturally as the unpredictable consequences of market interactions. At least, it should make us more cautious in the confidence with which we hold our views and in our appeal to science to justify our beliefs about the organization of society. The problems the former socialist countries have to face in transition have presented and continue to present great opportunity for economics. It is thus tempting for us to say that recent advances in economic theory, particularly in the area of information economics and game theory, can help us guide these economies more intelligently, by mapping out detailed transition strategies and by designing the institutions. But, as Hayek have written repeatedly, nobody ever invented the system of markets. And nobody ever invent the property right.

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[19]Winston Churchill once said that "No one pretends democracy is perfect or all-wise. Indeed, it has been said that democracy is the worse form of government except all those other forms that have been tried from time to time." The free market enterprise system is not perfect, and its defenders should not feel obliged to pretend that it is. The point of emphasizing its possible sources of inefficiency is to explain why things can often go wrong, not to condemn it.

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