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Disorganization and Network Institution: A Possible Source of Economic Downturn

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Abstract
This article considers the roles of networks on investment decisions to explain the existence of a possible economic downturn during a transition period from a dictatorship towards a democracy. A supplier is willing to invest in a state production only if there are enough other suppliers taking part such that the return on investment is at least equal to their private alternatives. The suppliers build knowledge of others' private alternatives through a communication network. The investment model presented here shows that a decision to invest not only depends upon knowledge about others, but also, more importantly, understanding of others' knowledge. When networks fail to fully disseminate knowledge, investment decisions are suboptimal. These suboptimal decisions consequently lead to a decline in output in the early stage of market decentralization as the state loses power to force suppliers into joining state production.

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Introduction

The fundamental economic problems in all societies are questions of what is to be produced, how to efficiently allocate resources, and how to distribute the production. These decisions can be made at the hand of a single dictator, which may be called a central planner, or a centralized government; these decisions can also be decentralized to all individuals of economic agents through some market mechanism. For instance, a decision to produce pencils, whether to use machines in the process of production and how to distribute its value among resource owners can be made by one entity, a dictator. This nation is under a regime of a dictatorship. In other situations, society as a whole can also make such decisions through a market mechanism; instead of force, markets work voluntarily to guide the decision-making process. When pencils are more valuable as indicated by an increase in their price, the society will voluntarily allocate their resources to produce pencils without being forced to do so. In this governance structure, the nation is under a regime of a decentralized market. Sometimes, political situations, such as a coup or revolution, may change the economic regime from a dictatorship to fully decentralized market. This typical regime change, as widely accepted by the neoclassical theorists, is expected to boost economic output.

However, changing economic regimes from a state where there is powerful government intervention to a state where there is strong market decentralization does not guarantee an increase in economic output. In fact, historical case studies show that output has a tendency to fall immediately after the collapse of a dictatorship and continue to decline during the transition from the centralized government to a decentralized governance structure (Blanchard and Kremer 1997, Brenton, Gros, and Vanadille 1997, and Duflo and Senik-Leygonie 1997). For example, most countries of the former Soviet Union experienced a large decline in output after the collapse of the Soviet Union. Their output was less than half of its pre-decentralization period (Blanchard and Kremer 1997). Despite a myriad of economic distortions during centralized planning and under dictatorships, the movement towards competitive, decentralized markets failed to increase output, contrary to common expectations.

This type of decline in output is an interesting puzzle for neoclassical theory because decentralized transactions between suppliers and buyers do not instantly boost economic growth. The existing literature has tried to explain the economic reasons behind this downturn. The explanations for these temporary output declines vary, ranging from changing the reporting incentives, the need to restructure enterprises and redeploy assets, to the increase in uncertainty that affects investment. Blanchard and Kremer (1997), for instance, argue that the economic downturn is due to the presence of incomplete contracts and asymmetric information. During the regime of dictatorships in the Soviet Union, the central government had the power to force each supplier to participate in state owned firms. The characteristics of the state firms' production processes were complex; they involved many stages of production starting from planning and designing to delivering the final product. The firms were served highly specified functions, in which the suppliers were almost perfect complements to each other, i.e. each supplier had its own specific roles in the production processes that was difficult to be substituted by other suppliers.

This specific relationship among suppliers opened an opportunity for each supplier to bargain for a higher wage for its services immediately after the regime of dictatorship collapsed. This bargaining mostly resulted in inefficiency due to asymmetric information in which some relevant information was hidden from each supplier. Moreover, the complexity in production stages resulted in incomplete contracts because it was difficult to accurately state all the production steps in the contracts from beginning to the end. Thus, both incomplete contract and inefficient bargaining caused a drop in national output shortly after the end of the dictatorship. The output loss may be even larger if more parties were involved in the complex set of specific relations, increasing the cost of disorganization.

One limitation of many existing theories, including Blanchard and Kremer (1997), is that they put too little attention on the communication relationship among individual suppliers when analyzing bargaining outcomes. Most of the existing literature uses models of non-cooperative game theories. That is, by assuming no communication among agents, the models predict the outcome of non-cooperative bargaining. In reality, however, some parties communicate to each other or rely on their prior existing communication network when deciding which strategic actions to take.[1] Therefore, I believe that the outcomes of bargaining are also influenced by the presence of communication network among those suppliers.

This paper proposes an alternative explanation of the reduction in output during transition by introducing the role of networks. This explanation will complement other studies using asymmetric information to explain the possible dramatic fall in output. I first modify the Blanchard and Kremer (1997) model on how specificity and complexity may create coordination failure between a state firm and its suppliers. I then transfer this coordination game into a type of collective action game by linking the supplier's private opportunities to the number of participants in the state firm. Finally, I borrow Chwe's (1999) style of network analysis on collective action problems to explain how a fall in output may result from the network structures among the suppliers.

Section 2 presents the model of an economy with one state firm and several suppliers. The suppliers are strategically rational and also take into account that the others are completely rational. Section 3 analyzes the equilibrium outcome for various institutions and shows that none of these institutions would produce efficient investments. Section 4 discusses the model's implications for a solution to coordination problems, and possible extensions to a more sophisticated and realistic network structures. The model has implications for countries in a transition period from a strong government power into more market-dominant or democratic structure, such as Turkey, Libya, or Egypt. The message is that the transition cannot be done radically if countries are attempting to maintain pre-transition levels of output. Section 5 draws conclusions that a better network relationship among suppliers is necessary to solve coordination problems and achieve the most efficient economic outcome during a transition period from a more centralized government regime to a more market-oriented regime.

The Model

The economy consists of only one state firm and several private firms. Both types of firms use intermediate capital inputs from $n + 1$ number of suppliers; the suppliers outnumber the private firms. We assume that profit-maximizing private firms have monopoly power, which allows them to offer take-it-or-leave-it rent to the suppliers. Hence, the suppliers will get paid their private thresholds if they decide to supply their intermediate inputs in the forms of capital, k, to private firms.[2]

The state firm

The state firm operates on an increasing return to scale with an $Y = Ak^{\alpha}$ type of production function where ≥ 1 . This type of economic scale is common for the state firm since the state usually is a natural monopolist for publicly crucial output such as electricity, telecommunication, and mining. Instead of being constant, however, we assume that the technology coefficient, A, increases with capital k. We can think of k as smart capital, which has positive externalities. In other words, this capital is more productive when it interacts with other forms of capital.[3] Specifically, for this model $A(k) = k$ so that the technology coefficient is just the units of capital. Hence, the state firm's effective production function would be

$$y = k^{1+\alpha} \tag{1}$$

We further assume for the purpose of the model that $\alpha = 1$, so that the effective production function is

$$y = k^2 \tag{2}$$

In addition, the state firm is not a profit-maximizing firm, but a welfare-maximizing firm. It operates under zero-profit conditions and ensures the equality of income among its suppliers. We can also think of suppliers as workers, where the state firm aims to distribute its output equally to its workers. To ensure equality, the state firm pays rent, r, to supplier i according to the firm's average product. With the above effective production function, as in (2), the rent is

$$r_i = \frac{y}{k} = k \ \ \forall i \tag{3}$$

Equation (3) reads the state firm as paying rents to every supplier equal to the units of capital used in production. Note here that only the quantity of capital matters, not the quality. Suppose, for instance, that two suppliers each supply one unit of capital to the state firm. Each capital supplied is not necessarily equal in quality. With two units of capital, the state firm's output is four units. The return on capital from the state firm to both suppliers is, therefore, $r_i = \frac{4}{2} = 2$ units, although each supplier supplies only one unit of capital. Of course, this does not mean that every supplier will join the state firm since they may have sufficiently high opportunity costs, which are alternatives from private firms. Consider, as an example, the case of public transportation, such as city buses. In some developing countries, the public transportation company is owned and controlled by state enterprises. However, these individual buses can be owned privately by community members or suppliers. Since the state firm controls the bus fare, the rent payment to the bus suppliers is based on the quantity of buses, not the quality. Each bus may have a different seat

capacity and a unique bundle of other accessories, but each gets paid equally. If the bus were hired by a private enterprise, the payment would be based on its quality.

The suppliers

There are $n+1$ suppliers to decide whether to engage in the state firm production or to accept take-it-or-leave-it rent from private firms. Each supplier has one unit of capital. The capital differs in quality, which is indicated by different threshold levels $c_i \in (2, \ldots, n+2)$.[4] As mentioned above, the private firms will pay each supplier exactly the supplier's threshold in regards to the supplier's product quality. The suppliers then compare these private alternatives to the rents earned from the state firm. However, each supplier must decide simultaneously whether or not to participate in the state firm's production without knowing the actions of other suppliers.

The decision of any particular supplier i is obvious. That is, to join (j) the state firm if $r_i \geq c_i$; or stay (s) and take the private opportunities at c_i. Notice, due to the specific production function in (2) and the value of private alternatives, the supplier decisions to join the state firm depend upon how many other suppliers would join the state production. This specific relation is the critical feature of this model. For example, supplier A with threshold of $c=2$ would join the state firm only if accompanied by at least one other supplier. To see this, suppose that only supplier A joined the state firm. This supplier then gets rent equal to one, which is lower than its threshold. If, instead, two other suppliers join, supplier A gets rent equal to three, which is strictly higher than its threshold. Moreover, a supplier with a threshold of $n+1$, which is equal to the number of suppliers, would prefer to join only if everyone else does. Meanwhile, a supplier with threshold of $n+2$ would never join the state firm. Thus, we can formulate the profit of supplier i given its own threshold and everyone else's actions $a=(a_1, \ldots, a_N)$ as follows:

$$\pi_i(c_i, a_i, \ldots, a_N) = \begin{cases} c_i, if\ a_i = s \\ r_i = k, if\ a_i = j \ \ and\ \#h_{\{s.t.\ a_h=j\}}=k \end{cases} \quad (4)$$

This profit equation (4) simply states that the supplier's profit (π) would be its private value, c, if it stays and takes an offer from a private firm. Otherwise, when it joins the state firm, the profit would be $r=k$, where k is the total number of suppliers that take part in the state production. Thus, the suppliers' decision simply depends on whether *ex-ante* $r_i \geq c_i$. The only problem for the supplier, then, is to accurately predict the value of r. In the following section, I describe how the supplier uses knowledge from networks to predict r_i.

Network

Suppliers use a network to communicate their thresholds and to gain knowledge of others. Since the decision under this type of network is voluntary, a commitment is not necessary. Even if there is a commitment, no penalties are levied for deviances. Following Chwe (1999), I define network $\rightarrow$ as a binary relation over n suppliers, where $g \rightarrow i$ means that supplier g communicates to supplier i. I define the neighborhood of i as every supplier who communicates to i. I also assume that supplier

i knows the thresholds of everyone in its neighborhood. Furthermore, supplier i knows all network relations among members in its neighborhood, i.e., whether the neighborhood members communicate with each other.

Succinctly, for supplier i, let $B(i) = \{g \in N: g \rightarrow i\}$ be its neighborhood, where $i \in B(i)$ and for all $p, q \in B(i)$, supplier i knows whether $p \rightarrow q$. Take 4 suppliers as an example: supplier 1, 2, 3 and 4. Supplier 2 and 3 communicate to supplier 1 but supplier 4 does not communicate back. However, supplier 4 communicates to supplier 2. Then, we write $B(1) = \{2,3\}$ and $B(2) = \{1,4\}$. In other words, supplier 2 and 3 are in the neighborhood of supplier 1 since both supplier 2 and 3 communicate with supplier 1. Moreover, supplier 1 also knows whether supplier 2 and 3 communicate with each other. Supplier 4 is not in the neighborhood of supplier 1, but it is in the neighborhood of supplier 2 for the same reason. Supplier 2 knows whether or not supplier 1 and 4 communicate each other.

Finally, since the suppliers' decisions depend upon the decisions of other suppliers joining the state firm, it is sufficient to model this situation as a collective action problem in which all player have to collectively take the same action in order to get the best outcome. If any players deviate from that action, it would cost all players since more costs are born to those who cooperate. Thus, everyone is reluctant to cooperate unless everyone confidently knows that everyone else will cooperate. Thus, the best outcome may not be achieved if players are uncoordinated. We will see how network structures play important roles in disseminating knowledge and predicting actions taken by others. In particular, networks have the potential to solve coordination problems among suppliers.

Equilibrium

Equilibrium under central planning and perfect decentralization

Before looking at the role of networks, let us analyze the outcomes of the economy under central planning and perfect decentralization with uncertainty. First, note that the best outcome of the economy is when there is no uncertainty and every supplier is free to choose its trading partners. In this environment, every supplier knows the other suppliers' thresholds due to perfect information. As mentioned above, there are $n + 1$ available suppliers in the economy and suppose that k of them voluntarily join the state firm where $k \leq n + 1$. The value of k is endogenous, not predetermined, depending on the suppliers' decisions. Consequently, a supplier with threshold of $c_i \in \{2, \ldots, k\}$ would join the state firm when k suppliers join. The supplier with threshold $c = k + 1$ or more would be better off staying (not joining); this supplier would take the rent offered by the private firms since the maximum rent the state firm can provide is only k, but the private firm will pay according to its threshold of $k + 1$. However, this option may not be available in an imperfect information environment.

In a fully centralized economy or dictatorship, the central planner or dictator has full power to force all suppliers to engage in state production for the purpose of advancing state interests. In this case, $k = n + 1$ since all suppliers are forced to join the state firm, where k is the number of

firms that join the state firm. The supplier with threshold $c = n + 2$ has no option but to join the state firm. Unfortunately, this forced participation creates distortion in the economy because it makes suppliers with threshold $n + 2$ or more worse off, as the state firm will pay only $n + 1$, which is equal to the number of total suppliers. If this supplier had been given the choice of joining the private firms and not the state firm, it would have been paid its threshold of $n + 2$. The degree of distortion is much larger when the upper limit of private thresholds is higher than $n + 2$. Hence, the outcome of central planning is suboptimal.

Under full market decentralization, all $n + 1$ suppliers are free to invest in the state production or in the private firms. The existence of asymmetric information among suppliers and between suppliers and private firms causes suboptimal investment decisions. The market may even collapse. In this case, an adverse selection problem may exist since the suppliers' thresholds are private information unknown to other suppliers and firms. What the firms and suppliers may know is the distribution of the suppliers' thresholds. For example, if we assume that each supplier has equal probability of having a certain threshold, then a uniform distribution would be appropriate to use. When the thresholds are uniformly distributed on the interval $[2, n + 2]$ the private firms will offer all suppliers the same rent, which is the expected value of the thresholds level, $n/2$. Thus, a supplier will join the private production if its threshold is no higher than $n/2$. Those whose thresholds are higher than $n/2$ will leave the market. They will not join the state production because they have high thresholds and need to coordinate prior to investing. This adverse selection phenomenon is familiar in economics and is known as a lemon problem, where the low quality suppliers drive out the good quality suppliers from the market (Akerlof 1970). Knowing that only low quality suppliers are available to trade, the private firms may lower the offered rent, causing more suppliers to leave the market. Thus, the market may collapse.[5] In short, asymmetric information among suppliers makes it hard to coordinate and asymmetric information between suppliers and firms triggers adverse selection causing the market to collapse.

We have seen that both central planning and perfect decentralization fail to produce optimal decisions. Communication networks, as we will see, may solve the coordination problems and eliminate the adverse selection problem associated with asymmetric information. However, we shall see that mere certainty about other suppliers' thresholds is not sufficient to induce suppliers to participate in the state firm. More important to this decision is whether one firm knows about the other firms' decisions.

Equilibrium under networks

A supplier is assumed to be rational and takes into account that other suppliers are also rational. Their rational decisions depend on their knowledge acquired from networks. This knowledge determines the supplier's ability to distinguish between states of the world – the set of all possible outcomes. If a supplier cannot distinguish between several states of the world, it must take the same action in all of them. Take for example that there are only two suppliers: $i = (1,2)$ and three possible threshold levels $c_i = (1,2,3)$. Hence, there are nine possible states of the world $\{1,1; 1,2; 1,3; 2,1; 2,2; 2,3; 3,1; 3,2; 3,3\}$, where 2,3 means supplier 1 has threshold 2 and supplier 2

has threshold 3. The rest of this section will present how each supplier distinguishes each state of the world through a communication network. Three network structures are discussed: null network, full network, and incomplete network.

Figure 1. Null network (no communication).

Supplier 1's partition

1,1	1,2	1,3
2,1	2,2	2,3
3,1	3,2	3,3

Supplier 2's partition

1,1	1,2	1,3
2,1	2,2	2,3
3,1	3,2	3,3

Supplier 1's actions

j	j	j
s	s	s
s	s	s

Supplier 2's actions

j	s	s
j	s	s
j	s	s

Figure 1 presents a null network in which supplier 1 does not communicate to supplier 2 and supplier 2 does not communicate to supplier 1. Hence, supplier 1 knows its own threshold, but does not know supplier 2's threshold. The best supplier 1 can do is realize that supplier 2's threshold is either 1, 2, or 3, but supplier 1 cannot be sure. The same situation also applies to supplier 2. Therefore, supplier 1's knowledge can be represented by the partition set {1,1;1,2;1,3}, {2,1;2,2;2,3}, and {3,1;3,2;3,3}. Similarly, supplier 2's knowledge is represented by {1,1;2,1;3,1}, {1,2;2,2;3,2}, and {1,3;2,3;3,3}. Each partition, {.}, means that the owner of the partition cannot distinguish between its contents; therefore, the owner has to take the same action when facing any content within the partition.

Let us consider supplier 1. It chooses whether to join (j) or stay (s) given a state of the world. If it has a threshold of one, it will surely join the state firm. If instead it has a threshold of three, it will never join the state firm, regardless of the threshold of supplier 2. How about if it has a threshold of two? In this case, it ideally joins if the state is (2,1) or (2,2) and stays if the state is (2,3). However, since it cannot distinguish between these three states, it has to take the same action. If it decides to stay, the state could be (2,1). But if it decides to join, the state could be (2,3) and the other supplier will not join. Thus, the number of suppliers joining the state firm would be lower than its threshold. If the latter happens, (2,3), I assume that supplier 1 suffers a large cost from joining the state firm and its profit is then lower than its threshold.[6]

An analogy for the situation above is as follows. Imagine two community members Adam and Eve who each wants to decide whether to volunteer for community work, which requires a total of two hours. If only one shows up, he or she will work for two hours and, if both show up, each will work for 1 hour. Each member may not be available to volunteer at all, or may be available for one hour or two hours, but neither of them knows the other's availability with certainty. In this case, Adam will show up if he has a free time of two hours and will not show up if he has no free time, regardless of Eve's decision. Eve will make a similar decision. The problem arises if Adam is only

available for one hour. Should he volunteer? His decision depends on his knowledge of Eve's availability. Since he does not communicate with Eve, he is not sure whether she will show up or not. Therefore, to minimize loss, Adam will stay home when he has only one hour of free time and does not know Eve's threshold.

Back to the supplier-state firm case above, supplier 1 joins only if it knows for certain that supplier 2 will join. Hence, in this example, if supplier 1 has a threshold of two, it stays in all three states: (2,1), (2,2), and (2,3). Supplier 2 takes similar actions. It joins only if it has a threshold of one and stays if it has a threshold of two or three. Their set of actions is depicted in Figure 1. The coordination problem here is when they have threshold of (2,2). Social efficiency requires that they both join the state firm but their knowledge gaps prevent them from doing so. Thus, the outcome of the null network is inefficient. In general, each supplier joins only if it knows with certainty that a sufficient number of the other suppliers will join the state firm

Figure 2. Full network (complete communication).

Supplier 1's partition

1,1	1,2	1,3
2,1	2,2	2,3
3,1	3,2	3,3

Supplier 2's partition

1,1	1,2	1,3
2,1	2,2	2,3
3,1	3,2	3,3

Supplier 1's actions

j	j	j
j	j	s
s	s	s

Supplier 2's actions

j	j	s
j	j	s
j	s	s

Figure 2 depicts a full network or complete communication. Here, supplier 1 communicates to supplier 2 and vise versa. Both suppliers know each other's threshold and can distinguish among all states of the world. The difference between figure 1 and figure 2 is best seen when supplier 1 has a threshold of two. In a null network, it stays in state (2,1); (2,2); and (2,3) because it cannot distinguish between the three states. Now, supplier 1 can distinguish between these three states and can take different actions in regards to each of them. Supplier 1 will definitely join in state (2,1) because it knows with certainty that supplier 2 has a threshold of one and hence will also join. In contrast, supplier 1 stays in state (2,3) because it knows that supplier 2 has a threshold of three and will also stay. Supplier 2 has a similar case in which it will join at state (1,2) and stay at state (3,2).

What if the state is (2,2)? In this case, there would be two equilibria: one point where both suppliers join and the other point where neither chooses to join. In this model, whenever there is this kind of indeterminacy, I assume that the equilibrium is one point where both choose to join. In other words, when each supplier with a threshold of two discovers the other also has a threshold of two, I assume they both join the state firm.

No coordination problem arises when the threshold is (2,2). Both suppliers join the state firm. That is because each supplier knows the other's threshold and each knows that it has mutual

knowledge of each other's threshold. Networks here materialize the gains from participation and hence solve the coordination problem

Figure 3. Incomplete network (partial communication).

Supplier 1's partition

1,1	1,2	1,3
2,1	2,2	2,3
3,1	3,2	3,3

Supplier 2's partition

1,1	1,2	1,3
2,1	2,2	2,3
3,1	3,2	3,3

Supplier 1's actions

j	j	j
j	j	s
s	s	s

Supplier 2's actions

j	s	s
j	s	s
j	s	s

After establishing the difference between the null and complete network, let us consider the incomplete network presented in Figure 3. Here, supplier 2 communicates with supplier 1, but supplier 1 does not communicate back to supplier 2. In this case, only supplier 1 has full knowledge of the exact state of the world. An interesting question here is whether supplier 1 chooses to join the state firm when it knows the exact state of the world is (2,2). The answer depends upon its expectation about supplier 2's decision. To join, supplier 1 has to make sure that supplier 2 also joins. However, it knows that supplier 2 cannot distinguish between the states of the world, and therefore it predicts that supplier 2 stays. From supplier 2's point of view, the state of the world could be (3,2). This indeterminacy would predict that supplier 2 chooses to stay and hence, supplier 1 will also stay. In short, under the incomplete network, both suppliers stay at state (2,2) because one supplier knows that the other supplier does not know for certain whether its counterpart will join the state firm. Thus, the coordination problem still exists and gains from participation cannot be materialized.

It is easy to extend the model to n players, which is simply a matter of writing down all states of the world. The point here is that *knowing the state of the world per se is not sufficient for a supplier to join the state firm*. It is more important to know what others know, and also to know that others know what we know (common knowledge), in order to solve the coordination problem.

Discussion and Extension

Chwe (1999) defines transition as moving "from plan and plan institution to market and market institutions." In this paper, this means moving from involuntary participation under the central planning (dictatorship) towards voluntary participation under networks (market decentralization). This transition may harm a nation's total economic production or output despite a common belief that market decentralization boosts economic growth. The main problem with voluntary participation under market decentralization is the existence of asymmetric information. Since

voluntary participation involves coordination, asymmetric information may inhibit the ability of economic agents to coordinate and to collectively take the preferred actions. This inability contributes to suboptimal investment decisions and hence suboptimal outcomes. During a transition period, after a regime change from a dictatorship towards democracy, economic agents such as laborers, capital owners, and entrepreneurs may not yet be ready to coordinate with each other due to limited knowledge of required information. The example below shows that a country can experience a sharp decline in output during a transition from dictatorship towards decentralization.

Suppose that there are two electrical power companies: one is state-owned and the other is private-owned. These companies require several electrical components, each supplied by an individual private supplier. Each supplier has its respective marginal cost of production. The lower its marginal cost, the higher the quality of the components. Thus, each supplier has its own threshold for a minimum rent at which the supplier is willing to sell its components. The thresholds are measured by units of capital equivalent. Suppose there are five suppliers with thresholds of one, two, two, nine, and nine units of capital, respectively. Here, I allow the upper limit of private thresholds to be sufficiently high to indicate the more advanced private sectors. Each supplier can provide its components to the state firm or to a private firm. The state firm has production function as in (2) and distributes the output equally to the suppliers. The private firm produces output equal to the sum of suppliers' thresholds and pays each supplier equal to their thresholds.

Under central governance or dictatorship, everyone is forced to engage in state production. The private firm does not exist in such regime. With a production function of the state firm of $y = k^2$ as defined earlier in (2), the total production of those five suppliers is 25 units. Every supplier then has capital income of five units since the state firm divides its value of output equally. Notice that two suppliers with a threshold of nine are worse off because their incomes are below their thresholds (incomes of five versus incomes of nine). Meanwhile, the other three suppliers are better off.

Under a regime of market decentralization with a network, the national output may be higher or lower than that under the central planner. This paper's purpose is to show that the output *may be lower*. If the network is empty, or there is a null network where there is no communication among the suppliers, only supplier 1 will voluntarily join the state firm while the other suppliers take their private alternatives from the private firm. Hence, the total output and income produced in the economy would be $1 + 2 + 2 + 9 + 9 = 23$ units, which is lower than that under the central planner. Under full networks or complete communication, three suppliers with thresholds of one, two, and two join the state firm while two suppliers with a threshold of nine join the private firm and take their private alternatives, delivering total output or total income of $3 + 3 + 3 + 9 + 9 = 27$ units, which is higher than that under the central planner. Finally, if the network is incomplete, the outcome will depend on the network's structure, i.e., who communicates to whom. When networks are incomplete, lower income is more likely to occur, but when networks are fully developed, higher income will be more probable.

There are two conditions that can make output fall after the collapse of dictatorship: *imperfect network communication* and *rapid growth in private industries*. Rapid growth in private sector industries, indicated by relatively high productivity or low marginal cost, gives suppliers more opportunities to

earn higher rents. Those opportunities are disseminated through a communication network. Hence, when information is well disseminated and the private sectors are relatively well developed, the economic distortions caused by central planning are relatively larger. However, if the network to disseminate information is ill developed and private sectors are still primitive, central planning or dictatorship provides a better solution to coordination problems.

This model is applicable to current political transitions and can be seen as a warning to countries that are now at the early stage of democracy such as Turkey, Libya, Egypt, Afghanistan, and Syria, among others. One could expect that their economic output would fall shortly after the collapse of the dictatorship or powerful central government. The main reason is the communication networks, which transmit relevant information, may not be feasible and may take some time to develop. Along with a fear of political instabilities, business owners need an economic adjustment period from the former forced participation by the central government to the voluntary participation under market institution. During this adjustment period, output is predicted to fall. Moreover, if the transition periods run radically instead of gradually, the fall in output would be even worse.

By the example above, this paper is able to show the importance of network development during a transition period from a centralized governance structure to a decentralized governance structure. Nevertheless, the model presented has some shortcomings in that it only deals with a simple network model that relies on an increasing return to scale in state production. In reality, networks are more complex and sophisticated. The assumption of increasing returns to scale is plausible under monopoly but too restricted for a competitive market economy. In a competitive market literature, firms are commonly assumed to have a technology of constant return to scale. Therefore, one possible extension of this paper's model would be to develop more sophisticated communication network models. These would allow for an exploration of the value of each economic agent in a network; in other words, the contribution each player makes in a network to disseminate information can be analyzed. Thus we can detect who the key players are and what their roles are in their respective strategic positions (Ballester, Calvo-Armengol, and Zenou, 2006). For example, in a star communication network, one can analyze the central player, the gains and costs of being at the center of the network and its roles in transmitting information.

Another possible extension of this paper is to allow for a more flexible production function in both public and private sectors. This relaxation would allow the production function to reflect different market structures such as monopoly, oligopoly, and perfect competition. Given market structures, a more flexible production function would also allow us to encompass firms with stronger network interactions. For example, in industrial organization literature, networks among suppliers play a crucial role when the market is oligopolistic rather than when it is monopolistic, as the suppliers use the network as a barrier to entry. Therefore, using a more flexible production function and a more sophisticated network, one should be able to better explain the decline in output during governance transitions.

Conclusion

This paper provides a theory for why changing institutions from dictatorship towards democracy does not necessarily improve economic performance. The theory is based on the argument that suppliers need to be able to predict their partner's knowledge in order to voluntarily invest in state production. During dictatorship, no voluntary decisions are necessary since all agents are forced to work for state production. Once this central government loses its power to compel actions, the availability of information plays a crucial role in mitigating coordination problems among suppliers. Unfortunately, no immediate set of institutions exists that can disseminate knowledge to society. As suppliers are heterogeneous and some information is hidden from other suppliers, investment decisions produce an inefficient outcome. Only when communication networks among suppliers are well developed can the hidden information be revealed and transferred through the network. These knowledge dissemination structures are necessary to reach the optimal economic decision.

We have seen various equilibrium scenarios. Under full centralization, all suppliers are forced to participate in state production leading to suboptimal investment for higher threshold suppliers. Under complete market decentralization, imperfect information may cause the entire market to collapse due to adverse selection problems. Under a communication network, output depends crucially on how the network has developed. When networks fail to produce common knowledge, investment decisions are also not optimal, even if there is no uncertainty about the other players' information. In all these scenarios, investment decisions are suboptimal and coordination problems exist as long as information is not fully transmitted.

Common knowledge is therefore a key to solve the coordination problems. Once every supplier knows each other and they have a mutual understanding of each other, investment decisions can be optimal. However, it takes some time to build this common knowledge. In the meantime, lack of communication causes output to fall. Moreover, output may continuously fall at the beginning of a transition period but start to recover once networks are developed and information is well disseminated. This prediction therefore can be seen as an early warning to countries which are now at the beginning of their transition periods. Those countries should let the transition process proceed gradually instead of radically to foster the development of networks among economic agents.

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[1] The literature on networks has been fast growing since the last decade. Readers may refer to Jackson (2008) for an excellent survey.

[2] An example for the existence of these three firms in reality is seen in any electronic products. Apple for example uses many components produced by several independence firms. This component-producing firms are called suppliers in this paper.

[3] It is relatively easy to show the externalities in terms of skilled labor. It can be argued that a smart worker is more productive when he or she collaborates with other smart workers than with less skilled workers.

[4] We set the thresholds as integer just to simplify the analysis in the following sections and we restrict the upper limit to just to make sure that there are suppliers that are always better off taking their private alternatives even when all n suppliers are forced to engage in the state firm. As stated above, if n suppliers

join the state firm, they each will get return of n units regardless their thresholds. The higher the upper limit, then, shows the larger economic distortions caused by the state firm. We will relax this assumption in later discussion to compare the outcomes under different institutions.

[5] The analysis is independent on the distribution of threshold. The uniform distribution is just used as an example.

[6] In case of workers, we can assume that the worker gets very large negative disutility when the number of people joining the state firm is less than his or her threshold.

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