Disorganization and Network Institution *

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Abstract

This article considers the roles of networks on investment decisions to explain a possible economic down turn during a transition period from a dictatorship toward democracy. A supplier wants to invest one unit of capital good in a state firm only if there are enough number of supplier taking part such that the return on investment is at least their private alternatives. The suppliers build knowledge of others' private alternatives through a network. The model shows that an investment decision not only depends upon the knowledge about others, but also more importantly upon the the understanding about others' knowledge. When networks fail to fully disseminate knowledge, the investment decisions are suboptimal. Similar results apply when the central planning loses power to force supplier participation. These suboptimal decisions consequently lead to a decline in output after decentralization.

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1 Introduction

Changing economic regimes from a strong government power into a strong decentralization does not guarantee an increase in output. In fact, experiences show that output fall immediately after the collapse of a dictatorship and continue to decline during transition (see Blanchard and Kremer, 1997; Brenton et al., 1997; Duflo and Senik Leygonie, 1997). For example, most countries of the former Soviet Union experienced a large decline on output after the collapse of Soviet Union. Even, their output was less than half of its pre-decentralization period (Blanchard and Kremer, 1997). Indonesia also experienced similar cases after the collapses of Suharto's New Era regime in 1999. Despite myriad economic distortions during central planning and dictatorships, the movement towards competitive market failed to increase output, contradicting to common expectation.

This kind of decline in output is an interesting puzzle for neoclassical theory because decentralized transactions between suppliers and buyers do not boost economic growth. Existing literatures have tried to explain the economic reasons behind this down turn. Blanchard and Kremer (1997), for instance, argue that the presence of incomplete contracts and asymmetric informations make bargaining inefficient. Their arguments are best described as disorganization as follows. During dictatorship, the central government has power to force each party to participate in state firms, which are complex and highly specific relations The specificity opens room for bargaining after the dictatorship collapse. The complexity forces incomplete contracts. However, due to asymmetric information, the bargaining produces inefficient outcome which leads to a drop in output. The output loss may larger the more parties get involved in that complex set of specific relation so the cost of disorganization is higher. There are, of course, many other explanations of temporary output decline, including changing reporting incentives, the need to restructure enterprises, redeploy assets, and the increase in uncertainty that affects investment, among other things.

One limitation of many existing literatures including Blanchard and Kremer (1997) is that they ignore the relation among parties in analyzing the bargaining outcomes. Most literatures use non-cooperative game theory assuming no relation between agents and then predict the outcome of bargaining. In reality, however, some parties rely on networking in deciding strategic actions. Therefore, we believe that the bargaining outcomes also result from network relations among agents.

This paper proposes an alternative explanation of reducing output during transition by introducing the role of networks. The explanation here will complement other studies using asymmetric information to explain the possible dramatic fall in output. To do so, we first modify Blanchard and Kremer's model on how specificity and complexity may create coordination failure between a state firm and its suppliers. We 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, we borrow Chwe (1999) style of network analysis on collective action problems to explain how a fall on output may result from the network structures among the suppliers.

The paper is organized as follows. 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 under different institutions. Section 4 discusses the model implications and possible extensions. Section 5 draws conclusions.

2 The Model

The economy consists of one state firm and several private firms. Both types of firms use intermediate capital inputs from m number of suppliers. Profit maximizing private firms has monopoly power which offer take-orleave-it rent to the suppliers. Hence, the suppliers will get paid their private thresholds if they decide to supply a unit intermediate input in the forms of capital, k, to a private firm.

2.1 The State Firms

The state firm operates on an increasing return to scale with Ak^{α} type of production function where a ~ 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. In stead of being constant, however, we assume that the technology coefficient, A, increases with capital k. We can think of k as a smart capital which has positive externalities. In other words, this capital is more productive when it interacts with other capitals.[1] Specifically, for this model A(k) = k, the tech- nology coefficient is just the number of capitals. So, the state firm effective production function would be :

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

We assume for the purpose of the model that a = 1, so that the effective production function is k^2.

In addition, the state firm is not a profit, but a welfare maximizing firm. It operates under zero profit conditions and ensures the income equality among suppliers. We can also think of suppliers as workers. To ensure equality, it pays rent, r, to supplier i according to the firm's average product. With that particular effective production function, rent therefore would be

$$r_i = \frac{y}{k} = k \quad \forall i$$

Note here that only the quantity of capital matters, not the quality. Suppose, for instance, that two suppliers supply each a unit of capital to the state firm. The capital supplied is not necessarily quality equal. The return on capital from the state firm to both suppliers, therefore, r = k = 2 units, although each supplier supply just 1 unit. Of course, this does not mean that every supplier will join the state firm because it may have a sufficiently high opportunity costs, which are private alternative from private firms.

[1] 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 collaborates with other smart workers than with low skilled workers.

2.2 The Suppliers

There are n number of suppliers to decide whether to engage in the state firm production or to accept take-or-leave-it rent from private firms. Each supplier has one unit of capital. The capital differs in quality which is indicated by different thresholds $c_i \in (1, 2, \ldots, n+1)$.[2] As mentioned above, the private firms will pay each supplier exactly their thresholds to regard their quality.

Since the number of supplier is equal to the number of capital available in the economy, we can rewrite the private alternative as $c_i \in (1, 2, \ldots, k+1)$. It will clear later that there exists a link from the state firm's rent to the thresholds. In addition, each supplier has to decide simultaneously whether to participate in the state firm before knowing other supplier's decisions.

The decision of any particular supplier is obvious, i.e. join (j) if $r_i \geq c_i$ otherwise stay (s) and take the private opportunities. Notice that by this type of production function and the value of private alternative, the threshold is related to how many suppliers join the state production. This specific relation is the critical feature of this model. For example, a supplier with threshold of c = 2 would join the state firm only if accompanied by at least 1 other supplier. To see this, suppose that only him joining the state firm, so he gets rent equal to 1, which is lower than his threshold. If, instead, there are 2 other suppliers join, he gets rent equal to 3, which is strictly higher than his threshold. Moreover, a supplier with threshold m would prefer to join only if everyone else does; a supplier with threshold m + 1 would never join the state firm. Thus, we can formulate the profit of supplier i given his own threshold and everyone else actions a = (a1, .. . , aN) as follows :

$$\pi_i(c_i, a_1, \ldots, a_N) = \begin{cases} c_i & \text{if } a_i = s \\ r_i = k & \text{if } a_i = j \text{ and } \#h\,\{\text{s.t } a_h = j\} = k \end{cases}$$

This profit equation simply state that the supplier will get their private value, c, if he stays, otherwise get return of r, which is dependent upon how many other suppliers taking part in the state firm. So, the decision is simply whether $ex\text{-}ante\ r_i \geq c_i$. The point to make in the next sections is that the supplier predicts r using knowledge from networks.

2.3 Network

Suppliers use a network to communicate their thresholds and gain knowledge of others. Since the decision under network is voluntary, a commitment is not necessary. Even if there is a commitment, no penalties are levied for deviances. Following Chwe (1999), we define network $\rightarrow$ is a binary relation over *n*, where s $\rightarrow$ *i* means that supplier *s* communicate to supplier i. We define the neighborhood of *i* be every supplier who communicate to *i*. We assume that supplier *i* knows the threshold of everyone in her neighborhood. Furthermore, supplier *i* knows all network relation among members in his neighborhood, i.e. whether they communicate each other. Succinctly, for supplier *i*, let $B(i) = \{s \in N : s \rightarrow i\}$ be his neighborhood, where $i \in B(i)$ and for all $p, q \in B(i)$, he knows whether $p \rightarrow q$. Finally, since the decision and thresholds relate to the number of others joining the state firm, we can model this problem as a collective action problem and we will see how network structures play important roles. In particular, networks are potential to solve coordination problem among suppliers.

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[2] We set the thresholds as integer just to simplify the analysis in the following sections and we restrict the upper limit to n + 1 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.

3 Equilibrium

3.1 Central planning and perfect decentralization

Before looking at the role of networks, let us analyze the outcome of the economy under central planning and perfect decentralization. The ideal outcome of the economy is when there is no uncertainty. In this case, suppliers would be better off by joining the state firm if he has thresholds $c_i \in \{1, 2, \ldots, k\}$, where *k* is the number of suppliers joining. The supplier with threshold $c_i = k + 1$ would better stay since the maximum rent from the state firm is *k*. The central planner force everyone to engage in state production for the reason of greater good for greater number. However, this creates distortion to the economy because it surely makes suppliers with threshold k + 1 worse off. The degree of distortion is much larger when the upper limit of private threshold is much higher than k.

Under decentralization with m number of suppliers and the existence uncertainty, the decision also would not be optimal. In this case, as usual, supplier's type is unknown. What is known is that the type is drawn from some known distribution, say uniform. Thus, a supplier would join the state firm if his threshold is lower than the expected value of all other thresholds, which in the case of uniform, is $\frac{n+2}{2}$. The sub optimality may results from uncertainty about others' thresholds and also from coordination problems. In short, both central planning and perfect decentralization fail to produce optimal decisions. Meanwhile, networks, as we will see, may solve the coordination problems, but mere certainty about other thresholds is not sufficient to induce suppliers to participate in the state firm.

3.2 Equilibrium under network

A supplier is rational and he takes into account that other suppliers are also rational. Their rational decisions depends upon knowledge acquired from networks. The key modeling principle here is that supplier's knowledge determines his ability to distinguish between states of the world. If a person cannot distinguish between several state of the world, he must take the same action in all of them. Take for example that there are only two suppliers: *i* = (1,2) and *Ci* = (1,2,3). Hence, there are nine possible states of the world {11, 12, 13, 21, 22, 23, 31, 32, 33}, where 23 means supplier 1 has a threshold of 2 and supplier 2 has a threshold of 3.

Figure 1 presents null networks in which supplier 1 does not communicate to person 2 and vise versa. Hence, each supplier only knows his own threshold. Supplier 1's knowledge can be represented by the partition set {11, 12, 13}, {21, 22, 23} and {31, 32, 33}. Similarly, supplier 2's knowledge is represented by {11,21,31}, {12,22,32} and {13,23,33}.

Let consider supplier 1. He chooses whether to join or stay given a state of the world. If he has threshold 1, he will surely join the state firm. If instead he has threshold 3, he will never join regardless the threshold of supplier 2. How about if he has a threshold of 2? In this case, he ideally joins if the state is 21 or 22 and stays in state 23. However, since he cannot distinguish between these three states, he has to take the same actions. If he decides to stay, the state could be 21. But if he decide to join the state could be 23, so that the number of suppliers joining the state firm is lower than his threshold. If the latter happen, we assume that the supplier suffer from a large cost of joining the state firm so that the profit is lower than his threshold.[3] Thus, he joins only if he knows for certain that enough supplier will join. Hence, in this example, supplier 1 stays in all three states 21,22 and 23. The actions are also similar to person 2. Their actions are depicted in bottom parts of figure 1.

Figure 2 depicts each supplier's partition and action in case of complete graph or full communication. Here each person knows each other's thresholds and can distinguish among all states of the world. The difference between figure 1 and 2 is best to see when supplier 1 has threshold of 2. Before, he stays in state 21, 22 and 23 because he cannot distinguish among them.

[3] In case of workers, we can assume that the worker gets very large negative dis-utility when the number of people joining the state firm is less than her threshold.

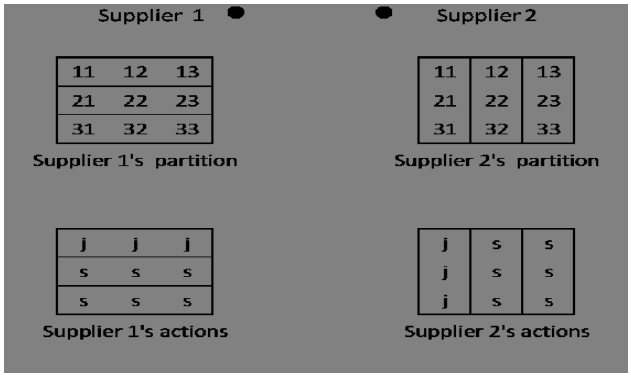

Figure 1: Null Network (No Communication)

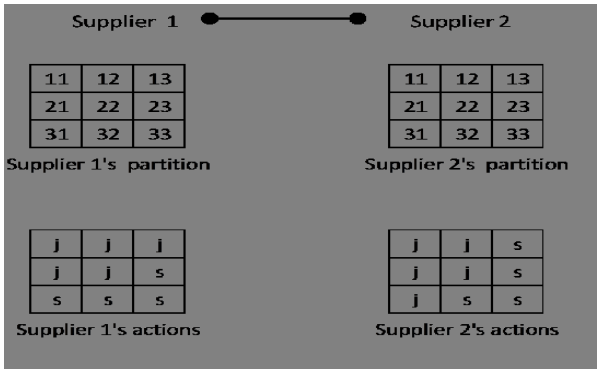

Figure 2: Complete Network (Full Communication)

Now, supplier 1 can distinguish between state 21, 22 and 23 and hence can take different actions in them. So, he will definitely decide to join at state 21 because he knows exactly supplier 2 has threshold of 1 and hence will join. In contrast, he definitely stays at the state 23 because he knows supplier 2 has threshold of 3 and hence will stay. Supplier 2 has similar case in which he join at state 12 and stay at state 32.

At state 22, when both have threshold of 2, there would be two equilibria; one for both suppliers to join and the other for neither to join. In this model, whenever there is this kind of indeterminacy, we assume that the equilibrium is one for both to join. In other words, when each supplier with threshold 2 discovers each other, we assume they join the state firm.

Having known the different of null and complete network, let consider incomplete network presented in figure 3. Here suppler 2 communicates with supplier 1, but supplier 1 does not. Of course, only supplier 1 knows exactly the state of the world. An interesting question is whether he joins the state firm when he knows the exact state of the world 22. The answer depends upon his expectation about supplier 2's decision. To join, he has to make sure that supplier 2 joins. However, he knows that supplier 2 cannot distinguish between state of the world, and therefore he predicts that supplier 2 stays. In particular, that is because from supplier 2's point of view, the state of the world could be 32. So, supplier 2 is predicted to stay and hence, supplier 1 will also stay. In short, under incomplete network, both suppliers stay at state 22 just because one supplier knows that the other supplier does not know for certain whether her counterpart will join.

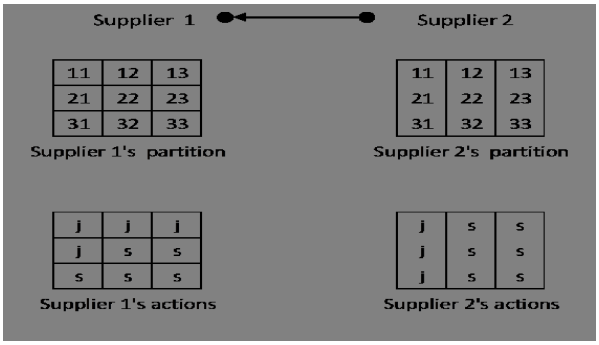

Figure 3: Incomplete networks

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 to make here is that knowing the state of the world is not sufficient to join. It is more important that knowing what other know, and knowing that others know what we know (common knowledge), so that the coordination problems can be solved.

4 Discussion and Extension

Improving the World Bank's definition of transition, Blanchard and Kremer (1997) define 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 towards voluntary participation under networks. Since our task is to explain why a country can experience a sharp decline in output even though it move from dictatorship towards decentralization, the example below partly answer that question. Here we allow the upper limit of private thresholds to be sufficiently high to indicate the more advanced private sectors.

Suppose that there are five suppliers with threshold 1,2,2, 9 and 9 units of capital respectively. Under central government, everyone are forced to engage in state production. With production function defined above, everyone has income from capital rent of 5 units, leading to total income of 25 units. Note here that two suppliers having threshold 9 are worse off. Meanwhile, when the economy is under decentralization without networks or null networks, only supplier 1 will join the state firm while others take their private alternative. Hence, the total income of the economy would be 1+2+2+9+9 = 23 units.

Under full networks, three suppliers join the state firm while two suppliers take their private alternatives, delivering total income of 3+3+3+9+9 = 27 units. Finally under incomplete network, the outcome would depend on the networks structures, i.e. who communicates to who. The important point here is that during transition period, income due to networks may be lower or higher than that due to central planner. When networks are incomplete, lower income are more likely to occur, but when networks are fully developed, higher incomes are more likely.

There are two conditions that make output falls after the collapse of dictatorship, imperfect network and the rapid growth in private sectors. Networks disseminates information. Rapid growth in private sectors indicated by relatively higher productivity gives more choices to economic agents. Hence, when informations and private sectors are relatively well developed, the economic distortions caused by central planning are relatively larger.
Nevertheless, this paper has some shortcoming. It only deals with a very simple network model and relying on an increasing return to scale in state production. Therefore, one possible extension is to involve more sophisticated network models. In that case we can look at the value of being in a network so that we can analyze the role of key players such as in Ballester et al. (2006). Another possible extension is to allow more flexible production function in both state and private sectors which requires stronger network interactions to be able to explain the decline in output during transition.

5 Conclusion

This paper provides a reason why changing institution from dictatorship towards democracy does not necessarily improve economic performances. The answer partly is that once the central government loses their power, there is no immediate institutions that can disseminate knowledge to the society. These knowledge disseminations are necessary to reach optimal decision. When networks fails to produce common knowledge, investment decisions are not optimal, even though there is no uncertainty about other player's characters. Thus, output may be continuously lower at the beginning of transition period and then start to recover once enough mechanism to do so.

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