Lecture Note on Disorganization

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0.1. Monopoly and Double Marginalization

Some would even argue that it is liberalization itself that causes output to decline. One argument is that with autonomy monopolistic enterprises use their freedom to raise prices and restrict output. This argument is hard to defend, however, given that the output fall is associated with increasing amounts of unsold output.

A more sophisticated argument along these lines focuses on the vertically integrated structure of production in STE's. The nature of industrial structure under central planning can be thought of in terms of vertical chains of production. An enterprise received inputs from one enterprise in the chain, and supplied output to another. We can think of the chain as an integrated production activity,

$$m \rightarrow x_1 \rightarrow x_2 \rightarrow ... \rightarrow x_n \rightarrow y$$

where m is the primary input, the x's are intermediate inputs, and y is the final output. In fact, we can think of the chain as a single multi-plant enterprise, organized and coordinated by the ministry. The fact that the plants are independent is not of great importance under planning because their activities are governed by the plan. The situation changes, however, once liberalization and enterprise autonomy occurs.

Suppose, for example, that the enterprises in the chain are monopolists in their respective industries. Then liberalization will allow each enterprise to exert their monopoly power in the chain. Breaking up a horizontally integrated structure leads to increased competition, but the situation is different for a vertical chain. We can assume that under planning enterprises delivered their outputs at marginal

cost.[1] Such an assumption would be what a planner is supposed to set prices at.[2] Now if prices are freed the movement to marginal cost pricing, in and of itself, would not result in a fall in output. Rather, it would mean that the value of output is now measured correctly. But if the constituent enterprises in the chain exert monopoly power, they will raise prices above marginal cost, and hence, restrict output. This would cause output to fall, as each enterprise in the chain would face an upward shift in its marginal cost curve.

The problem with the monopoly argument is two-fold. First, as already mentioned, the fall in output is associated with unsold output, making it hard to believe that the cause is restricted production. Second, the assumption of monopoly power is unwarranted, at least in the case of Russia. It is true that chains of production were tightly organized, but this does not mean that potential competition was absent.

The vertical chain argument is suggestive of another phenomenon, however: disorganization.

0.2. Disorganization

Return to the notion of producers in a vertical chain. Rather than focus on the role of monopoly, we know focus on the role of disorganization in response to liberalization.[3] Recall the discussion of network capital, and the effects of one producer defecting from the chain. Let us now pursue this with an example.

Suppose that a good is produced with a Leontief technology, and requires n steps of production.[4] This means that output is produced according to a technology where the input-output coefficients are constant. Let output be given by y and let x_1 and x_2 be inputs. Then the production function can be written as:

$$y = \min(a_{11}x_1, a_{12}x_2) \tag{1}$$

[1] This is, of course, an unrealistic assumption but it does not really detract from the analysis. The key point is that the prices charged under planning were less than the market-clearing prices. This is not true for all output, but it is probably the case in much of industry where prices did not reflect the opportunity cost of production.

[2] Think of a planner who maximizes the value of production. Such a planner will choose input-output combinations that put the economy on the efficiency frontier. The solution to the planners' problem will yield a set of shadow prices that value the opportunity cost of goods and factor services. When such a solution is decentralized this will im

[3] This example follows Blanchard and Kremer, though the argument is really from Ickes and Ryterman (1993).

[4] The point of the assumption about technology is to eliminate substitution possibilities. This is not essential; indeed, the spirit of the example is consistent with many other sources of rigidity.

where the $a'_{ij}s$ are the input-output coefficients. Output is constrained by the minimally available input. The important point is the absence of substitution in production of the two inputs.

Now we consider vertical chains. Under planning the production of a good was organized under the authority of a ministry. We can illustrate this as:

$$\overset{Ministry}{\boxed{m \rightarrow x_1 \rightarrow x_2 \rightarrow ... \rightarrow x_n \rightarrow y}}$$

where the point of the box is to illustrate that all of the activities take place within a unified organization. Transition leads to independence of the elements in the chain. The technology is the same, however; the difference is the lack of a coordinating authority. The industry is now characterized by:

$$m \rightarrow x_1 \rightarrow x_2 \rightarrow ... \rightarrow x_n \rightarrow y$$

We assume that each step is carried out by a different enterprise. A unit of a primary good is needed at the first step. At the end of the n steps one unit of the final good results, and we normalize the value of this to unity. The value of the intermediate output, at each step, is zero. The supplier of the primary input has an alternative use, which is c. This could be much lower than one. It is a private opportunity that could be exporting the good, or selling it for a less fabricated use.

Following Blanchard and Kremer we can develop three examples of problems that may arise.

0.2.1. Model 1: Bargaining

The important assumption is that each buyer along the chain knows only the supplier it was paired with under planning, and vice versa. This is not a bad assumption. We know from survey evidence that firms have little information about alternative suppliers.[5] This was especially true at the early stages of transition. The end of planning thus leads to n bargaining problems. Each unit must bargain with a supplier and a customer. We assume that there is Nash bargaining at each step, so that the surplus is split given the symmetry of the situation.

[5]For example, Ickes and Ryterman (1995) report that: In 1994, we interviewed the director of a firm in Voronezh, Russia, who said that he searched all of Russia for months for a supplier for a particular input, and found it quite accidentally through casual conversation at a party: the supplier was located across the street!

To see what happens start with the last step. The value of the surplus in the last stage (bargaining between the final producer and the last intermediate producer) is 1. This follows because the value of the good at stage n is still zero. So the last intermediate producer gets one-half of the surplus, 1/2. Now what happens at the prior stage? The surplus here is 1/2, so the next-to-last intermediate producer and the last producer each get 1/4. Continue in this fashion and it follows that the first intermediate producer gets $(1/2)^n$.

The surplus available to split at the first stage is $(1/2)^n - c$, since the first producer must purchase the primary input to produce. Clearly then we must have $c < (1/2)^n$ in order for there to be positive surplus to split. If $c > (1/2)^n$, then the primary producer will prefer to sell to someone else. Notice that c does not need to be all that large to trigger defection.

Suppose the primary producer defects. What is the magnitude of the fall in output? Notice that it could be as large as $1 - \left(\frac{1}{2}\right)^n$. Thus rather meager private opportunities can cause a rather large fall in output. We can interpret n as the level of complexity of production. As n increases the likelihood of defection increases exponentially.

This is a hold-up problem. Each producer in the chain must produce before bargaining with the next in line. Since the value of the intermediate step is 0, his reservation value is 0. This suggests that the problem would go away if each of the producers could sign an enforceable contract before production takes place. As long as $c < 1$, production could take place if the intermediate producers could sign a contract to split the $1 - c$. So really this problem is one of asset specificity and incomplete contracts. The notion that producers in transition could suffer from this problem is not farfetched.[6]

Notice that one solution to this problem would be vertical integration. As we noted earlier, under planning the production chain operated as if it were a single production unit organized by the ministry. Vertical integration of the enterprises recreates this chain. In this specific example vertical integration eliminates the bargaining problem between the enterprises. A related solution would be long-term contracts between the enterprises.

[6]It is interesting to compare this outcome with the double marginalization case. Notice, that in that case the raw materials producer has market power and thus a higher share of the surplus than is the case in the bargaining problem. This makes production in the state sector more likely. Of course, what is not explained is why the producer is able to extract monopoly rents in a situation of bilateral monopoly.

0.2.2. Model IA: Insurance

We can think about this problem in a related way by considering the insurance aspects of the problem. Links in a chain may insure each other. It could be that shocks to production at various points in the chain differ, and by sticking together the process is more robust. Prior to transition, the center subsidizes the chain, eliminating the need for the budget to balance. But after transition the budget must balance, so if one segment has an adverse shock other parts must pay more. Once this occurs, the surplus sectors may wish to defect.

Notice that this requires that the surplus sectors know that on average they will be surplus sectors. If they perceive their outside opportunities to be poor, they will hold on rather than defect because of the risk that the chain will break.

0.2.3. Model II: Uncertainty

Another example of disorganization, this time due to asymmetric information, arises when we consider a state-owned enterprise that needs n inputs to produce, each of which is produced by a different supplier. Again, we assume that production is Leontief, so that if there is a shortage of any input, output is zero. If all supply the input to the state firm then production is equal to n. If not, then output is zero. The suppliers, in turn, have alternative uses of their good, the value of which is c, distributed uniformly on $[0, \overline{c}]$.[7] The distribution of c is known, but the specific realization of c is private information to each supplier. We could think of these alternative uses as in the private sector. Therefore $\overline{c}$ could be quite low at the onset of transition.

The state firm chooses a price (the same for all inputs given the symmetry of the model).[8] If the price exceeds the reservation price production takes place. If not, suppliers use their private opportunities. How is the price determined? Notice that the probability that production will take place (given symmetry) is $(F(p))^n$. If production takes place the firm earns $1-p$ per unit of output, or $n(1-p)$. Hence, expected profits are given by

$$E\pi = (F(p))^n (n(1-p)) \tag{2}$$

Differentiating 2 with respect to price we find that the profit maximizing price is given by $p = \frac{n}{n+1}$, as long as this is less than $\overline{c}$. As long as $p < \overline{c}$, then the price

[7] Let $F(\cdot)$ be the distribution function, so that $F(0) = 0$ and $F(\overline{c}) = 1$. Draws are independent across suppliers.

[8] Presumably the firm chooses the price to maximize expected profits.

the firm will pay is increasing in n; higher n lowers the probability of production, so a higher price is needed to insure that production takes place. But the firm will never pay more than the alternative opportunity, since the probability of production is already unity with $p = \overline{c}$.

Notice that if the buyer was fully informed about the alternative opportunities of each supplier, then production would take place as long as $\overline{c} < 1$. If $\overline{c} > 1$ it may still be efficient to produce in the state sector, since the draws may be less than the upper bound. Eventually, as $\overline{c}$ increases production in the state sector declines, but total production increases as the private sector develops. As $\overline{c}$ rises above 1 it may still be efficient to continue to produce in the state sector, but sometimes there will be realizations of c such that suppliers defect. So expected output in the state sector declines, but this is efficient.

Under incomplete information the problem is more severe. Prior to transition there are no alternative opportunities so that state firm can offer a very low price. As transition starts and alternatives improve, some suppliers have more attractive opportunities. They start asking the State-owned Enterprise for a higher price. The State-owned Enterprise does not know which firms are bluffing and which are not, so they offer a given price and take the risk of not getting the inputs. If $\overline{c}$ is very low then the probability that any firm will defect is low, so state production is unaffected. As outside opportunities improve, however, the chances that the price offerred will be too low increases.

Contrast this with the case under incomplete information. In this case even with $\overline{c} < 1$ there may be cases when suppliers defect. Why? Because under incomplete information the price that the state firm sets may be less than $\overline{c}$, and with positive probability some enterprise may draw c such that $p < c < \overline{c}$. In this case output starts to fall before $\overline{c}$ reaches one, which is inefficient, because the outside opportunities are inferior to continued state production.

Expected output in the state sector, assuming the law of large numbers holds, is given by $Y_s = nF(p)^n = nF\left(\frac{n}{n+1}\right)^n$ given that $p < \overline{c}$ Once $p = \overline{c}$ then the probablity that production takes place is unity, so expected output is n. Hence, we can write expected output as:

$$Y_s = n \min\left[1, \frac{n}{n+1}\frac{1}{\overline{c}}\right]^n, \tag{3}$$

which clearly is decreasing in $\overline{c}$. As $\overline{c}$ gets larger, the probability that state-sector production takes place gets smaller and smaller.

Expected production in the private sector depends on the likelihood that state

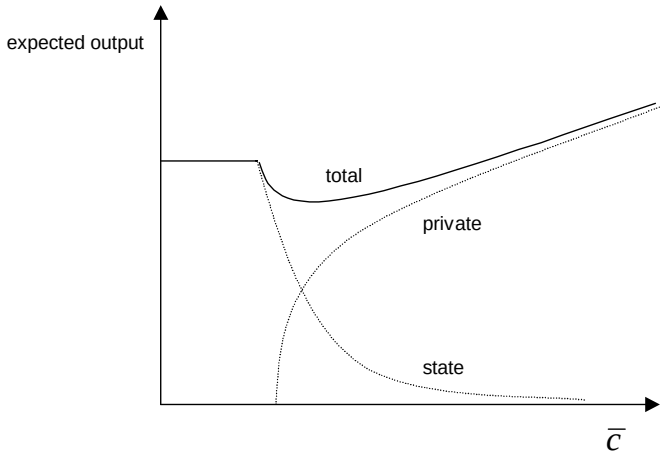

Figure 1: Expected State, Private, and Total Output

sector produces, multiplied by the expected conditional sum of alternative opportunities (conditional on at least one private alternative being larger than what the state offers). When $\frac{n}{n+1} > \overline{c}$ production takes place in the state sector with probability one, and it is thus certain that private production is zero.so private sector output is 0. If $\frac{n}{n+1} < \overline{c}$ then the probability that production takes place in the state sector is less than one. The probability that production takes place in the private sector is thus $1 - \left(\frac{n}{n+1}\frac{1}{\overline{c}}\right)^{n+1}$. Now suppose that the probability that state-sector production goes to zero. What is private sector output? Since c is uniformly distributed on $[0, \overline{c}]$ the mean private sector value of the input is $\frac{\overline{c}}{2}$. As there are n suppliers, expected private sector output must go to $\frac{n\overline{c}}{2}$. Hence, we can write, following Blanchard and Kremer, expected private sector output as:

$$Y_p = \frac{n\overline{c}}{2} \max\left[0, 1 - \left(\frac{n}{n+1}\frac{1}{\overline{c}}\right)^{n+1}\right] \tag{4}$$

which is clearly increasing in $\overline{c}$. Expected total production is obviously equal to the sum of these expressions, $Y = Y_s + Y_p$. The dynamics are evident in figure 1:

Notice that expected output falls in the intermediate range for $\overline{c}$. Why? When outside opportunities are very low then state sector production takes place for sure. When outside opportunties are very high state sector production collapses for sure. At intermediate levels, however, output can fall rather abruptly. The

result is that output initially falls as alternatives improve.

What is the effect of an increase in n on the size of the output decline? We can think of higher n as greater complexity of production. Suppose that n gets very large, and that $\overline{c}$ increases above unity. Then p approaches unity and state production collapses.[9] Why? Because with high n the probability that some firm will have a realization of $c > 1$ goes to unity. Notice that as $n \to \infty$ then $p \to 1$, and as soon as $\overline{c}$ exceeds unity state production collapses. Output falls from n to $\frac{n\overline{c}}{2}$.

There are two key assumptions used in this model. First, technological complementarities. Second, inefficient bargaining. The former is unexceptional. What about the latter? Roland suggests that the SOE could offer to pay the outside option. But this is unverifiable, and contract enforcement is problematic in transition. In the early stages of transition the inability to contract must be taken as the appropriate assumption.

Note the relationship of this argument to the supply diversion story. There partial liberalization leads to diversion. In this story full liberalization can still lead to output falls, due to uncertainty over outside opportunities.

0.2.4. Model III: Coordination

A coordination example can also be constructed. Suppose that the firm needs n workers (it could be supplying firms, but this is easier), and the technology is Leontief. If all workers stay, the firm produces one unit of output per worker. If a worker leaves, a replacement is hired with output per worker $\gamma < 1$. Here again n measures the degree of complexity, while γ is an inverse measure of the specificity of the production process.

Each worker has an alternative opportunity given by c, distributed on $[0, \overline{c}]$, with draws independent across workers. The distribution is known, but the specific realization is private information. We could think of this as alternative employment, perhaps in a western multinational. The firm pays a common wage, w, to all workers, equal to output per worker. This simplifies the analysis, but is probably not crucial.

The key assumption of the model is that workers must decide whether to take up the alternative before they know the decision of the other workers. This created the coordination problem. Workers are risk neutral, so that all we need to look at is expected output. There are thus two potential outcomes:

[9] The price never rises above unity because then expected profits would be negative.

1. all workers stay, output per worker and thus the wage are equal to unity

2. one or more workers leave, output per worker and the wage are equal to γ.

The decision problem for the agents boils down to determining some threshold level of outside opportunities, c^*, such that if $c < c^*$, they stay and vice versa. If a worker leaves he receives c. If he stays his expected earnings will depend on what the other $n-1$ workers do. Assume symmetry so that the other workers also have the same c^*. Then the probability that they all stay is $(F(c^*))^{n-1}$. So expected output per worker is thus equal to

$$(F(c^*))^{n-1} + \gamma(1 - (F(c^*))^{n-1}) \tag{5}$$

and the threshold is such that he is indifferent between staying and leaving:

$$c^* = \gamma + \min\left[1, \left(\frac{c^*}{\overline{c}}\right)^{n-1}\right](1-\gamma) \tag{6}$$

and the wage is[10]

$$w = \gamma + \min\left[1, \left(\frac{c^*}{\overline{c}}\right)^{n}\right](1-\gamma) \tag{7}$$

The key point is that there may be multiple equilibria, depending on the level of outside opportunities.

See figure

If alternative opportunities are very low, workers always stay in the firm, and output equals one. As outside opportunities increase there are two equilibria; in one of these output falls close to γ. With very high outside opportunities production in the state sector ceases.

Note the problem here is coordination, not uncertainty. If the outside opportunity were common knowledge, with $\gamma < c < \overline{c}$ there would still be two equilibria.

Remark 1. *Which equilibrium should prevail? Since they are Pareto ranked, one would expect the better one, especially if workers talk. But if workers think that the outside opportunities may vanish, and that others may defect, they will too; the good equilibrium can unravel.*

[10]The reason why we have $n-1$ in 6 and n in 7 is that the worker knows his own outside opportunity; the uncertainty is only with respect to the others.

Remark 2. *Notice that in this model output can just collapse. Why? As soon as* $\overline{c} > 1$ *there is some probability that a worker will leave. This reduces expected output for all other workers, and increases the likelihood that others will leave. As the complexity increases (higher* n*) this interaction is magnified.*

Remark 3. *This model captures the idea that key managers may not stay because they are worried that others will leave, even if there is a large payoff to turning the enterprise around. Or we could interpret it in a supplier context as enterprise A will not supply because he is afraid others will not, and payment depends on successful production. But then why not demand payment in advance?*

Remark 4. *Note the importance of the assumption of asymmetric information. What if the SOE offerred a contract to pay the outside option upon verification? If this is a take-it-or-leave it offer, then it ought to be in the interest of suppliers to accept the price. The question for transition is whether the assumption of verifiability is legitimate.*

0.2.5. Search Frictions

Roland and Verdier develop a related model of disorganization, focusing on search frictions rather than bargaining problems. In their model liberalization means that enterprises can search for new suppliers and customers. There are good matches and bad matches. If too many bad clients are searching the productivity of potential matches may fall. What is critical in their model is that relationship-specific investments take place only after long-term matches are formed. If search continues this will not happern, investment demand will fall, and output can fall.

Investment specificity is crucial in this model. Without it output would not fall even with bad matches, since the partners could produce this period and keep on searching. It is the asset specificity that introduces the cost of bad matches.

0.2.6. Assessment

The Roland-Verdier model is interesting from a theoretical point of view, but it does not seem to capture a really important element of transition. The problem is that very little search for new suppliers and customers took place in the early stages of transition. Rather there was a relationship-conservatism. Agents tried to maintain their relationships as much as possible. Networks of suppliers already

had relationship-specific investments. The problem is that they had no cusotmers who would purchase the goods at a price that covered their new costs.

It is important to interpret these examples carefully. In practice, instances of hold-up have been overcome precisely by maintaining production chains based on historical relations.[11] The problem for the enterprise is that if it enters a new productive chain it may be subject to hold-up because of the lack of historical relations. So the firm may stay in its existing network to avoid the hold-up problem.

The key point here is uncertainty. Consider the situation where a supplier is thinking of taking an outside opportunity, and suppose that if he does the state firm punishes by ceasing to deal with the supplier in the future.[12] The supplier does not know how permanent the alternative opportunities are.[13] Hence, the supplier will raise the minimum alternative opportunity that leads to switching. Risk aversion and irreversibility keep the producer in the chain. So uncertainty here acts as a conservative force to slow restructuring.

Notice that if the probability that the state-owned enterprise will survive is low, then the threshold for switching will fall. A lower probability of survival of the state-owned enterprise increases the opportunistic behavior of the other suppliers. Transition could be thought of as a period where these probabilities are low, so defection may be more common. We could think, for example, that if firms are flush with cash suppliers may be more reluctant to defect because there is a higher probability that they get paid. An enterprise with deep pockets could guarantee the price that will be paid independent of production, thus enhancing the probability that suppliers will not defect. But transition is precisely a period when enterprises do not have deep pockets. And lack of access to credit, due in large part to the lack of clarity of property rights in the early period of transition, then firms have "shallower" pockets.

Note, however, that with strong specificity the action of a given supplier affects the probability of survival. So if the supplier is worried about maintaining this production chain, they may not act opportunistically. That is, they consider the option value of sticking with the current production chain rather than risking its

[11] A good example would be the requirement for prepayment for new customers and purchase on credit for historical relations. This also acts as a conserving force, independent of uncertainty.

[12] Alternatively, we could think that if the supplier defects the rest of the production chain collapses, so the chances of reversing the decision are low.

[13] Alternatively, the supplier may anticipate that if he leaves the production chain he will be subject to a hold-up in the new chain. If the supplier defects the initial chain collapses, and the bargaining power of the supplier will fall. This also may raise the threshold for defection.

demise.

Similar problems occur in market economies. The question is whether the institutions necessary to deal with these problems exist in the early, or even late phases of transition. For example, we know that contract enforcement is more difficult in transition, especially in the FSU compared with CE. Vertical integration is another potential solution, but this raises difficult bargaining issues, precisely for the reasons that are clear in the first example.

The problem with the disorganization argument, however, is that it predicts that output falls are not associated with unwanted production. But we observe that the output fall is associated with unwanted output. These models are supply-driven (also the credit crunch models) yet unwanted output is associated with the declines in measured output. This is much more consistent with liberalization rendering unmarketable value destroying output.

1. Notes on Output Fall

How should we think about the output fall? Is it necessary restructuring or interim inefficiency due to lack of markets? The latter is the disorganization view. But it suffers from several discrepancies. Most notably, it is a supply effect, and the output fall is associated with inflationary pressure. Moreover, note that inflation was higher for industrial prices than for final goods prices.

The latter observation might be thought of as due to monopoly. But recall that while output prices went up unsold production did as well. Without state orders the demand for many products falls, especially with the higher prices meant to cover materials costs. Enterprises continue to produce and ship output even though it was not paid for. This led to inter-enterprise arrears, and to the decapitalization of enterprises – amortization funding collapses as does maintenance of the existing capital stock. This freezes in place the existing stock and makes restructuring even more difficult. Subsidies and other means of softening the blow exacerbates the distortion, freezing in place the irrational capital stock. This is all very hard to square with the monopoly story.

A much better explanation is the Ericson model. Ericson shows how the irrational structure of Soviet pricing meant that liberalization required a relative price shift that produced much of the observed phenomena. Materials prices increased with liberalization raising the costs of production for industry. Enterprises passed these increased costs into their prices, which further raised input prices. This process would continue indefinitely, except for the fact that demand limits

how high prices can go, as does external liberalization. With real limits on purchasing power some of this higher priced output cannot be purchased. Prices for these goods rise dramatically, but sales decline. This resembles very closely what happened in Russia and other post-Soviet economies.

The source of the problem here is the inherited industrial structure. It does not accord with economic rationality and it distorts the true sources of value added. Liberalization requires prices to adjust, but this industrial structure cannot be made productive.

1.1. Budget Constraints

Hardening budget constraints are part of the story of transition. But the context is typically missed.

What do we mean by hardening of budget constraints? Typically firms must satisfy a net worth constraint: the net present value of the firm must be positive. But in the context of transition this amounted to a cash-flow constraint. Why?

- financial underdevelopment
- pooling of *wa* and *ca*

In this context, hard budget constraints meant a more stringent constraint than typical. Enterprises reacted. The government could not enforce it. Enterprises found other means to survival.

2. Restructuring

One could certainly argue that the real issue is lack of restructuring. The output fall is a detour from this more important question. The issue is what prevents the replacement of ineffcient capital-labor combinations with ones that are economically rational. Is it just politics? Hopefully we can explain more than simply arguing that.

What determines the decision to restructure? Think of enterprises in a production chain as a coalition. An enterprise knows it value as a member of the coalition, but not the individual value of its assets. If the enterprise leaves the coalition then value of the rest of the coalition falls dramatically.