Disorganization

DISORGANIZATION*

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Under central planning, many firms relied on a single supplier for critical inputs. Transition has led to decentralized bargaining between suppliers and buyers. Under incomplete contracts or asymmetric information, bargaining may inefficiently break down, and if chains of production link many specialized producers, output will decline sharply. Mechanisms that mitigate these problems in the West, such as reputation, can only play a limited role in transition. The empirical evidence suggests that output has fallen farthest for the goods with the most complex production process, and that disorganization has been more important in the former Soviet Union than in Central Europe.

Figures I and II show the evolution of official measures of GDP in the countries of the former Soviet Union since 1989. The two figures give a striking picture, that of an extremely large decline in output. In ten out of the fifteen countries, GDP for 1996 is estimated to stand at less than half its 1989 level.[1]

The evolution of these official measures reflects in large part a shift to unofficial, unreported activities. But studies that attempt to adjust for unofficial activity still conclude that there has been a large decline in output. For example, a recent study by Kaufmann and Kaliberda [1995] puts the actual decline in GDP from 1989 to 1994 for the set of countries of the former Soviet Union at 35 percent.[2]

This large decline in output presents an obvious challenge for neoclassical theory. Given the myriad price and trade distortions present under the Soviet system, these countries surely operated far inside their production frontier before transition. With the removal of these distortions, one would have expected them to operate closer to the frontier, and thus output to increase. And

*We thank Susan Athey, Abhijit Banerjee, Simon Commander, William Easterly, Avner Greif, Daniel Kaufmann, Rody Manuelli, Gian-Maria Milesi-Ferreti, Simon Johnson, Paula de Masi, Wolfgang Pesendorfer, David Romer, Julio Rotemberg, Andrei Shleifer, Antonio Spilimbergo, and V. V. Chari for discussions and comments. We thank Lawrence Katz and an anonymous referee for helpful suggestions. We thank Esther Duflo and Claudia Senik-Leygonie for providing us with their data for Russia. We thank Maciej Dudek, Edward Miguel, and Andrei Sarychev for excellent research assistance. Michael Kremer thanks the Research Department of the International Monetary Fund, where some of the initial work for this paper was conducted.

1. These figures are constructed from data in Table 1, Statistical Tables, *The Economics of Transition,* Volume 4 (1), 1996, Oxford University Press.

2. Estimates for a number of other studies are given and discussed in European Bank for Reconstruction and Development [1996], Annex 11–1.

The Quarterly Journal of Economics, November 1997.

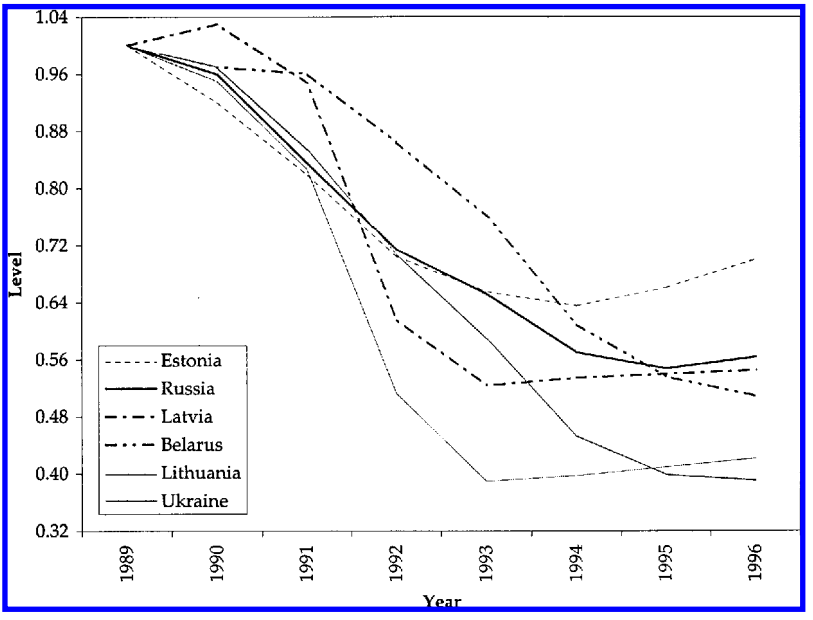

FIGURE I
The Evolution of GDP in Russia, Belarus, Ukraine, and the Baltics

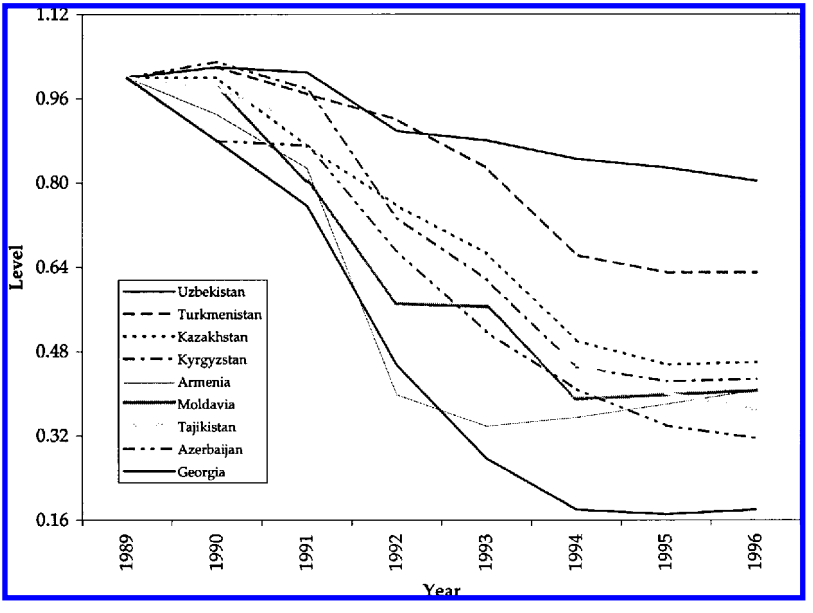

FIGURE II
The Evolution of GDP in the Republics of the former Soviet Union

one would have expected that the development of new activities would shift the production frontier out, leading to further increases in output over time. This clearly is not what has happened.

In this paper we explore one explanation for the decline of output, which we believe has played an important role. The best word to describe it is disorganization. Its logic goes as follows.

- Central planning was characterized by a complex set of highly specific relations between firms. (Following standard usage, we shall call a relation "specific" if there is a joint surplus to the parties from dealing with each other rather than taking their next best alternative.) There were typically fewer firms in each industry than in the West.[3] For many inputs, firms had or knew of only one supplier from which to buy. For many of their goods, firms had or knew of only one buyer to whom to sell.[4]
- Specificity opens room for bargaining. Under asymmetric information or incomplete contracts, the result of bargaining may be inefficient. If many parties are linked in a complex set of specific relations, the output loss may be large.
- Through various institutions and arrangements, economies develop ways of limiting the adverse effects of specificity.

Under central planning, the main instrument was the coercive power of the central planner to enforce production and delivery of goods.

In the West, for some goods, there are many alternative buyers and sellers, eliminating specificity altogether. And for the other goods the scope for adverse effects of specificity is reduced by arrangements ranging from vertical integration, to contracts, to long-term relations between firms.

- Transition eliminated the central planner, and thus the main instrument used to limit the adverse effects of specificity under the previous regime. But the mechanisms that exist in the West could not operate right away. New buyers and sellers cannot be created overnight. The role of contracts is reduced when many firms are close to bankruptcy. At the

3. One reason is that, in the West, (nonnatural) monopolies and associated monopoly rents create incentives for entry of new firms. There was no such mechanism under central planning.

4. The buyer was often a centralized trade organization, which disappeared altogether during transition.

same time, transition has created the anticipation that many state firms will disappear or change suppliers, thus shortening horizons and reducing the scope for long-term relations to avoid the adverse effects of specificity.

• The result has been the breakdown of many economic relations. Trade between the republics of the former Soviet Union has fallen by far more than seems consistent with efficient reallocation. Despite price liberalization many firms report shortages of inputs and raw materials. Firms lose crucial workers/managers, who may have been their only hope for restructuring and survival. Cannibalization of machines is widespread, even when it appears that machines could be more productive in their original use. This general disorganization has played an important role in explaining the decline in output.

Our paper is organized as follows.

• In Sections I to III we show through three examples how specificity, together with either incompleteness of contracts or asymmetric information, can lead to large output losses. We show how the effects depend both on the degree of specificity in the relations between firms, and on the complexity of the production process. We also show how the emergence of new private opportunities can lead to a collapse of production in the state sector, and to a sharp reduction in total output.

• In Section IV we argue that the mechanisms used in the West to deal with specificity take time to develop and have therefore played a limited role in transition.

• In Section V we provide evidence that, in line with our theory, in the former Soviet Union, output has fallen farthest in those sectors with the most complex production processes.

• In Section VI, taking measures of reported shortages of inputs by firms as indicators of disorganization, we show that disorganization appears to have played an important role in the former Soviet Union, but a more limited one in Central Europe.

• In the conclusion we compare our explanation of the decline in output with several other explanations, and argue that it helps to explain why output in China has increased, rather than decreased, in transition. We also discuss policy implications.

Before starting, it is useful to do some product differentiation.

Our analysis is based on standard ideas in microeconomics, from holdup problems under incomplete contracts, to problems of bargaining under asymmetric information, to the breakdown of cooperation in repeated games as the horizon shortens or as alternative opportunities arise.[5] The potential importance of specificity for macroeconomics has been emphasized recently by Caballero and Hammour [1996]. Our contribution is to point to the potential importance of these problems in the context of transition.

Our analysis complements other explanations of the decline in output in transition. Most explanations start from the need for state firms to decline and transform, and for new private firms to emerge. Some argue that the output decline may reflect efficient reorganization and unmeasured investment in information capital, as firms try new techniques and workers look for the right jobs [Atkeson and Kehoe 1995; Shimer 1995]. The others combine reallocation with some remaining distortions, explaining the decline in output as a second-best outcome. Perhaps the most widely accepted explanation argues that efficient reallocation would have implied a decrease in real wages of some workers inconsistent with either actual wage determination or political concerns about income distribution; as a result of these constraints, employment and output have decreased (see Blanchard [1997] for further discussion). Three theories are related to ours. The first, developed by Murphy, Shleifer, and Vishny [1992], emphasizes the potentially perverse effects of partial price liberalization. The second, developed by Shleifer and Vishny [1993], focuses on the role of corruption, and emphasizes the adverse effects of rent extraction by government officials. The third, developed by Li [1996], focuses on the scope for decentralization to activate monopoly power and lead to a decrease in output. We shall point out the relations as we go along.

Finally, our analysis is related to an older literature on the role of complex networks of production in the pretransition Soviet Union [Banerjee and Spagat 1991, 1992]. More recently, Ickes, Ryterman, and Tenev [1996] have discussed the role of these networks in transition.

5. Wells and Maher [1995], for example, show how outcomes within a household may be worsened by improved outside opportunities for a member providing "public goods" to the household.

I. A Chain of Production

This section and the next two present examples of how market imperfections that lead to inefficient bargaining can cause output to fall with transition. In the example of this section, bargaining breaks down because contracts are incomplete.

The example goes as follows.

- A good is produced according to a Leontief technology and requires n steps of production. Each step of production is carried out by a different state firm. (A point of semantics. We shall use "state" firms to denote the firms that existed under central planning and produced under the plan, whether or not they have been privatized since the beginning of transition. We shall use "private" firms to denote the firms that have been created since transition.) One unit of the primary good leads, after the n steps, to one unit of the final good. Intermediate goods have a value of zero, and the price of the final good is normalized to one.

  One may replace "distribution" by "production" here: for an interpretation with a Soviet flavor, think of a good having to travel through n republics, to go from the primary producer to the final distributor.
- The supplier of the primary good has an alternative use for the input equal to c. One can think of c as a private opportunity, perhaps the production of a much simpler good, avoiding the division of labor implicit in the chain of production; c may therefore be much lower than 1. It is straightforward to introduce similar private opportunities for the intermediate producers along the chain of production, but the point is made more simply by ignoring that possibility.[6]
- Each buyer along the chain knows only the supplier it was paired with under central planning, and vice versa. The end of central planning thus leaves n bargaining problems. We assume that there is Nash bargaining at each step of production, with equal division of the surplus from the match.

We assume that it is possible to simultaneously exchange goods and cash, but not to commit to deliver goods in the future.

6. An assumption that would make a difference is if outside opportunities were always equal to or larger than c, and were increasing with the stage of processing. As will be clear below, under our assumptions about bargaining, state production would then always take place when it was efficient for it to do so. In other words, it is essential for our results to assume that a partly processed good has a lower outside value than the initial input.

Thus, it is impossible for each firm in the chain to sign a contract with the buyer (the next firm in the chain) before it has produced the good. Each firm must first buy inputs and produce, and only then—once the cost of producing is sunk—strike a bargain with the next producer in the chain. This assumption makes sense in the West in contexts in which each producer needs the input processed in a specific way, which cannot be fully contracted on in advance, as in Grossman and Hart [1986] and Hart and Moore [1990]. The assumption is likely to be of broader relevance in the former Soviet Union, where the legal system is still in construction, contract enforcement is weak, and firms often have few valuable assets, making it hard to punish them for deviating from contracts.

The characterization of the solution is straightforward and is obtained by working backward from the last stage of production. The value of the surplus in the last bargaining problem, between the final producer and the next-to-last intermediate producer is equal to one (by assumption, the good is useless before the final stage). Thus, the next-to-last intermediate producer receives $(1/2)$. Solving recursively, the first intermediate producer receives $(1/2)^n$.

The surplus to be divided between the first intermediate producer and the supplier of the primary good is equal to $(1/2)^n - c$. If $c < (1/2)^n$, the surplus is positive, and production takes place along the chain. If instead $c > (1/2)^n$, the primary producer prefers to take up his private opportunity. Thus, the appearance of even mediocre private opportunities will lead to the collapse of production in the state sector (what matters here is not the absolute level of private opportunities, but their level relative to opportunities in the state sector); in our example, the decrease in total output may be as large as $1 - (1/2)^n$. The more complex the structure of production (the higher n), the smaller the private opportunities needed to trigger the collapse of the state sector.

Note that the collapse of output is really due to the combination of two factors: the improvement in private opportunities, *and* the loss of coercive power by the government. If, in the face of improving private opportunities (an increase in c), the government retained its coercive power, i.e., could still force suppliers to deliver, it could achieve the efficient outcome, and output would not decline. To the extent that the last years of the Soviet Union were associated with a steady decrease in the coercive power of the central planner, this may explain why Soviet economic perfor-

mance deteriorated before the start of transition. And this also implies that a transition in which the central planner retained some power, and could thus limit the role of decentralized bargaining, might be associated with a smaller decline in output. We shall return to this theme both in our next example, and in our discussion of China in the conclusion of the paper.

The source of the inefficiency and of the collapse of output under decentralized bargaining in our example is a "holdup" problem: each intermediate producer must produce its intermediate good before bargaining with the next producer along the chain. Once he has produced the intermediate good and has no alternative use for it, his reservation value is equal to zero. The inefficiency would therefore disappear if all the producers could sign an enforceable contract before production took place. In this case, production would take place as long as c was less than 1. The source of the problem is thus the combination of specificity, which gives rise to the bargaining problems, and incomplete contracts.

Even in the West, many goods are sufficiently specific that firms can only get them from one supplier, or sell them to one buyer. In Section IV we argue that vertical integration and long-term relations between producers, which help alleviate this problem in Western economies, can play only a limited role in transition.

II. A State Firm and Its Suppliers: Case I

In our second example the source of bargaining breakdown is not incomplete contracts but asymmetric information.

- A state firm needs n inputs in order to produce. If all inputs are available, the firm can produce n units of output. Otherwise, output is equal to zero.
- Each input is supplied by one supplier. Each supplier has an alternative use for his input, with value c, distributed uniformly on $[0,\bar{c}]$. Let $F(\cdot)$ denote the distribution function, so that $F(0) = 0$ and $F(\bar{c}) = 1$. Draws are independent across suppliers.

  We can again think of c as a private sector alternative, such as small scale production or sale of the input to a foreign buyer. The distribution of c is known, but the specific realization of each c is private information to each supplier. $\bar{c}$ can be

thought of as indicating the degree of development of the private sector, which we assume is very low pretransition, and increasing over time thereafter.

- The state firm maximizes expected profit. We assume that it announces a take-it-or-leave-it price p to each supplier (given the symmetry built in the assumptions, the price is the same for all suppliers). If the price exceeds the reservation prices of all suppliers, production takes place in the state firm. Otherwise, it does not, and all suppliers use their own private opportunity.

We can now characterize expected state, private, and total production as a function of $\bar{c}$ and n. We must first solve for the profit-maximizing price set by the state firm. Given price p, expected profit is given by

$$\pi = (F(p))^n(1 - p)n.$$

The first term is the probability that production takes place. The second is equal to profit if production takes place. Maximizing with respect to p yields the profit-maximizing price,

$$p = \min(\bar{c}, n/(n + 1)).$$

The firm never pays more than the maximum alternative opportunity $\bar{c}$. But, if the maximum alternative opportunity exceeds $(n/(n + 1))$, the firm does not increase its price. Increasing the price would increase the probability that production takes place, but would decrease expected profit.

Given this price, expected state production Y_s is equal to

$$Y_s = n \min\left(1, \left(\frac{n}{n + 1}\frac{1}{\bar{c}}\right)^n\right).$$

Expected private production Y_p is equal to the probability that state production does not take place, times the conditional expected sum of alternative opportunities (conditional on at least one private alternative being larger than the price offered by the state firm). Y_p can be written as[7]

7. The expression for Y_p is derived as follows. Denote by Ω the event where at least one private opportunity exceeds the price, so that production takes place in the private sector. Y_p is thus given by

$$Y_p = \int_\Omega (c_1 + \ldots + c_n) f(c_1) \ldots f(c_n) dc_1, \ldots, dc_n.$$

$$Y_p = \frac{n\bar{c}}{2} \max\left(0, 1 - \left(\frac{n}{n+1}\frac{1}{\bar{c}}\right)^{n+1}\right).$$

Expected total production is in turn equal to

$$Y \equiv Y_s + Y_p.$$

The best way to see what these equations imply is to look at Figure III, which plots the behavior, for $n = 4$, of expected state, private, and total production (all three normalized by the number of inputs, n) for values of $\bar{c}$ ranging from 0.4 to 2.4.

To interpret the figure, it is useful to keep the efficient benchmark in mind (which would be the outcome if the monopsonist was fully informed about the alternative opportunities of each supplier and thus was fully discriminating, or if there were markets for inputs that revealed these alternative opportunities). As long as $\bar{c}$ was less than one, production would always take place in the state sector. As $\bar{c}$ increased above 1, it would sometimes be efficient not to produce in the state sector: expected production in the state sector would decrease, but total expected production would increase. Eventually, as $\bar{c}$ became very large, most production would take place in the private sector, with expected total production increasing linearly with $\bar{c}$.

In contrast with the efficient outcome, increases in private opportunities lead initially to such a large decrease in state production that the net effect is a decrease in total production. Total production starts declining when $\bar{c}$ exceeds $(n/(n+1)) = 0.8$. For $\bar{c}$ equal to 1, the efficient outcome would be that production still only takes place in the state firm, with total production equal to n (1 in the figure, as output is divided by the number of inputs). The actual outcome is a production level of only 0.75. It is not

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Let Ω^c be the complement of Ω, the event where each private opportunity is less than the price. Rewrite Y_p as

$$Y_p = \int (c_1 + \ldots + c_n) f(c_1) \ldots f(c_n)\, dc_1, \ldots, dc_n - \int_{\Omega^c} (c_1 + \ldots + c_n) f(c_1) \ldots f(c_n)\, dc_1, \ldots, dc_n.$$

Solving the two integrals gives

$$Y_p = \frac{n\bar{c}}{2} - \frac{n\bar{c}}{2} \min\left(1, \left(\frac{n}{n+1}\frac{1}{\bar{c}}\right)^{n+1}\right).$$

Rearranging gives the equation in the text.

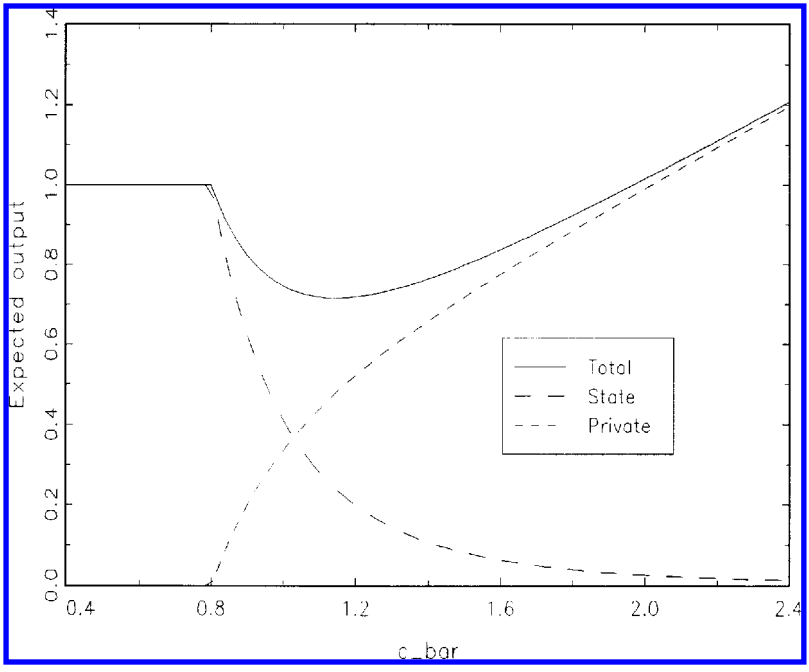

FIGURE III
Behavior of Expected State, Private, and Total output; $n = 4$

before $\bar{c}$ has reached a value of about 2.0 that total production is again equal to its pretransition level.

Complexity of production in the state sector increases the size of the decline in output. We can think of n as an index of the complexity of the production process. Figure IV shows the effects of alternative values of n on the evolution of expected total production (again normalized by the number of inputs) as a function of $\bar{c}$. The larger n, the higher the price that the state firm offers: for $\bar{c}$ large enough so that the minimum condition does not bind, $p = n/(n + 1)$. Thus, the higher n, the higher the value of $\bar{c}$ required to trigger the collapse of the state sector. But, also the higher n, the smaller the probability that production takes place in the state firm for $\bar{c} \geq p$, and thus the greater the initial collapse of total production as $\bar{c}$ increases. As n approaches infinity, the price offered by the state firm approaches 1, and state production collapses as soon as $\bar{c}$ increases above 1: the probability that at least one supplier will have a realization of $\bar{c}$ greater than 1 goes

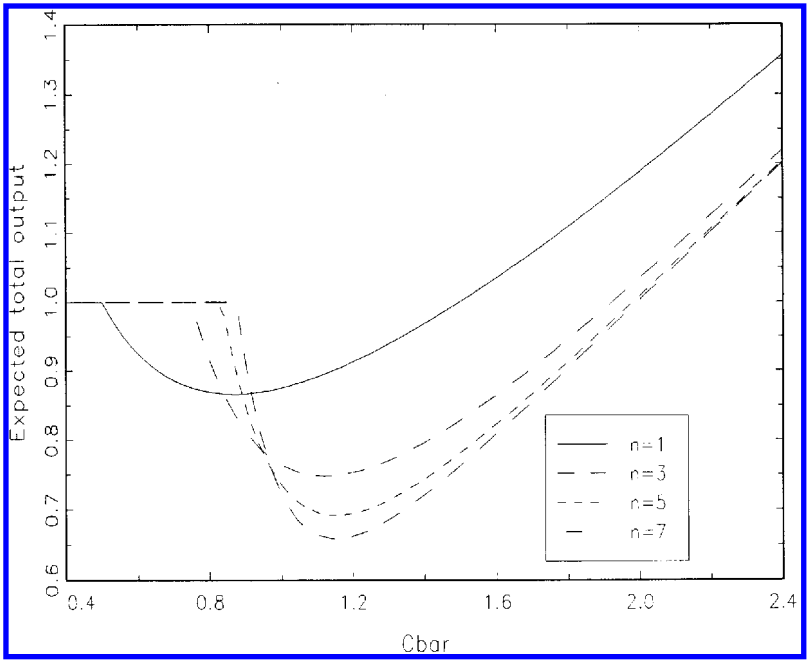

FIGURE IV
Behavior of Expected Total Output for Different Values of n

to 1. Thus, as n approaches infinity, the path of total production (normalized by the number of inputs) approaches 1 for $\bar{c} < 1$, and $\bar{c}/2$ (the expected value of private production) for $\bar{c} > 1$. When $\bar{c}$ increases above 1, output falls by 50 percent.

Putting our results in words: pretransition, suppliers have such poor alternative opportunities that the state firm can offer a price at which there is no better alternative than to supply. As transition starts, and alternatives improve, some suppliers now have more attractive opportunities. They start asking the firm for more. Not knowing which suppliers are bluffing and which are not, the firm offers a given price and takes the risk of not getting the inputs. The result is an initial decrease in total production as opportunities improve.

Let us take up five related issues at this point.

(1) We have restricted the state firm to make take-it-or-leave-it offers to suppliers. One may ask what would happen if we considered more general mechanisms, in which suppliers sent messages about their outside opportunities, with both the decision of

whether to operate the state firm and the payments to suppliers depending on these messages. The answer follows from the work on multiagent bargaining under asymmetric information by Mailath and Postlewaite [1990a, 1990b] and Rob [1989]. In the context of our model, their results imply that, as the number of suppliers gets large, the probability that the state firm will operate goes to zero—even when it is efficient for the state firm to produce. Intuitively, this is because, as the number of suppliers gets large, the chance that a single supplier is pivotal in determining whether the state firm will produce becomes small, and hence the amount suppliers are paid cannot vary much with their announced private opportunity. In this sense, the optimal mechanism has similar properties to the take-it-or-leave-it mechanism we have assumed here.

(2) We have assumed that transition implied the disappearance of the central planner, and that outcomes were fully determined by decentralized bargaining. One may ask what would happen if, in the face of improved private opportunities, the government retained some coercive power.

Suppose that the government could still impose some punishment to those suppliers who did not supply (say, by using transfers, demotions, or even fines or jail sentences for those who did not deliver to the state firm).

As long as $\bar{c}$ was less than 1, a sufficiently strong government could, just as in our first example, achieve the efficient outcome: by using a sufficiently large punishment, it could make sure that all suppliers delivered to the state firm—the efficient outcome when $\bar{c}$ is less than 1. If $\bar{c}$ was greater than 1, the government (which, by assumption, does not know the values of private opportunities) could not achieve the efficient outcome, but could still increase expected total output by using some positive level of punishment. To see this, take the case where $\bar{c}$ is only slightly greater than 1; we saw earlier that, in that case, absent the central planner, state production would almost surely collapse when n got large, leading to a large decrease in total output. In that case, it is clear that a small punishment will be sufficient for suppliers to supply and for state production to always take place, an outcome which is nearly always efficient, and leads to an increase in expected output. Thus, the collapse of output in our second example can be seen as the combination of improved private opportunities and a decrease in the coercive power of the government.

We can reinterpret this result in the light of the work on multiagent bargaining under asymmetric information referred to earlier. D'Aspremont and Gerard-Varet [1979] have shown that, in such games, a social planner who can impose negative utility on players can achieve a fully efficient outcome through a revelation mechanism. This result relies crucially on the absence of a participation constraint—the social planner must have the power to extract sufficient payments from the agents in order to provide them with the incentives to behave efficiently. In the Soviet Union participation constraints became binding with the end of central planning and privatization.

(3) We have assumed that the sellers had private information, and that the buyer set the price. But the roles could be reversed. What is essential for our results is that there be private information, and that the uninformed party have some bargaining power.

Suppose, for example, that the state firm has private information about the value of final production, but that, now, suppliers make price offers to the firm. Assume that they have no private opportunities, and choose the price so as to maximize their expected revenue. If the sum of the prices charged by suppliers is higher than the actual value of final production, production does not take place. It is straightforward to show that in this case the probability that suppliers collectively ask for too much and that final production does not take place is positive. It is also easy to show that this probability increases in the number of suppliers: the more complex the production process, the more likely is state production to collapse.[8] To relate this result to the previous point, note that what triggers the collapse of output here is the emergence of decentralized bargaining, not the appearance of private opportunities.

This result is also closely related to results on the adverse effects of corruption on output. We have assumed that the price setters were suppliers. But they may be government officials selling permits to operate the firm. There is therefore a close parallel between our argument that decentralized bargaining between firms has led to a decline in output, and the argument made by

8. More formally, assume that if all inputs are supplied, output is equal to $n\varepsilon$, with ε distributed, for example, uniformly on [0,1]. Now consider the problem facing supplier i. Denote the sum of the prices set by all other suppliers as p_{-i}. Supplier i maximizes $(1 - (p_{-i} + p_i)/n)p_i$, and thus chooses a price equal to $p_i = (n - (p_{-i})/2$. In the symmetric equilibrium $p_i = (n - 1)p_i$, so that the common price is equal to $p = n/(n + 1)$, and the state firm produces with probability $1/(n + 1)$.

Shleifer and Vishny [1993] that political decentralization has led to competition among rent extractors, with large adverse effects on output.[9]

(4) Our example is closely related to the analysis by Murphy, Shleifer, and Vishny [1992] of the effects of partial price liberalization. In their model, the fact that some prices are held fixed while others are left free can also lead to an inefficient diversion of output from state to private firms (Young [1996] argues that a similar perverse mechanism is relevant in China, and has led to too much replication of activities across provinces). Our argument is that the same perverse effects can occur even under full price liberalization. The fact that shortages were particularly high in Russia in the early transition (see Section V) indeed suggests the relevance of partial price liberalization. But the fact that, years after nearly complete price liberalization, firms still report shortages (again see Section V) suggests that more is at work than partial price liberalization. The implications of the two models for policy are potentially quite different. The Murphy-Shleifer-Vishny model implies the desirability of full price liberalization, while our model supports the idea that full price liberalization may lead to reductions in output and welfare, at least in the short run.

(5) Our example overstates the adverse effects of private sector growth. Private sector growth has at least two dimensions. We have focused on the first, the improvement in private opportunities for existing suppliers. We have shown that such an improvement may lead to a decrease in state and in total output. The second is the creation of new suppliers and is likely to work the other way: the increase in the number of suppliers is likely to decrease specificity, alleviate bargaining problems, and thus increase both state and total output. To the extent that entry of new suppliers takes time, the first dimension seems likely to dominate early in transition; the second, however, may dominate later on.

III. A State Firm and Its Suppliers: Case II

The third example shows how specificity and complexity can combine to create coordination failures, and a collapse of output.

In this model, technology is again Leontief in n inputs. Be-

9. Empirical evidence on the number and the size of bribes needed to run a business in the Ukraine today is given by Kaufmann and Kaliberda [1995].

cause the interpretation is more natural here, we think of the n suppliers as the n crucial workers in the firm. But this is not essential. The essential difference between this and the previous model is in the timing of decisions. In the previous model, if state production did not take place, suppliers could still take up their private opportunity. Here, suppliers have to decide whether or not to take their private opportunity *before* they know whether production is taking place in the state firm. This difference in timing introduces problems of coordination between workers, which we now examine.

The model is as follows.

- A state firm needs n workers in order to produce efficiently. Assume that its technology is Leontief in those workers (who are therefore the workers who are difficult to replace; we can think of the other workers as having been solved out of the production function).

  If all workers stay, the firm produces n units of output, equivalently one unit of output per worker. If one or more workers leave, the firm can hire replacements; replacements, however, are less productive. If the firm has to hire one or more replacements, output per worker is equal to $\gamma < 1$.

  Thus, n measures the complexity of the production process. The parameter γ (which was implicitly put equal to 0 in the first example) is an inverse measure of the specificity of existing workers.
- Each worker has an alternative opportunity given by c, distributed uniformly on $[0,\bar{c}]$. Draws are independent across workers. The distribution of c is known, but the specific realization of each c is private information. We can think of $\bar{c}$ as representing the opportunities open to the most qualified workers after transition, from opening their own business, to working for foreign consulting firms, and so on.[10]
- The wage paid is equal for all workers (this follows from the assumption that alternative opportunities are private information, and the symmetry in production), and is equal to output per worker. This assumption simplifies the analysis and is reasonable in the case of many state firms (where there is, de facto, no outside residual claimant), but the

10. An alternative interpretation of this model is as a model of shirking, where workers have different costs of effort. If all workers put in effort, output per worker is one. If some do not, output per worker is equal to γ instead. Under that interpretation, one may interpret the model as applying to all workers.

analysis would be qualitatively similar as long as wages increased with other workers' participation.

• Workers must decide whether to take up their private opportunity *before* they know the decisions of other workers, and thus the level of output and the wage per worker in the state firm. We assume that they are risk neutral, so that their decision is based on the expected wage.

Thus, if all workers decide to stay, output per worker, and therefore the wage, is equal to one. If one or more workers take up their private alternative, some replacement workers must be hired, and output per worker and the wage are equal to γ.

It is clear that the solution to the problem facing each worker has the following form: stay if c is less than some threshold c^*; otherwise leave. To characterize c^*, think of the decision problem facing one worker. If he leaves and takes up his alternative opportunity, he will receive c. Suppose that he decides instead to stay. Given that, by symmetry, the $(n - 1)$ other workers also have a threshold equal to c^*, the probability that they all stay is given by $(F(c^*))^{n-1}$. Expected output per worker, and thus the wage he can expect to receive if he stays, is therefore equal to $(F(c^*))^{n-1} + \gamma(1 - (F(c^*))^{n-1})$. The threshold level c^* is such that he is indifferent between leaving or staying, so that

$$c^* = \gamma + \min(1,(c^*/\bar{c})^{n-1})(1 - \gamma). \tag{1}$$

Expected output per worker, and thus the expected wage, are given in turn by[11]

$$w = \gamma + \min(1,(c^*/\bar{c})^{n})(1 - \gamma)\,. \tag{2}$$

The solution to equation (1) can be one of three types, depending on the value of $\bar{c}$. These three cases are represented in Figure V which plots both sides of equation (1) on the vertical axis against c^* on the horizontal axis. The figure is drawn assuming values of $n = 5$, and $\gamma = 0.2$. The left-hand side of the equation is represented by a 45-degree line. The right-hand side is represented by a curve that is initially convex, turning flat and equal to 1 for $c^* \geq \bar{c}$.

11. Note the different exponents in equations (1) and (2), $(n - 1)$ versus n. Each worker knows his own alternative opportunity when choosing whether to stay or not, and thus the uncertainty comes from what the $n - 1$ other workers will do. The expected wage is the unconditional expectation of the wage and depends on what all n workers do. The difference between c^* and w goes to zero as n is large.

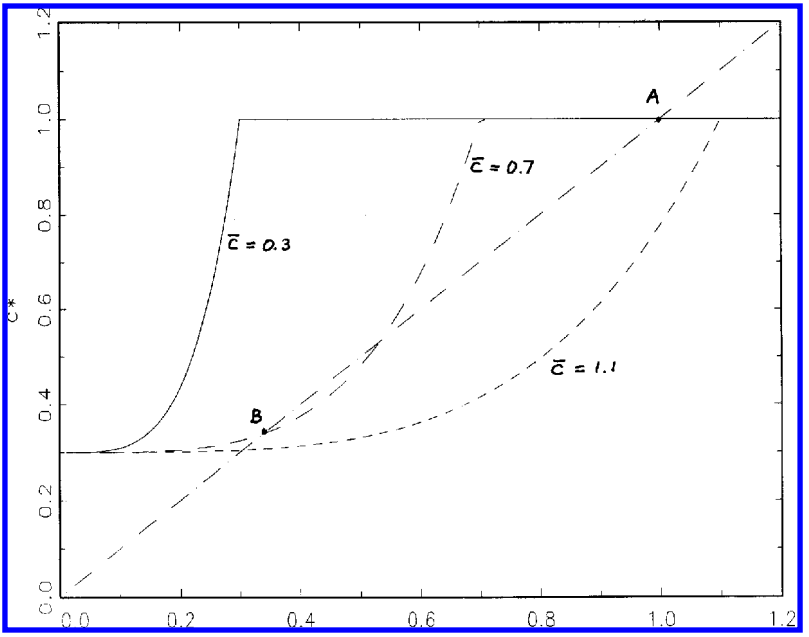

FIGURE V
Equilibrium c^* for Alternative Values of $\bar{c}$

- For low alternative opportunities there is only one equilibrium, in which all initial workers decide to stay, leading to a level of output per worker equal to one. In Figure V the only equilibrium corresponding to the case where $\bar{c} = 0.3$ is at point A.
- For intermediate alternative opportunities there are two equilibria (the equilibrium in-between is unstable using standard arguments), one in which all workers stay and output per worker is 1, and one in which most workers are likely to leave, where c^*, and in turn expected output per worker, are close to γ. In Figure V, for $\bar{c}$ equal to 0.7, the two equilibria are at points A and B. At A, c^* is 1. At B, c^* (and the expected wage from equation (2)) is very close to 0.2: the probability that at least one worker will leave is very high.
- For higher alternative opportunities—for $\bar{c} > 1$—there is a unique, low activity, equilibrium.

In Figure V, for $\bar{c} = 1.1$, the only equilibrium is at point

B, where c^*, and the expected wage, are both equal to a value close to 0.2: production in the state sector is very unlikely.

We want to emphasize two separate aspects of these results.

(1) The first is the existence, over some range, of multiple equilibria. Some firms may disappear simply because they are expected to, either by their suppliers or their essential workers. This occurs not because of private information, but because workers cannot commit beforehand. To see this, note that even when workers have an alternative opportunity equal to a known and common value c, then, for values of c between γ and $\bar{c}$, there are still two equilibria, one in which all workers stay in the state firm (the efficient outcome), and one in which all workers take up their alternative opportunity.[12]

Is one equilibrium more likely to prevail? The arguments here are standard. On the one hand, the equilibrium with high production is Pareto superior. The game is one of pure coordination, so if the workers can talk beforehand, one could argue that they should be able to coordinate on the equilibrium which is better for all of them. On the other hand, if each worker believes that there is some probability that some other worker will irrationally refuse to participate, then the high equilibrium can unravel. As n becomes large, even a small probability that one worker will irrationally refuse to participate can lead to the rational collapse of output.

(2) The second aspect derives from the combination between private information and interactions between decisions given the timing of decisions. It is the rapid collapse of state output as soon as there is a positive probability that at least one private alternative exceeds the wage under efficient production in the state firm. For example, for the case where $\bar{c} = 1.1$ in Figure V (so that the expected value of private opportunities is only equal to 0.55, compared with 1 in the state firm if workers stay), the probability that all initial workers stay in the state firm is nearly equal to 0, and expected production per worker in the state firm is very close to 0.2, a highly inefficient outcome.

To see why output collapses, note that as soon as $\bar{c}$ is greater than 1, there is a chance that a worker will leave. The wage that remaining workers can expect to receive is thus reduced in pro-

12. The structure of this special case is identical to the model in Bryant [1983].

portion to the probability that at least one worker will leave. In turn, this reduction in the expected wage prompts more workers to leave, and so on. The effect of higher values of n is to magnify the interactions between the workers' decisions. For example, for $\bar{c} = 1.01$, expected output per worker in the state firm is equal to 0.92 if $n = 2$, but falls to 0.21 when $n = 3$.[13]

This aspect of the model appears to capture a number of aspects of transition. It captures the idea that crucial managers may leave a firm, despite potentially large payoffs from turning it around, because they are not sure that others will stay around long enough. If we return to an interpretation of the model with suppliers rather than workers, the model is consistent with anecdotal evidence from Russia that suppliers are often very reluctant to supply state firms, because of the difficulties of getting paid. If they are not paid on delivery but only if the firm succeeds in producing and selling its production, then, just like workers in our example, suppliers become residual claimants. (This raises the issue of why state firms do not pay their suppliers on delivery. More on this in the next section.) The probability that one of them will not supply leads all of them to be leery of supplying, leading to collapse of the state firm.

IV. Managing Specificity

We have presented three examples of how decentralization of decision-making under transition can lead to a breakdown in bargaining and, if there are many participants in the bargaining, to large decreases in output. But these examples raise a general issue. If anything, the production structure in the West is even more complex than it is in the East. Why are problems arising from specificity not as severe in the West?

We have already hinted at some of the answers.

(1) In the West many goods are traded in thick markets, markets with many buyers and many sellers. And while for many intermediate goods, firms deal with only one supplier, there are likely to be other potential suppliers; shifting suppliers may be difficult but not impossible.

13. To see the role of timing decisions, these results can be compared with those that obtain when workers decide whether or not to take their private opportunity *after* having observed the decisions of others. In that case, the probability that all workers stay in the state firm is equal to $(1/\bar{c})^n$, and expected output per worker in the firm is equal to $\gamma + (1/\bar{c})^n(1 - \gamma)$. For $\bar{c} = 1.01$, expected output per worker in the state firm is equal to .98 if $n = 2$, and .97 if $n = 3$.

In those sectors in which new firms can be created quickly, such as retail trade, transition has not led to a collapse of output. For many goods, however, thick markets cannot be created overnight. There are just not enough suppliers or buyers in the economy to start with; and it takes time to create new firms. Opening the economy to foreign trade increases the potential number of buyers and sellers, and that can clearly help. Indeed, one of the arguments for imposing convertibility and low tariffs in Poland in 1990 was to limit the monopoly power of domestic firms by increasing competition, an argument closely related to ours [Sachs 1993].

(2) The very nature of (any) transition is such that there is limited scope for *long-term relations* in solving problems arising from specificity.

In stable economic regimes, such as under central planning in the Soviet Union in the past, or in Western market economies today, long-term relations can play an important role in reducing inefficiencies arising from specificity. To see this, take for example our third model, and assume that workers who decide to take up a private opportunity cannot work for the state firm in the future (one can again replace "workers" by "suppliers" in what follows). This may be either for technological reasons (they have to move to another city) or because it is the optimal punishment from the point of view of the state firm. Then, if individual private opportunities are partly transitory, workers will think twice about leaving. More formally, they will use a much higher threshold, a higher value of c^*, for deciding whether to take up a private opportunity. The result will be a higher probability that workers stay, and higher expected production overall.

In that context, the value of c^* will depend crucially on the probability that the firm still exists and relies on the same workers in the future. If this probability is low, then workers will behave opportunistically, in a way close to that characterized in the previous section. But by the nature of transition, this probability is indeed likely to be low: transition implies that many state firms will disappear, and that, even if they survive, they will have to change operations as well as many of their suppliers.

In a neoclassical benchmark, if it took time for new, more productive firms to arise following transition, state firms would continue producing until they were replaced by the new firms. The argument we have just developed suggests that the mere anticipation that more efficient private firms will eventually appear

can lead to a decline in production in state firms. It may also explain why the preofficial transition period in the Soviet Union was characterized by increasing disorganization and decreasing output, as the shortening of horizons led to more opportunistic behavior on the part of firms. There is indeed some evidence that the degree to which state firms felt they had to satisfy the plan decreased in the Soviet Union with the increased likelihood of reform in the mid-1980s.[14]

(3) Most state firms in transition are short on "*cash*" (more precisely, have limited liquid assets, and limited access to credit).

The potential role of cash in reducing problems coming from specificity is clearest in our third example. Consider the case where there are two equilibria, one in which existing workers stay and productivity is high, and one in which they leave, forcing the firm to hire less efficient replacements. A commitment by the firm to pay each existing worker a wage of one, independently of what the other workers do, will lead all workers to stay, and will sustain the efficient equilibrium, at no cost to the firm.

Thus, firms with "deep pockets" can alleviate some of the problems arising from specificity.[15] But state firms in the former Soviet Union typically do not have such deep pockets: firms have limited access to credit, and many are close to bankruptcy. Under these conditions, they have no easy way of convincing their workers to stay or their suppliers to supply. This argument points to the role of foreign direct investment: foreign firms typically have deep pockets. They can pay suppliers on delivery; they can credibly promise to pay their workers even if things go wrong. They can therefore avoid the problems of coordination faced by most domestic firms.

(4) There is more scope in the West for *contracts* to handle problems created by specificity.

The potential role of contracts in solving or alleviating problems of specificity is clearest in our first example. In that model, if producers can sign binding contracts before production takes place, then they will avoid holdup problems, and achieve an effi-

14. Fear of shortening horizons can also explain why industry opposes laws requiring firms to provide workers advance notification of plant shutdowns and why some firms choose to pay severance pay rather than provide their workers with notice of layoffs. Ellickson [1989] notes that at the time of the collapse of the nineteenth century whaling industry, the norms of cooperation that had evolved among whalers began to break down.

15. See Holmstrom [1982] for a related point.

cient outcome. Total output will not decline when private opportunities improve.

There is little question, however, that the scope for contracts to alleviate holdup problems is more limited in the East. The deficiencies of the current Russian legal system have been pointed out by many (for example, Greif and Kandel [1994]). Contract enforcement is weak (in our first example, once a firm has produced, the buyer of its output has an incentive to renege and offer a lower price). Contract enforcement is therefore crucial. Firms have few assets that can be seized, and thus less to lose from breaking a contract. This last aspect takes us to the next point.

(5) While state firms were often more vertically integrated than in the West, the type of *vertical integration* needed to alleviate problems of specificity during transition is different from what it was in the past.

The reason to vertically integrate under central planning was the imperfect ability of the central planner to enforce timely delivery of some inputs, leading firms to protect themselves against such disruptions. Sachs [1993] gives the example of an industrial firm installing pigpens to raise pigs and insure the delivery of food to their workers in the face of food shortages.

After decisions are decentralized, vertical integration is most needed for those inputs with a high degree of specificity, and thus a large potential for serious bargaining problems. Pigpens are not necessary anymore: markets in agricultural goods have eliminated the problem. But the problem may now be that a friend in the Ministry who used to be able to ensure that a specific engine part was delivered by the sole supplier is no longer in a position to guarantee delivery.

Thus, the initial structure of vertical integration can play only a limited role in transition. And creating new vertically integrated structures of production both has sharp limits and takes time. The arguments here are standard. First, chains of production interlock. When suppliers have more than one buyer, which supplier integrates with the buyer? Second, if vertical integration is to be achieved through the purchase of existing firms, the bargaining problems we saw become relevant, this time not in the determination of input prices, but now in the determination of the purchase price of firms. If $n - 1$ of the firms in our first example vertically integrate, the remaining firm has an incentive to hold out for a large part of the rents, and thus a high purchase

price. Thus, no firm will want to be the first to be vertically integrated. This suggests much of vertical integration needs to proceed through the development of new activities within the firm. This, like the development of new firms, takes time.

V. Evidence on Output Decline across Sectors

One implication that appears specific to our explanation of the output decline during transition is that the decline should have been more pronounced for goods with more complex production processes. We have explored this implication and report the results in this section. In short, we find that output has indeed fallen more for more complex goods.

We proceeded as follows.

We gathered data on the output of 159 goods for nine countries (Moldova, FYR Macedonia, Kyrgyzstan, Georgia, Belarus, Azerbaijan, Armenia, Albania, and Russia) from 1992 to 1994 (1991 to 1994 for Russia), and constructed output growth for each country/good. Our choice of countries was determined by data availability, and our prior belief that disorganization might have played an important role. Our choice of dates was determined by data availability, and by the fact that in all of these countries, the bulk of price liberalization was implemented in 1992. We are indebted to the IMF for providing us with those data; these come in turn from the National Authorities and IMF staff estimates. We do not have data on output for all goods for all countries: the number of country/good observations is only 310.

We then used the 1990 "100-sector" input-output table for Russia in current producer prices to construct an index of complexity for each good.[16] We first allocated each of the goods to its corresponding sector (so that the goods which belong to the same sector have the same index of complexity).[17] We then defined the index of complexity for sector i, call it c_i as

$$c_i \equiv 1 - \sum_j (\phi_{ij})^2,$$

where ϕ_{ij} is the share of input j in the production of i.

16. We are indebted to Esther Duflo for providing us with the table, which is based on unpublished Goskomstat information.

17. We excluded one good, fruits and berries, because it is listed in the input-output matrix under "other goods," a residual sector that also includes movies, for example, and is too heterogeneous for our purposes (the results do not depend on that exclusion).

Note that c_i is equal to 1 minus the Herfindahl index of input concentration for sector i. By construction, complexity is equal to zero if there is only one input, and complexity tends to one if the sector uses many inputs in equal proportions. The Appendix shows the resulting complexity index for the different sectors.[18] Most but not all the rankings make sense. For example, medical equipment is among the most complex sectors, and cotton production among the least. However, some of the numbers are less plausible: for example, logging is more complex than railway equipment. We did not try to second guess our mechanical rule.

We constructed three additional variables to control for some of the other factors which may have contributed to the decline in output. The first variable, Durability, is a dummy that is equal to one if the good is durable, zero otherwise. The production of durable goods typically falls relative to the production of nondurable goods during recessions in the West. The next two variables, which we took from the work of Duflo and Senik-Leygonie [1997] on Russia, try to capture the degree to which the sectors were subsidized directly and indirectly pretransition, and the degree to which these subsidies have been phased out. The Price ratio is the ratio of 1990 world-to-domestic prices for each sector. The Cost growth variable is the growth rate of the factor cost index for each sector, namely the sum of the growth rates of each factor price from 1990 to 1992 multiplied by the share of that factor in production in 1990.[19] Table I shows summary statistics for output growth, complexity, and these additional variables.

We then regressed output growth on a set of country dummies, the index of complexity, and various combinations of the other three variables. The results are reported in Table II. Column 1 reports the results of a regression that includes only the index of complexity (and the country dummies). The index is highly significant. The results of including the additional variables are reported in columns 2 to 8. Durability and complexity are highly correlated; thus, not surprisingly, introducing the durability variable leads to a decrease in the estimated effect of complexity; the effect, however, remains significant. The price ratio variable is typically insignificant; the cost growth typically highly significant. But neither variable has much of an effect on

18. "M&E" in the Appendix stands for machinery and equipment.

19. Note that these two variables are constructed using data from Russia, and therefore may be less accurate for other regions, in particular the two countries outside the former Soviet Union: Macedonia and Albania.

TABLE I
OUTPUT GROWTH, COMPLEXITY, AND OTHER VARIABLES: SUMMARY STATISTICS

Variable	Observations	Mean	S.D.
Output growth	308	−46.2	34.4
Complexity	308	0.72	0.16
Durability	308	0.21	0.41
Price ratio	308	0.77	0.67
Cost growth	308	1.28	0.50

Sources. see text.

the coefficient on the complexity variable. We examined whether our results were driven by outliers; they do not appear to be. To summarize the results of the table, looking across columns, a one-standard deviation increase in complexity leads to a fall in output of roughly 3 percent when durability is included, of 5 to 8 percent when it is not.

The complexity measure we use is surely a very noisy measure of n, the theoretical variable of interest. Our earlier examples imply that the fall in output is determined by the number of inputs for which there is specificity in the relationship between buyer and seller, rather than by the total number of sectors from which inputs are purchased. The complexity index will therefore tend to underestimate true complexity for goods that require several different specialized inputs from within a single sector, and overestimate it for goods that require competitively supplied inputs from many different sectors. Further noise is introduced because our data on complexity are for sectors, but the goods for which we have output data may be more or less complex than the sector as a whole. To the extent that our measure of complexity is subject to classical measurement error, the coefficient on complexity is biased downwards. However, there may be other sources of measurement error that lead to an upward bias. In particular, the coefficient on complexity may be picking up some of the effects of durability, since the durability measure we use in estimation is discrete, and therefore measures durability with error.

VI. EVIDENCE ON SHORTAGES ACROSS TIME AND COUNTRIES

In this section we attempt to assess the relative importance of disorganization, both over time and across countries in transi-

TABLE II
REGRESSION RESULTS

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Complexity	−37.67	−22.40	−38.37	−22.54	−56.08	−54.98	−43.23	−41.71
	(11.28)	(11.87)	(11.49)	(12.13)	(11.11)	(11.21)	(11.95)	(12.06)
Durability	—	−16.36	—	−16.34	—	—	−12.24	−12.45
		(4.61)		(4.63)			(4.46)	(4.47)
Price ratio	—	—	−0.92	−0.15	—	2.05	—	2.42
			(2.73)	(2.69)		(2.63)		(2.61)
Cost growth	—	—	—	—	−21.01	−21.53	−19.38	−19.97
					(3.51)	(3.58)	(3.52)	(3.58)
Adjusted R^2	0.72	0.73	0.72	0.73	0.75	0.75	0.76	0.76

Ratio is the percentage output growth of various goods from 1990 to 1992 for all countries (1991 to 1994 for Russia). All the regressions included the complexity measure and nine country dummies for Moldova, Macedonia, Kyrgyzstan, Georgia, Belarus, Azerbaijan, Armenia, Albania, and Russia. The standard errors presented are Huber heteroskedasticity-robust.

tion. To do so, we rely on measures of reported shortages of raw materials and intermediate products by firms. Two remarks are in order at the start.

What firms exactly mean when they report "shortages" is admittedly unclear. And it is also not clear whether the breakdowns in supply that occur in our three examples should be called shortages. It is plausible that firms facing breakdowns in supply as in our examples would report them as shortages. It is also possible that firms experiencing sharp changes in supply and thus in market-clearing input prices—as is likely to be the case in transition—may report those as shortages. There are, however, no measures of "breakdowns in supply," while there are measures of reported shortages. We are reasonably confident that reported shortages are a decent proxy for disorganization, and are thus worth looking at.

We focus on shortages because most alternative theories of the output decline do not naturally predict shortages.[20] One exception is the theory developed by Murphy, Shleifer, and Vishny [1992] based on partial price liberalization: shortages may reflect the effects of partial price liberalization. In most republics, however, most prices have now been liberalized, so that partial price liberalization probably plays a limited role in explaining shortages at this point.[21] Another is the theory developed by Berkowitz [1996], who argues that, if local authorities keep control of some prices, they may prefer to set low prices and use rationing; we have not explored how to distinguish empirically between this and our explanation.

We read the available evidence as suggesting that disorganization has played a limited role in the major Central European countries, some role in Russia and the Baltics, and a major role in the other republics.

(1) Since 1992–1993 the OECD has carried out a survey of firms in manufacturing in a number of Central European and

20. Phenomena such as wage compression in state firms compared with private firms (for example, Rutkowski [1996] for Poland and Köllô [1996] for Hungary), the collapse of interrepublican trade, cannibalization of machines, "spontaneous privatization," and the carving up of firms are also consistent with our story. The problem is that they are also consistent with other explanations. The volume of trade may well have been too high. Cannibalization of machines or of firms may be associated with efficient reorganization, and so on.

21. For a survey of progress on price liberalization as of 1995, see European Bank for Reconstruction and Development [1996].

TABLE III
PERCENTAGE OF FIRMS EXPERIENCING SHORTAGES OF MATERIALS

Country	min percent	max percent	1996-1 value
Czech Republic 93-1–96-1	3	9	5
Hungary 92-1–96-1	6	11	5
Poland 93-3–96-1	3	6	5
Bulgaria 93-1–96-1	15	33	25
Romania 92-1–96-1	8	39	15
Latvia 93-1–96-1	21	32	21
Lithuania 93-3–96-1	13	43	17

Source. CCET [1996b], business survey annex, quarterly data. "min" and "max": minimum and maximum percentage of firms experiencing shortages of materials during the period.

Baltic countries. Among other things, the surveys ask firms about factors limiting production in manufacturing. The strength of these data is that they come from roughly identical surveys. Unfortunately, they do not cover the early period of transition, when disorganization is likely to have been relatively more important. The evidence from these surveys is summarized in Table III.[22]

In the three major Central European countries, shortages of materials have played a very limited role since 1992–1993. The numbers are comparable to those obtained from similar surveys of firms in Western Europe. Numbers from Berg and Blanchard [1994] show that, even in 1990 in Poland (the first year of transition), disruptions were not an important part of the story. The proportion of firms citing "supply and employment shortages" as a limiting factor in production was 62 percent in October 1989, 37 percent in January 1990 (the month of the "big bang"), but down to only 10 percent by April 1990.

The evidence from those Central European countries that are doing less well suggests a larger role for disorganization. In Bulgaria and Romania, two of the countries with the largest drop in output, supply shortages played an important role more than two

22. The list of answers from which firms can choose varies slightly from country to country. A typical list (in this case for Bulgaria) includes: "None, Insufficient demand, Weather conditions, Cost of Materials, Financial problems, Shortage of skilled labour, Lack of appropriate equipment, Shortage of raw materials, Competition in own sector." Firms can answer yes or no to each. The number reported in the table is the proportion of firms saying yes. For more detail about the questions and the composition of the firms in the surveys, see CCET [1996a, pp. 43–54].

TABLE IV
PROPORTION OF FIRMS IN INDUSTRY MENTIONING THE FOLLOWING CONSTRAINTS AS LIMITS TO PRODUCTION: RUSSIA, 1991–1995

	Insufficient demand	Shortages of materials	Shortages of financial resources	Shortages of labor
1991	4	82	18	28
1992	51	46	45	8
1993	41	23	62	6
1994	48	19	64	5
1995	47	22	64	8

Source. Russian Economic Barometer, various issues.

years after the beginning of transition. The same is true of the Baltic states.[23]

(2) Table IV gives corresponding numbers for Russia, since 1991 (from a sample of about 500 industrial firms, with a response rate of 30–40 percent over time).

The most striking number is the proportion of firms experiencing shortages of materials in 1991. However, this is the last year before full price liberalization (which took place in January 1992).[24] Nonetheless, the numbers remained high in 1992, and are still high by standards of market economies.

Another piece of evidence, which speaks more directly to disorganization, is the proportion of work time in firms lost to *full* stoppages of production, by reason. The time series for Russia for the years 1992 to 1995 are given in Table V.

"Lack of materials" is a close second to "Lack of Demand" in explaining work stoppages during the period 1992–1995.

(3) Shortages of materials appear to play still a more important role in the republics of the former Soviet Union. Table VI gives some numbers for the Kirgiz Republic. The numbers are from a survey of firms by Windell, Anker, and Sziraczki [1995] for the ILO and are for 1993, thus a year after price liberalization in the Kirgiz Republic, and one year after the collapse of trade between the Kirgiz Republic and the other republics of the former

23. Admittedly, part of this relation may reflect reverse causality from output to shortages. A large output decline, for whatever reason, together with inefficient bankruptcies, can lead to the inefficient shutting down of more firms, and thus to more shortages.

24. It would be interesting to find out how the proportion of firms experiencing shortages evolved pre-1991. The survey used above starts in 1991. We have searched for earlier surveys, but without success.

TABLE V
PERCENTAGE OF WORKING HOURS LOST DUE TO FULL STOPPAGE OF PRODUCTION, AND REASONS FOR IT: RUSSIA, 1992–1995

		By reason		
	Percentage of hours lost	Lack of demand	Lack of materials	Other
1992	10	59	40	1
1993	10	50	39	11
1994	18	53	35	13
1995	7	37	53	10

Source. Goskomstat Rossii, various issues. 1992 is August only. 1993 is the average over four quarters. 1994 is the average of May and October. 1995 is the average of the first two quarters.

TABLE VI
MAIN BUSINESS PROBLEMS OF FIRMS IN INDUSTRY. KIRGIZ REPUBLIC, 1993

	Shortages of materials	Low demand	Other factors
Food processing	57	13	30
Textiles	36	17	47
Nonmetallic minerals	26	32	42
Fabricated metals	31	22	47
Wood and paper	63	16	21
Other	43	21	36

Source. Windell et al. [1995]. Proportion of firms, in percent.

Soviet Union. (However, 1993 is a period of very high inflation—23 percent a month on average—High inflation is typically associated with disruptions in trade, and this may account for some of the shortages reported by firms.)

These numbers are in sharp contrast to those for, say, Poland or Hungary. Shortages of materials seem to being playing a central role. Further evidence suggests that they reflect mainly internal disorganization, rather than the collapse of trade between republics: the same survey gives for each industry the proportion of materials coming from domestic and nondomestic sources. Surprisingly—given the collapse of trade with the rest of the FSU—the correlation across sectors between the proportion of firms citing shortages and the share of materials coming from nondomestic sources is roughly equal to zero.

Can one explain the differences between Central Europe and the former Soviet Union? Our discussion suggests a number of

potential explanations. By design, specialization was much higher in many of the republics of the Soviet Union than in, say, Poland or the Czech Republic, leading to a larger collapse of both intra- and interrepublican trade. Distance from the West, and thus the volume of trade, and the scope for foreign firms to alleviate problems of specificity, may also have played an important role. These, however, are speculations at this point.

VII. Conclusions

Transition was conceptualized in a recent World Bank *World Development Report* [1996] as a movement "From Plan to Market." If our argument is right, then a more accurate, if less succinct, title would have been "From Plan and Plan Institutions to Market and Market Institutions." Transition may cause the existing organization of production to collapse, leading to a large decline in output until new institutions can be created. Empirical evidence on output decline across goods suggests that transition has caused a breakdown of complex chains of production. Evidence on shortages suggests that disorganization has played a limited role in Central Europe, a more important one in the Baltics and Russia, and an even more important one in the other republics.

The fact that output has risen during transition in China is difficult to reconcile with many of the explanations for output collapse in Eastern Europe. For example, there is no obvious reason why efficient reallocation should have led to an increase in output in one case and a decline in the other. Our theory, however, suggests several reasons why China may have been less susceptible to breakdowns in bargaining, and disorganization. China's lower level of industrial development, and Mao's explicit policy of decentralizing industry to many small factories, implied that complexity and specificity were less in the first place [Wong 1985; Qian, Roland, and Xu 1996]. The maintenance of political control by the Chinese government and the continued role of quotas for delivery of materials to state factories implies that centralized allocation has not been fully replaced by decentralized bargaining. And China's commitment to maintain state firms, using subsidies if necessary, may have lengthened horizons, allowing for a larger role of long-term relations between state firms and their suppliers, thus avoiding the collapse of state firms in the face of new private opportunities.

This raises the question of whether the need to preserve existing production networks provides a justification for gradualism. Suppose that in a neoclassical benchmark (i.e., absent the effects we have focused on so far), and absent subsidies, many state firms can be expected to disappear over time. The argument we have developed implies that, once the implications of specificity are taken into account, this may well lead to the immediate collapse of those firms. Shorter horizons may lead suppliers to behave more opportunistically, leading to the collapse of state production. By the same argument, a commitment by the government to subsidize state firms for some time may avoid their immediate collapse.[25]

However, subsidizing state firms would be counterproductive either if private firms were expected to develop rapidly or if they were expected to take a very long time to emerge. If efficient private firms (firms with values of c equal to or greater than productivity in the state firms) are expected to develop quickly, then the cost of maintaining state firms for a long time is not worth the short-run benefits. If it takes a long time for private firms to reach the stage where the presence of private opportunities leads to the collapse of state firms, there is no need for subsidies either, at least for some time. In-between these two extremes, however, if c is expected to be high enough to create problems of bargaining, but low enough that state production is more efficient than private production for some time, the model suggests the desirability of committing to subsidize state firms for some time, in order to avoid their immediate collapse in the face of positive, but mediocre, private opportunities.

Thus, the model provides a—limited—theoretical case for gradualism. We believe, however, that factors outside the model still militate strongly against subsidizing state firms. Subsidies reduce the incentives of state firms to adjust. Subsidies have to be financed, and through the tax channel, slow the growth of new private firms. And in the end, political economy considerations may well still lead to the conclusion that the only way to stop

25. Think of subsidies by the government as affecting the probability that the state firm will be alive at any point in the future. A high enough probability will lead suppliers to increase the threshold at which they take up their private opportunities. Technically, the commitment of the government must be such that there is a positive probability, however small, that the state firm survives forever. The argument is standard: if it were known that a firm was going to disappear with certainty at some future point in time, things would unravel, and the firm would collapse at the beginning.

subsidies is to stop them at once. Finally, while it may be possible for a future reformist Cuba or North Korea to preserve some production networks, it would probably now be impossible to restore the old networks of production in most of the former Soviet Union. Once Humpty-Dumpty has fallen down, all the King's horses and all the King's men cannot put him back together again.

APPENDIX: COMPLEXITY BY SECTOR

Sector	Complexity	Sector	Complexity
Construction ceramics	0.94	Shipbuilding	0.86
Medical equipment	0.94	Electrotechnical M&E	0.86
Other products	0.93	Prefab concrete	0.85
Glass & porcelain	0.93	Roofing & insulation	0.85
Pharmaceuticals	0.92	Mining M&E	0.85
Printing M&E	0.92	Plastic products	0.85
Wall materials	0.92	Hoisting technology	0.85
Household appliances	0.92	Railway equipment	0.84
Medical products	0.92	Leather	0.84
Fire-resistant mater.	0.92	Chemical fibers	0.84
Linoleum products	0.92	Tools and dies	0.84
Trade & dining M&E	0.91	Sanitary engineering	0.84
Microbiology	0.91	Organic chemicals	0.84
M&E repair	0.90	Energy & power equip.	0.83
Light industry M&E	0.90	Synthetic paints	0.83
Cement	0.90	Synthetic diamonds	0.83
Processed food M&E	0.89	Combustible shales	0.82
Furniture	0.89	Other constr. materials	0.82
Metal products	0.89	Bearings	0.82
Other chem. products	0.88	Paper & pulp	0.82
Confections	0.88	Synthetic resins	0.82
Logging	0.88	Forging/pressing M&E	0.82
Other textile prod.	0.88	Precision instruments	0.81
Rubber & asbestos	0.88	Perfume oils	0.81
Casting M&E	0.88	Radio electronics	0.81
Transportation	0.88	Gas & gas products	0.80
Construction M&E	0.87	Other food	0.79
Peat	0.87	Power	0.79
Pumps & chem. equip.	0.87	Oil products	0.78
Nonferrous ores	0.87	Ferrous metals	0.78
Communal M&E	0.87	Sewn goods	0.77
Tractors & agri. M&E	0.87	Vegetable oils	0.75
Paints & lacquers	0.87	Wines	0.74
Mineral chemistry	0.86	Tires	0.74
Basic chemicals	0.86	Plywood	0.73
Autos & parts	0.86	Asbestos products	0.73
Machine tools	0.86	Synthetic rubber	0.73

APPENDIX: CONTINUED

Sector	Complexity	Sector	Complexity
Animal feed	0.72	Other industries M&E	0.61
Tobacco	0.72	Wool products	0.60
Hosiery/knitwear	0.72	Meat products	0.58
Flax products	0.68	Dairy products	0.57
Cable products	0.68	Metal products	0.55
Sawmills & lumber	0.67	Fish products	0.53
Metal construction	0.66	Flour & cereals	0.53
Silk products	0.64	Wood chemistry prod.	0.52
Distilleries	0.64	Bread & bakery prod.	0.34
Coal	0.63	Coking products	0.30
Fruit/vegetables	0.62	Refineries	0.24
Sugar	0.61	Cotton products	0.19
Nonferrous metals	0.61		

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