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The Sensitivity of the Soviet Economy to
Foreign and Domestic Economics Shocks

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Summary

Because of its historical stability and the presumption that central planning somehow provides effective mechanisms for containing economic disturbances, it is usually inferred that the Soviet economy is virtually invulnerable to either internal or external shocks. An analysis of the mechanisms of Soviet economic control and a novel interpretation of the concept of an economic shock in terms of systems states suggests that this traditional judgment is too strong. While the Soviet economic system is certainly shock resistant, it is by no means shock proof and under plausible circumstances may exhibit crisis responses not very dissimilar to those observed in the West when decision makers find it difficult to predict the future course of economic activity.

I. Introduction

In ordinary speech the terms disturbance and shock are used more or less interchangeably to describe events that alter an existing equilibrium. A shock has the connotation of being a stronger stimulus than a disturbance, but beyond this distinction the two terms have roughly the same meaning. In economics, this conventional usage has been reinforced by the conceptual framework of general equilibrium theory in which the magnitude of a perturbing event has little bearing on the adjustment mechanisms that restore the system to a new point of stable equilibrium.

The implication that the magnitude of a perturbing event is only a matter of degree and not a matter of substance however can be misleading. Under certain circumstances perturbations can be sufficiently large that they change the state of the system itself.¹ The worldwide inflation touched off by the Arab oil boycott for instance vividly exemplifies an extraordinary response to an event that unmistakably altered the state of the international economic system.

In this paper we will be primarily concerned with events that change the state of the Soviet economic system. To distinguish between perturbations contained within the existing system and perturbations that change the state of a system, the term disturbance will be reserved for the former and shock for the latter phenomenon. As will be seen shortly, the distinction drawn here goes far beyond semantics and bears decisively on any analysis of the effect perturbations might have on real world economies.

Although for the sake of generalization the distinction between disturbances and shocks limned above has been expressed in the context of general equilibrium, the concept of changed economic states need not be restricted to market economies. In principle at least, centrally planned

economies may exhibit patterns of behavior that cannot be adequately explained by the discretionary revision of official plans designed to cope with unforeseen events. During the NEP period for example, the record shows that the Soviet economy experienced numerous crises and therefore it should be considered an open question whether similar crises might not recur in the present Soviet institutional environment.²

This essay accordingly has been written as an exploratory study of how various kinds of economic shocks might alter the state of the Soviet economy and generate economic crises. The focal point of the investigation is the interface between discretionary actions likely to be taken by diverse agents in the central planning system and the behavior of the economy under crisis conditions. Before turning to this subject however a brief discussion of how Soviet central planning deals with ordinary disturbances is necessary in order to cast our discussion of crisis behavior in the clearest possible light.

II. The Conventional Dynamic Adjustment Process under Soviet Central Planning

Historical experience has shown that centrally planned economies possess mechanisms for containing both internal and external disturbances. In the Soviet Union, which can be taken as the archetype of a centrally planned economy, postwar trends in sectoral growth and capital formation have fluctuated in a very narrow range despite recurrent exogenous disturbances.

The robustness of the Soviet economy is attributable to a complex of administrative mechanisms commonly referred to as central planning. These mechanisms can be broadly divided into two classes, one founded on the principle of physical planning, the other on bonus maximizing.³ The physical planning system is based on the principle of executive directives or commands.

Institutionally it encompasses the Council of Economic Ministers, Gosplan and the ministerial bureaucracy. In theory commands issued by these agencies are legally binding instructions which comprehensively determine all aspects of economic behavior under socialism.⁴ In practice however central planning is so complex that commands are neither comprehensive nor consistent in an operational sense. To insure operational control therefore the Soviet planning system has developed a mechanism which permits producers to flexibly respond to various exigencies as they arise, and guide the command system in plan formulation. This control subsystem is the independent microplanning enterprise, including all institutions on khozraschyot (independent cost accounting) which are expected to govern their behavior according to the bonus incentives in force.

The relationship between the command system and the microplanning enterprise is one of mutual interdependence. At the start of the planning cycle enterprises are required to compile a set of prospective plans, quantifying their output objectives and their input needs. These projections are based on detailed calculations carried out by managers and their technical staffs using official bonus incentives as a guide in selecting an optimal production program. Since experienced managers through the process of learning-by-doing can anticipate that their enterprise plans will be revised, the projections which are submitted to their superiors in the ministerial bureaucracy will be carefully hedged.

When the ministerial bureaucrats receive these enterprise plans they aggregate them, making whatever adjustments seem expedient. Because the performance of the enterprises under their supervision strongly influences the evaluation made of their own work, the ministerial bureaucrats have little incentive to dispute enterprise projections so long as they exceed

the targets of the preceding year. They therefore concentrate on cosmetic revisions, forwarding aggregate projections for their industry to the State central planning agency.

These data collected from all the branches of the economy are then collated and arrayed in the form of material balances, enabling Gosplan to construct a preliminary variant of the national plan. After consulting with the political authorities in the Council of Economic Ministers and making appropriate revisions, the central plan formation process terminates with the publication of the annual plan.

The targets finally determined by Gosplan invariably exceed the recommendations of the ministries and alter the structure of production established in the preliminary enterprise microplans. Since the revisions mandated by Gosplan and the Council of Economic Ministers are necessarily taken without any direct knowledge of enterprise production possibilities, official plans must frequently be infeasible.⁵ Responsibility for reconciling the technical contradictions of the national plan falls on the shoulders of the ministerial bureaucracy. It is their duty to disaggregate Gosplan's targets and establish operational enterprise plans. Receiving little if any guidance however on how disaggregation should proceed, the ministries expediently adjust initial enterprise plans to nominally comply with the national plan. This is achieved partially in collusion with enterprise managers, the only agents in the system who know what the enterprises are capable of producing and partially by imposing arbitrary demands on enterprises, leaving the managers to cope as best they can.

Insofar as managers are directed to alter their preliminary plans either in the form of negotiated targets or through the direct imposition of legally binding production tasks, the command component of Soviet central planning effectively determines the course of production. Insofar as managers provide

critical inputs into the plan formulation process and are expected to bonus maximize by satisfying some plan targets while ignoring others, enterprise microplanning plays an independent role in determining the observed production pattern. Although it is difficult to assess the relative contribution made respectively by the command system and the microplanning firms, it can safely be deduced that the influence of central planning is largely confined to exerting pressure for full resource utilization, except in cases where the impact of an enterprise's output visibly effects production in other branches of the national economy. The actions of the central planning authorities therefore assume particular importance when large changes are imposed on the branch structure of national production. When sectoral proportions are left unmodified as has been the case in the post-Stalin period, the microplanning enterprises largely determine the observed micro product mix and function as the principal institution of economic adjustment in the overall system.

The microplanning enterprise is able to perform this crucial function because of the special character of the bonus incentive structure guiding managerial behavior. Managers in the Soviet Union are rewarded primarily for meeting quantitative output targets and maximizing accounting profits. Both criteria induce managers to fully employ and overfully employ the resources at their disposal. Bonuses are paid for every percentage point realized output exceeds the plan, and as a fixed proportion of profit. Since bonuses may constitute a large share of a manager's gross income, it is in his interest to acquire all the resources he can and squeeze as much effort as possible out of his workers in order to meet the planned output target. In a market economy this strategy might be counterproductive because if it were pursued simultaneously by all enterprises shortages of labor and nonlabor inputs would raise production costs and reduce profits. In the Soviet Union

however where wages and prices are fixed by the state pricing authority and where strikes are illegal, the obstacle to overfull resource utilization is sharply diminished. Profit margins which are quite wide when production occurs at normal full capacity utilization in the USSR would in all likelihood remain positive over a substantial range if enterprises were somehow able to acquire additional inputs.

From the perspective of systems control the strong, mutually reinforcing nature of the output and profit incentives means that even without central planning enterprises would tend to fully employ their resources, determining assortment according to the imperatives of managerial bonus maximization. Moreover, the fact that the state wholesale purchasing agency stands ready to buy all nonstandard output enterprises produce buttresses full resources utilization by eliminating the normal market risks associated with overproduction. As a consequence, the Soviet system is extremely robust, responding to disturbances by altering the structure of production rather than by underutilizing available factors of production.

The mechanisms employed for containing disturbances vary with their magnitude. Minor disturbances are almost entirely the responsibility of enterprise managers who when confronted with a shortage or a surplus adjust enterprise behavior in accordance with bonus incentives without further outside negotiation. Disturbances of a somewhat larger magnitude may require the intervention of glavks and ministries either for the purpose of transferring resources within their jurisdiction or revising the plan targets that affect the bonus function. In deciding whether to reallocate resources, administrators at the lower levels of the command system apply a variety of rules of thumb. Military goods take priority over civilian products. Full resource utilization is more important than an optimal product mix, etc. These principles insure in accordance with the logic of the system

that disturbances will not interfere with resource mobilization; losses being sustained by changes in assortment, quality and only secondarily in the volume of final output.

From time to time major disturbances occur which require intervention at the commanding heights of the economy. Recurrent grain shortages for example necessitate the direct action of Gosplan, which has a variety of policy alternatives at its disposal. Grain can be imported from abroad by diverting resources to the export sector at the expense of other domestic production activities. Alternatively, the direct loss caused by the grain shortfall can be accepted and minimized by reallocating food processing resources into other productive uses so that the indirect impact of the initial disturbance does not produce unemployment elsewhere in the economy. As in the case of lesser disturbances, containment is achieved by maintaining full resource utilization with the brunt of the burden being absorbed by changes in assortment, quality and productivity. This approach to disturbance management not only effectively eliminates the dynamic income effects which accompany disturbances in market economies, it also mitigates accounting losses since something is always produced. Indeed given the irrationalities of Soviet pricing, if the command component of the planning system sanctions an increase in inferior goods, accounting values could actually rise. While such gains of course are fictitious, anomalies of this kind help explain the ostensible robustness of the Soviet economy to unexpected disturbances.

Another factor contributing to the disturbance resistant nature of the Soviet economy is the separation of real effects from monetary phenomena. Money under Soviet conditions is passive because changes in money stocks have no independent effect on prices. The money supply is set so that aggregate purchasing power equals the aggregate transactions value of produced goods

and services computed at established prices. Disturbances, which alter this balance or cause excess supplies and demands for specific goods due to the redistribution of purchasing power, are certainly possible. They are easily contained however by adjusting credit relations with various economic agents, by adjusting turnover taxes on intermediate and final goods, or simply by passively tolerating repressed inflation. Such adjustments, of course, are seldom optimal in a general equilibrium sense. Like real disturbances, inept monetary and financial management affects the precise mix of produced goods and services, but the effect is more or less imperceptible expressed as it is in the form of changes in assortment and quality.

The ability of the resource mobilization strategy to contain both real and monetary internal disturbances also explains why the Soviet economy is largely impervious to external disturbances. External disturbances differ from internal disturbances only in their point of origin. Foreign monetary disturbances such as worldwide price inflation can no more affect domestic accounting prices than repressed domestic inflation. All decisions regarding imports and exports are made by the Ministry of Foreign Trade in terms of constant domestic prices and relative foreign prices. Changes in the world price level will alter the nominal ruble dollar ratio, but will not influence comparative advantage. Pure external monetary disturbances therefore have no effect on the domestic Soviet economy.

Real disturbances either in the form of altered terms of trade or related changes in the physical structure of trade do no doubt impinge upon domestic resource allocation. Imports however constitute only about 2.5% of Soviet GNP, more than half of which is supplied by CMEA members on the basis of long term contracts. Since only a small portion of the remaining import bill is composed of intermediate inputs, disturbances caused by changes in the pattern

of foreign trade can be easily contained by the central planning system. Resources except under the most extraordinary conditions will remain fully mobilized, adjustment being borne by changes in assortment, quality and productivity. The two level Soviet planning system with its command and bonus incentive components therefore must be perceived as an extremely effective mechanism for containing unanticipated disturbances. Despite its robustness however it should not be surmised that the Soviet system is shock proof.

III. Shocks and Changes in the State of the Soviet Economic System

Shocks, it will be recalled, were defined in the introduction as events that change the state of a system. Using examples from physics for the purpose of analogy it is easily perceived that such changes can manifest themselves in diverse ways. A prolonged drought might contribute to the formation of a dust bowl, permanently impairing the fertility of the soil. Water heated to a hundred degrees centigrade vaporizes and assumes the properties of a gas rather than a liquid. The collision of antimatter with matter results in their mutual annihilation.

A drought can be likened to any economic shock that permanently alters productivity. The depletion of petroleum resources for example might force various industries to abandon their present technologies in favor of less productive methods. This would constitute a change in the state of the system, without however necessarily generating more remote dynamic instabilities.

The vaporization of water represents a more dramatic transformation in the laws governing the behavior of a system. In the economic sphere, an analogous transformation might occur if the Soviet Union suddenly took worker's demands into consideration in setting wages, creating a centrally planned surrogate for negotiated wages. Such a change would make the

determination of enterprise activity levels a function of the price of labor, undermining the inflexible price incentive mechanism that sustains full employment. The change in the state of the system in this case has dynamic significance. Not only would the pattern of economic production be significantly altered, but the process through which the new pattern was determined would be radically revised.

The annihilation of matter can be treated as representative of shocks which are so severe that observed changes in the state of the system virtually coincide with its destruction. The effects of War Communism, for example, on the Soviet economy were so devastating that modern economic activity almost ceased altogether.

The concept of shock, as can be seen from the preceding analogies, encompasses a wide variety of behavioral possibilities. Shocks may have either positive or negative consequences. They may result in revolutionary improvements in systems productivity or in systems collapse. The little work that has been carried out in this field has tended to focus on the negative side of changes in system's states, and has been limited largely to the drought analogy. Numerous studies carried out by the Central Intelligence Agency of how the Soviet economy might respond to catastrophic events such as a change in climate, depletion of its natural resources, or a famine are of this type.

This research has been useful, but has suffered from the lack of a clear perception of the role changes in the state of the system play in determining the character of economic crises. In order to advance the analysis of crises one step further, therefore a crisis model based on the water vaporization analogy needs to be explored.

IV. A Crisis Model of the Soviet Economy: The Case of Diminishing Technological Progress

Legitimate crisis models of the Soviet economy which take existing institutions as their point of departure must specify whether assumed changes in the state of the system affect the command mechanism, the bonus incentive mechanism or the system in its entirety. Each specification will entail different sets of explanatory variables and will provide correspondingly different descriptions of causal process. Models emphasizing the command mechanism will depend primarily on the central allocation of resources, while models constructed in terms of the bonus incentive mechanism will prominently involve prices.

For purposes of exposition let us concentrate on one of these classes of crisis models, leaving the others for further research. More specifically, consider the problem of diminishing technological progress from the standpoint of the central command mechanism. Suppose that due to the continuous decline in the contribution of technical progress to Soviet growth plan targets were underfulfilled and planners decided to take positive action to correct the situation. Diminished technological progress here constitutes a shock that changes the state of the system by altering the normal relationship between investment and output. Among the various alternatives at the planners' disposal for rectifying the underfulfillment of the output target are an increase in the tempo of new investment on the assumption that technology is largely embodied in capital or the adjustment of bonus incentives to encourage innovation.

The behavioral assumption underlying the first approach implies that

$$(1) \quad Y = f(I)$$

output (Y) is a positive function of investment (I). Ignoring the problem

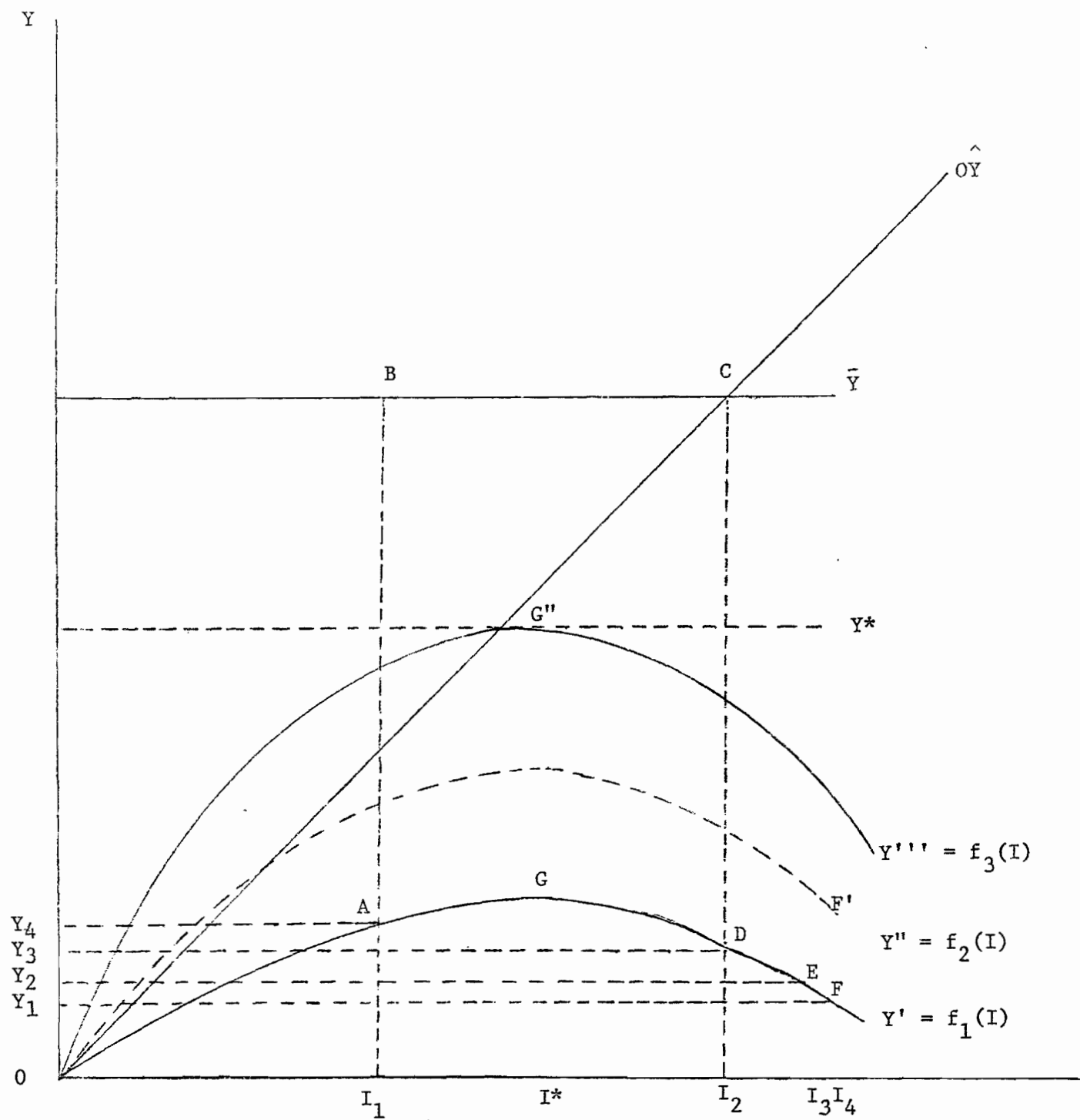


Diagram 1

of time lags, this specification suggests that planners might achieve their production targets by increasing the rate of new capital formation, simultaneously deepening the stock and enhancing its average technical productivity. While output is usually positively correlated with the level of investment, the marginal productivity of investment normally declines as the share of GNP devoted to new capital formation increases, and could even become negative if productive effort falls with real consumption.⁶ The behavioral pattern exhibited by the investment function therefore in all likelihood should resemble a marginal net revenue curve, a parabolic function rising to a maximum then decreasing with further investment,

$$(2) \quad Y = \alpha I - \beta I^2 \quad \alpha > \beta$$

This function is graphed in Diagram 1 where income (Y) is arrayed on the ordinate and investment (I) is arrayed on the abscissa.

The height of the parabola and the location of its maximum along the investment axis is not invariant, but depends on how effective the incentive system is in generating worker effort, technological innovation and diffusion. By varying the real wage (for example by cutting military production) and altering the specific pattern of incentives a given volume of investment may produce very different magnitudes of final output.⁷ This implies that equation 1 should be written as

$$(3) \quad Y = F[f(I), I]$$

where the function transforming investment into output is itself a function

$$(4) \quad f(I) = g(b, w)$$

of the bonus structure (b) and the real wage (w). Geometrically this

relationship is expressed in Diagram 1 by a family of parabolas which differ from one another due to the influence the bonus structure and the real wage have on investment productivity.

In addition to these elementary behavioral assumptions, an equally simple planners' decision rule is postulated

$$(5) \quad \frac{dI}{dt} = \phi(\bar{Y} - Y_1)$$

which stipulates that investment will be augmented if targeted income exceeds realized production or decreased if the observed level of output exceeds the target. Targeted output is designated by the horizontal line \bar{Y} in Diagram 1.

Under ordinary circumstances Soviet planners not knowing the exact shape of the parabolas would use historical experience to project the probable relationship between income and investment. Suppose that in the past targeted output never had been set higher than the apogee of the effective investment response parabola. Planners would logically surmise that output could be described for policy purposes as a linear function of investment expressed by the ray, \hat{OY} . Therefore, if at the beginning a crisis period, observed output were Y_4 , shortfalling the target \bar{Y} due to a decline in technical progress, (a fall in the investment response parabola), then applying equation 5 it can be anticipated that planners would increase investment beyond I^* to I_2 in a vain attempt to achieve the planned output target. Had the state of the system remained unaltered an increase in investment from I_1 to I_2 would have moved production along the ray \hat{OY} to an equilibrium at point C. The decline in technical progress however precludes this outcome by transforming the investment response schedule from the linear approximation \hat{OY} to the parabola, OY' . As a consequence instead of the parabola cutting the target at C, output actually declines to point D, causing the plan to be underfulfilled by a greater margin than before.

Assuming that the investment decision function is not revised, planners confronted with a widened income gap might increase investment once again to I_3 , which would cause output to fall further. At some point, of course, planners will realize what is happening and will attempt to take corrective action, but they will not know precisely what to do. They may try to reduce investment in an attempt to discover the peak output level at G. Or, perceiving the link between real wages, bonuses, and investment, the planners might try to shift the entire investment response schedule upward by increasing bonus rewards for innovation and diffusion, skewing real income in favor of those best in a position to increase the productivity of investment. Were such a policy to partially succeed in raising the investment response schedule from Y' to Y'' , output would rise for all levels of investment but would still fall short of the target \bar{Y} . The observed increase in output however might cause planners to confuse the effect of increased incentives with increased investment, inducing the systems directors to retain their old investment decision function, which in turn would prompt further increase in investment, F' .

The simultaneous process of refining incentives and increasing investment could be expected to continue until further changes in rewards no longer raised the investment response schedule and output was unambiguously identified as a negative function of investment. As can be easily seen in Diagram 1, the appropriate course of action once the investment response function Y''' was in force would be to reduce investment to I^* , generating peak feasible income Y^* at point G" which would then be accepted by the planners as the new optimum output target. In the process equation 5 would be supplemented by a side constraint which instructed planners to curtail investment if the first and second derivatives of the investment response

equation were negative and to continue contracting investment until the first derivative became zero, indicating that peak output had been attained.

Such a course of action would constitute a successful adaptation to a crisis brought on by faltering technological progress. The correct economic policy solution to the problems created by the changed state of the system however would only be achieved through a protracted period of trial and error until the new set of causal relations were better understood by the systems directors. In the interim between the onset of the crisis and its final resolution output would contract dysfunctionally as investment rose and real consumption fell. If the citizenry began to lose confidence in the competency of the planners, they might adapt by developing negative attitudes which would further complicate the task of crisis policy making. In particular if the new low levels of worker productivity associated with production at point F became the basis for revised work norms, the reversibility of the investment response function might be called into question. Cutting back investment might not immediately generate increased output adding to the economic losses already suffered by the system.

The extent, duration and even the eventual outcome of the crisis therefore would depend on how the secondary consequences of the changed state of the system ramify, making it more and more difficult for the planners to determine the appropriate course of action. Although it appears unlikely, matters could conceivably deteriorate to such an extent that the final result takes on the appearance of a collapse solution with the observed level of production far below what could be reasonably attributed to the direct effects of diminishing technical progress.

The probability of severe crises is increased if allowance is also made for the compounding of dysfunctional events. A grain crisis or a sudden

increase in the cost of acquiring natural resources could exacerbate matters. Likewise, if military considerations prompted an escalation in national security expenditures which the Ministry of Defense refused to curtail, additional pressure could be placed on consumption, causing a further decrease in output and a further impetus to increase investment. Obviously, there are few limits to the speculative possibilities that could be envisioned. Our purpose however is not to suggest that extreme outcomes are likely, but only to indicate that despite the ostensible robustness of the Soviet economy, crises are not inconceivable. Much depends on the adequacy of the rules of thumb used in policy making, and the ability of the planners to ascertain the behavioral response pattern of various components of the economic system under crisis conditions.⁸

V. External Shocks and the Generation of Crises in the Soviet Union

The discussion of crises just concluded assumed that the Soviet Union was a closed economy. Both the source of the internal shock and the mechanisms employed to restore equilibrium were treated as if they were internal to the system. The extension of the crises model to encompass an open economy offers policymakers increased degrees of freedom in dealing with changed states of the system; at the same time, it augments the number of potential sources of disequilibrating shocks.

The dual nature of external interactions as vehicles both for mitigating and generating shocks is easily seen from a straightforward extension of our diminishing technical progress model. To bolster flagging growth planners might try to increase their purchases of Western technology intensive capital durables, which would have the effect of shifting the investment response parabola upward toward \hat{Y} . On the other hand, if the achievement of the output target, \bar{Y} , were predicated on technology transfer and the West for

some reason shut off the flow of technology durables to the Soviet Union, the embargo itself might serve as the catalyst that altered the state of the system. Given the unlikelihood of an effective Western embargo, on balance the benefits of an open economy undoubtedly outweigh the costs.

It should be noted however that both the benefits and costs associated with foreign trade from the crisis perspective depend critically on the internal state of the Soviet economy because the relatively small size of Western trade with the Soviet Union implies that a foreign disturbance per se will have only a commensurately small effect on domestic production. Even in such obvious cases as technology transfer and the sale of grain, it is unlikely that the Soviet economy would be vulnerable to an embargo unless other internal factors conjoined to trigger a crisis response.

The only plausible exception to this principle of limited vulnerability to externally generated shocks, internal conditions impounded, has little to do with foreign trade. Reference, of course, is to the military climate. Should the West actively embark on an all out arms race or allow its national security posture to deteriorate vis-a-vis the Soviet Union, Soviet leaders might respond with a massive arms buildup for defense or offensive purposes as conditions dictated. The concomitant transfer of resources out of investment and consumption into weapons could potentially induce a crisis similar in conception to the technological progress crises model elaborated above. At the moment, for example, the Soviets are probably spending 13%-15% of their GNP on defense. Any sizable augmentation of this share would put enormous pressure on the growth potential of the economy and threaten the already meager Soviet standard of living. While an external shock of this sort may not generate a crisis within the class of foreign disturbances, its impact alone appears sufficiently strong to constitute a credible threat to the internal stability of the Soviet economic system.

VI. Conclusion

The architects of the modern Soviet economic system by foregoing the efficiency benefits of competitive markets and flexible prices were able to fashion a shock resistant planning mechanism that mobilized resources and provided rapid economic growth. The secret of this resilience, it has been argued, lies in the flexible character of Soviet planning which provides a coherent basis for the general allocation of resources at the command level, and allows a wide latitude for discretionary decision making on the part of individual managers at the periphery. This arrangement prevents the dysfunctional overcentralization of economic control in the hands of authorities far removed from the practical realities of operating an enterprise, at the same time the behavior of managers is regulated through bonus incentives and the price system. Moreover by setting prices so that enterprises almost always make profits, a powerful inducement for the maintenance of full employment has been provided that not only supports high levels of economic activity, but prevents destabilizing managerial behavior of the kind associated with business cycles in the West. Unanticipated disturbances encountered in production instead of expressing themselves in the level of aggregate economic activity, primarily manifest themselves in product assortment and quality. While these effects usually constitute real losses to the economy their statistical consequences are difficult to detect and their indirect ramifications are comparatively circumscribed.

The resilience of the Soviet economy to exogenous disturbance however does not imply that the Soviet system is shock proof. Going beyond the usual interpretation of crises characterized by the drought analogy, this exploratory essay has revealed that the Soviet economy is vulnerable to shocks that alter the state of the system. Just as the properties of water

vapor differ from water, an unanticipated change in the state of the system such as an unexplained decrease in technical progress could easily generate dysfunctional economic behavior until the planners through a process of trial and error discover an appropriate set of decision rules for coping with the new situation. While needless to say, it has not contended that the Soviet economy is on the brink of a crisis, the delineation of the conditions under which a crisis could manifest itself makes it clear that the chances of a crisis are less remote than one might surmise if the issue of the state of the system were ignored. This insight is especially illuminating in regard to the potential impact of foreign disturbances on Soviet economic behavior because it suggests that under the appropriate conditions a technology embargo or a grain embargo could serve as a catalyst altering the internal state of the system. Although the likelihood of such a contingency is unevaluable, it seems safe to infer that the greater the burden of defense placed on the Soviet economy, the more vulnerable the system will be to changes of state induced either by foreign or domestic shocks.

Notes

1. The concept of state employed here refers to the state of the system, not to changes in particular outcomes within a given system. For example, an increase in the output of textiles can be analyzed in terms of comparative statics (states) by studying the changes in demand inducing the observed increase and the dynamic laws which enable that change to take place. A change in the state of the system by contrast substantially alters the dynamic laws which determine the behavior of the economy. Modern mathematical economics has established branches which deal explicitly with statics, comparative statics, dynamics and optimization but has not developed a systematic body of literature on changes in the state of a system. Work related closely to the concept of state change employed in this essay however can be found in the field of adaptive economics. See Richard H. Day and Theodore Graves, eds. Adaptive Economic Models, (Academic Press, New York, 1975).
2. See Alec Nove, An Economic History of the USSR, (Allen Lane, London, 1969), Chapters 3-6. Reference here is not only to the infamous scissors crisis and the grain market crises that developed after 1927, but to the high rates of urban unemployment and the inadequate control of the government over the behavior of the cartels and the cartels over the behavior of their subordinate enterprises.
3. For a more complete discussion of this slightly unorthodox view of Soviet planning, see Steven Rosefielde and Henry Latané, "Decentralized Economic Control in the Soviet Union and China: One-Man-Rule versus Collective Self-Management," in Steven Rosefielde and James Leutze, editors, World Communism in Transition: Economic, Political and Military Problems of Contemporary Communism, (UNC Press, Chapel Hill, 1978).

On bonus maximizing see Martin Weitzman, "The New Soviet Incentive Model," Bell Journal of Economics, Spring 1976, #7, pp. 251-57; J. P. Bonin, "On the Design of Managerial Incentive Structures in a Decentralized Planning Environment," American Economic Review, September 1976, #66, pp. 682-87.
4. On the subject of optimal planning theory see Edward Ames, "Kantorovich on Planning," in Rosefielde and Leutze, World Communism in Transition, (UNC Press, Chapel Hill), 1978.
5. Gosplan typically plans some two thousand composite goods. See Joseph Berliner, The Innovation Decision in Soviet Industry, (MIT Press, Cambridge, 1976), p. 67. Enterprises however produce between 12 and 20 million distinct commodities which testifies more eloquently than anything else to the enormous gap between central control of aggregate production and enterprise microplanning. See Edward Ames, op. cit.
6. The effect of investment on output varies with the time framework specified. In the short run investment is a substitute for current consumption, especially in a macro context where the gross national product is conceived as the sum of consumption and investment. As the share of GNP derived from investment rises, the consumption share must decline. Likewise.

in the short term perspective, as more resources are devoted to investment, the marginal cost of capital should rise driving the rate of return down. This decline in real return may also be compounded by a fall in the marginal physical productivity of investment as capital is deepened. All of these factors plus the possibility that workers may substitute leisure for labor (effort) as the real consumption contracts with increased investment explain why the rate at which output rises in response to increased investment will be decreasing and may become negative if pushed to excess.

In the long run, assuming increasing embodied technical progress, the falling tendency of the marginal product of capital may be offset or reversed. Here too, however, the more rapid the rate of accumulation the more likely it will be that the overall long term rate of return will diminish due to sacrificed consumption and problems of efficient absorption.

For the purposes of the model developed in the text it is assumed that both short run and long run effects are in force, but that short run influences predominate. Notice however that even if an intermediate term were defined where the short and long run rates of investment varied in the same proportion, the shape of the investment response schedule would still in most cases have a parabolic form.

7. The real wage depends in part on the productivity of the economic system. In theory higher real income increases the volume of voluntarily supplied labor.
8. The affinity between the behavioral model developed above and game theory should be noted. For example in the case of bilateral monopoly unstable Cournot solutions depend on the inability of decision makers to correctly interpret the shape of their competitor's reaction function. If reaction functions were constantly and unpredictably changing, the state of the system would be altered in a fashion quite similar to that observed in our Soviet model. See Charles Ferguson and Ralph Pfouts, "Learning and Expectations in Dynamic Duopoly Behavior," Behavior Science, Vol. 7, No. 2, April 1962, pp. 223-37.

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Summary

Because of its historical stability and the presumption that central planning somehow provides effective mechanisms for containing economic disturbances, it is usually inferred that the Soviet economy is virtually invulnerable to either internal or external shocks. An analysis of the mechanisms of Soviet economic control and a novel interpretation of the concept of an economic shock in terms of systems states suggests that this traditional judgment is too strong. While the Soviet economic system is certainly shock resistant, it is by no means shock proof and under plausible circumstances may exhibit crisis responses not very dissimilar to those observed in the West when decision makers find it difficult to predict the future course of economic activity.

I. Introduction

In ordinary speech the terms disturbance and shock are used more or less interchangeably to describe events that alter an existing equilibrium. A shock has the connotation of being a stronger stimulus than a disturbance, but beyond this distinction the two terms have roughly the same meaning. In economics, this conventional usage has been reinforced by the conceptual framework of general equilibrium theory in which the magnitude of a perturbing event has little bearing on the adjustment mechanisms that restore the system to a new point of stable equilibrium.

The implication that the magnitude of a perturbing event is only a matter of degree and not a matter of substance however can be misleading. Under certain circumstances perturbations can be sufficiently large that they change the state of the system itself.¹ The worldwide inflation touched off by the Arab oil boycott for instance vividly exemplifies an extraordinary response to an event that unmistakably altered the state of the international economic system.

In this paper we will be primarily concerned with events that change the state of the Soviet economic system. To distinguish between perturbations contained within the existing system and perturbations that change the state of a system, the term disturbance will be reserved for the former and shock for the latter phenomenon. As will be seen shortly, the distinction drawn here goes far beyond semantics and bears decisively on any analysis of the effect perturbations might have on real world economies.

Although for the sake of generalization the distinction between disturbances and shocks limned above has been expressed in the context of general equilibrium, the concept of changed economic states need not be restricted to market economies. In principle at least, centrally planned

economies may exhibit patterns of behavior that cannot be adequately explained by the discretionary revision of official plans designed to cope with unforeseen events. During the NEP period for example, the record shows that the Soviet economy experienced numerous crises and therefore it should be considered an open question whether similar crises might not recur in the present Soviet institutional environment.²

This essay accordingly has been written as an exploratory study of how various kinds of economic shocks might alter the state of the Soviet economy and generate economic crises. The focal point of the investigation is the interface between discretionary actions likely to be taken by diverse agents in the central planning system and the behavior of the economy under crisis conditions. Before turning to this subject however a brief discussion of how Soviet central planning deals with ordinary disturbances is necessary in order to cast our discussion of crisis behavior in the clearest possible light.

II. The Conventional Dynamic Adjustment Process under Soviet Central Planning

Historical experience has shown that centrally planned economies possess mechanisms for containing both internal and external disturbances. In the Soviet Union, which can be taken as the archetype of a centrally planned economy, postwar trends in sectoral growth and capital formation have fluctuated in a very narrow range despite recurrent exogenous disturbances.

The robustness of the Soviet economy is attributable to a complex of administrative mechanisms commonly referred to as central planning. These mechanisms can be broadly divided into two classes, one founded on the principle of physical planning, the other on bonus maximizing.³ The physical planning system is based on the principle of executive directives or commands.

Institutionally it encompasses the Council of Economic Ministers, Gosplan and the ministerial bureaucracy. In theory commands issued by these agencies are legally binding instructions which comprehensively determine all aspects of economic behavior under socialism.⁴ In practice however central planning is so complex that commands are neither comprehensive nor consistent in an operational sense. To insure operational control therefore the Soviet planning system has developed a mechanism which permits producers to flexibly respond to various exigencies as they arise, and guide the command system in plan formulation. This control subsystem is the independent microplanning enterprise, including all institutions on khozraschyot (independent cost accounting) which are expected to govern their behavior according to the bonus incentives in force.

The relationship between the command system and the microplanning enterprise is one of mutual interdependence. At the start of the planning cycle enterprises are required to compile a set of prospective plans, quantifying their output objectives and their input needs. These projections are based on detailed calculations carried out by managers and their technical staffs using official bonus incentives as a guide in selecting an optimal production program. Since experienced managers through the process of learning-by-doing can anticipate that their enterprise plans will be revised, the projections which are submitted to their superiors in the ministerial bureaucracy will be carefully hedged.

When the ministerial bureaucrats receive these enterprise plans they aggregate them, making whatever adjustments seem expedient. Because the performance of the enterprises under their supervision strongly influences the evaluation made of their own work, the ministerial bureaucrats have little incentive to dispute enterprise projections so long as they exceed

the targets of the preceding year. They therefore concentrate on cosmetic revisions, forwarding aggregate projections for their industry to the State central planning agency.

These data collected from all the branches of the economy are then collated and arrayed in the form of material balances, enabling Gosplan to construct a preliminary variant of the national plan. After consulting with the political authorities in the Council of Economic Ministers and making appropriate revisions, the central plan formation process terminates with the publication of the annual plan.

The targets finally determined by Gosplan invariably exceed the recommendations of the ministries and alter the structure of production established in the preliminary enterprise microplans. Since the revisions mandated by Gosplan and the Council of Economic Ministers are necessarily taken without any direct knowledge of enterprise production possibilities, official plans must frequently be infeasible.⁵ Responsibility for reconciling the technical contradictions of the national plan falls on the shoulders of the ministerial bureaucracy. It is their duty to disaggregate Gosplan's targets and establish operational enterprise plans. Receiving little if any guidance however on how disaggregation should proceed, the ministries expediently adjust initial enterprise plans to nominally comply with the national plan. This is achieved partially in collusion with enterprise managers, the only agents in the system who know what the enterprises are capable of producing and partially by imposing arbitrary demands on enterprises, leaving the managers to cope as best they can.

Insofar as managers are directed to alter their preliminary plans either in the form of negotiated targets or through the direct imposition of legally binding production tasks, the command component of Soviet central planning effectively determines the course of production. Insofar as managers provide

critical inputs into the plan formulation process and are expected to bonus maximize by satisfying some plan targets while ignoring others, enterprise microplanning plays an independent role in determining the observed production pattern. Although it is difficult to assess the relative contribution made respectively by the command system and the microplanning firms, it can safely be deduced that the influence of central planning is largely confined to exerting pressure for full resource utilization, except in cases where the impact of an enterprise's output visibly effects production in other branches of the national economy. The actions of the central planning authorities therefore assume particular importance when large changes are imposed on the branch structure of national production. When sectoral proportions are left unmodified as has been the case in the post-Stalin period, the microplanning enterprises largely determine the observed micro product mix and function as the principal institution of economic adjustment in the overall system.

The microplanning enterprise is able to perform this crucial function because of the special character of the bonus incentive structure guiding managerial behavior. Managers in the Soviet Union are rewarded primarily for meeting quantitative output targets and maximizing accounting profits. Both criteria induce managers to fully employ and overfully employ the resources at their disposal. Bonuses are paid for every percentage point realized output exceeds the plan, and as a fixed proportion of profit. Since bonuses may constitute a large share of a manager's gross income, it is in his interest to acquire all the resources he can and squeeze as much effort as possible out of his workers in order to meet the planned output target. In a market economy this strategy might be counterproductive because if it were pursued simultaneously by all enterprises shortages of labor and nonlabor inputs would raise production costs and reduce profits. In the Soviet Union

however where wages and prices are fixed by the state pricing authority and where strikes are illegal, the obstacle to overfull resource utilization is sharply diminished. Profit margins which are quite wide when production occurs at normal full capacity utilization in the USSR would in all likelihood remain positive over a substantial range if enterprises were somehow able to acquire additional inputs.

From the perspective of systems control the strong, mutually reinforcing nature of the output and profit incentives means that even without central planning enterprises would tend to fully employ their resources, determining assortment according to the imperatives of managerial bonus maximization. Moreover, the fact that the state wholesale purchasing agency stands ready to buy all nonstandard output enterprises produce buttresses full resources utilization by eliminating the normal market risks associated with overproduction. As a consequence, the Soviet system is extremely robust, responding to disturbances by altering the structure of production rather than by underutilizing available factors of production.

The mechanisms employed for containing disturbances vary with their magnitude. Minor disturbances are almost entirely the responsibility of enterprise managers who when confronted with a shortage or a surplus adjust enterprise behavior in accordance with bonus incentives without further outside negotiation. Disturbances of a somewhat larger magnitude may require the intervention of glavks and ministries either for the purpose of transferring resources within their jurisdiction or revising the plan targets that affect the bonus function. In deciding whether to reallocate resources, administrators at the lower levels of the command system apply a variety of rules of thumb. Military goods take priority over civilian products. Full resource utilization is more important than an optimal product mix, etc. These principles insure in accordance with the logic of the system

that disturbances will not interfere with resource mobilization; losses being sustained by changes in assortment, quality and only secondarily in the volume of final output.

From time to time major disturbances occur which require intervention at the commanding heights of the economy. Recurrent grain shortages for example necessitate the direct action of Gosplan, which has a variety of policy alternatives at its disposal. Grain can be imported from abroad by diverting resources to the export sector at the expense of other domestic production activities. Alternatively, the direct loss caused by the grain shortfall can be accepted and minimized by reallocating food processing resources into other productive uses so that the indirect impact of the initial disturbance does not produce unemployment elsewhere in the economy. As in the case of lesser disturbances, containment is achieved by maintaining full resource utilization with the brunt of the burden being absorbed by changes in assortment, quality and productivity. This approach to disturbance management not only effectively eliminates the dynamic income effects which accompany disturbances in market economies, it also mitigates accounting losses since something is always produced. Indeed given the irrationalities of Soviet pricing, if the command component of the planning system sanctions an increase in inferior goods, accounting values could actually rise. While such gains of course are fictitious, anomalies of this kind help explain the ostensible robustness of the Soviet economy to unexpected disturbances.

Another factor contributing to the disturbance resistant nature of the Soviet economy is the separation of real effects from monetary phenomena. Money under Soviet conditions is passive because changes in money stocks have no independent effect on prices. The money supply is set so that aggregate purchasing power equals the aggregate transactions value of produced goods

and services computed at established prices. Disturbances, which alter this balance or cause excess supplies and demands for specific goods due to the redistribution of purchasing power, are certainly possible. They are easily contained however by adjusting credit relations with various economic agents, by adjusting turnover taxes on intermediate and final goods, or simply by passively tolerating repressed inflation. Such adjustments, of course, are seldom optimal in a general equilibrium sense. Like real disturbances, inept monetary and financial management affects the precise mix of produced goods and services, but the effect is more or less imperceptible expressed as it is in the form of changes in assortment and quality.

The ability of the resource mobilization strategy to contain both real and monetary internal disturbances also explains why the Soviet economy is largely impervious to external disturbances. External disturbances differ from internal disturbances only in their point of origin. Foreign monetary disturbances such as worldwide price inflation can no more affect domestic accounting prices than repressed domestic inflation. All decisions regarding imports and exports are made by the Ministry of Foreign Trade in terms of constant domestic prices and relative foreign prices. Changes in the world price level will alter the nominal ruble dollar ratio, but will not influence comparative advantage. Pure external monetary disturbances therefore have no effect on the domestic Soviet economy.

Real disturbances either in the form of altered terms of trade or related changes in the physical structure of trade do no doubt impinge upon domestic resource allocation. Imports however constitute only about 2.5% of Soviet GNP, more than half of which is supplied by CMEA members on the basis of long term contracts. Since only a small portion of the remaining import bill is composed of intermediate inputs, disturbances caused by changes in the pattern

of foreign trade can be easily contained by the central planning system. Resources except under the most extraordinary conditions will remain fully mobilized, adjustment being borne by changes in assortment, quality and productivity. The two level Soviet planning system with its command and bonus incentive components therefore must be perceived as an extremely effective mechanism for containing unanticipated disturbances. Despite its robustness however it should not be surmised that the Soviet system is shock proof.

III. Shocks and Changes in the State of the Soviet Economic System

Shocks, it will be recalled, were defined in the introduction as events that change the state of a system. Using examples from physics for the purpose of analogy it is easily perceived that such changes can manifest themselves in diverse ways. A prolonged drought might contribute to the formation of a dust bowl, permanently impairing the fertility of the soil. Water heated to a hundred degrees centigrade vaporizes and assumes the properties of a gas rather than a liquid. The collision of antimatter with matter results in their mutual annihilation.

A drought can be likened to any economic shock that permanently alters productivity. The depletion of petroleum resources for example might force various industries to abandon their present technologies in favor of less productive methods. This would constitute a change in the state of the system, without however necessarily generating more remote dynamic instabilities.

The vaporization of water represents a more dramatic transformation in the laws governing the behavior of a system. In the economic sphere, an analogous transformation might occur if the Soviet Union suddenly took worker's demands into consideration in setting wages, creating a centrally planned surrogate for negotiated wages. Such a change would make the

determination of enterprise activity levels a function of the price of labor, undermining the inflexible price incentive mechanism that sustains full employment. The change in the state of the system in this case has dynamic significance. Not only would the pattern of economic production be significantly altered, but the process through which the new pattern was determined would be radically revised.

The annihilation of matter can be treated as representative of shocks which are so severe that observed changes in the state of the system virtually coincide with its destruction. The effects of War Communism, for example, on the Soviet economy were so devastating that modern economic activity almost ceased altogether.

The concept of shock, as can be seen from the preceding analogies, encompasses a wide variety of behavioral possibilities. Shocks may have either positive or negative consequences. They may result in revolutionary improvements in systems productivity or in systems collapse. The little work that has been carried out in this field has tended to focus on the negative side of changes in system's states, and has been limited largely to the drought analogy. Numerous studies carried out by the Central Intelligence Agency of how the Soviet economy might respond to catastrophic events such as a change in climate, depletion of its natural resources, or a famine are of this type.

This research has been useful, but has suffered from the lack of a clear perception of the role changes in the state of the system play in determining the character of economic crises. In order to advance the analysis of crises one step further, therefore a crisis model based on the water vaporization analogy needs to be explored.

IV. A Crisis Model of the Soviet Economy: The Case of Diminishing Technological Progress

Legitimate crisis models of the Soviet economy which take existing institutions as their point of departure must specify whether assumed changes in the state of the system affect the command mechanism, the bonus incentive mechanism or the system in its entirety. Each specification will entail different sets of explanatory variables and will provide correspondingly different descriptions of causal process. Models emphasizing the command mechanism will depend primarily on the central allocation of resources, while models constructed in terms of the bonus incentive mechanism will prominently involve prices.

For purposes of exposition let us concentrate on one of these classes of crisis models, leaving the others for further research. More specifically, consider the problem of diminishing technological progress from the standpoint of the central command mechanism. Suppose that due to the continuous decline in the contribution of technical progress to Soviet growth plan targets were underfulfilled and planners decided to take positive action to correct the situation. Diminished technological progress here constitutes a shock that changes the state of the system by altering the normal relationship between investment and output. Among the various alternatives at the planners' disposal for rectifying the underfulfillment of the output target are an increase in the tempo of new investment on the assumption that technology is largely embodied in capital or the adjustment of bonus incentives to encourage innovation.

The behavioral assumption underlying the first approach implies that

$$(1) \quad Y = f(I)$$

output (Y) is a positive function of investment (I). Ignoring the problem

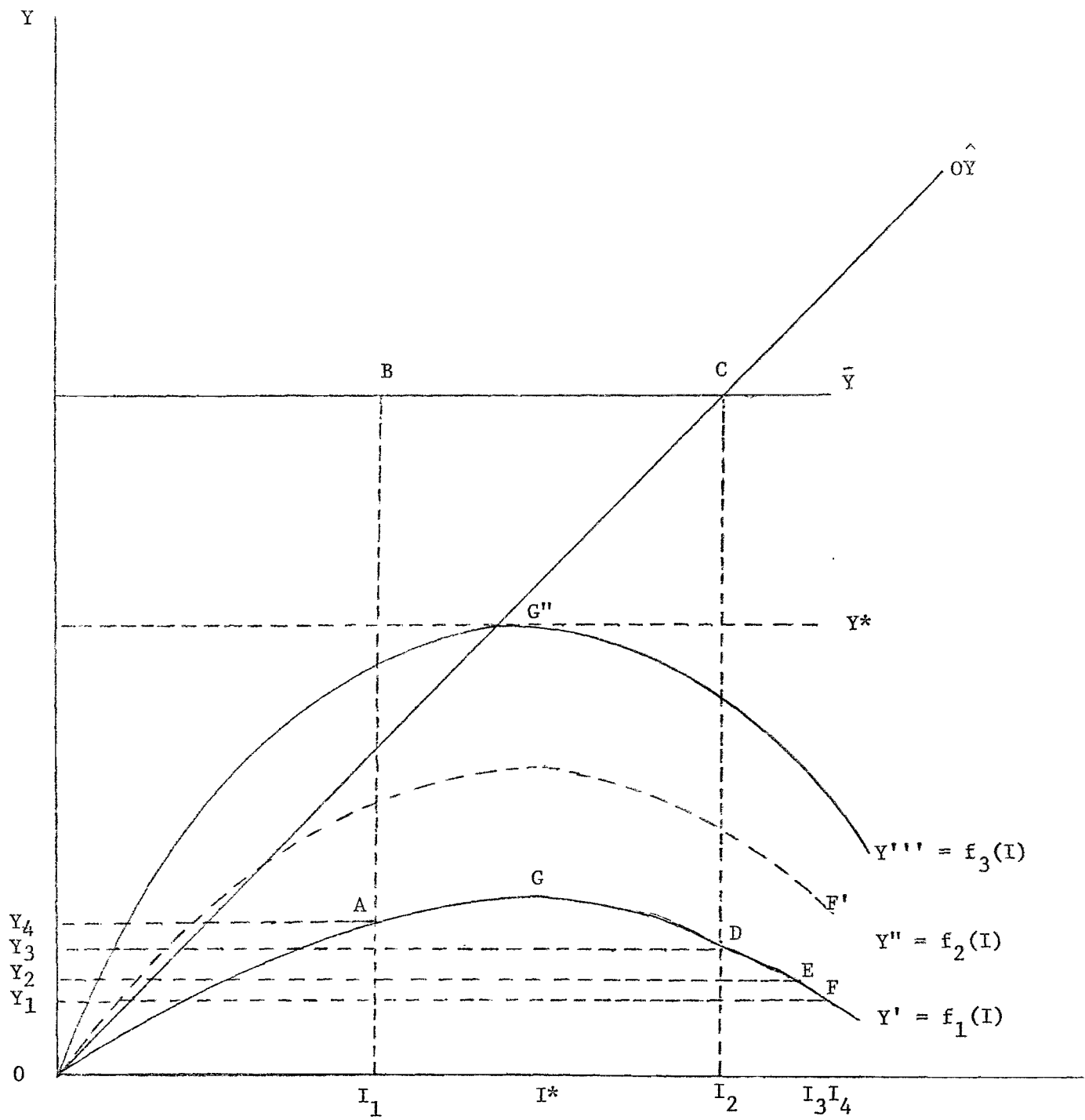


Diagram 1

of time lags, this specification suggests that planners might achieve their production targets by increasing the rate of new capital formation, simultaneously deepening the stock and enhancing its average technical productivity. While output is usually positively correlated with the level of investment, the marginal productivity of investment normally declines as the share of GNP devoted to new capital formation increases, and could even become negative if productive effort falls with real consumption.⁶ The behavioral pattern exhibited by the investment function therefore in all likelihood should resemble a marginal net revenue curve, a parabolic function rising to a maximum then decreasing with further investment,

$$(2) \quad Y = \alpha I - \beta I^2 \quad \alpha > \beta$$

This function is graphed in Diagram 1 where income (Y) is arrayed on the ordinate and investment (I) is arrayed on the abscissa.

The height of the parabola and the location of its maximum along the investment axis is not invariant, but depends on how effective the incentive system is in generating worker effort, technological innovation and diffusion. By varying the real wage (for example by cutting military production) and altering the specific pattern of incentives a given volume of investment may produce very different magnitudes of final output.⁷ This implies that equation 1 should be written as

$$(3) \quad Y = F[f(I), I]$$

where the function transforming investment into output is itself a function

$$(4) \quad f(I) = g(b, w)$$

of the bonus structure (b) and the real wage (w). Geometrically this

relationship is expressed in Diagram 1 by a family of parabolas which differ from one another due to the influence the bonus structure and the real wage have on investment productivity.

In addition to these elementary behavioral assumptions, an equally simple planners' decision rule is postulated

$$(5) \quad \frac{dI}{dt} = \phi(\bar{Y} - Y_i)$$

which stipulates that investment will be augmented if targeted income exceeds realized production or decreased if the observed level of output exceeds the target. Targeted output is designated by the horizontal line \bar{Y} in Diagram 1.

Under ordinary circumstances Soviet planners not knowing the exact shape of the parabolas would use historical experience to project the probable relationship between income and investment. Suppose that in the past targeted output never had been set higher than the apogee of the effective investment response parabola. Planners would logically surmise that output could be described for policy purposes as a linear function of investment expressed by the ray, \hat{OY} . Therefore, if at the beginning a crisis period, observed output were Y_4 , shortfalling the target \bar{Y} due to a decline in technical progress, (a fall in the investment response parabola), then applying equation 5 it can be anticipated that planners would increase investment beyond I^* to I_2 in a vain attempt to achieve the planned output target. Had the state of the system remained unaltered an increase in investment from I_1 to I_2 would have moved production along the ray \hat{OY} to an equilibrium at point C. The decline in technical progress however precludes this outcome by transforming the investment response schedule from the linear approximation \hat{OY} to the parabola, OY' . As a consequence instead of the parabola cutting the target at C, output actually declines to point D, causing the plan to be underfulfilled by a greater margin than before.

Assuming that the investment decision function is not revised, planners confronted with a widened income gap might increase investment once again to I_3 , which would cause output to fall further. At some point, of course, planners will realize what is happening and will attempt to take corrective action, but they will not know precisely what to do. They may try to reduce investment in an attempt to discover the peak output level at G. Or, perceiving the link between real wages, bonuses, and investment, the planners might try to shift the entire investment response schedule upward by increasing bonus rewards for innovation and diffusion, skewing real income in favor of those best in a position to increase the productivity of investment. Were such a policy to partially succeed in raising the investment response schedule from Y' to Y'' , output would rise for all levels of investment but would still fall short of the target \bar{Y} . The observed increase in output however might cause planners to confuse the effect of increased incentives with increased investment, inducing the systems directors to retain their old investment decision function, which in turn would prompt further increase in investment, F' .

The simultaneous process of refining incentives and increasing investment could be expected to continue until further changes in rewards no longer raised the investment response schedule and output was unambiguously identified as a negative function of investment. As can be easily seen in Diagram 1, the appropriate course of action once the investment response function Y''' was in force would be to reduce investment to I^* , generating peak feasible income Y^* at point G'' which would then be accepted by the planners as the new optimum output target. In the process equation 5 would be supplemented by a side constraint which instructed planners to curtail investment if the first and second derivatives of the investment response

equation were negative and to continue contracting investment until the first derivative became zero, indicating that peak output had been attained.

Such a course of action would constitute a successful adaptation to a crisis brought on by faltering technological progress. The correct economic policy solution to the problems created by the changed state of the system however would only be achieved through a protracted period of trial and error until the new set of causal relations were better understood by the systems directors. In the interim between the onset of the crisis and its final resolution output would contract dysfunctionally as investment rose and real consumption fell. If the citizenry began to lose confidence in the competency of the planners, they might adapt by developing negative attitudes which would further complicate the task of crisis policy making. In particular if the new low levels of worker productivity associated with production at point F became the basis for revised work norms, the reversibility of the investment response function might be called into question. Cutting back investment might not immediately generate increased output adding to the economic losses already suffered by the system.

The extent, duration and even the eventual outcome of the crisis therefore would depend on how the secondary consequences of the changed state of the system ramify, making it more and more difficult for the planners to determine the appropriate course of action. Although it appears unlikely, matters could conceivably deteriorate to such an extent that the final result takes on the appearance of a collapse solution with the observed level of production far below what could be reasonably attributed to the direct effects of diminishing technical progress.

The probability of severe crises is increased if allowance is also made for the compounding of dysfunctional events. A grain crisis or a sudden

increase in the cost of acquiring natural resources could exacerbate matters. Likewise, if military considerations prompted an escalation in national security expenditures which the Ministry of Defense refused to curtail, additional pressure could be placed on consumption, causing a further decrease in output and a further impetus to increase investment. Obviously, there are few limits to the speculative possibilities that could be envisioned. Our purpose however is not to suggest that extreme outcomes are likely, but only to indicate that despite the ostensible robustness of the Soviet economy, crises are not inconceivable. Much depends on the adequacy of the rules of thumb used in policy making, and the ability of the planners to ascertain the behavioral response pattern of various components of the economic system under crisis conditions.⁸

V. External Shocks and the Generation of Crises in the Soviet Union

The discussion of crises just concluded assumed that the Soviet Union was a closed economy. Both the source of the internal shock and the mechanisms employed to restore equilibrium were treated as if they were internal to the system. The extension of the crises model to encompass an open economy offers policymakers increased degrees of freedom in dealing with changed states of the system; at the same time, it augments the number of potential sources of disequilibrating shocks.

The dual nature of external interactions as vehicles both for mitigating and generating shocks is easily seen from a straightforward extension of our diminishing technical progress model. To bolster flagging growth planners might try to increase their purchases of Western technology intensive capital durables, which would have the effect of shifting the investment response parabola upward toward \hat{Y} . On the other hand, if the achievement of the output target, \bar{Y} , were predicated on technology transfer and the West for

some reason shut off the flow of technology durables to the Soviet Union, the embargo itself might serve as the catalyst that altered the state of the system. Given the unlikelihood of an effective Western embargo, on balance the benefits of an open economy undoubtedly outweigh the costs.

It should be noted however that both the benefits and costs associated with foreign trade from the crisis perspective depend critically on the internal state of the Soviet economy because the relatively small size of Western trade with the Soviet Union implies that a foreign disturbance per se will have only a commensurately small effect on domestic production. Even in such obvious cases as technology transfer and the sale of grain, it is unlikely that the Soviet economy would be vulnerable to an embargo unless other internal factors conjoined to trigger a crisis response.

The only plausible exception to this principle of limited vulnerability to externally generated shocks, internal conditions impounded, has little to do with foreign trade. Reference, of course, is to the military climate. Should the West actively embark on an all out arms race or allow its national security posture to deteriorate vis-a-vis the Soviet Union, Soviet leaders might respond with a massive arms buildup for defense or offensive purposes as conditions dictated. The concomitant transfer of resources out of investment and consumption into weapons could potentially induce a crisis similar in conception to the technological progress crises model elaborated above. At the moment, for example, the Soviets are probably spending 13%-15% of their GNP on defense. Any sizable augmentation of this share would put enormous pressure on the growth potential of the economy and threaten the already meager Soviet standard of living. While an external shock of this sort may not generate a crisis within the class of foreign disturbances, its impact alone appears sufficiently strong to constitute a credible threat to the internal stability of the Soviet economic system.

VI. Conclusion

The architects of the modern Soviet economic system by foregoing the efficiency benefits of competitive markets and flexible prices were able to fashion a shock resistant planning mechanism that mobilized resources and provided rapid economic growth. The secret of this resilience, it has been argued, lies in the flexible character of Soviet planning which provides a coherent basis for the general allocation of resources at the command level, and allows a wide latitude for discretionary decision making on the part of individual managers at the periphery. This arrangement prevents the dysfunctional overcentralization of economic control in the hands of authorities far removed from the practical realities of operating an enterprise, at the same time the behavior of managers is regulated through bonus incentives and the price system. Moreover by setting prices so that enterprises almost always make profits, a powerful inducement for the maintenance of full employment has been provided that not only supports high levels of economic activity, but prevents destabilizing managerial behavior of the kind associated with business cycles in the West. Unanticipated disturbances encountered in production instead of expressing themselves in the level of aggregate economic activity, primarily manifest themselves in product assortment and quality. While these effects usually constitute real losses to the economy their statistical consequences are difficult to detect and their indirect ramifications are comparatively circumscribed.

The resilience of the Soviet economy to exogenous disturbance however does not imply that the Soviet system is shock proof. Going beyond the usual interpretation of crises characterized by the drought analogy, this exploratory essay has revealed that the Soviet economy is vulnerable to shocks that alter the state of the system. Just as the properties of water

vapor differ from water, an unanticipated change in the state of the system such as an unexplained decrease in technical progress could easily generate dysfunctional economic behavior until the planners through a process of trial and error discover an appropriate set of decision rules for coping with the new situation. While needless to say, it has not contended that the Soviet economy is on the brink of a crisis, the delineation of the conditions under which a crisis could manifest itself makes it clear that the chances of a crisis are less remote than one might surmise if the issue of the state of the system were ignored. This insight is especially illuminating in regard to the potential impact of foreign disturbances on Soviet economic behavior because it suggests that under the appropriate conditions a technology embargo or a grain embargo could serve as a catalyst altering the internal state of the system. Although the likelihood of such a contingency is unevaluable, it seems safe to infer that the greater the burden of defense placed on the Soviet economy, the more vulnerable the system will be to changes of state induced either by foreign or domestic shocks.

Notes

1. The concept of state employed here refers to the state of the system, not to changes in particular outcomes within a given system. For example, an increase in the output of textiles can be analyzed in terms of comparative statics (states) by studying the changes in demand inducing the observed increase and the dynamic laws which enable that change to take place. A change in the state of the system by contrast substantially alters the dynamic laws which determine the behavior of the economy. Modern mathematical economics has established branches which deal explicitly with statics, comparative statics, dynamics and optimization but has not developed a systematic body of literature on changes in the state of a system. Work related closely to the concept of state change employed in this essay however can be found in the field of adaptive economics. See Richard H. Day and Theodore Graves, eds. Adaptive Economic Models, (Academic Press, New York, 1975).
2. See Alec Nove, An Economic History of the USSR, (Allen Lane, London, 1969), Chapters 3-6. Reference here is not only to the infamous scissors crisis and the grain market crises that developed after 1927, but to the high rates of urban unemployment and the inadequate control of the government over the behavior of the cartels and the cartels over the behavior of their subordinate enterprises.
3. For a more complete discussion of this slightly unorthodox view of Soviet planning, see Steven Rosefielde and Henery Latané, "Decentralized Economic Control in the Soviet Union and China: One-Man-Rule vers s Collective Self-Management," in Steven Rosefielde and James Leutze, editors, World Communism in Transition: Economic, Political and Military Problems of Contemporary Communism, (UNC Press, Chapel Hill, 1978).
- On bonus maximizing see Martin Weitzman, "The New Soviet Incentive Model," Bell Journal of Economics, Spring 1976, #7, pp. 251-57;
J. P. Bonin, "On the Design of Managerial Incentive Structures in a Decentralized Planning Environment," American Economic Review, September 1976, #66, pp. 682-87.
4. On the subject of optimal planning theory see Edward Ames, "Kantorovich on Planning," in Rosefielde and Leutze, World Communism in Transition, (UNC Press, Chapel Hill), 1978.
5. Gosplan typically plans some two thousand composite goods. See Joseph Berliner, The Innovation Decision in Soviet Industry, (MIT Press, Cambridge, 1976), p. 67. Enterprises however produce between 12 and 20 million distinct commodities which testifies more eloquently than anything else to the enormous gap between central control of aggregate production and enterprise microplanning. See Edward Ames, op. cit.
6. The effect of investment on output varies with the time framework specified. In the short run investment is a substitute for current consumption, especially in a macro context wherethe gross national product is conceived as the sum of consumption and investment. As the share of GNP derived from investment rises, the consumption share must decline. Likewise.

in the short term perspective, as more resources are devoted to investment, the marginal cost of capital should rise driving the rate of return down. This decline in real return may also be compounded by a fall in the marginal physical productivity of investment as capital is deepened. All of these factors plus the possibility that workers may substitute leisure for labor (effort) as the real consumption contracts with increased investment explain why the rate at which output rises in response to increased investment will be decreasing and may become negative if pushed to excess.

In the long run, assuming increasing embodied technical progress, the falling tendency of the marginal product of capital may be offset or reversed. Here too, however, the more rapid the rate of accumulation the more likely it will be that the overall long term rate of return will diminish due to sacrificed consumption and problems of efficient absorption.

For the purposes of the model developed in the text it is assumed that both short run and long run effects are in force, but that short run influences predominate. Notice however that even if an intermediate term were defined where the short and long run rates of investment varied in the same proportion, the shape of the investment response schedule would still in most cases have a parabolic form.

7. The real wage depends in part on the productivity of the economic system. In theory higher real income increases the volume of voluntarily supplied labor.
8. The affinity between the behavioral model developed above and game theory should be noted. For example in the case of bilateral monopoly unstable Cournot solutions depend on the inability of decision makers to correctly interpret the shape of their competitor's reaction function. If reaction functions were constantly and unpredictably changing, the state of the system would be altered in a fashion quite similar to that observed in our Soviet model. See Charles Ferguson and Ralph Pfouts, "Learning and Expectations in Dynamic Duopoly Behavior," Behavior Science, Vol. 7, No. 2, April 1962, pp. 223-37.