

# COMMUNIST RÉGIME COLLAPSE: OUTPUT AND THE RATE OF REPRESSION

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## INTRODUCTION

The history of communist régimes was characterized by periods of strong repression interspersed with periods of moderation, and, finally, in most cases, by régime collapse. Thus, it would seem that, in general, the use of repression was not sufficient to save a communist dictatorship. It is also widely agreed that economic crisis was an important factor in the collapse. However, there has been little, if any, analysis of the relationship between the politics of repression and the economics of régime collapse. The purpose of this paper is to present a model which answers the rather obvious question: Why were communist dictatorships unable to keep power by means of repression, even in the face of economic difficulties?

Of course, this question could be posed with respect to any kind of dictatorship. Our answer applies exclusively to communist dictatorships since it hinges on a unique feature of such régimes; namely, that communist régimes have a monopoly of both the means of production and foreign trade. In other words, if a segment of the population wishes to overthrow the régime, the resources for an uprising must be financed exclusively out of wages. In the presence of either a private sector or free trade — in particular, the ability to import privately, say, arms or weapons components — the model presented below would break down.

We show that the level of output, allocations to consumption, and the rate of repression are connected. There are levels of output at which increasing the repression rate is not optimal, but at which decreasing it might lead to a régime collapse. We develop a game theoretic model of communist dictatorship which uses the relationship between output, consumption, and repression to explain changes in the rate of repression and communist régime collapse.<sup>1</sup>

We show that the course of communist history through changes in repression, moderation, and finally collapse may be explained by economic factors. Such exogenous factors as political pressure from the West are not needed — if, indeed, valid — to explain the decisions of communist dictators to reduce the size of their repressive apparatus. The level of output provides a sufficiently powerful explanatory variable.

In the literature the relationship between output and repression in communist systems has been analyzed, however mostly in the opposite direction, i.e., the effect of the level of repression on output and productivity. Thus, Wintrobe [1988], building on the theory developed by Breton and Wintrobe [1982] in the context of the operation of the soviet bureaucracy shows that repression reduces the ratio of the size of the horizontal network, i.e., the extent of relationships between subordinates at any given level of the hierarchy, over the vertical network — the relationships between superiors and subordinates. Indeed, the Party leaders, in particular Stalin, used repression to strengthen vertical trust — the extent to which reports by subordinates to superiors are credible — and prevent the formation of coalitions. Since, as Wintrobe argues, productivity increases with the extent of vertical trust within the hierarchy, it falls as horizontal trust increases.<sup>2</sup> This gives rise to a tendency, over time, for the hierarchy to decline in its productivity.

In the same spirit, Murrell and Olson [1991] show that an increase in the size of the bureaucracy reduces the effectiveness of a centrally planning system and therefore reduces productivity. They argue that since “information has to be passed up through layer and layer of bureaucracy ... the information losses also increase with the size of the bureaucracy” [*ibid.*, 255]. Moreover, they claim that the bureaucrats “have an incentive to overstate the difficulties faced and to understate potential production” [*ibid.*, 256]. These informational and transactions costs in the flow of information up the hierarchy lead, eventually, to a decline in output; i.e., to “red sclerosis” [Olson, 1995].

By contrast, in our model, what we term “the rulers” are one player — a Party leader or the Politburo or, indeed the entire hierarchy — and the repression that we model is that used against the population at large in order to prevent régime-threatening popular unrest, and not repression within the hierarchy. It seems reasonable to assume that the members of the hierarchy, including the leaders, share the goal of maintaining a monopoly of political power. Consequently, in modeling repression, we will overlook repression within the hierarchy. Since we are concerned with the problem of régime collapse as it may be affected by worker unrest, and not with the workings of the hierarchy, we shall take output to be exogenously determined. Thus, for us, the hierarchy is a “black box”.<sup>3</sup>

Our model is a development of those presented by Wintrobe [1990] and Schnytzer [1995] in that it assumes rationality on the part of communist dictators. Its innovation is that the population is also considered an actor, thus converting a simple optimization process for the communist rulers into a game.

This paper focuses on the effects of the level of output on the optimal allocation of that output. In the model, the rulers determine the allocation of output among two uses: they provide wages for the workers and allocate a proportion of output to such means of repression as the army, the police force, the secret police, etc. The rulers obtain utility from the remaining output, which is used for investment as well as their own consumption. In order to focus on the tradeoff between wages and repression, however, the allocation between consumption and investment is not modeled explicitly. In a Stackelberg game, the workers then decide whether or not to attempt an overthrow of the régime, the outcome of which is uncertain.

We provide a model of a *pre-reform* socialist economy, (i.e., when economic reform in the sense of privatization of the means of production is not on the policy agenda). Because the means of production are nationalized, this model is specific to a communist régime. Therefore, this model would not apply to a dictatorship with a significant private sector such as, for example, contemporary Iraq, or the European absolute monarchies of the past. As a consequence of the centralization of the means of production in the hand of the rulers, they are the sole residual claimants of output. Thus, the population is reliant exclusively for its consumption and the financing, if any, of attempts at régime overthrow, on the wages allocated by the rulers.

When privatization of the means of production is ruled out for ideological or other reasons, we show that régime survival depends critically on the level of output (while in dictatorships or monarchies with a private sector, the nexus between output and repression, as we model it, would be broken). We prove the existence, *inter alia*, of two types of equilibria in which the communist régime is stable.

If output is sufficiently high — in a sense to be discussed below — a high level of repression is employed to maintain power. In this case, the optimal rate of repression is set and the wage rate follows as a residual. On the other hand, if the level of output is insufficiently high to maintain a “hard line” régime, a second type of equilibrium emerges — one in which the standard of living of the population is kept sufficiently high, for a given relatively weaker repressive apparatus, to prevent unrest. For even lower levels of output, the régime becomes unstable as workers attempt to overthrow the government.

The theoretical model is offered in the next section, followed by our argument, using stylized facts, that the first equilibrium characterizes the Stalinist phase of development in the Soviet Union and Eastern Europe. The second equilibrium corresponds to the pre-collapse, more liberal phases of the communist economies in the Soviet Union and Eastern Europe. This phase began at some point during the 1970s. The collapse of the communist monopoly of political power follows the deepening of the economic crisis at the end of the 1980s as the economy moves into the third equilibrium. The final section concludes the paper.

## THE MODEL

### *The Assumptions of the Model*

Consider an economy in which the communist party has a monopoly of political power and the means of production are state owned. Assume that economic reform implying privatization is not a valid policy option, either for ideological or other reasons. The economy has two players: rulers and workers.

***Output and its Distribution.*** The rulers determine the allocation of output ( $Y$ ) among themselves, workers and means of repression, as follows: workers receive a fixed proportion of output,  $\omega$ , which generates a wage bill,  $W$ :

$$(1) \quad W = \omega Y.$$

Define  $W_f$ , the subsistence level wage bill, as the minimum wage bill which must be allocated to workers by the rulers. Thus for every level of output, there exists a minimum wage rate,  $\omega_f = W_f/Y$ . A further fixed proportion of output,  $\beta Y$ , is allocated to the means of repression, leaving the rulers with:

$$(2) \quad R = [1 - \beta - \omega] Y.$$

Since our primary interest is in the tradeoff between repression of the population and the wage rate, following the discussion in the introduction, we assume that output is determined exogenously. Included in the definition of output are all available resources including foreign transfers. For ease of exposition, a static framework is adopted. The results obtained do not differ in essence from those which would be obtained were a fixed rate of investment to be assumed in a dynamic framework.

**Timing of decisions.** The rulers first decide how much of the available output will be allocated to the means of repression and to the workers. Given their share of output, workers then decide, seeing the size of the repressive apparatus and their share of output, whether or not to fight the régime. Equilibrium in the model is, therefore, the outcome of a Stackelberg game.

**Payoffs.** Assume the existence of a minimum consumption basket,  $W_o = \omega_o Y$ . An allocation to workers of less than this amount ensures an attempt to overthrow the régime. This is the wage bill required to prevent social unrest. It will evidently differ from society to society and as between different periods within the same society. It seems reasonable to assume that it is greater than  $W_f$ .

If the rulers give workers more than the minimum consumption basket, the decision to fight is based on the size of the means of repression. If the workers do not fight, they receive the wage  $W$  paid by the rulers, which must be higher than  $W_o$ , (otherwise, they would have fought). The rulers get the remaining rents,  $R$ . The utility of the workers and rulers, respectively, are therefore:

$$(3) \quad V_{NF} = V(W); \quad U_{NF} = U(R)$$

where  $V$  and  $U$  are continuous utility functions for the workers and rulers respectively; outcomes associated with no fight being denoted by the subscript  $NF$ .  $V$  is a positive concave function of the workers' share of output and also depends of the state of upheaval, as explained below.

If the workers fight, then with probability  $p$  they overthrow the régime. Assume that  $p$ , defined on the closed interval  $[0,1]$  is a convex decreasing function of the allocation of output to the means of repression,  $\beta$ .<sup>4</sup> We assume for simplicity that  $p(1) = 0$  and  $p(0) = 1$ .<sup>5</sup> Should the revolution be successful, workers seize all output, while the rulers' payoff is zero. Conversely, a failed revolution leaves workers with their

original consumption bundle but they are punished in such a way that their utility is set to zero for having tried to overthrow the régime.<sup>6</sup> Denoting outcomes associated with fighting by a subscript  $F$ , the payoffs for rulers and workers are:

$$(4) \quad V_r = p(\beta) \cdot V(Y) \quad \text{where } p' < 0 \text{ and } p'' > 0.$$

$$U_r = [1 - p(\beta)]U(R).^7$$

### **Equilibrium**

Since in our model, the rulers first decide how to allocate output between the workers and the means of repression, and then the workers decide either to fight or not, the equilibrium is the outcome of a Stackelberg game where  $\beta$  (the share allocated to the means of repression),  $\omega$  (the share allocated to consumption), and  $F$  (fight) or  $NF$  (no fight) are endogenously determined. As we show in Appendix 1, there are three possible types of equilibria.

The first equilibrium possible, Equilibrium #1, is that workers do not fight and the rulers chose the shares to repression and consumption that maximize their utility given by equation (3). We denote this equilibrium as:  $(NF, \beta = \beta^*, \omega = p(\beta^*))$ , where  $\beta^*$  is the argmax of equation (3), and the share to consumption maximizes rents such that workers will not fight (i.e., at the margin, the workers are indifferent between fighting and not fighting).

The second equilibrium, Equilibrium #2, is similar to Equilibrium #1 in that workers do not fight, but the level of output is such that rulers cannot choose  $\beta^*$ , without leaving consumption lower than  $W_0$  thereby rendering a fight inevitable. Thus, in this case, rulers choose to give to worker exactly  $W_0$ , and set the share of repression to be such that workers will not be interested in fighting. The equilibrium is denoted:  $(NF, \beta = p^{-1}(\omega_0), \omega = \omega_0)$ .

The third equilibrium, Equilibrium #3, involves a fight. In this case, the rulers allocate to the workers the subsistence level,  $W_p$  and set the share of repression as the one that maximize equation (4). The equilibrium is denoted  $(F, \beta = \beta_p, \omega = \omega_p)$ . The rulers choose the one equilibrium among these three that give them the highest pay-offs. The size of output,  $Y$ , is critical for the choice of the equilibrium, as we show in the next proposition:

### **Proposition**

The size of output determines the equilibrium chosen. For a level of output greater than  $Y_1$ , Equilibrium #1 is chosen; that is, workers do not fight,  $\omega^* = p(\beta^*)$ , and  $|d\omega/d\beta^*| = 1$ . For a level of output between  $Y_1$  and  $Y_2$ , Equilibrium #2 is chosen (i.e., workers do not fight, and the rulers distribute  $\omega = \omega_0$  to the workers). When output is less than  $Y_2$ , Equilibrium #3 is chosen i.e., workers receive  $\omega_p$  and fight.

This proposition is a direct consequence of the form of the three equilibria. The dependence of equilibrium on output is shown in Figure 1. Recall that  $\beta^*$  is the repression rate at which utility,  $U_{NF}$ , is maximized, and that utility level is denoted  $U_{NF}^*$ , and  $\beta_f$  is the repression rate at which utility  $U_f$  is maximized, this being denoted as  $U_f^*$ . We show in Appendix 2 that  $U_{NF}^* > U_f^*$  for  $\omega_f$  sufficiently high; that is, the best choice for the rulers is to set  $\beta = \beta^*$ .<sup>8</sup> However this is a solution only when  $\omega^* \geq \omega_0$ ; that is, for output greater than  $Y_1$ . Therefore, for levels of output greater than or equal to  $Y_1$ , Equilibrium #1 at point A is chosen. The repression rate is  $\beta^*$  and the consumption rate,  $\omega^*$ .

For values of output between  $Y_1$  and  $Y_2$ ,  $U_{NF} > U_f$ , the best choice is the no fight equilibrium #2 (since Equilibrium #1 is not feasible). That occurs at some point between A and B and the rulers opt for a  $\beta = p^{-1}(\omega_0)$ , lower than  $\beta^*$ . For output less than  $Y_2$ , rulers maximize their expected utility by forcing a revolution, choosing  $\beta_f$  and  $\omega_f$ , and equilibrium #3 is attained at point C.

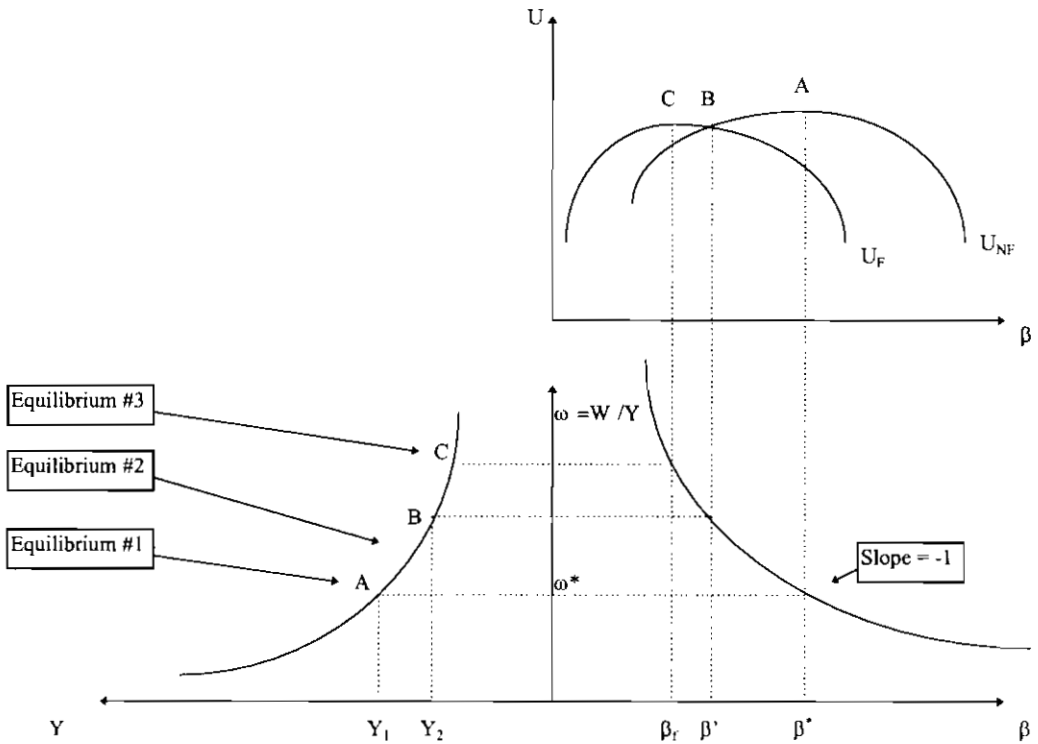
The above proposition establishes the nexus between output, the size of the repressive apparatus and consumption. It shows that the extent of the repression is not a continuous function of output. Suppose that output begins at a high level,<sup>9</sup> but owing to increased sclerosis within the hierarchy, it falls over time. This will have an effect on allocations to repression and consumption. When output is high, the rulers maintain a constant ratio of the size of the repressive apparatus to consumption. The reduction in output is at the expense of rents, affecting neither the repressive apparatus nor the people. When output falls below  $Y_1$  (but still above  $Y_2$ ), the rulers give the workers the minimum bundle of consumption,  $W_0$  (since the optimal share of repression,  $\beta^*$  is no longer feasible). They do not change the total size of the wage bill. However, the size of the repressive apparatus is decreased in a continuous manner from  $\beta^*$  to  $\beta'$ . If output falls to as low a level as  $Y_2$ , then there is a discrete reduction in both repression and consumption rates to  $\beta_f$  and  $\omega_f$  respectively, the consumption is set at its minimum, i.e., the subsistence level (we show in Appendix 2 that  $\beta_f$  is lower than  $\beta^*$ ).

The size of output is therefore a major determinant of its distribution between rulers and workers. When output is high enough, they give the workers the minimum amount of output which prevents a fight. However, when output does not allow such an equilibrium, the best strategy is then to reduce the repressive apparatus. When output is sufficiently low, rulers cannot avoid a fight.

## STYLIZED FACTS

The three equilibria summarized in the Proposition provide a reasonable description of the different types of socialist centrally-planned economy in the absence of privatizing reforms.<sup>10</sup> The two non-fighting equilibria of the Proposition relate to two stable states in which communist economies functioned prior to the output crisis which led to either successful reform — as, for example, in China — or collapse elsewhere. Equilibrium #1 describes the hard-line régime, which devotes relatively more resources to repression than to workers' consumption, compared with the ratio in equilibrium #2, in order to stay in power. This equilibrium provides the rulers with more rents —

**FIGURE 1**  
**Equilibria Under Central Planning**



and thus a higher level of utility — than Equilibrium #2, in which a reduction in output (*vis à vis* that in Equilibrium #1) forces the rulers to reduce allocations to the means of repression in order to pay workers a wage just sufficient to prevent a struggle. It should be noted that, since the ratio of means of repression to wages in Equilibrium #2 is feasible — but not optimal for the rulers — also at the higher level of output required for Equilibrium #1, our model implies that communist rulers prefer, *ceteris paribus*, a hard-line to the more moderate régime implied by Equilibrium #2. This accords well with the view of such scholars of communism as, for example, Winiecki [1986], that communist governments in the Soviet Union and Eastern Europe were forced on the path of moderation by a realization that their economies were in long-term economic decline.<sup>11</sup>

Equilibrium #3, in which the population fights, occurred on a number of occasions with both possible outcomes. Thus, the workers' riots in Poland, which brought about the replacement of Gomulka by Gierek at the head of the Polish leadership in 1970, and the declaration of martial law by the Jaruzelski government in 1981, in response to the communists' struggle with Solidarity, are both examples of a successful defense of its political power by the rulers. Similar cases of workers' defeat subsequent to a fight are Hungary in 1956 and Czechoslovakia in 1968.<sup>12</sup> Soviet intervention was of evident importance in the latter cases. Within the context of our model, this inter-

vention may be viewed as the one-time provision of foreign aid in the form of means of repression. The collapse — without privatizing reforms — of communist governments in East Germany, Czechoslovakia, Bulgaria, Albania, Mongolia and the Soviet Union in 1989-90 represent examples of Equilibrium #3 in which the rulers lost the struggle.<sup>13</sup>

The question that arises in these cases is: why didn't the rulers in these countries embark on privatizing reforms of one kind or another? Within our game-theoretic framework, the only thing both rulers and workers do not know with certainty is the outcome of a fight. Since this outcome is uncertain, it may be argued that these régimes were mistaken in their evaluation of the probability,  $p$ . Some evidence supporting this assertion is that in all the above countries but East Germany, partial reform measures of one kind or another were undertaken in the months or weeks prior to the collapse of the communist monopoly of political power.<sup>14</sup> Further, in the case of East Germany, there is evidence that one night just preceding the collapse, the Politburo decided to send in troops to put down the anti-government demonstrations in Berlin. This decision was soon rescinded because high ranking army officers informed the communist leadership that soldiers would refuse to obey such an order.<sup>15</sup>

## CONCLUSIONS

The course of communist history through changes in repression, moderation and finally collapse may be explained by economic factors. Such exogenous factors as political pressure from the West are not needed — if, indeed, valid — to explain the decisions of communist dictators to reduce the size of their repressive apparatus. The level of output provides a sufficiently powerful explanatory variable.

The long-term downward trend in the growth rate of output — the so-called “red sclerosis” — has been widely analyzed. With the passage of time, increasing systemic inefficiency led to stagnation. Given this fact, the ruling elite needed to decide how output would be divided between themselves and the rest of the population. Our model shows that so long as the level of output was sufficiently high, a strong repressive apparatus was maintained, while allocations to consumption were a residual which held the ratio of means of repression to wages constant. However, as output continued to fall — or, in dynamic terms, as the rate of growth declined — it was the repressive apparatus whose size was reduced, the ratio of wages to the means of repression increasing. This new equilibrium explains the period of relative political moderation which began in the 1970s.

With the further deepening of the “red sclerosis”, a point was reached at which the system underwent a qualitative change, with the population attempting to bring down the régime. For sufficiently low levels of output, it was better for the régime to “permit” a struggle which it might have won, than to forego the rents necessary to prevent such a struggle.



## APPENDIX 1

In this framework there are three types of equilibria, two non-fighting ones, and a fighting one. We start by analyzing the non-fighting equilibria.

i. For a non-fighting outcome to be an equilibrium it is necessary that:

$$(A1.1) \quad V_{NF} \geq V_F \text{ and } \omega \geq \omega_0.$$

Given that the workers do not fight, we find the optimal  $\beta$  and  $\omega$  for the rulers. We first find the optimal  $\beta$ , for a given  $\omega \geq \omega_0$ ; and then the optimal  $\omega$ .

The rulers' best reaction, which maximizes equation (3), is to choose the smallest  $\omega$  that satisfies equation (A1.1). So we state that  $\omega$  is such that:

$$(A1.2) \quad p(\beta) \cdot V(Y) = V(\omega Y) \text{ or}$$

$$(A1.3) \quad \omega = V^{-1}[p(\beta)V(Y)]/Y \equiv S(\beta).$$

$\omega$  is therefore a function of  $\beta$ . In a non-fighting equilibrium, when the workers are allowed a bigger consumption set, the optimal repressive apparatus is smaller. Let us now find the optimal repressive apparatus,  $\beta^*$ . As stated above, in the case of no-fight, the rulers maximize:

$$(3) \quad U_{NF} = U([1 - \beta - \omega]Y).$$

Substituting  $\omega$  from equation (A1.3) into equation (3), and differentiating with respect to  $\beta$ , we obtain:

$$(A1.4) \quad p'(\beta^*) = -Y/[V^{-1} \cdot V].$$

From equation (A1.3), we have at the optimal  $\beta$  that:

$$(A1.5) \quad d\omega/d\beta^* = V^{-1} \cdot V \cdot p'/Y.$$

Therefore, substituting from (A1.4), we get:

$$(A1.6) \quad d\omega/d\beta^* = -1.$$

The optimal shares allocated to consumption,  $\omega^*$ , and to the repressive apparatus,  $\beta^*$ , are such that:

$$(A1.7) \quad \omega^* = S(\beta^*) = V^{-1}[p(\beta^*)V(Y)]/Y \text{ and}$$

$$S'(\beta^*) = -1.$$

When  $V(W) = W$  (i.e., we assume risk neutrality), the function  $S(\beta)$  simplifies to  $p(\beta)$ , and equation (A1.7) becomes:

$$(A1.8) \quad \begin{aligned} \omega^* &= p(\beta^*) \\ p'(\beta^*) &= -1. \end{aligned}$$

Thus, the rulers choose the size of the means of repression,  $\beta^*$  such that  $S'(\beta^*) = -1$ , and allocate to the workers resources such that  $\omega^* = S(\beta^*)$ . We denote this equilibrium as equilibrium #1. For the sake of simplicity, we calculate the rulers and workers payoffs in the risk neutral case for both rulers and workers. In equilibrium #1, the rulers' payoff is:

$$(A1.9) \quad U_{NF} = [1 - \beta^* - p(\beta^*)]Y.$$

ii. The equilibrium #1 is possible only if  $\omega^* \geq \omega_o$ . The second type of equilibrium occurs when  $\omega^* = p(\beta^*) < \omega_o$ . In this case, equilibrium #1 is not feasible but the rulers can choose to give the workers exactly  $\omega = \omega_o$ , and set a  $\beta_o$  that leaves workers indifferent between fighting and not fighting:

$$(A1.10) \quad p(\beta_o) \cdot V(Y) = V(\omega_o Y) \quad \text{or}$$

$$(A1.11) \quad \beta_o = p^{-1}(V(\omega_o Y)/V(Y)) \quad \text{where } \beta_o < \beta^*$$

and for the linear case:

$$(A1.12) \quad \beta_o = p^{-1}(\omega_o).$$

The rulers' payoff (in the linear case) in this second equilibrium is:

$$(A1.13) \quad U_{NF} = [1 - p^{-1}(\omega_o) - \omega_o]Y.$$

iii. Let us now analyze an equilibrium where workers fight. In this case, the optimal share of output left to workers is the smallest possible for survival,  $\omega_r$ , while rulers choose the size of the army,  $\beta_r$ , at which utility is maximized, that is:

$$\beta_r = \operatorname{argmax}[1 - p(\beta)] [1 - \beta - \omega_r]Y.$$

In this equilibrium #3, the rulers' expected payoff is:

$$(A1.14) \quad U_r = [1 - p(\beta_r)] [1 - \beta_r - \omega_r]Y.$$

## APPENDIX 2

**I. Proof that  $\beta_f < \beta^*$ .****I.1**

First let us show that  $\partial\beta_f/\partial\omega_f < 0$  (i.e., that  $\beta_f$  is a decreasing function of  $\omega_f$ ). For maximizing  $U_F^*$ , the first-order condition is:

$$(A2.1) \quad p'(\beta_f) = - [1 - p(\beta_f)]/[1 - \beta_f - \omega_f].$$

Therefore, we have:

$$(A2.2) \quad \omega_f = [1 - \beta_f] + \{[1 - p(\beta_f)]/p'(\beta_f)\}.$$

Since  $p'' > 0$ , by differentiating (A2.2) we obtain:

$$(A2.3) \quad \partial\omega_f/\partial\beta_f < 0, \text{ and therefore, } \partial\beta_f/\partial\omega_f < 0.$$

**I.2**

We define  $\omega_f^*$  as the  $\omega_f$  such that  $\beta_f = \beta^*$ .

Since  $\beta^*$  is such that  $p'(\beta) = -1$ , it follows from (A2.1) that:

$$(A2.4) \quad -1 = - (1 - p(\beta^*))/(1 - \beta^* - \omega_f^*).$$

Hence:

$$(A2.5) \quad \omega_f^* = p(\beta^*) - \beta^*.$$

Since  $\partial\beta_f/\partial\omega_f < 0$ , we get that  $\beta_f < \beta^*$  for all  $\omega_f$  such that  $\omega_f > \omega_f^*$ .

However, we have assumed that  $p(\beta^*) < \beta^*$ , thus, for all  $\omega_f > 0$ , we have  $\beta_f < \beta^*$ .<sup>16</sup>

**II. Proof that  $U_{NF}^* > U_F^*$  for  $\omega_f > \bar{\omega}_f$ .**

$U_{NF}^* > U_F^*$  requires:

$$(A2.6) \quad \Psi(\beta_f) = 1 - p(\beta^*) - \beta^* - [1 - p(\beta_f)][1 - \beta_f - \omega_f] > 0$$

Substituting  $\omega_f$  from (A2.2) we get:

$$(A2.7) \quad \Psi(\beta_f) = \lambda + [1 - p(\beta_f)]^2/p'(\beta_f) \quad \text{where } \lambda = 1 - p(\beta^*) - \beta^*.$$

Since  $\Psi(0) > 0$  and  $\Psi' < 0$ , we denote  $\bar{\beta}_f$  such that  $\Psi(\bar{\beta}_f) = 0$ .

Therefore for  $\omega_f > \bar{\omega}_f$  we have  $\Psi > 0$ , where

$$(A2.8) \quad \bar{\omega}_f = [1 - \bar{\beta}_f] + [1 - p(\bar{\beta}_f)]/p'(\bar{\beta}_f).$$

## NOTES

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1. However, we do not model the dynamic process of régime collapse. For this, see Schnytzer [1994].
2. He also assumes diminishing marginal productivity gains to vertical trust and increasing marginal productivity damages to horizontal trust.
3. It could be argued that the allocation itself between rulers and workers has an effect on output, but for ease of exposition we overlook this point.
4. We could instead write that  $p$  is a function of the size of the means of repression,  $\beta Y$ . Either approach is plausible but since the results are not affected significantly, we take the simpler approach.
5. We therefore state  $1 - p(\beta) > \beta$ . For simplicity, we also assume that the point where  $p' = -1$  is below the 45° line.
6. We could formally write the utility function as a function of two variables, the allocation of output and a quality of life variable. When there is no fight this quality of life variable is set to zero, but when they have fought and the revolution fails the variable is set to bring the workers' utility to zero.
7. While there is little doubt that output is disrupted during a revolution, the output referred to in equation (4) is distributed prior to the revolution.
8. If indeed  $\omega_r$  is very small (almost 0), then the rulers are better off by accepting a fight and not paying  $\beta$ . Only for a sufficiently high  $\omega_r$  (higher than  $\bar{\omega}_r$ )  $U_{NR}$  is optimal for rulers.
9. While we have, for ease of exposition, modeled in terms of the level of output, the argument applies equally to growth rates. Further, what is a "high" level of output in one period may not be considered in a later period, when the level of  $W_0$  has risen.
10. For an excellent chronology of events in Eastern Europe throughout this period, see Dawisha [1990].
11. The word "moderation" is used here in the strict sense of the previous sentence; namely, an increase in the wages to means of repression ratio over that implied by the "optimal" ratio of the hard-line Equilibrium #1.
12. Note that the reform process in Czechoslovakia followed a severe recession in the last years of the Novotny government.
13. For an analysis of the Peaceful Revolution in East Germany, Czechoslovakia and Bulgaria, see Schnytzer [1994].
14. For details of the belated measures taken by rulers in these countries, see Jeffries [1991].
15. See Schnytzer [1994] for details.
16. Without this assumption, this would hold only for  $\omega_r > \omega_r^*$ .

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