The Carrot and The Stick of The Socialist Economy

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1. Introduction

In December, 1991, the former Sovet Union collapsed. In 1992, January, Russia decided to introduce a market mechanism in place of a command economic system. Other socialist countries, the East European countries, China, Vietnam and so on, are also trying to change their economic mechanism from a centralized planning economic system to a market economic system. This change of economic system in socialist countries mentioned that a market mechanism was a more efficient economic system than a centralized planning system.

Until now, many scholars have discussed many reasons why the centralized planning economic system collapsed. Many articles suggested that the main reasons of the collapse were no competition, no management, no technical progress and no efficiency of a socialist planning economic system.

A bonus system and a norm system are very important factors for a centralized socialist planning economic system. The bonus system and the norm system were, what we call, "the carrot and the stick" for workers of the socialist state enterprises. The central government of the socialist countries

introduced the bonus system and the norm system in order to increase the output of state enterprises. But, the bonus system and the norm system did not succeed in increasing the output of the state enterprises. Then, the socialist economies were defeated, when they tried to compete with capitalist economies.

The purpose of this paper is to analize that the bonus system and the norm system to expose why were not effective in increaseing the output of state enterprises in a centralized socialist planning systems.

2. Bonus System

The central government of socialist countries introduced a bonus system as "the carrot" for workers of the state enterprises. The former Soviet Union had adopted two representative bonus systems.

(1) The First Type Bonus System

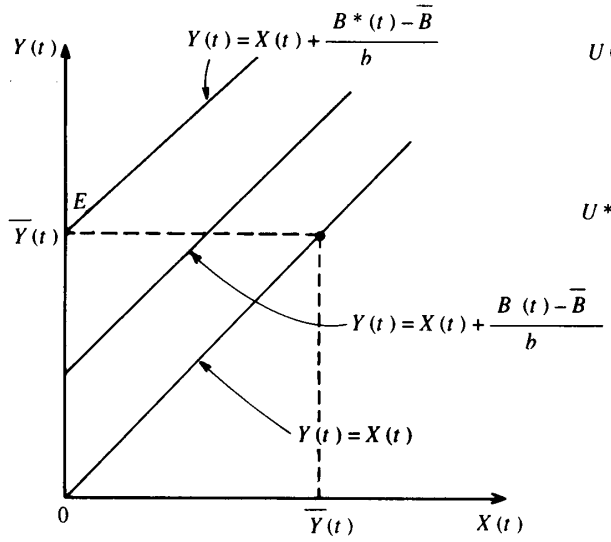
$$B(t)=\bar{B}+b(Y(t)-X(t)), \qquad (Y(t)\geqq X(t)),$$
$$B(t)=0, \qquad (Y(t)<X(t)).$$

$B(t)$ is a total bonus of t period, $\bar{B}$ is a constant bonus when the realized output $Y(t)$ achives to be equal to a target $X(t)$. b is a bonus parameter ($b>0$). t is a period. The first type of bonus system means that if the realized output exceeds the target of production, then the manager and workers of that state enterprise obtain the bonuses, on the other hand, if the realized output cannot exceed the target, then they cannot get the bonuses. This was the most familiar bonus system.

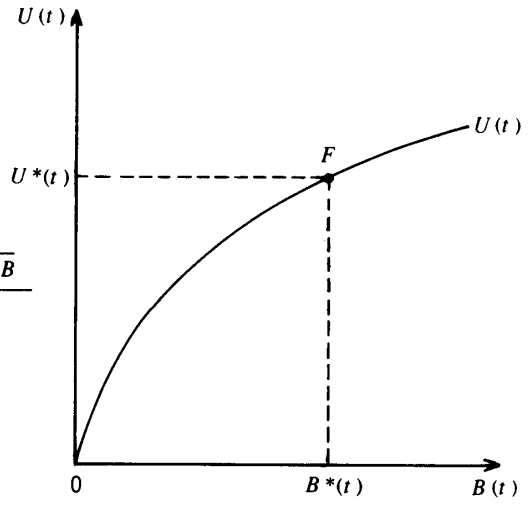
The objective function of the state enterprise is supposed to be the utility function of the manager of the state enterprise. The utility function is dependent on the bonus. We assume that the utility function is continuous and differentiable ($U'(t)>0$, $U''(t)<0$).

$$U(t)=U(\bar{B}+b(Y(t)-X(t)).$$

The partial differentials of $X(t)$ and $Y(t)$ are,



(Figure 1)



(Figure 2)

$$\frac{\partial U(t)}{\partial X(t)} = -bU'(t) < 0,$$

$$\frac{\partial U(t)}{\partial Y(t)} = bU'(t) > 0.$$

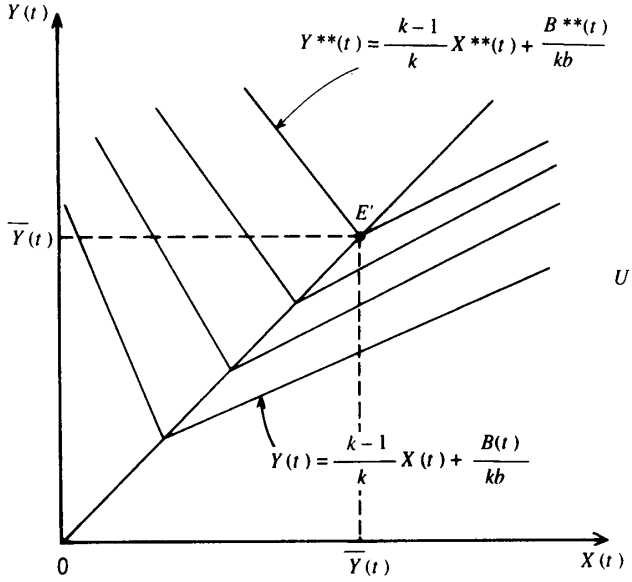
These equations mean that a decrease of the target increases utility, and an increase of the realized output brings about increasing utility. Therefore, many smart managers make an effort to get a lower target in order to obtain a high bonus, instead of increasing the output. This is the drawback of the first type bonus system.

The optimal problem is as follows,

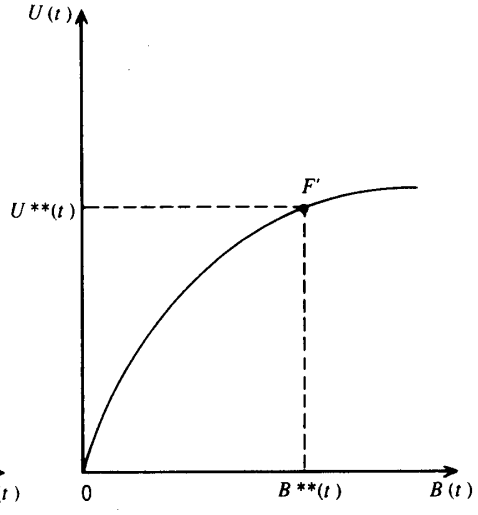
$$\begin{aligned} &\text{maximize} && U(t)=U(B(t)), \\ &&& B(t)=\bar{B}+b(Y(t)-X(t)), \\ &\text{subject to} && 0 \leqq X(t) \leqq \bar{Y}(t), \\ &&& 0 \leqq Y(t) \leqq \bar{Y}(t), \end{aligned}$$

here, $\bar{Y}(t)$ is the production capacity of the state enterprise in period t. A feasible set $(X(t), Y(t))$ is a compact convex set and $B(t)$ is continous, then a feasible set $B(t)$ is also compact convex and we can obtain the optimal solution $X^*(t)$, $Y^*(t)$, $B^*(t)$ and $U^*(t)$.

In figure 1, the 45° lines express the equations $Y(t)=X(t)+(B(t)-\bar{B})/b$. The optimal solution which maximizes $B(t)$ is the point E $(0, \bar{Y}(t))$. The maximum utility is,



(Figure 3)



(Figure 4)

$$U^*(t)=U(B^*(t))=U(\bar{B}+b\bar{Y}(t)).$$

The equilibrium point F is shown in figure 2. Therefore, on the optimal conditions ($X^*(t)=0$, $Y^*(t)=\bar{Y}(t)$ and $U^*(t)=U(B^*(t))$, the state enterprise wants to have zero target and the maximum output. If the central government orders to increase the norm, then the utility of the state enterprise decreases.

(2) The Second Type Bonus System

$$B(t)=bX(t)+kb(Y(t)-X(t)),$$
when $Y(t)\geqq X(t)$, then $0<k<1$,
when $Y(t)<X(t)$, then $k>1$,

here, k is an adjustment parameter. This type of bonus system is a revised type of the first bonus system. Under the first type bonus system, the manager of the state enterprise makes an effort to get a lower target in order to obtain a high bonus. But under the second type bonus system, if the manager wants to get a low target, then he cannot obtain a high bonus. Therefore, he makes an effort to get a high target in order to obtain a high bonus.

The optimal problem of the second type bonus system is as follows,

$$\begin{aligned} &\text{maximize} && U(t)=U(B(t)),\\ &&& B(t)=bX(t)+kb(Y(t)-X(t)),\\ &\text{subject to} && 0\leqq X(t)\leqq \bar{Y}(t),\\ &&& 0\leqq Y(t)\leqq \bar{Y}(t). \end{aligned}$$

A feasible set $(X(t),\ Y(t))$ is a compact convex set and $B(t)$ is continous, then a feasible set $B(t)$ is also compact convex and we can get the optimal solution $X^{**}(t)$, $Y^{**}(t)$, $B^{**}(t)$ and $U^{**}(t)$. U is continous and a feasible set $B(t)$ is compact convex, then $U(t)=U(B(t))$ has the maximun $U^{**}(t)=U(B^{**}(t))$. In figure 3, the equations $B(t)=bX(t)+kb(Y(t)-X(t))$ are shown and they are kinked lines on the 45° line.

The optimal point in figure 3 is E'. The optimal solutions are $X^{**}=\bar{Y}(t)$, $Y^{**}(t)=\bar{Y}(t)$, $B^{**}(t)=b\bar{Y}(t)$ and $U^{**}(t)=U(b\bar{Y}(t))$.

Under the second type bonus system, the manager of the state enterprise wants to have the maximun target and the maximun output. This is the best target and the best output that the socialist central government can hope for.

But, infact, this second type bonus system was not employed in the socialist countries. Because, it was actually very difficult to find out the proper value of the adjustment parameter k. Then, in the socialist countries, the first type bonus system was almost always employed.

3. Norm System

There are many kinds of norm systems. In this paper, we indicate two norm systems.

(1) The First Type Norm System

$$X(t)=X(t-1)+\alpha(Y(t-1)-X(t-1)),$$

α is a target parameter $(0<\alpha<1)$. This norm system means that, if the realized output exceeds the target in this period, then the central government gives a higher target to that state enterprise in the next period, and vice versa. This is the most familiar norm system in the socialist countries.

(2) The Second Type Norm System

$$X(t)=(1+\alpha)Y(t-1).$$

This norm system means that the target of this period is dependent on the realized output of the previous period. Many Japanese enterprises are used to adopt this type of norm system.

4. Effects of Bonus and Norm

In this section, we will analize the effects of the bonus and the norm on the equilibrium output $Y^*(t)$.

The utility function is assumed to be dependent on the bonus and the norm.

$$U(t)=U(B(t),\ X^e(t+1)),$$
$$B(t)=\bar{B}+b(Y(t)-X(t)),$$
$$X^e(t+1)=X(t)+\alpha(Y(t)-X(t)).$$

$X^e(t+1)$ is an expected value of norm in period $t+1$.
The first and the second conditions of utility maximization are[1],

$$\frac{\partial U(t)}{\partial Y(t)}=b\cdot U_1+\alpha\cdot U_2=0, \quad \cdots\cdots(1)$$
$$\frac{\partial^2 U(t)}{\partial Y^2(t)}=b^2\cdot U_{11}+2\alpha b\cdot U_{12}+\alpha^2 U_{22}\equiv D_1<0 \quad \cdots\cdots(2)$$

The equilibrium condition (1) means that the marginal utility of the bonus is equal to the marginal disutility of the norm in the absolute values. The output value of the equation (1) is the equilibrium output ($Y^*(t)$).

Next, we will consider the comparative static analysis.

$$\frac{\partial Y^*(t)}{\partial \bar{B}}=-\frac{bU_{11}+\alpha U_{21}}{D_1},$$
$$\frac{\partial Y^*(t)}{\partial b}=-\frac{(bU_{11}+\alpha U_{21})(Y(t)-X(t))+U_1}{D_1},$$
$$\frac{\partial Y^*(t)}{\partial X(t)}=-\frac{-(bU_{11}+\alpha U_{12})+(1-\alpha)(bU_{12}+\alpha U_{22})}{D_1},$$

(1) U_1 is a partial differential of the bonus and U_2 is a partial differential of the norm.

Table 1 Effects of Bonus and Norm

$bU_{11}+\alpha U_{21}$	+		−	
$bU_{12}+\alpha U_{22}$	+	−	+	−
$\frac{\partial Y^*(t)}{\partial \bar{B}}$	+	+	−	−
$\frac{\partial Y^*(t)}{\partial b}$	+	+	?	?
$\frac{\partial Y^*(t)}{\partial X(t)}$	?	−	+	?
$\frac{\partial Y^*(t)}{\partial \alpha}$	?	−	?	−

$$\frac{\partial Y^*(t)}{\partial \alpha}=-\frac{(bU_{12}+\alpha U_{22})(Y(t)-X(t))+U_2}{D_1}.$$

We assume that $Y(t)\geqq X(t)$, $b>0$ and $0<\alpha<1$.

According to the table 1, if $bU_{11}+\alpha U_{21}>0$, then the manager of the state enterprise increases the output, as the bonus parameter increases. If $bU_{12}+\alpha U_{22}<0$, then he intends to decrease the output as the norm parameter increases. When $bU_{11}+\alpha U_{21}>0$, then he wants to increase the output as the constant bonus increases. On the contrary, when $bU_{11}+\alpha U_{21}<0$, then he decreases the output as the constant bonus increases. Then, we can conclude that an increase of the bonus parameter doesn't necessarily bring about an increase of the output, and an increase of the norm parameter doesn't necessarily bring an increase of the output. Thus, in our economic model, the bonus and the norm systems are not necessarily "the carrot and the stick".

5. Bonus and Leisure

In this section, we will analize the relations the bonus and the leisure. Usually, we are apt to think that an increase of the bonus brings about an increase of working hours of workers and a decrease of leisure. We will check this common sense about the relation of the bonus and the leisure.

It is assumed that the production function is as follows,

$$Y(t)=F(N(t)),$$

here $F'>0$, $F''<0$.
The utility function is assumed to be a function of the bonus $B(t)$ and the leisure $S(t)$, and $U_1>0$, $U_2>0$, $U_{11}<0$, $U_{22}<0$ and $U_{12}=U_{21}>0$.

$$U(t)=U(B(t),\ S(t)).$$

Then, the optimal problem is formulated as follows,

objective function: $U(t)=U(\bar{B}+b(F(N(t))-X(t)),\ S(t))$,
subjective function: $N(t)+S(t)=T(t)$,

here, $N(t)$ is working hours, $S(t)$ is leisure hours and $T(t)$ is the total time for workers.
The Lagrange function is as follows,

$$L(N(t),\ S(t),\ \lambda(t))=U(\bar{B}+b(F(N(t))-X(t)),\ S(t))-\lambda(t)(N(t)+S(t)-T(t)).$$

From the first condition of maximization, the following equilibrium equation is given.

$$b\cdot\frac{\partial U(t)}{\partial B(t)}\frac{\partial F(t)}{\partial N(t)}=\frac{\partial U(t)}{\partial S(t)}$$

The above equation means that on the equilibrium the marginal utility of the bonus by the unit labor is equall to the marginal utility of the unit leisure.
The second condition of maximization is that the bordered Hessian is positive.

$$\begin{vmatrix} 0 & -1 & -1 \\ -1 & (bF')^2U_{11}+bF''U_1 & bF'U_{12} \\ -1 & bF'U_{21} & U_{22} \end{vmatrix} \equiv D_2>0.$$

Next, we analize the effects of changes of economic parameters on working hours and leisure hours.

$$\frac{\partial N(t)}{\partial \bar{B}}=\frac{bF'U_{11}-U_{21}}{D_2}<0,$$

$$\frac{\partial S(t)}{\partial \bar{B}}=\frac{-bF'U_{11}+U_{21}}{D_2}>0,$$

$$\frac{\partial N(t)}{\partial b}=\frac{(F(N(t))-X(t))(bF'U_{11}-U_{21})+F'U_1}{D_2},$$

$$\frac{\partial S(t)}{\partial b}=\frac{-(F(N(t))-X(t))(bF'U_{11}-U_{21})-F'U_1}{D_2},$$

$$\frac{\partial N(t)}{\partial X(t)}=\frac{-b(bF'U_{11}-U_{21})}{D_2}>0,$$

$$\frac{\partial S(t)}{\partial X(t)}=\frac{b(bF'U_{11}-U_{21})}{D_2}<0,$$

$$\frac{\partial N(t)}{\partial T(t)}=\frac{bF'U_{12}-U_{22}}{D_2}>0,$$

$$\frac{\partial S(t)}{\partial T(t)}=\frac{bF'(U_{21}-bF'U_{11})-bF''U_1}{D_2}>0.$$

From the above comparative static analyses, the following results were made clear.

(1) An increase of the constant bonus makes workers decrease working hours and increase leisure hours.

(2) The effects of the bonus parameter change on the working hours and the leisure hours are not apparent.

(3) An increase of the norm makes workers increase working hours and decrease leisure hours.

(4) An increase of the total hours makes workers increase working hours and increase leisure hours, too.

6. Concluding Remarks

First, this paper proved that the centralized socialist planning economic system theoretically had the optimal solution, but it was very hard to get that optimal solution in fact.

Secondly, the most familiar bonus system in the socialist countries had a

big drawback, was proved.

Third, the centralized socialist planning economic system which introduces the bonus and norm systems, what we call,"the carrot and the stick", didn't work very well as the central government had intended. That is, an increase of the bonus sometimes brings about a decrease of the output of state enterprises, and an increase of the norm brings to decrease the output. These reactions of the state enterprises are not the economic behavior which the central government intended.

Generally speaking, under the condition of low income, workers may work hard when the central government raises the norm to the state enterprises. But, the high income workers prefer to more leisure hours than more income. Therefore,"the carrot and the stick" sometimes didn't work very well in the socialist economy.

Thus, the carrot and the stick didn't overcome the market mechanism.

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