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Introduction of the Market Mechanism into the Soviet Command Economy¹

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1 Introduction

The coup d'état on August in 1991 fell into failure. The Western Countries hope that the USSR will smoothly change from the command economy into the market economy.² But the USSR has numerous hard political and economic problems to reform the economic system.

On the 19th of October 1990, the USSR decided to adopt the new economic plan which had many kinds of economic reforms ; introducing the market mechanism, non-nationalization, decreasing of the government deficit, pursuing of economic efficiency,³ financial reforms and so on^{4,5}. In spite of these new economic policies, the USSR economy was marked by the further shrinkage of the production during the first 6 months in 1991. Compared to the same period of 1990, the gross national product dropped by 10 percent, the net national product by 13 percent, and the labor productivity by 10 percent. The worst phenomena in the USSR economy were a sharp decline in investment activity and a big decreasing of agricultural production. The former will affect a future production during a long term⁶ and the latter will increase the nation's dissatisfactions with consumption goods during a short term. In addition to the above phenomena, the Soviet economy is bothered with the high inflation, high defense cost, income differentials, production inefficiency, incomplete transportation system, decreasing of foreign trade, weakened "Ruble" and so on.

The main purpose of introducing market mechanism is to improve the above defects of the Soviet economy.⁷ But it seems that the Soviet Government wants to keep the plan and command economic system partially. That is, the Soviet Government wants to keep its power to control the industries of energy, information, defense, cosmos, transportation and so on. Therefore, for the present, it seems that the USSR is going to set the new economic system in which the market mechanism stands side by side with the command economy. We call it the "partial market economy."⁸

In this paper, first we will prove that the partial market economy does not always guarantee the Pareto Optimum and the efficient production. Secondly, we will analyze how the partial market economy works in a short period. Finally, we will find the balanced growth path in the long period under the partial market mechanism.

2 Partial Market Economy and Pareto Optimum

In this section, it will be proved that the partial market economy does not always guarantee the Pareto Optimum and the efficient production.

It is supposed that two kinds of goods Y_1 and Y_2 are produced in the whole economy. It is also supposed that the whole economy has two kinds of production resources, capital (K) and labor (L), and the total amount of these resources are given, K and L .

The social production function is a function of Y_1 , Y_2 , K and L .

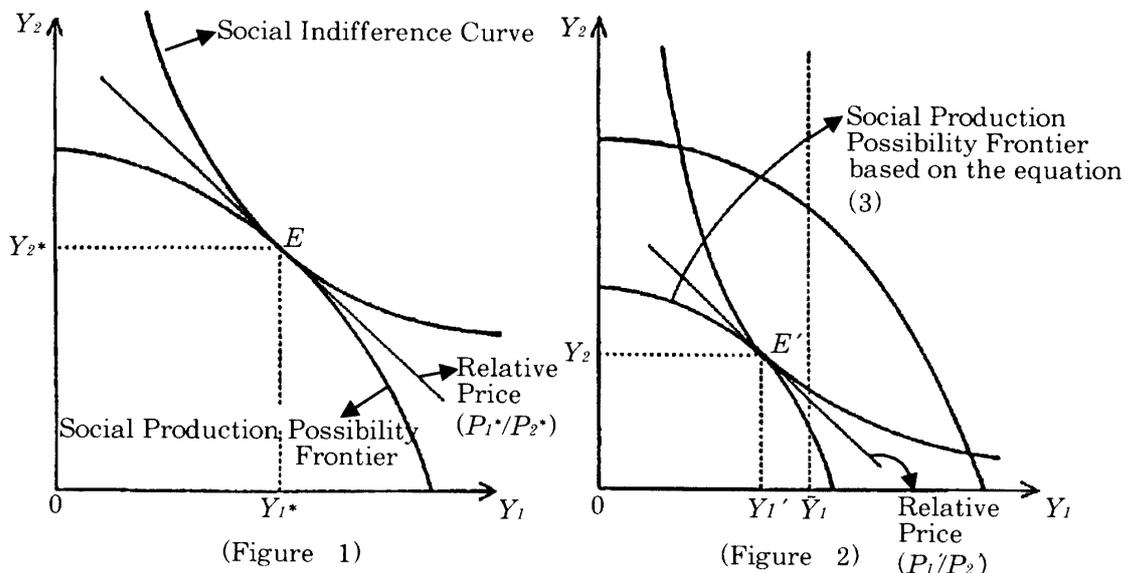
$$f(Y_1, Y_2, K, L) = 0. \quad (1)$$

Under the condition of the given total amount of capital and labor, it is supposed that the social production possibility frontier is concave to the origin, as drawn in figure 1.

The social welfare function is a function of two goods, Y_1 and Y_2 .

$$U = U(Y_1, Y_2). \quad (2)$$

The social indifference curves which depend on the above social welfare function are drawn in figure 1. It is assumed that they are convex against the origin.



Under the perfect competition, on point E in figure 1 where the social indifference curve is tangent to the social production possibility frontier, the Pareto Optimum is guaranteed, that is well known. The slope of tangency on point E is the equilibrium relative price ratio (P_1^*/P_2^*), and Y_1^* and Y_2^* are the optimal productions which maximize the social welfare function under the

condition of the given amount of production resources. The following equalities are obtained on the equilibrium (on point E).

$$\frac{\frac{\partial U}{\partial Y_1}}{\frac{\partial U}{\partial Y_2}} = \frac{\frac{\partial f}{\partial Y_1}}{\frac{\partial f}{\partial Y_2}} = \frac{P_1^*}{P_2^*} .$$

Next, we analyze the case of the partial market economy. It is the new adjustment mechanism that the market mechanism is side by side with the command economy. Suppose that the Soviet Government controls the first production sector (state enterprise) and commands the prior production order \bar{Y}_1 to the first sector. The second production sector is a private sector. \bar{K} and \bar{L} are priorly allocated by the government to the first sector to produce the prior order \bar{Y}_1 . Then, in the free capital market two sectors will employ $K - \bar{K}$ and in the free labor market they will employ $L - \bar{L}$ in order to produce two kinds of goods respectively. The social production function is,

$$f(Y_1, Y_2, K - \bar{K}, L - \bar{L}) = 0. \quad (3)$$

The social production possibility frontier based on the equation (3) is shown in figure 2. It is smaller than the one based on the equation (1). The equilibrium point in figure 2 is E' where the social indifference curve is tangent to the social production possibility frontier. In the free goods market, the amount of the two kinds of goods Y_1' and Y_2' are produced respectively. The equilibrium price in the partial market economy is the slope of tangency on point E' , that is P_1'/P_2' . Therefore, this whole economy has the total amount of productions $\bar{Y}_1 + Y_1'$ of the first sector and Y_2' of the second sector.

In the perfect competitive market economy, the total amount of productions Y_1^* and Y_2^* are the equilibrium outputs and guarantee the Pareto Optimum and the efficient production. On the other hand, in the partial market economy the equilibrium total outputs are $\bar{Y}_1 + Y_1'$ and Y_2' in the partial market economy do not necessarily guarantee the Pareto Optimum and the efficient production.

First, the equilibrium outputs $\bar{Y}_1 + Y_1'$ and Y_2' in the partial market economy are not always equal to Y_1^* and Y_2^* which guarantee the Pareto Optimum and the efficient production. That is, there is a possibility that the following inequalities are held.

$$\begin{aligned} \bar{Y}_1 + Y_1' &\neq Y_1^*, \\ Y_2' &\neq Y_2^*. \end{aligned}$$

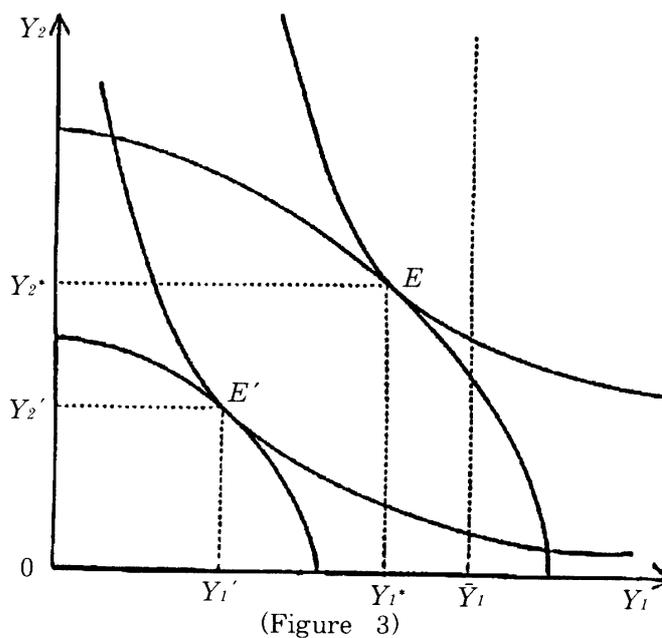
Secondly, the equilibrium relative price in the partial market economy is not always equal to the equilibrium relative price in the perfect competitive

economy which guarantee the Pareto Optimum and the efficient production. That is, the following inequality may be held.

$$\frac{P_1'}{P_2'} \neq \frac{P_1^*}{P_2^*} .$$

Finally, there is a possibility that the production order by the Soviet Government exceeds the optimal output Y_1^* . In that case, the following inequality is held. The Figure 3 shows this case.

$$Y_1 + Y_1' > Y_1^* .$$



In these cases, the outputs $\bar{Y}_1 + Y_1'$ and Y_2' in the partial market economy are not equal to Y_1^* and Y_2^* which guarantee the Pareto Optimum and the efficient production. Therefore, the partial market economy has the possibilities that the system does not guarantee the Pareto Optimum and the efficient production.

3 Short Term Analysis in the Partial Market Economy

In this section, we will analyze the equilibrium condition and the comparative statics in the partial market economy.

(1) Economic Model

It is supposed that the whole economy has two production sectors, the first sector is partially controlled by the government and the second sector is a private sector.

Y_1 is the output of the first sector and the government commands the prior production order (\bar{Y}_1) to the first sector and buys it from the first sector directly at the constant government price (\bar{P}_1). The first sector can sell the amount of $Y_1 - \bar{Y}_1$ in the free market at the free market price (P_1). We assume that $Y_1 > \bar{Y}_1$. It is also assumed that the production function of the first sector is the following Leontief type function. We assume that $P_1 > \bar{P}_1$.

$$Y_1 = aL_1 .$$

L_1 is a production resource and a is a production coefficient of L_1 .

Y_2 is the output of the second sector. It is assumed that the production function of the second sector is the Neoclassical production function. The second sector can sell its goods at the market price (P_2) in the free market.

$$Y_2 = f(L_2) .$$

L_2 is a production resource which is employed in the second sector. It is assumed that $f' > 0, f'' < 0$.

In the short period, the total amount of production resource is given and is perfectly employed by the two sectors. w_1 is the official price of the resource which the government supplies to the first sector. The market price of this resource which the second sector buys in the free market is w_2 . We assume that $w_2 > w_1$.

$$L = L_1 + L_2 .$$

The purpose of the government is to maximize the social welfare of whole economy. It is assumed that the social welfare function depends on the social profit. Therefore, the social welfare function is,

$$U = U(P_1(Y_1 - \bar{Y}_1) + \bar{P}_1\bar{Y}_1 + P_2Y_2 - w_1L_1 - w_2L_2) .$$

We assume that $U' > 0$ and $U'' < 0$.

(2) Equilibrium Condition

Under the condition of the given production resource, the maximization condition of the social welfare is as follows,

$$U'(P_1a - w_1) = U'(P_2f' - w_2).$$

This equilibrium condition means that the marginal welfare in the first sector per unit resource is equal to one of the second sector.

The necessary condition of existence of the equilibrium solution is,

$$\min f' < \frac{P_1a - w_1 + w_2}{P_2} < \max f'.$$

Then, the second sufficient condition of the welfare maximization is that the following Bordered Hessian is positive, and D stands for it.

$$\begin{vmatrix} 0 & 1 & 1 \\ 1 & U''(P_1a - w_1)^2 & U''(P_1a - w_1)(P_2f' - w_2) \\ 1 & U''(P_1a - w_1)(P_2f' - w_2) & U''(P_2f' - w_2) + P_2Uf'' \end{vmatrix} = D > 0.$$

(3) Comparative Statics

In the above analysis, the equilibrium condition of the partial market economy was introduced. In this part, we will analyze the effects of the parameter's change on the equilibrium values.

$$\frac{\partial L_1}{\partial P_1} = \frac{U''(Y_1 - \bar{Y}_1)\{(P_1a - w_1) - U'a - (P_2f' - w_2)\}}{D},$$

$$\frac{\partial L_2}{\partial P_1} = \frac{U''(Y_1 - \bar{Y}_1)\{-(P_1a - w_1) + U'a + (P_2f' - w_2)\}}{D}.$$

An increase of the market price of the first sector increases the total amount of resource in the first sector and decreases the total amount of resource in the second sector. Therefore, It brings an increase of the first goods and a decrease of the second goods, and vice versa.

$$\frac{\partial L_1}{\partial P_2} = \frac{U''Y_2\{(P_1a - w_1) - (P_2f' - w_2) - Uf'\}}{D},$$

$$\frac{\partial L_2}{\partial P_2} = \frac{U''Y_2\{-(P_1a - w_1) + (P_2f' - w_2) + Uf'\}}{D}.$$

$$\frac{\partial L_1}{\partial P_1} = \frac{U''\bar{Y}_1\{(P_1\alpha - w_1) - (P_2f' - w_2)\}}{D},$$

$$\frac{\partial L_2}{\partial P_1} = \frac{U''\bar{Y}_1\{-(P_1\alpha - w_1) + (P_2f' - w_2)\}}{D}.$$

An increase of the government price for the first sector goods has no effect for the two sectors in the equilibrium. But if the marginal profit of the first sector exceeds the one of the second sector, then an increase of the government price for the first sector goods increases the output of the first sector and decreases the one of the second sector.

$$\frac{\partial L_1}{\partial \alpha} = \frac{P_1L_1U''\{(P_1\alpha - w_1) - (P_2f' - w_2) + UP_1\}}{D},$$

$$\frac{\partial L_2}{\partial \alpha} = \frac{P_1L_1U''\{-(P_1\alpha - w_1) + (P_2f' - w_2) - UP_1\}}{D}.$$

An increase of the production efficiency in the first sector increase the output of the first sector and decreases the one of the second sector.

$$\frac{\partial L_1}{\partial \bar{Y}_1} = \frac{(\bar{P}_1 - P_1)U''\{(P_1\alpha - w_1) - (P_2f' - w_2)\}}{D},$$

$$\frac{\partial L_2}{\partial \bar{Y}_1} = \frac{(\bar{P}_1 - P_1)U''\{-(P_1\alpha - w_1) + (P_2f' - w_2)\}}{D}.$$

An increase of the government order to the first sector has no effect for the two sector's production in the equilibrium. But, if the marginal profit of the second sector exceeds the one of the first sector, then an increase of the government order decreases the output of the first sector and increases the one of the second sector.

$$\frac{\partial L_1}{\partial w_1} = \frac{U''L_1\{-(P_1\alpha - w_1) + (P_2f' - w_2)\} - U'}{D},$$

$$\frac{\partial L_2}{\partial w_1} = \frac{U''L_1\{(P_1\alpha - w_1) - (P_2f' - w_2)\} + U'}{D}.$$

An increase of the official price of the resource decreases the output of the first sector and increases the one of the second sector.

$$\frac{\partial L_1}{\partial w_2} = \frac{U''L_2\{-(P_1a-w_1)+(P_2f'-w_2)\}+U'}{D},$$

$$\frac{\partial L_2}{\partial w_2} = \frac{U''L_2\{(P_1a-w_1)-(P_2f'-w_2)\}-U'}{D}.$$

An increase of the market price of the resource increases the output of the first sector and decreases the one of the second sector.

$$\frac{\partial L_1}{\partial L} = \frac{(P_2f'-w_2)U''\{(P_1a-w_1)-(P_2f'-w_2)\}+P_2f''}{D},$$

$$\frac{\partial L_2}{\partial L} = \frac{(P_1a-w_1)U''\{-(P_1a-w_1)+(P_2f'-w_2)\}}{D}.$$

An increase of the total amount of the resource increases the output of the first sector. But it has no effect for the output of the second sector.

In the above comparative static analysis, we analyzed the effects of increasing parameters on the outputs of the two sectors. We can easily obtain the same results in the case of the decreasing parameters.

4 Balanced Growth

In this section, the balanced growth path in the long period will be analyzed. The balanced growth is the economic growth which has the same proportion of the output of the first and the second sectors.

y stands for the ratio of the two kinds of goods, Y_1 and Y_2 .

$$y = \frac{Y_2}{Y_1}.$$

l_2 stands for the resource ratio.

$$l_2 = \frac{L_2}{L}$$

$$\dot{y} = \frac{dy}{dt}, \quad \dot{l}_2 = \frac{dl_2}{dt}.$$

\dot{y} and \dot{l} stand for the differentials of y and l by time (t).

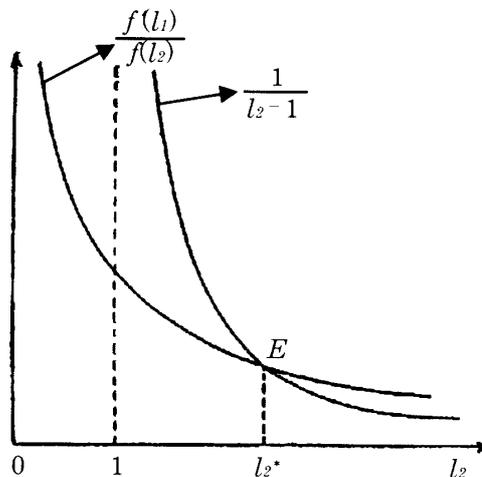
$$\frac{\dot{y}}{y} = l_2 \left\{ \frac{f'(l_2)}{f(l_2)} - \frac{1}{l_2 - 1} \right\}.$$

From the calculation of the equation y , the following equation is obtained.

$$\frac{f'(l_2)}{f(l_2)} = \frac{1}{l_2 - 1}.$$

l_2^* that satisfies the above equation, guarantees the existence of the balanced growth path. If the two curves of the right-hand and the left-hand of the above equation intersect on point E in figure 4, then l_2^* is the equilibrium resource ratio which guarantees the balanced growth path in the long period.

- (a) If $l_2 = l_2^*$, then the outputs of the both sectors grow up at the same rate.
- (b) If $l_2 > l_2^*$, then the output of the second sector grows up at a higher rate than the first sector.
- (c) If $l_2 < l_2^*$, then the output of the first sector grows up at a higher rate than the second sector.



(Figure 4)

5 Concluding Remarks

In this paper, we proved three important results concerning the introduction of the market mechanism into the Soviet command economy.

First, the partial market mechanism, in which the market mechanism is side by side with the command economy, does not always guarantee the Pareto Optimum and the efficient production. Secondly, an economic parameter change in the equilibrium usually increases the output of the one sector which obtains more profit than the other sector by that parameter change. Finally, it is proved that our economic model has the possibility of the balanced growth path of the two sectors in the long period. If the real resource ratio of the second sector (l_2) is less than the balanced growth resource ratio (l_2^*), then the output of the first sector grows up at a higher rate than the one of the second sector. That is, if the first sector is the munitions industry and the second sector is the consumption industry, and the resource allocation ratio of the second sector is less than the balanced growth resource ratio, then the munitions industry grows up at the higher ratio than the consumption industry. That was the Soviet case in the past, we think.

Footnotes

- 1 I thank Prof. K. Mochizuki and Prof. W. Fukuda for their helpful comments.
- 2 The Soviet official opinions about introducing the market mechanism into the Soviet planning economy were presented in Абалкин (1), Горбачев (6), and Горбачев и Ельцин (7).
- 3 The efficiency problems of the decentralized economic planning procedures were analyzed in Arrow and Hurwicz (2), Arrow, Hurwicz and Uzawa (3), and Malinvaud and Bacharach (13).
- 4 The theoretical analysis of the Soviet-type economy was discussed in Campbell (5) and Gregory and Stuart (9).
- 5 The surveys of the mathematical analysis of the socialist economy were discussed in Heal (10) and Miyamoto (14).
- 6 The estimation for the Soviet economy in the future was analyzed in Bergson and Levine (4).
- 7 The classical analysis for the socialist economy was discussed in Lerner (11) and Lange (12).
- 8 The mathematical analysis of the partial market economy was discussed in Ericson (8).

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