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A Model of the Socialist Firm in Transition to a Market Economy

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1. INTRODUCTION

For the typical socialist firm, the transition to a market economy is an unexpected shock in its economic environment. The monopoly position established by the governmental demarcation of the industry and enforced by the international coordination of specialization in the Comecon, is lost. Competition is the rule of the game, and product quality matters. The system of subsidies is abandoned and access to new capital is no longer possible through a "soft budget restraint", but capital has to be attracted competitively from the capital market. Demand and producer's price fall abruptly, and the existing capital stock becomes obsolete to a large extent.

The stylised fact concerning the socialist firm in transition to a market economy are

- Without adjustments, the firm cannot survive because it now faces tougher competition, and its technology is outmoded.
- Adjustments require investment in modern capital equipments, and possibly the disposal of old equipments.
- It may be neccessary to reduce the work force, at least during some initial phase of adjustment.

We attempt to capture these stylised facts in a simple model of adjustment in which the firm experiences a price shock. We show that the optimal time path of investment may involve an initial phase of sharply rising investment, to be followed by a second phase where investment is positive but gradually slows down to its steady state value. Under certain conditions, the adjustment calls for a quantum upward jump in the capital stock. This quantum jump may occur after an initial phase of gradual accumulation of capital. Old equipments are either left to decay, or scrapped. In the latter case, a quantum downward jump in the stock of old equipment may be optimal. The aggregate stock of capital may therefore at first fall, then rise. Like output, the aggregate capital stock will follow a J-curve.

Since for a given quantity of labour a higher capital stock increases the marginal product of labour, the labour force will be adjusted optimally to maintain the equality of its marginal product with the real wage if the wage rate is flexible. Taking into account the initial overmanning or hidden unemployment of the socialist firm, a J-shaped time path of the aggregate capital stock of the firm does not imply a J-shaped time path of labour employment, but a u-curve where the initial level of employment may not be reached again. If wages rise as in the German case, the exogenous increase in the wage rate will lead to a lower capital stock and will affect the viability of the firm.

We also explore the effects of fiscal incentives (such as investment subsidies and a reduced corporate income tax rate) on the time path of adjustment and on the steady state capital stock of the firm. We show that an investment subsidy will - unsurprisingly - increase the steady state capital stock. The effects of a reduction in the corporate tax rate are ambiguous, however. If we impose certain reasonable assumptions on tax allowance for depreciation, then a fall in the corporate tax rate has similar effects to those of an investment subsidy.

The paper is organised as follows. In Section 2 we present the assumptions and notation. Section 3 is concerned with the simplest case, where new equipments are m times more productive than old equipments, and where adjustment costs are so steep that jumps in the capital stock are never optimal. Section 4 modifies the assumptions on adjustment costs and derives the optimal conditions for upward jumps in the capital stock. In Section 5, we relax the assumption that new equipments are simply m times more productive than old ones. The J curve effect is discussed in that section. Whether firms are viable, is a core problem for the restructuring of industry and for the privatization issue (Section 6). Finally, Section 7 offers some concluding remarks.

2. NOTATION AND ASSUMPTIONS

The firm is assumed to be a price-taker. The change in its environment is modelled as a sudden drop in the price of its output, and also the availability of more expensive, but more efficient, modern equipments.

Before the transition to a market economy, the firm did not have access to modern equipments, and its production function was

$$Q = F(K_0, L)$$

where

K_0 = the capital stock embodying the old technology,
L = the firm's labour force.

Let

p = price of the output
p_0 = price of a unit of K_0
r = interest rate
w = wage rate
δ = rate of physical depreciation of K_0.

We assume that the output price has fallen so sharply that the firm cannot remain viable unless it modernizes its capital stock:

$$\underset{K_0,\ L}{\text{Max}} \left\{ pF(K_0, L) - wL - p_0(\delta+r)K \right\} < 0 \qquad (1)$$

where $(\delta+r)p_0$ is the implicit rental rate on the old equipments.

New equipments are more efficient than old ones. The simplest way to capture this fact is to assume that one unit of new equipment is m times more efficient than its old counterpart. We then can aggregate the capital stock

$$K = K_0 + mK_N \qquad (2)$$

where K_N is the stock of new equipment. In (2), K is measured in efficiency units. The production function can then be written as

$$Q = F(K_0+mK_N, L) \qquad (3)$$

A more general approach would be to assume that the efficiency measure of K_N is non-linear, and the aggregate capital stock is

$$K = K_0 + h(K_N) \qquad (2')$$

where $h(K_N)$ is non-linear, and $h'(K_N) \geq m$. Since formulation (2) is much simpler than (2'), most of our analysis relies on (2), until Section 5, where the implications of (2') are explored.

Let I_N and I_0 be gross investments in the two capital stocks K_N and K_0 respectively, so that

$$\dot{K}_N = I_N - \delta K_N \quad , \; I_N \geq 0, \tag{4}$$

$$\dot{K}_0 = I_0 - \delta K_0 \quad , \; I_0 \geq 0. \tag{5}$$

The cost of purchasing equipments are p_N and p_0 per unit. We assume that

$$p_0 < p_N < mp_0 \tag{6}$$

to reflect the fact that new equipments are more expensive, but also more economical (i.e. cheaper in terms of efficiency unit).

In addition to the cost of purchasing equipments, there are also internal adjustment costs caused by any change in the firm's aggregate capital stock. We denote these adjustments costs by

$$C = g(\dot{K}) = g(\dot{K}_0 + m\dot{K}_N) \tag{7}$$

Following Treadway (1969), Rothschild (1971) and Milne (1977) we take it that in the typical case the adjustment cost function has the following properties:

$$g(0) = 0, \quad g'(0) = 0 \tag{8a}$$

$$g'(\dot{K}) > 0 \quad \text{if} \quad \dot{K} > 0 \tag{8b}$$

$$g'(\dot{K}) < 0 \quad \text{if} \quad \dot{K} < 0 \tag{8c}$$

$$g''(\dot{K}) \geq 0. \tag{8d}$$

The quadratic function $g(\dot{K}) = \dot{K}^2$ satisfies all these properties. Note that (7) and (8) imply that adjustment costs depend on the level of net investment. An alternative formulation would be to make adjustment costs dependent on the ratio of investment to the capital stock; see Hayashi (1982) and Auerbach (1989). Our model can be readily adopted to accommodate this alternative specification, without substantial changes in results.

In order to focus on the investment behaviour of the firm, we assume that the firm can adjust its labour force without cost. It follows that at each point of time, the size of the labour force is chosen to equate the marginal productivity of labour with the real wage rate. For example, if the production function is

$$F(K, L) = \gamma(K)K^{\beta}L^{1-\alpha} \qquad (0<\beta<1,\ 0<\alpha<1) \tag{9}$$

then the labour force is chosen such that

$$L = \gamma(K)^{1/\alpha}K^{\beta/\alpha}\,[(1-\alpha)(p/w)]^{1/\alpha} \tag{10}$$

Gross profit (before taking into account the cost of capital) is

$$\begin{aligned}\pi(K, p, w) &= pF(K, L) - wL \\ &= \gamma(K)^{1/\alpha}K^{\beta/\alpha}[(1-\alpha)(p/w)]^{1/\alpha}[w\alpha/(1-\alpha)]\end{aligned} \tag{11}$$

Here $\gamma(K)$ represents a shift in the production function $K^{\beta}L^{1-\alpha}$, and suitable assumptions on $\gamma(K)$ would make π have interesting properties. In what follows, we assume that π is at first convex, then concave in K, and that its derivative π_K has the bell shape. Figures 1 and 2 illustrate the shape of π and π_K.

FIGURE 1

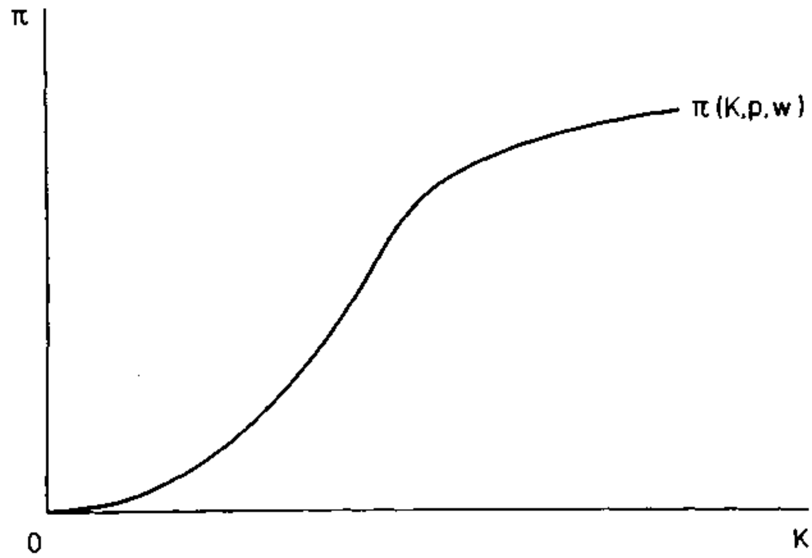
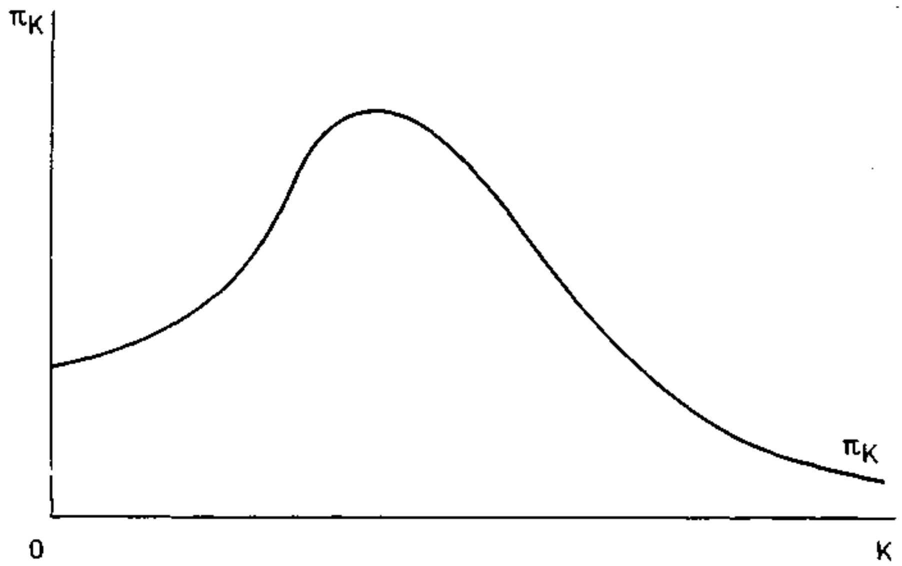


FIGURE 2



We now turn to taxation, because one of our objectives is to investigate the effects of tax incentives on the adjustment path of the firm.

Following Auerbach (1989), we simplify matters by ignoring personal taxes, and corporate interest deductibility. Let $s_N \geq 0$ denote the subsidy per unit of gross investment in new equipments, the total cost of capital accumulation at any time t is

$$B_t = (p_N - s_N)I_N + p_0 I_0 + g(\dot{K}) \tag{12}$$

The tax bill at date s is

$$T_s = \theta_s \pi(K_s, p_s, w_s) - \theta_s \int_{-\infty}^{s} B_u D(s, s-u)du - \mu_s B_s \tag{13}$$

where θ_s is the corporate tax rate, μ_s is the investment tax credit, and $D(s, s-u)$ is the depreciation allowance at date s per dollar of date u capital expenditures. This formulation closely resembles that of Auerbach (1989).

The firm maximizes the value of the discounted stream of cash flow.

$$V_t = \int_t^{\infty} e^{-r(s-t)}[\pi(K_s, p_s, w_s) - B_s - T_s]ds \tag{14}$$

where r is the after tax cost of capital. Following Auerbach, this expression can be transformed to

$$V_t = \int_t^{\infty} e^{-r(s-t)}[(1-\theta_s)\pi_s - B_s(1-\mu_s-G_s)]ds + A_t \tag{15}$$

where A_t is independent of decisions made at (or after) time t:

$$A_t = \int_t^{\infty} e^{-r(s-t)} \theta_s \int_{-\infty}^{t} B_u D(s, u-s)duds \tag{16}$$

and G_s is the value of the discounted stream of tax deduction per dollar of date s capital expenditures:

$$G_s = \int_s^{\infty} e^{-r(u-s)} \theta_u D(u, s-u)du \tag{17}$$

As a special case, consider the following constant proportional depreciation allowance rule, where u-s is the age of the machine:

$$D(u, u-s) = D(u-s) = be^{-(u-s)c}, \quad b>0, \ c>0 \tag{18}$$

If θ_u is a constant, θ, then substituting (18) into (17) gives:

$$G_s = \theta b/(r+c) \tag{19}$$

3. THE STEEP ADJUSTMENT COST CASE

We now derive the optimal path of adjustment under the assumption that the adjustment cost function is strictly convex for all $\dot{K}$ and in particular

$$\lim_{\dot{K}\to\infty} g(\dot{K})/\dot{K} = \infty \tag{20}$$

This assumption implies that the adjustment cost is so steep that it is never optimal to have a very high rate of investment. (Technically, as is shown by Milne (1977), this rules out upward jumps in the capital stock.) The firm's optimization problem can now be stated as follows: Find $I_N \geq 0$ and $I_0 \geq 0$ that maximize

$$\int_0^{\infty} e^{-rt}[(1-\theta)\pi(K, p, w) - (1-\mu-G)B]dt \tag{21}$$

subject to

$$\dot{K} = I_0 + mI_N - \delta K \tag{22}$$

$$I_0 \geq 0, \quad I_N \geq 0 \tag{23}$$

In (21), we have assumed that θ, μ, and G are constant from the present time (t=0) onwards, and we have used B to denote the total capital expenditures at time t:

$$B = (p_N - s_N)I_N + p_0 I_0 + g(I_0 + mI_N - \delta K) \tag{24}$$

Let ψ denote the shadow price of capital, and let

$$\omega = 1 - \mu - G. \tag{25}$$

The Hamiltonian is then

$$H = (1-\theta)\pi(K) - \omega[(p_N - s_N)I_N + p_0 I_0 + g(I_0 + mI_N - \delta K)] + \psi[I_0 + mI_N - \delta K] \tag{26}$$

where the dependence of π on p and w has been suppressed for simplicity of notation. The first order conditions are

$$\partial H/\partial I_0 = -\omega(p_0 + g') + \psi \le 0 \tag{27a}$$

$$I_0 \ge 0,\ I_0(\partial H/\partial I_0) = 0 \tag{27b}$$

$$\partial H/\partial I_N = -\omega(p_N - s_N + mg') + m\psi \le 0 \tag{28a}$$

$$I_N \ge 0,\ I_N(\partial H/\partial I_N) = 0 \tag{28b}$$

$$\dot{\psi} = r\psi - \partial H/\partial K = \psi(r+\delta) - \omega\delta g'(K) - (1-\theta)\pi_K \tag{29}$$

$$\dot{K} = \partial H/\partial\psi = I_0 + mI_N - \delta K \tag{30}$$

It follows from (27) and (28) that $I_0 = 0$ always. This is because a positive I_0 would imply $\psi = \omega(p_0 + g')$, and this condition together with (6) would yield

$$m\psi > \omega(p_N + mg')$$

which would contradict (28a).

From (28) and the fact that $I_0 = 0$, we deduce that

(a) $I_N = 0$ if $\psi < \omega[(1/m)(p_N - s_N) + g'(-\delta K)]$ (31)

(b) Otherwise, I_N is given by

$$g'(mI_N - \delta K) = (1/m)(s_N - p_N) + (\psi/\omega) \tag{32}$$

Figure 3 depicts some I_N = constant loci. Notice that $I_N = 0$ in the region to the left of the curve

$$\psi = \omega[(1/m)(p_N - s_N) + g'(-\delta K)].$$

The $\dot{K} = 0$ curve is obtained by setting $I_N = \delta K$. Using (32) and the fact that $g'(0) = 0$, it is clear that this locus is the horizontal line

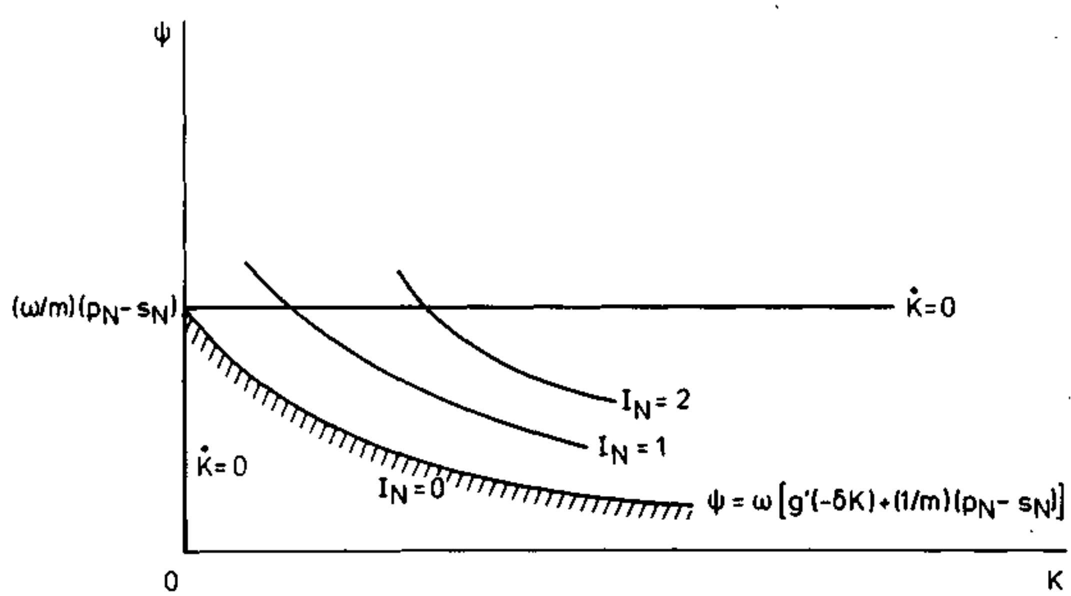
$$\psi = (\omega/m)(p_N - s_N)$$

if $K > 0$, and is the vertical line segment defined by

$$\{(K, \psi) \;:\; K = 0, \;\; 0 \le \psi \le (\omega/m)(p_N - s_N)\}$$

if $K = 0$. See Figure 3.

FIGURE 3



Turning now the $\dot{\psi} = 0$ locus, it is convenient to draw the reference curve

$$\psi = (1-\theta)\pi_K/(\delta + r) \tag{33}$$

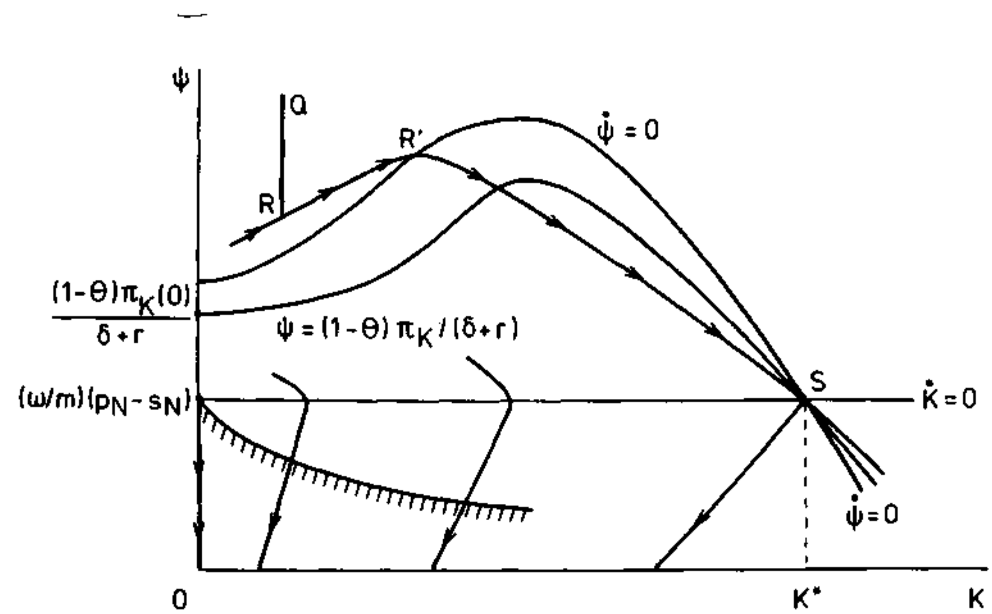
There are two cases:

Case 1: $(1-\theta)\pi_K(0)/(\delta+r) > (\omega/m)(p_N-s_N)$ (34)

Case 2: $(1-\theta)\pi_K(0)/(\delta+r) \leq (\omega/m)(p_N-s_N)$ (35)

In case 1, the curve (33) cuts the locus $\dot{K} = 0$ only once, at K*, as illustrated in Figure 4. In the region above the line $\psi = (\omega/m)(p_N-s_N)$, $\dot{K}$ is positive, and so is $g'(\dot{K})$. It follows from (29) that the $\dot{\psi} = 0$ locus lies above [respectively, below] the reference curve (33) for all values of K to the left [respectively, right] of K*. It can be checked that the equilibrium point (K*, ψ*), where $\psi^* = (\omega/m)(p_N-s_N)$, is a saddle-point. The phase diagram (Figure 4) shows (and this can be confirmed) that all paths in the region to the left of the $\dot{\psi} = 0$ curve and below the $\dot{K} = 0$ line will hit the horizontal axis at some K > 0 in finite time and afterwards ψ becomes negative. These paths cannot be optimal. Similarly, one can rule out paths that lead to infinite value of either K or ψ. It follows that the stable branch of the saddle-point is the only optimal path.

FIGURE 4



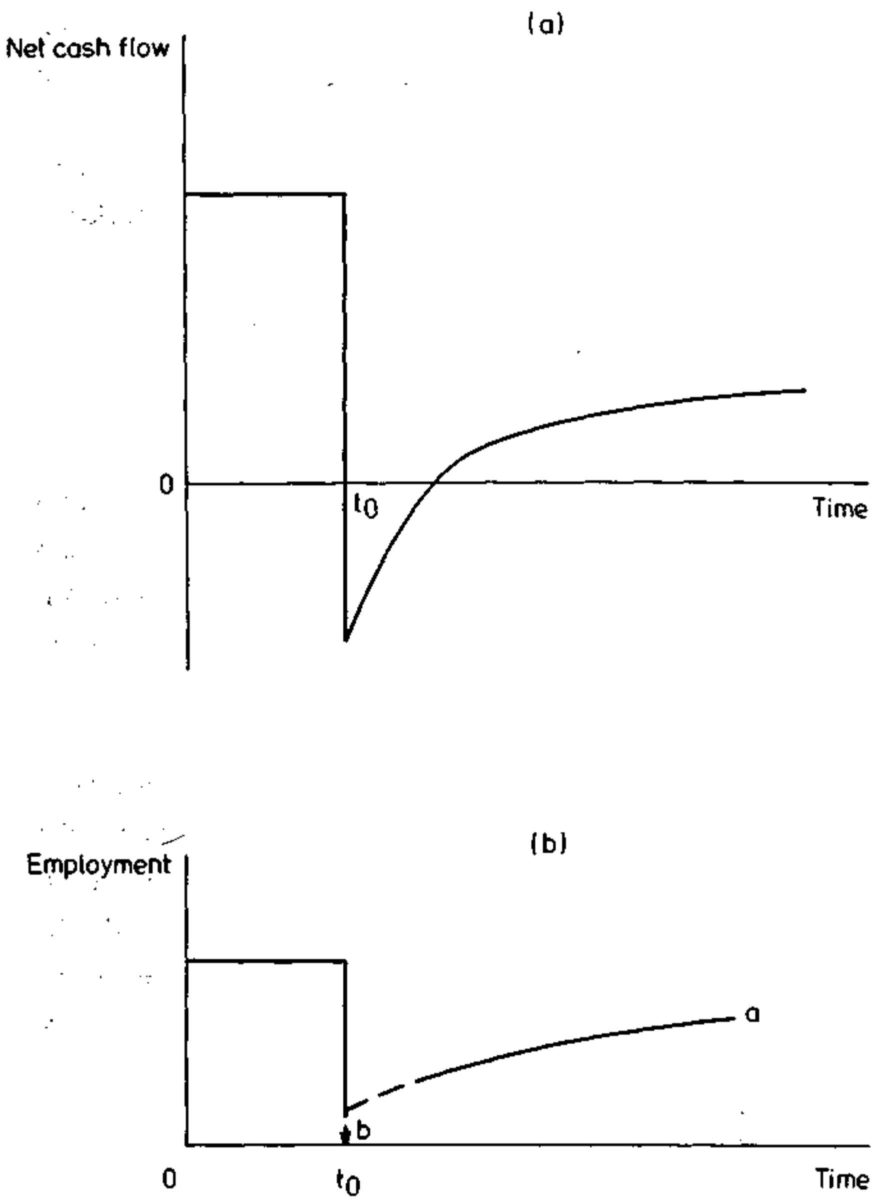
A possible depiction of the adjustment of the socialist firm is the path QRR'S in Figure 4. As soon as the firm receives a shock due to a sharp fall in the price of its output, the value of its capital immediately falls from Q to R. But the firm now has access to the market for modern equipments. It therefore accumulates capital. Along RR' the rate of investment is increasing over time. Afterwards net investment remains positive, but its rate of change may be negative. The path approaches the steady state S asymptotically. Note that the shadow price ψ rises temporarily from R to R' (Figure 4; Figure A1 in the appendix). This is due to the role of adjustment costs and to the bell shape curve for the marginal productivity of capital (Figure 2). Without adjustment costs and without the positive impact of new capital on productivity as in equation 3 (or 2'), ψ should fall after the jump.

Case 2 is rather more complicated, because there are three stationary points for (ψ, K) (see appendix).

A typical time path of net cash flow associated with the optimal adjustment path is depicted in Figure 5a where t_0 is the time of the shock. Due to investment outlays, period net cash flow is negative for some initial time interval, but it eventually becomes positive in the case of a viable firm.

Employment falls abruptly in t_0. If adjustment pays off, employment will pick up. From equation 10, the demand for labour is positively related to K and p. At t_0, p falls by a sudden jump (Figure 5b). This means that L has a downward jump. Afterwards, as capital is accumulated, labour demand grows too (for the case of the viable firm; curve a in Figure 5b). For non-viable firms, immediate shut down implies that L jumps to zero (b in Figure 5b).

FIGURE 5



The implications of tax incentives can now be explored. Consider the steady state capital stock K* of Figure 4 (or K_2 of Figure A1 or A2 in the appendix). It is determined by the equation

$$(1-\mu-G)[(p_N-s_N)/m] = (1-\theta)\pi_K(K^*)/(\delta+r) \tag{36}$$

Clearly, an increase in the investment tax credit μ or in the subsidy rate on investment goods, s_N, will result in a higher steady state capital stock, because the $\dot{K} = 0$ locus is shifted down. In fact, such a tax change may transform case 2 into case 1, if the $\dot{K} = 0$ locus is shifted down far enough. Thus, a firm that is reducing its capital along β of Figure A1 or A2 in the appendix may, as a result of the above tax incentives, reverse its direction and aim at attaining the capital stock K^* of Figure 4.

The effect of a reduction in the corporate tax rate θ may or may not encourage capital accumulation. Take for example the case of proportional depreciation allowance given by (19). Substituting this into (36), we see that

$$(-\pi_{KK})(dK^*/d\theta) = (\delta+r)[(p_N-s_N)/m]\ \frac{d}{d\theta}[(1-\mu-\frac{\theta b}{r+c})/(1-\theta)] \qquad (37)$$

Thus, if $\mu = 0$ and $b = r+c$, then the change in the corporate tax rate has no effect on the steady state stock of capital. This is essentially the Samuelsonian neutrality result: if the present value of tax claims on depreciation allowance of a dollar of investment is θ, that is, if

$$\theta \int_0^{\infty} (be^{-ca})e^{-ra}da = \theta \qquad (38)$$

where a is the "age" of the machine (The "age" is by definition zero at the time of investment), then the corporate tax rate has no effects on the steady state capital stock (in fact it has no effects on the path of accumulation, as can be seen from the objective function (21), when $\mu = 0$ and $G = 0$).

Real world depreciation allowance is however closer to the following formula

$$D(u-s) = \delta e^{-\delta(u-s)} \qquad (39)$$

because of the typical tax law requirement that the sum of <u>non-discounted</u> claims on a dollar equal a dollar:

$$\int_0^{\infty} \delta e^{-\delta a}da = 1 \quad (a = u-s) \qquad (40)$$

If (39) applies, then, as is clear from (37), a reduction in corporate tax rate θ will increase the steady state capital stock K^*.

4. THE BIG PUSH

Assumption (20) of section 4 prevents upward jumps in the capital stock. We now relax that assumption, and postulate instead

$$\lim_{\dot{K}\to\infty} g(\dot{K})/\dot{K} = \lambda \quad (\lambda > 0 \text{ and finite}) \tag{41}$$

Under these conditions, a jump in the capital stock may occur. Drawing on the results reported in Long and Vousden (1977), Milne (1977) and Leonard and Long (1991, Chapter 10), the conditions characterizing the jump can be identified. The per unit cost of the jump is $\omega[\lambda + (1/m)(p_N - s_N)]$. The shadow price ψ remains continuous at all time, and if t_J denotes the time of the jump, we must have

$$\omega[\lambda + (1/m)(p_N - s_N)] \geq \psi\ , \quad \text{all } t \tag{42}$$

$$\omega[\lambda + (1/m)(p_N - s_N)] = \psi(t_J) \tag{43}$$

The size of the jump, $K(t_J^+) - K(t_J^-)$ is determined by the condition

$$e^{-rt_J}\{H[K(t_J^+),\ \psi(t_J^+)] - H[K(t_J^-),\ \psi(t_J^-)]\}$$

$$= -[K(t_J^+) - K(t_J^-)]\frac{d}{dt}[e^{-rt}(\lambda + (1/m)(p_N - s_N))] \tag{44}$$

In our problem, p_N and s_N are constant for all $t \geq 0$, and (44) reduces to

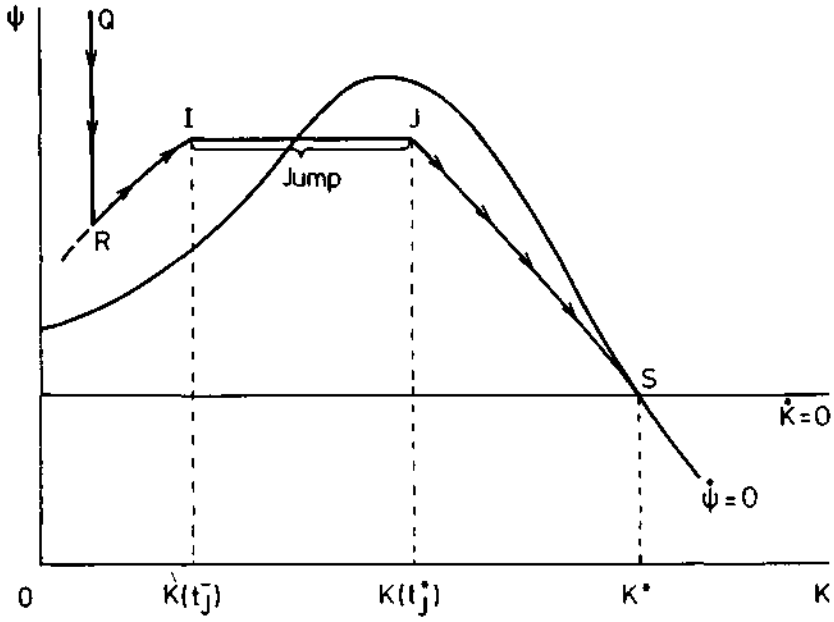
$$H[K(t_J^+),\ \psi(t_J^+)] - H[K(t_J^-),\ \psi(t_J^-)] =$$

$$r\omega[\lambda + (1/m)(p_N - s_N)][K(t_J^+) - K(t_J^-)] \tag{45}$$

It is well known that $H = rV$, where V is the value of the discounted stream of future cash flow. Hence condition (45) says that the increase in the value of the firm is equal to the cost of the jump.

In Figure 6, we depict the case of an upward jump after some initial gradual adjustment. Arrow and Kurz (1970, p. 57), drawing on the work of Vind (1967), stated that in strictly concave problems any jump must occur at the initial instant. Our problem, however, is not strictly concave, and therefore a jump in the interior of the time horizon is possible.

FIGURE 6



5. A MORE GENERAL FORMULATION OF THE ADJUSTMENT PROBLEM

In Sections 2, 3 and 4 we have made a number of simplifying assumptions so that a detailed analysis using phase diagram is possible. A more general formulation would have to relax these assumptions. In particular, firms may expect that the time path of investment subsidy rate to be non-stationary. For example, at first, there may be no subsidy because of policy inertia, then a rising subsidy due to concern about unemployment, and finally a decline in subsidy after most firms have made their full adjustment. Another generalisation would be to relax the assumption that new capital equipments and old ones are linear substitutes. As a modest step in this direction, we define the aggregate capital stock as

$$K = K_0 + h(K_N) \tag{46}$$

where $h(K_N)$ is an increasing and concave function, and $h'(K_N) \geq m > 1$ for all K_N. The stock K is measured in efficiency units. From (46)

$$\dot{K} = \dot{K}_0 + h'(K_N)\dot{K}_N \,, \tag{47}$$

and we can postulate an adjustment cost function

$$C = g(\dot{K}) = g[I_0 - \delta K_0 + h'(K_N)(I_N - \delta K_N)] \tag{48}$$

To capture the fact that new capital is more cost efficient than old capital, we assume that the counterpart of (6) holds:

$$p_N/h'(K_N) < p_0 \tag{49}$$

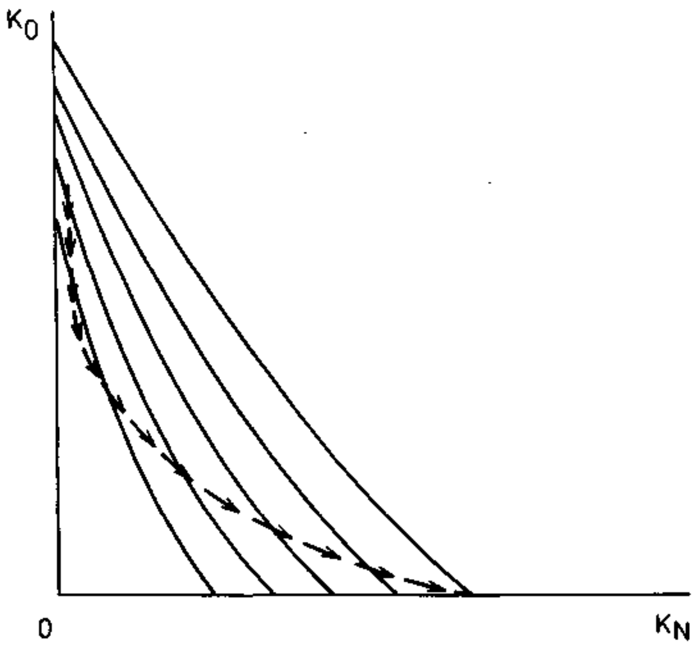
The control problem now involves two state variables, K_0 and K_N, because they are no longer linearly related. Let ψ_0 and ψ_N be the associated shadow prices, the Hamiltonian is

$$H = (1-\theta)\pi(K, p, w) - \omega[(p_N-s_N(t))I_N + p_0I_0 + g(\dot{K})]$$

$$+ \psi_0(I_0-\delta K_0) + \psi_N(I_N-\delta K_N) \tag{50}$$

The necessary conditions can then be derived in the usual way, and it is easy to show that $I_0 = 0$ always. The possibility of a J curve for the time path of the firm's aggregate capital stock is depicted in Figure 7. The dark curves are the "iso-capital" curves, along any such curve, aggregate capital is a constant. The slope of these curves exceeds m. The dotted curve with arrows is a possible time path. The firm's aggregate capital stock at first falls, then rises, as the firm first concentrates on getting rid of old equipments, then begins to emphasize investment in new equipments. The time path of employment would follow a J curve in that case.

FIGURE 7



6. THE VIABILITY ISSUE

A core issue in the adjustment of firms and in the restructuring of industry is whether a firm is viable. Viability should be defined in terms of the present value of the stream of net cash flow. The value V_τ of the firm at time τ is defined as the result of the maximization problem in equation (21), with 0 replaced by τ and e^{-rt} replaced by $e^{-r(t-\tau)}$. If the capital stock is owned completely by the firm, i.e. if there is no outstanding debt, then the viability condition is

$$V_\tau \geq 0. \tag{51}$$

If the capital stock is not completely owned by the firm because of debt financing and R_τ ($\leq K_\tau$) stands for the stock of debt at time τ, then viability requires that the net value N_τ of a firm is positive, i.e.

$$N_\tau = V_\tau - R_\tau \geq 0. \tag{52}$$

The value of the firm is increased by an increase in the investment tax credit (or in the subsidy rate on investment goods), a reduction in the corporate tax rate and through depreciation allowances of the type specified in (39).

The value of the firm is also affected by the wage rate. Consider an exogenous increase in the wage modelled as

$$w(t) = \begin{cases} w(t_0)e^{h(t-t_0)} \quad (h \geq 0) & \text{if } t_0 \leq t \leq t_1 \\ w_1 & \text{if } t \geq t_1, \text{ when } w_1 = w(t_0)e^{ht} \end{cases} \tag{53}$$

where t_1 is the exogenous time at which the wage is expected to stop rising. Note that the wage cannot rise forever, unless we have continual technological progress and we have not assumed this, for simplicity.

It would be difficult to incorporate the above wage equation into the main analysis, because phase diagrams like Figures 4 or 6 cannot be drawn when the wage is time-dependent. However, certain inference can be made from equation 53.

If h is positive (h>0) - i.e. there is a wage rise - then the profit function will be shifted downwards, and the marginal contribution of capital to profit will be lower (see for example, equation 11). So h>0 implies a lower capital stock in the long run equilibrium. The viability of the firm is affected. This can be calculated using the "dynamic envelope theorem" of Caputo (1990), and Lafrance and Barney (1991). From (21):

$$\frac{\partial V(t_0)}{\partial h} = \int_{t_0}^{\infty} e^{-r(s-t_0)} (1-\theta)\frac{\partial \pi}{\partial w(t)} \cdot \frac{\partial w(t)}{\partial h}\, dt < 0. \tag{54}$$

Thus, the value of the firm is reduced when wages rise. The time path of employment will be lower, the higher the wage increase h.

A wage subsidy increases the value of the firm. Note, however, that the analysis assumes the wage (or the wage increase) as given and does not consider the moral hazard problem of a wage subsidy on the bargaining behavior of trade unions.

If old debt is forgiven, viability of the firm is enhanced; this also holds if the government takes over environmental damages of the past such as cleaning up contaminated soil or liabilities for health risks of previously employed workers.

In the transition process to a market economy the issue arises under what conditions firms have to be shut down. Consider a situation in which old debts are forgiven and in which environmental damages of the past are taken over by the government. Then, the base line for shutting down a firm is that the value of the firm after adjustment is negative, i.e. $V_T \leq 0$. Government and government agencies such as Treuhand do not have sufficient information on the value of the firm. Consequently, governments must determine the value of the firm (or of parts of the firm) in the market of firms. If a firm cannot be sold to a private investor and if the market of selling firms is reasonably efficient, there is reason to expect that the firm has to be closed down.

7. CONCLUDING REMARKS

It is important to understand that the adjustment of the socialist firm and the transition from central planning to a market economy is a phenomenon of shock, a problem of dynamic change and of transformation or of "creative destruction" (Schumpeter 1934). This implies an intertemporal analysis with some discontinuity. A comparative-static analysis or the approach of allocative distortions may not do sufficient justice to the transition problem.

In modelling the transformation problem, we have simplified by analysing a price shock. Other important aspects of the shock have been neglected. Ownership, corporate control and removing the nomenklatura are important issues. Privatization methods are a core problem.

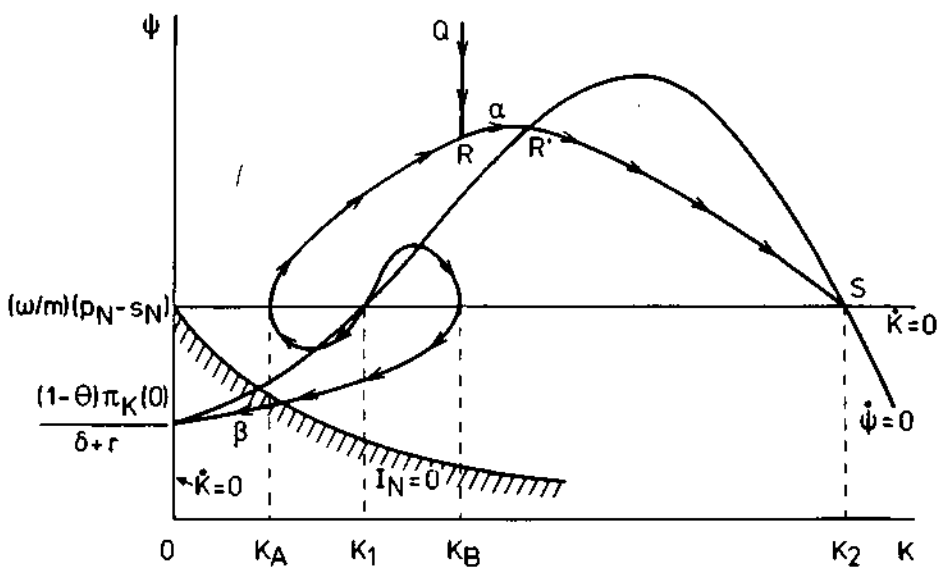
The shock to the typical socialist firm can be modelled more richly than a price shock including a more comprehensive change in the restraints such as competing for new capital in the capital market instead of facing a soft budget constraint, losing subsidies and explicitly allowing for the change in the market position. In addition, the adjustment process could be modelled more richly, not only including new capital (and technology) and laying off workers but developing new products, redefining in-house and out-house production of intermediate inputs, building up a new distribution system, marketing the products etc.

Finally, the model of the adjustment of the socialist firm can be used to portray the transition of the total economy in aggregating the picture derived from a set of firms. This would allow to develop a model of dynamic change of an economy. In such a context, a taxanomy of firms with respect to viability must be developed, sectorial conditions can be considered, and the adjustment cost function can be specified. Adjustment costs may be high initially, for instance due to ownership uncertainty, a lacking infrastructure and a deficient administration. Over time, these bottlenecks will be reduced and the adjustment cost function shifts downward. Moreover, in an aggregate picture of the adjustment process, one cannot only study the adjustment of existing firms but must analyze the birth of new firms and the conditions that forster their creation and their development.

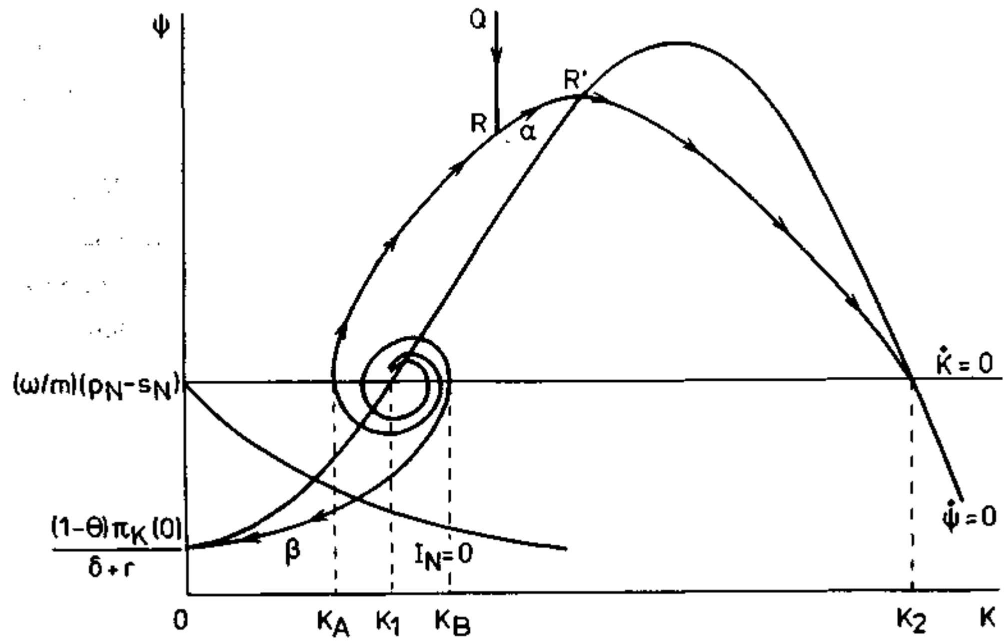
APPENDIX

In case 2 (equation 35), there are three stationary points for (ψ, K). These are $[0, (1-\theta)\pi_K(0)/(\delta+r)]$, $[K_1, (\omega/m)(p_N-s_N)]$, and $[K_2, (\omega/m)(p_N-s_N)]$. See Figure A1. The stationary point at K_2 is a saddle-point. The one at K_1 is either an unstable mode (Figure A1) or a spiral (Figure A2). Using an argument similar to that of Skiba (1978), it can be shown that there are two critical values K_A and K_B such that if $K(0) > K_B$, then it is optimal to take the path α (the stable branch leading to the saddle-point at K_2), and if $K(0) < K_A$ then it is optimal to let the capital stock depreciate, taking the system along path β to the equilibrium with a zero capital stock.

A 1



A 2



Skiba's arguments can be adapted to establish that there exists a critical value K_C somewhere between K_A and K_B such that starting from the right of K_C, one should take path α, while path β is optimal for any initial capital stock below K_C. The path QRR'S in Figure A1 and A2 has the same properties as that of Figure 4.

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