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Peer, H.

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The growth of labor-management in a private economy

by

H. Peer

1. Introduction

In many countries there is a tendency to give the workers or representatives of the workers a role in the management of the firms they are working in. It has been shown that if workerscollectives pursue the objective of maximization of the netincome per worker this would not distort the efficient allocation of scarce resources in the economy. (1); (2); (3). The models used by these authors do not distinguish capital goods with respect to ownership. It should be clear however that at least for a definite transition period it can be expected that full workers-management has to start in an environment where private capital still plays an important role. Meanwhile a stock of social capital goods has to be build up if one wants to enlarge the self-managed sector in the economy. It is the purpose of this paper to study economic growth and stability of economic growth during a transition period. By transition period we mean the period in which all firms are actually maneged by workerscollectives or their representatives. It is assumed that all these firms try to maximize net-income per worker. In the production proces they all use the private and the social capital good. Although the social capital good and the private capital good should be defined legally, for the purpose of economic analysis it is sufficient to distinguish between them by the different ways they are generated. It is assumed that the private capital good is financed through the savings of private capital-owners. They save all their income. The social capital good is forthcoming through imposing taxes on economic agents. This will raise the question of designing an optimal tax structure and the problem of determining the optimal tax rates. Furthermore it is assumed that an economy incurs transformation costs during such an transition period.

Those costs can appear in many forms e.g. educational expenses to increase decision-making skills of the workers in the economy or the organizational costs in production. It is investigated how the transformation costs might influence the tax program and the level of the tax rates in the transition period. In section 2 a model will be developed in the context of which the above mentioned problems can be analyzed, while section 3 proposes an optimal tax policy for the transition period. Concluding remarks can be found in section 4.

2. The model

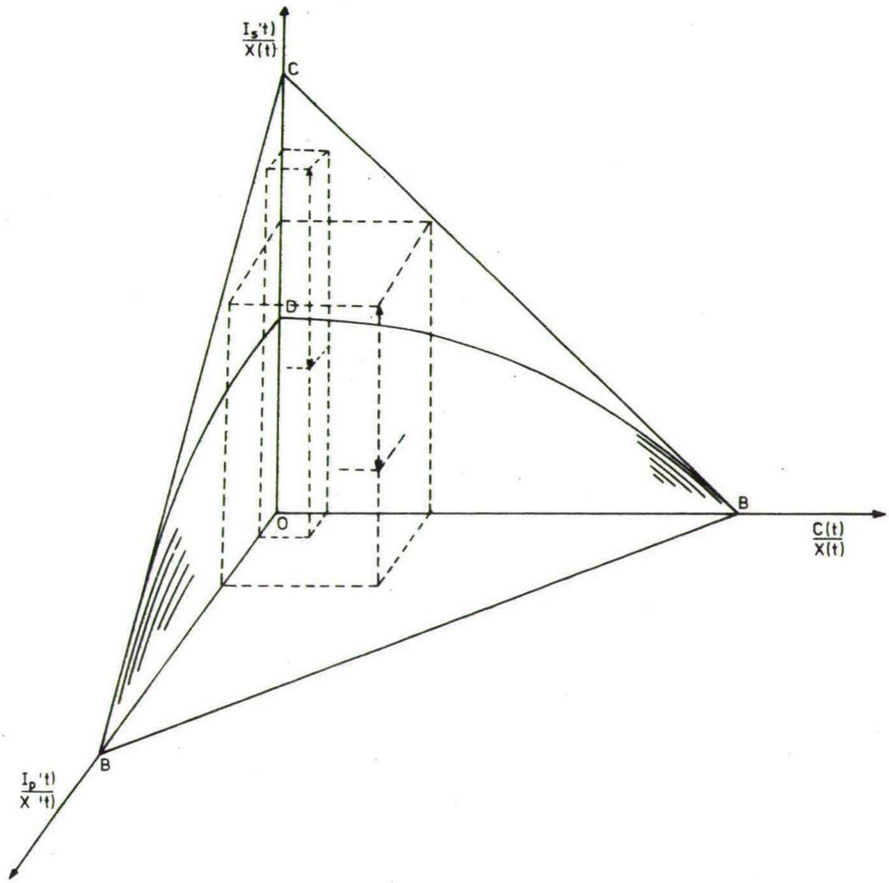
The frame work in which economic growth and stability of economic growth in the transition period will be analyzed is the neo-classical growth model for an aggregate closed economy. This means that the economy produces a single homogeneous good, the output of which at time t is X(t), using three homogeneous factor inputs, labor L(t), the private capital good $K_p(t)$ and the social capital good $K_s(t)$. By closed we mean that imports and exports are ignored. Therefore all output is either consumed or invested in the economy, giving the income identity:

$$X(t) = C(t) + I_p(t) + I_s(t) \tag{1}$$

Dividing both sides by X(t) reveals the fact that for each t,

$$\frac{C}{X} + \frac{I_p}{X} + \frac{I_s}{X} = 1 \tag{2}$$

giving the transformationplane ABC in fig. 1. This transformationplane is the set of all conceivable average consumption ratio's and investment ratio's for each t. Since this paper only investigates the effects of creating a social capital good in the economy it is assumed that changing the consumtion/private investment ratio is costless while increasing the social capital/private capital ratio causes transformation costs, being the vertical distance between the original transformationplane ABC and the transformationplane ABD for each consumption/private investment ratio. The shape of the transformationplane ABD reflects the assumption of increasing transformation costs in choosing higher investments in social capital. One can conceive of these transformation costs as the educational costs involved in introducing organizational structures for labor-management in the existing firms in the economy. Another way of looking at the increasing transformation costs is to assume that private capital owners are more reluctant



$\frac{I_s(t)}{X(t)}$
C
D
O
B
$\frac{C(t)}{X(t)}$
B
$\frac{I_p(t)}{X(t)}$

to give up management prerogatives the higher social capital/ private capital ratio's are. This reluctance can be taken away by paying them a sort of bonus for giving up their management-rights. If one chooses the latter interpretation one need not assume that capitalist do not consume as is usually done in this type of models.

Proceeding with the development of the model gross investments in the private capital good and the social capital good are defined as:

$$I_p(t) = \frac{dK_p(t)}{d\ t} + \mu_p K_p(t) \tag{3}$$

$$I_s(t) = \frac{dK_s(t)}{d\ t} + \mu_s K_s(t) \tag{4}$$

where μ_p and μ_s are the depreciation rates for the private capital good and the social capital good respectively.

Gross investments in social capital are, however, dependent upon the level of national output $X(t)$, the consumption level $C(t)$ and the gross investments in the private capital good $I_p(t)$.

Or, equivalently, since for each consumption/private investment ratio the transformation costs are specified they are a function of the level of national output $X(t)$ and the level of transformation costs $TC(t)$.

$$I_s(t) = \frac{dK_s(t)}{d\ t} + \mu_s K_s(t) = G(X(t),\ C(t),\ I_p(t)) =$$

$$= F(TC(t),\ X(t)) \tag{5}$$

If lineair homogenity is assumed (5) can be written as:

$$I_s(t) = X(t).H(\frac{TC(t)}{X(t)}) \tag{6}$$

Assuming that all private savings $S_p(t)$ are invested in the private capital good and that the transformation costs are covered by collecting the scarcity rent for the social capital good, labor-income tax $T_l(t)$, private capital income tax $T_p(t)$ and sales tax $T_s(t)$ we have:

$$I_p(t) = S_p(t) \tag{7}$$

$$TC(t) = \bar{P}_{k_s} K_s(t) + T_l(t) + T_p(t) + T_s(t) \tag{8}$$

where $\bar{P}_{k_s}$ is the price of social capital deflated by the price level P_x.
Private savings are equal to the disposable income of owners of private capital:

$$S_p(t) = (1-t_p)\bar{P}_{k_p} K_p(t) \tag{9}$$

where t_p is the tax rate on private capital income and $\bar{P}_{k_p}$ is the real price of private capital.
The tax generated by taxing the income of workers equals

$$T_l(t) = t_l.\bar{y}.L(t) \tag{10}$$

t_l is the tax rate on labor income and $\bar{y}$ is the real net-income per worker.
Profit tax is equal to:

$$T_p(t) = t_p.\bar{P}_{k_p}.K_p(t) \tag{11}$$

while sales tax can be defined as:

$$T_s(t) = t_s.X(t) \tag{12}$$

in which t_s is the sales tax rate. For consumption will be left:

$$C_l(t) = (1-t_l).\bar{y}.L(t) \tag{13}$$

The individual labor-managed firm in the economy faces the following constrained maximization problem for each t:

$$\max_{{}_iL,\,{}_iK_p,\,{}_iK_s} y_i = \frac{P_x(1-t_s)X_i(t)-P_{k_s}\cdot{}_iK_s(t)-P_{k_p}\cdot{}_iK_p(t)}{{}_iL(t)} \tag{14}$$

$$\text{S.T. } X_i = {}_iL^{\alpha}\cdot{}_iK_p^{\beta}\cdot{}_iK_s^{\gamma} \quad \text{for all 1} \quad (i=1,2,\ldots,n) \tag{15}$$

$$\alpha+\beta+\gamma=1$$

In the long run the net-income per worker in the individual enterprise will be maximized if:

$$(1-t_s)\alpha\,{}_iL^{\alpha-1}\cdot{}_iK_p^{\beta}\cdot{}_iK_s^{\gamma} = \bar{y}_i \tag{16}$$

$$(1-t_s)\beta\,{}_iL^{\alpha}\cdot{}_iK_p^{\beta-1}\cdot{}_iK_s^{\gamma} = \bar{P}_{k_p} \tag{17}$$

$$(1-t_s)\gamma\,{}_iL^{\alpha}\cdot{}_iK_p^{\beta}\cdot{}_iK_s^{\gamma-1} = \bar{P}_{k_s} \tag{18}$$

Since (15) is lineair homogeneous and if we assume that the economy consists of n identical firms we can simply multiply (14) by n giving the same long run decision rules on the macro level. If reference is made to the macro interpretation the subscript i will be left out in equations (14)-(18).
By (16)-(18) long term factor incomes will be known thus by using (9) and (17) private savings for each t can be calculated:

$$S_p(t) = (1-t_p)(1-t_s)\beta X(t) \tag{19}$$

and by using (8), (10)-(12) and (16), (18) the transformation costs for each t can be found:

$$TC(t) = \{(\alpha t_1+\beta t_p+\gamma)(1-t_s)+t_s\}\;X(t) \tag{20}$$

Consumption for each t will then be, substituting (16) in (13):

$$C_1(t) = (1-t_1)(1-t_s)\alpha X(t) \tag{21}$$

It can be checked that for each t:

$$X(t) = C(t) + S_p(t) + TC(t) \tag{22}$$

For the purpose of continuing in per worker quantities the following definitions are needed:

$$\begin{aligned} &\frac{dK_p(t)}{d\ t} = I_p(t) && \frac{dK_s(t)}{d\ t} = I_s(t) \\ &\frac{K_p(t)}{L(t)} = k_p(t) && \frac{K_s(t)}{L(t)} = k_s(t) \\ &\frac{X(t)}{L(t)} = x(t) && \frac{C_1(t)}{L(t)} = c(t) \\ &\frac{dL(t)}{d\ t} = \dot{L} && \frac{\dot{L}}{L} = \pi \end{aligned} \tag{23}$$

If it is assumed that all private savings go into private investments by using (3) and (19) private investments per worker are:

$$\frac{I_p(t)}{L(t)} = \frac{\frac{dK_p(t)}{d\ t}}{L(t)} + \mu_p \frac{K_p(t)}{L(t)} = (1-t_p)(1-t_s)\beta\frac{X(t)}{L(t)} \tag{24}$$

From (4), (6) and (20) social capital investments per worker are obtained:

$$\frac{I_s(t)}{L(t)} = \frac{\frac{dK_s(t)}{d\ t}}{L(t)} + \mu_s \frac{K_s(t)}{L(t)} = \frac{X(t)}{L(t)} H[(\alpha t_1+\beta t_p+\gamma)(1-t_s)+t_s] \tag{25}$$

Given the definitions in (23) and deriving:

$$\dot{k}_p = \frac{d}{dt}\left(\frac{K_p(t)}{L(t)}\right) = \frac{\frac{d}{dt}(K_p)L-\frac{d}{dt}(L)K_p}{L^2} = \frac{\frac{dK_p}{dt}}{L} - \frac{\frac{dL}{dt}}{L}\cdot\frac{K_p}{L} =$$

$$= \frac{\frac{dK_p}{dt}}{L} = \dot{k}_p + \pi k_p \tag{26}$$

Going through the same derivation for the social capital good:

$$\frac{\frac{dK_s}{dt}}{L} = \dot{k}_s + \pi k_s \tag{27}$$

Substituting (26) and (27) in (24) and (25) respectively:

$$\dot{k}_p + (\pi+\mu_p)k_p = (1-t_p)(1-t_s)\beta x(t) \tag{28}$$

$$\dot{k}_s + (\pi+\mu_s)k_s = H[(\alpha t_1+\beta t_p+\gamma)(1-t_s)+t_s]\,x(t) \tag{29}$$

Because the production function (15) is lineair homogeneous it can be written as: $x = k_p^{\beta}.k_s^{\gamma}$ so that after dividing (28) and (29) by k_p and k_s respectively the following system of differential equations can be obtained:

$$\frac{\dot{k}_p}{k_p} = (1-t_p)(1-t_s)\beta k_p^{\beta-1}.k_s^{\gamma} - (\pi+\mu_p) \tag{30}$$

$$\frac{\dot{k}_s}{k_s} = H[(\alpha t_1+\beta t_p+\gamma)(1-t_s)+t_s]\ k_p^{\beta}.k_s^{\gamma-1}-(\pi+\mu_s) \tag{31}$$

Balanced economic growth requires a net growth rate for the private capital stock and the social capital stock equal to the natural rate of growth π. This condition is satisfied if capital/labor ratio's have reached their long run equilibrium values. Thus this condition implies $\dot{k}_p = \dot{k}_s = 0$.
The two functions that satisfy (30) and (31) are:

$$k_p = \left[\frac{(1-t_s)(1-t_p)\beta}{(\pi+\mu_p)}\right]^{\frac{1}{1-\beta}} . k_s^{\frac{\gamma}{1-\beta}} \tag{32}$$

being a function increasing at a decreasing rate since

$$\frac{dk_p}{dk_s} = \frac{\gamma}{1 - \beta}\frac{k_p}{k_s} \quad \text{and} \quad \frac{\gamma}{1 - \beta} < 1$$

and:

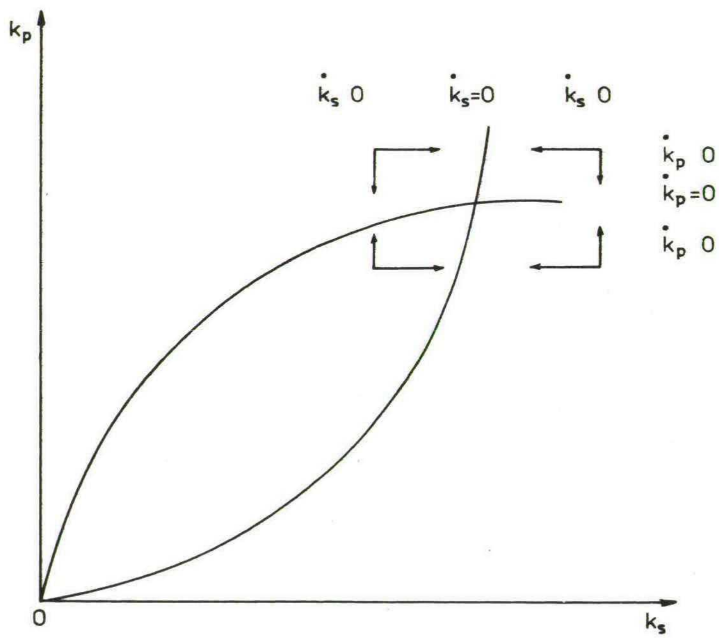
$$k_p = \left[\frac{H[(\alpha t_1+\beta t_p+\gamma)(1-t_s)+t_s]}{(\pi+\mu_s)}\right]^{-\frac{1}{\beta}} . k_s^{\frac{1-\gamma}{\beta}} \tag{33}$$

being a function increasing at an increasing rate since

$$\frac{dk_p}{dk_s} = \frac{1 - \gamma}{\beta} . \frac{k_p}{k_s} \quad \text{and} \quad \frac{1 - \gamma}{\beta} > 1 \quad \text{as drawn in fig. 2.}$$

By varying around $\dot{k}_p = 0$ and $\dot{k}_s = 0$ in (30) and (31) the behaviour of the capital/labor ratio's can be studied if they are not on the balanced growth path. Four regions can be distinguished marked by the four pairs of arrows indicating the four possibilities of the equilibrium growth path: increase or decrease in both ratio's on the one hand and increase in the social capital/labor ratio and decrease in the private capital/labor ratio or vice versa on the other hand. Since in the four relevant intersections in fig. 2 the arrows have the appropriate direction for stability the point where the two points intersect is stable. Now stability is guaranteed solving (32) and (33) simultaneously is justified giving the long run equilibrium capital/labor ratio's.

$$k_s^* = \frac{(\pi+\mu_s)^{\frac{\beta-1}{\alpha}}}{(\pi+\mu_p)^{\frac{\beta}{\alpha}}} \cdot \left[(1-t_p)(1-t_s)\beta\right]^{\frac{\beta}{\alpha}} \left[H[(\alpha t_1+\beta t_p+\gamma)(1-t_s)+t_s]\right]^{\frac{1-\beta}{\alpha}} \tag{34}$$


k_p
$\dot{k}_s$ 0
$\dot{k}_s=0$
$\dot{k}_s$ 0
$\dot{k}_p$ 0
$\dot{k}_p=0$
$\dot{k}_p$ 0
0
k_s

$$k_p^* = \frac{(\pi+\mu_p)^{\frac{\gamma-1}{\alpha}}}{(\pi+\mu_s)^{\frac{\gamma}{\alpha}}} \cdot \left[(1-t_p)(1-t_s)\beta\right]^{\frac{1-\gamma}{\alpha}} \left[H[(\alpha t_1+\beta t_p+\gamma)(1-t_s)+t_s]\right]^{\frac{\gamma}{\alpha}} \tag{35}$$

As can been seen from (34) and (35) the balanced growth capital labor ratio's are dependent upon the long run tax program t_s, t_p and t_1 and the level of these tax rates. Moreover both ratio's are influenced by the increasing costs of transformation through $H[\cdot]$. The implications of these dependencies will be investigated in more detail in the next section.

3. Transformation costs and tax policy

If during the transition period a national goal of maximizing consumption per worker is pursued one has to choose the independent variables entering that objective function such that a true maximum is obtained. From (21) and (23) we have:

$$c(t) = (1-t_l)(1-t_s)\alpha\ x(t) \tag{36}$$

But using (15) and the long run equilibrium capital/labor ratio's of (34) and (35) it can be seen that the consumption per worker is dependent upon the transformation costs through the H[·] function and upon the tax policy through the choice and level of tax rates.

$$c(t) = (1-t_l)(1-t_s)\alpha \frac{(\pi+\mu_s)^{\frac{\gamma}{\alpha}}}{(\pi+\mu_p)^{\frac{\beta}{\alpha}}} \cdot$$

$$\cdot \left[(1-t_p)(1-t_s)\beta\right]^{\frac{\beta}{\alpha}} \left[H[(\alpha t_l+\beta t_p+\gamma)(1-t_s)+t_s]\right]^{\frac{\gamma}{\alpha}} \tag{37}$$

The problem is to choose those taxes of the tax program that will reflect the role of transformation costs during the transition period directly and those levels of sales tax t_s, tax on private capital income t_p and tax on labor income t_l that will maximize consumption per worker in the economy. Putting the partial derivatives with respect to t_s, t_p and t_l in (37) equal to zero the following conditions are obtained:

$$\frac{\gamma}{\alpha}(1-t_l)\epsilon = (\alpha t_l+\beta t_p+\gamma)(1-t_s) + t_s \tag{38}$$

$$\frac{\gamma}{\alpha+\beta}(1-t_s)\epsilon = (\alpha t_l+\beta t_p+\gamma)(1-t_s) + t_s \tag{39}$$

$$\frac{\gamma}{\beta}(1-t_p)\epsilon = (\alpha t_l+\beta t_p+\gamma)(1-t_s) + t_s \tag{40}$$

in which $\in$ is the elasticity of transformation defined as:

$$\in = (\alpha t_l + \beta t_p + \gamma)(1-t_s) + t_s \frac{H'}{H} \quad 0 < \in < 1 \tag{41}$$

(38)-(40) can be summarized as:

$$\frac{1-t_l}{\alpha} = \frac{1-t_s}{\alpha+\beta} = \frac{1-t_p}{\beta} \tag{42}$$

Apperently $\in$ does not play a role in determining the optimal tax rates for the three taxes. Moreover it appears that the three equations cannot be solved simultaneously since they are not independent. Let therefore the sales tax be determined exogeneously from the interval $0 < t_s < 1$, then from (42) we obtain:

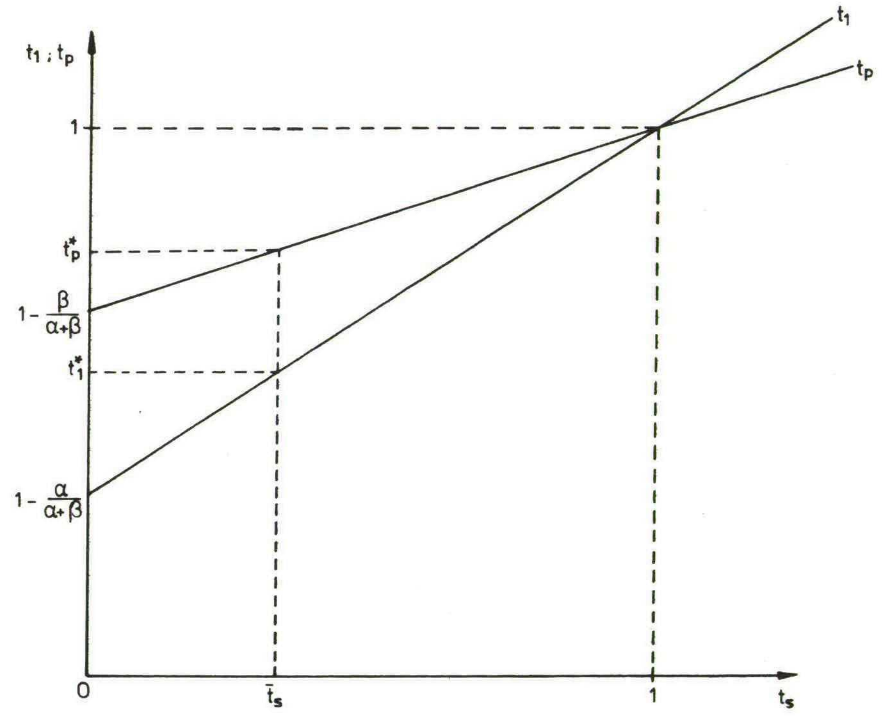
$$t_l = (1-\frac{\alpha}{\alpha+\beta}) + \frac{\alpha}{\alpha + \beta} t_s \tag{43}$$

$$t_p = (1-\frac{\beta}{\alpha+\beta}) + \frac{\beta}{\alpha + \beta} t_s \tag{44}$$

Fig. 3 shows that if a sales tax rate is chosen from the interval (0,1) the tax rate on private capital income and the tax rate on labor income are determined simultaneously; the former from the interval $(1-\frac{\beta}{\alpha+\beta}, 1)$, the latter from the interval $(1-\frac{\alpha}{\alpha+\beta}, 1)$. For each t_s the optimal tax rates for labor is smaller than the optimal tax rate for capitalists. Moreover in determining the optimal tax rates on private capital income and labor income the limits and the actual values are completely determined by the elasticity of output with respect to labor (α) and the elasticity of output with respect to the private capital good (β).

One of the shortcomings of the tax-structure chosen above is the cutting off of the relationship between transformation costs and the tax rates.

If one wants to reflect the increasing transformation costs in choosing a higher social capital/labor ratio one should


$t_1 ; t_p$
t_1
t_p
1
t_p^*
$1-\frac{\beta}{\alpha+\beta}$
t_1^*
$1-\frac{\alpha}{\alpha+\beta}$
0
$\bar{t}_s$
1
t_s

make use of the sales tax instrument. To show this the model developped in section 2 is changed such that the consumption per worker will be:

$$c(t) = (1-t_l)\alpha \frac{(\pi+\mu_s)^{\frac{\gamma}{\alpha}}}{(\pi+\mu_p)^{\frac{\beta}{\alpha}}} \left[\beta(1-t_p)\right]^{\frac{\beta}{\alpha}} \left[H(\alpha t_l+\beta t_p+\gamma)\right]^{\frac{\gamma}{\alpha}} \quad (45)$$

Pursuing long run maximization of consumption per worker implies choosing such values for t_l and t_p that $\frac{\delta c}{\delta t_l} = \frac{\delta c}{\delta t_p} = 0$.

This will give the following set of conditions:

$$\frac{\alpha}{\gamma(1-t_l)} (\alpha t_l+\beta t_p+\gamma) = \in \quad (46)$$

$$\frac{\beta}{\gamma(1-t_p)} (\alpha t_l+\beta t_p+\gamma) = \in \quad (47)$$

In this case the optimal tax rates can be solved directly from (46) and (47):

$$t_p^* = \frac{\alpha(\alpha-\beta) + \gamma(\in-\beta)}{\gamma\in + \alpha^2 + \beta^2} \qquad t_p < 1 \quad (48)$$

$$t_l^* = \frac{-\beta(\alpha-\beta) + \gamma(\in-\alpha)}{\gamma\in + \alpha^2 + \beta^2} \qquad t_l < 1 \quad (49)$$

The question rises if t_p and t_l will be greater than zero. This will only be the case when the following two conditions hold simultaneously:

$$t_p > 0 \quad \Leftrightarrow \quad \alpha^2 + \beta^2 > \beta - \gamma\in$$

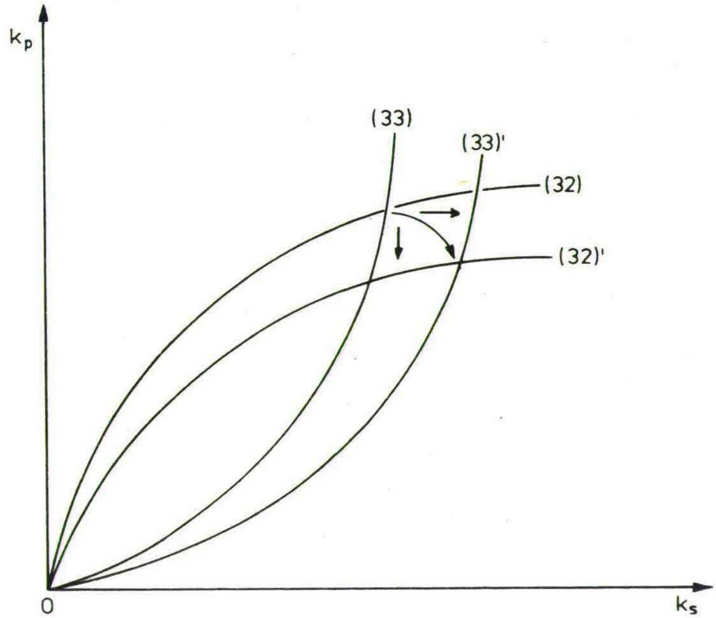
$$t_l > 0 \quad \Leftrightarrow \quad \alpha^2 + \beta^2 > \alpha - \gamma\in$$

If e.g. the elasticity of transformation is very low ($\in = 0$), implying very high marginal transformation costs, and $\alpha = .6$,

$\beta = .3$ and $\gamma = .1$ only the tax rate on capital income is positive whereas the tax rate on labor income is negative. This means subsidies for the workers during the period in which they have to learn and actually manage the enterprises in the economy.
By differentiating (48) and (49) with respect to $\in$ it is clear that

$$\frac{\delta t_p}{\delta \in} > 0 \quad \text{and} \quad \frac{\delta t_l}{\delta \in} > 0$$

This implies that increasing transformation costs in the proces of choosing higher social capital investment quota's and lower private capital investment quota's require lower tax rates on private capital income and labor income.
Since the optimal tax rates determine the equilibrium capital/labor ratio's in (32) and (33) it can be seen that an increased tax rate on private capital income and labor income (given $t_s = 0$) will shift both curves downward as shown in fig. 4.
This means that through higher transformation costs and an appropriate tax program it is possible to increase gradually the social capital/labor ratio while decreasing the role of the private capital good in the economy in the meantime remaining on the balanced growth path that maximizes consumption per worker.


k_p
(33)
(33)'
(32)
(32)'
0
k_s

4. Conclusions

This paper investigated the creation of a social capital good in a labor-managed economy. It was assumed that the transformation proces required transformation costs, e.g. educational costs for teaching workers self-management or costs involved in introducing self-management structures in the organization of the enterprises. Besides the social capital good there remained the role of the private capital good in the labor -managed economy. In the context of a neo-classical growth model it was specified how both capital goods were forthcoming. More specifically the social capital good was created through taxation of the economic agents and the private capital good through savings of the owners of private capital. It is shown that through increasing educational efforts the economy can adopt a growing influence of the social capital good. A well designed tax program is necessary though. One should not make use of a sales tax if a direct relationship between transformation costs and a higher social capital/labor ratio is to be preserved in the economy.

One can confine oneself to a tax on private capital income and labor income alone in that case provided that the possibility of subsidizing the labors during the transformation period is not ruled out. This additional labor income could be seen as a renumeration for the input of enterpreneurial skills of the workers in the labor-managed enterprises.

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