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Problems of Transition from a Planned to a Market Economy

by

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Abstract

The paper shows that a transition from a planned to a market economy implies an important change of the structure of production, i. e. a reallocation of resources which takes time and induces sufferings for some people. These sufferings may be reduced by subsidization of some sectors, with some negative effects on GDP and growth if subsidization exceeds a certain size. The time till the economy in transition reaches an "old" market economy (asymptotically or totally) is estimated by different methods. Finally other problems, mostly non–economic ones, which are connected with the transition process are discussed.

Contents

Problems of Transition from a Planned to a Market Economy

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1 Introduction

The nations which decided to change from a Planned to a Market Economy face much more difficulties than expected, when this decision was taken. Why is that so? Must there be passed a valley of sorrow before on the other side a mountain of bliss can be reached (if there is one)? Or is there a smooth transition path where everybody (or almost everybody) is better off than under the planning regime? This is the problem we are dealing with in this paper. We shall concentrate on the economic problems and only hint at the psychological, sociological and political problems which are also great indeed. We start with the different "philosophies" of a market and of a planned economy and state the consequences for the factor allocation and for the distribution. This deals mainly with the structural change which is necessarily connected with such a change. In section 2 we disregard the structural composition of the economy and consider it as producing one kind of output (the GDP) and ask whether it will reach the standard of life of the "old" market economies and if so at what time. This is a special application of growth theory. In section 3 we deal shortly with the whole bunch of mostly non-economic problems which are nevertheless of great importance since a market economy depends on a functioning legal and political system and on the private initiative and on daring of the members of the society.

1.1 The Basic Model of a Market Economy[1]

The factors of production are owned by private persons who are free in their economic decisions in the limits of their income and of the prices. The income follows from the distribution of the initial resources; production is subject to a production function (which may be approximated by production coefficients), which connects factor input to product output. Prices are determined by the entrepreneurs on the base of profit maximization, wage levels are such that each worker gets the the value of his marginal product, interest such that the capital owner gets the marginal product of his capital. If one assumes perfect

[1] I assume that this is generally known. Thus I present only a simplified sketch. For details see Annex 1.

competition on all markets, one gets the ideal of a market economy[2] which is characterized by the following features[3]:

- Production is ultimately determined by the effective demand of all persons in the society. Prices and income limit the demand.
- The demand of all persons and firms determines the production. Only those firms are viable in the long run where the value of inputs (i. e. the consumption of value) does not exceed the value of the output (the production value).
- Each person gets as much from the production as it contributes to the value of the production by offering a part (or all) of its initial resources.
- All markets are cleared; the solution is pareto-optimal, and all possible pareto-optimal situations may be reached by a suitable redistribution of the initial resources.

Thus, if one privatizes the state property in a socialist society and then introduces a market economy, a structure of production follows which will in general not be compatible with the structure of production which is inherited from the planning system. Thus, closing down production units, unemployment and a new beginning at a low level will be the inevitable consequences if one tries a fast transition and especially if one exposes this "weak" economy (weak from the point of view of a market economy) suddenly to the cold wind of international competition.

Details may be found in annex 1. The model in annex 1 considers also the age structure of capital and explains it. As a rule, very old capital is still in use in a planned economy wheras in a market economy the average age of capital goods is much smaller. This is due to the fact that in a planned economy the Politburo or the planning office puts the production quotas as high as possible such that the managers are forced to use also the eldest machines to fulfill the quota, irrespectible of costs. In a market economomy old machines are scrapped if the price of their output does not cover the cost of production, irrespective of the fact that the machine may still be technically unobjectionable. The model also explains the structural composition of capital, which is endogenously determined in a market economy, but subject to central decision in a planned economy. The same is true for wages, interest rates and, of course, production. Thus the structural change which follows inevitably a transition to a market economy is the main reason for the difficulties and hardships of this transition.

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[2] Walras was the first to introduce this model of general equilibrium. His model has been thoroughly analysed and extended in the 60ies, 70ies and 80ies by Arrow, Debreu, Hildenbrand and others. We do not follow this line here completely but present a model which facilitates the direct comparison with a planned economy.

[3] Only some characteristics of the solution are mentioned here.

1.2 The Basic Model of a Planned Economy

The physical factors of production are owned by the government. Labor is regulated by the government. A politburo decides with the help of a planning office on the production of all commodities and also on prices, wages, and interest rates. The planning of physical production in the form of imposing production targets is the central point of the planning system we know. Prices play a secondary role.

The interdependence of the sectors of production are considered by input–output–relations. The limits of production are provided by the amount of capital and labor available in the country. Thus, full employment is always ensured, given the input coefficients of the planning regimes. The input coefficients are not the same as in a market economy but are much larger in general. There is no inducement to economize on factor input, the opposite holds true. The more labor is used for a specific work, the less effort is necessary per worker, the more comfortable is the work, the more pauses and breaks and vacations and absence from work are possible without danger of missing the production target. The communist parties which realized the planning systems we know are labor parties, and something which is good and nice for workers cannot be false. A similar mechanism induces the management of a firm to understate its production possibilities: the lower the production target, the easier it is to fulfill the plan and overfulfill it which is rewarded by a premium for the workers and the management. Prices, wage rates and rates of interest are also fixed by the planning office or by a price board. Thus, the cost of production and the resulting profits or losses are not subject to the control of the management and are no indicator for the efficiency of production. Profits go to the government and losses are covered by the government. Interest on debts at the banking system are part of the cost and without special interest for the management of a plant.

This is a sketch of a planning system which (in different variations) existed under communist rule in Middle and Eastern Europe. Details may be found in annex 2. The results may be stated as follows:

- Production will be lower than in a corresponding market economy.
- The production structure is different and in general does not correspond to the demand of the households.
- The structure of capital will be different.
- Labor supply will be larger.
- Labor productivity will be lower: there are more persons working at a machine of a certain age.
- Elder machines are still in use.

1.3 The Basic Difficulties of the Transition from a Planned to a Market Economy

The basic difficulties of a transition from a planned to a market economy follow already from these general considerations on the base of the theories of a market and of a planned economy.

1. The production structure of a planned economy does not conform to the demand structure of a market economy. The preferences of the consumers and private investors are not those of a politburo, thus the final demand is different and thus the production structure.

2. This means that also the structure of capital goods is different. New industries have to be built up, old ones must be given up.

3. Many plants which are now exposed to competition cannot compete with the costs inherited from the planning period. Efficiency of production is needed, which in turn leads in most cases to dismissal of workers.

4. If the borders are opened to free trade, the economy has to be integrated into the world trade, i. e. into the international division on labor, which may lead to another type of structural change and in many cases also to unemployment.

5. Prices have to be adapted to marginal cost and wages to the value of the marginal product of labor. This leads to changes in the income distribution which will hurt some people.

6. Elder capital which still has been used in the planning era must be scrapped.

7. With high rates of unemployment labor supply decreases. The real wage of those persons who are nevertheless employed will be higher than under the planning regime because those who are now working at the more modern machines produce a value which is larger than their real wage under the planning regime.

There are, of course, more problems of the transition to a market economy which we shall consider in the next sections. But these are those which follow directly from the different principles of organization of a market and a planned economy.

2 Subsidization of Firms During The Process of Transition[11]

[3] This section draws heavily from the research of Dr. Ackermann at this institute published in his dissertation: Die optimale Angleichung der neuen Bundesländer an die Lebensverhältnisse in Westdeutschland, 1997.

There are many important problems in the transition process from a planned to a market economy: change of the constitution and of political and social institutions, freeing of prices, privatization, establishing a banking system, fighting inflation and others. The problem we are concerned with in this section is: should the government during the transition process subsidize firms which would otherwise go bankrupt? The general opinion of most economists seems to be: no, or "in general" no. This is the opinion of the Board of Economic Advisers to the Ministry of Commerce (Wissenschaftlicher Beirat (1991),p. 7) as far as East Germany is concerned. The Shatalin plan for economic reform in the former USSR states the same (see Lavigne (1990), p. 19), Almost all papers and books on the transition process request a reduction of the budget deficit of the government in order to restore monetary equilibrium. This also amounts to abolition or substantial reduction of government subsidies to firms; see e. g. Blommestein and Marrese (1991), p. 18/19. But there are exceptions: Schneider (1992), p. 11 distinguishes between a "big reform jump" with a large but temporary decline of production and employment, and a slow transition which actually implies continuing the old system of subsidies, at least partially. But how many firms should be subsidized? This is our problem.

2.1 A General Approach

Before coming to this problem it is appropriate to place it into the context of the general problem of the transition from one economic order (the planning system) to the other (the market system). Given the amount of labor and capital, the state of technology and an optimal allocation of ressources the economy can produce a certain set of commodities. In the two-dimensional case as in Fig. 1 all combinations (x_1, x_2) of commodities 1 and 2 which lie in the spheric triangle $0AB$ can be produced. AB is the production possibility curve. In the planned economy the point P_0 may be realized. It does not lie on the efficient border of the production set (which forms the production possiblity curve AB) since the planning system (due to the lack of an appropriate price system) is not able to realize an efficient allocation of resources. Now let the economy be opened to the world market (where the price ratio of the two goods is p_{2w}/p_{1w}). Let the transitory phase to a market economy start at point P_0. After the transition is successfully finished the production structure is changed. The new production point P_1 lies on the production possibility curve and is characterized by the fact that the marginal rate of substitution between these commodities equals the price ratio on the world market. Cost minimizing firms will choose this point. Domestic demand under world market prices may be given by the point P_2. If the demand of this economy is such that it could have been derived from a utility maximizing representative household, this point P_2 maximizes social utility. It is characterized by the equality of the ratio of marginal utilities and the ratio of world market prices. Commodity 1 will be exported (by the amount of EX_1), commodity 2 will be imported (by the amount of IM_2).

Our problem is how to get from P_0 to P_1. Production of commodity 2 has to be reduced by the amount $\hat{x}_2$, production of commodity 1 has to be increased by $\hat{x}_1$ which is only possible if an efficient allocation of resources is provided for. But unfortunately the conversion of a plant to internal cost efficiency takes time, the additional demand EX_1 from abroad does not fall from heaven but needs marketing efforts to materialize, the imports cannot be financed at once and so on. Thus it is not easy to got from P_0 to P_1 in Fig. 1. Our problem is: which transition path is the best? The direct path R_1 would be most comfortable for the workers since a reduction of production of x_2 is compensated by an increase in production of x_1, and if the transition goes slowly workers have time to be retrained and to change location. But unfortunately it is very unlikely that this path can be realized. A large part of the firms in the planning regime which produce at point P_0 runs losses under the price system of a market economy and cannot stay in business without subsidies. This applies for the firms where the production should be reduced (x_2 in Fig. 1) as well as for firms where the production should be increased finally (x_1 in Fig. 1). The situation is such as if plants which are grown and live under the shelter of a glass house are suddenly exposed to the cold wind of the free nature: all kinds of plants will suffer first. Thus production will be reduced almost everywhere. Instead of path R_1 in Fig. 1 we may expect R_2. But this "detour" may be shortened by subsidies. But they may hurt other firms and generally the consumers. Is there an optimal size of subsidies? This problem will be dealt with next.

2.2 Subsidization in a Small Sector of the Economy

We shall first consider the simplest case: subsidization of firms in a sector which is relative small such that the repercussions of changes in this sector to the other sectors of the economy may be disregarded. Complete models of this kind may be found in Krelle (1992), Krelle (1993) and Ackermann and Krelle (1995). We do not reproduce them here but only indicate the main features of such a model (following Krelle (1993)) and the main results. Let us consider one sector of the economy which comprises many firms the outputs of which are identical, but the costs are different. If we arrange all firms in the order of their cash flow $q(\bar{x})$ per unit of output at capacity level and if we assume that lower cash flows (e. g. negative ones) are due to a smaller labor productivity (i. e. to more labor $a(\bar{x})$ per unit of output) and if we approximate these step functions by continuous ones we get a picture of the state of the sector like in Fig. 2. Total cash flow Q of all firms which could stay in business without government subsidies is

$$Q = \int_0^{\bar{x}_o} q(\xi)d\xi, \quad q(\xi) \geq 0, \quad q'(\xi) < 0$$

If the government wants to preserve total capacity $\bar{x}_{max}$ in this sector, it has to pay

subsidies S of the size of total negative cash flow of the firms in this sector:

$$S = \int_{\bar{x}_0}^{\bar{x}_{max}} q(\xi)d\xi, \quad q(\xi) \leq 0, \quad q'(\xi) < 0$$

If the capacity $\bar{x}$ is preserved, employment in this sector is

$$L = \int_0^{\bar{x}} a(\xi)d\xi, \quad a(\xi) > 0, \quad a'(\xi) > 0$$

Without government aid the firms with negative cash flow are bankrupt and have to get out of business. But the cash flow $q(\bar{x})$ refers to the situation where these firms have been still in business and (if subsidies S are paid) will continue to stay. If the government does not act, the firms which procure the capacity from $\bar{x}_0$ to $\bar{x}_{max}$ are bankrupt and disappear from the scene. This reduces the supply and increases the price of the output, and this will increase the cash flow of those firms which stay in business such that the $\tilde{q}(x)$-function for the cash flow is valid. This saves some firms which had been deficitary before: the total capacity $\tilde{x}_0 > \bar{x}_0$ can survive without government aid. If the government wants to preserve deficitary firms to a larger extent, say such that the capacity $\bar{x}^*$ is preserved it would have to pay subsidies by the amount $S(x_0^*)$, see the black triangle in Fig. 2. Subsidization is a sort of unfair competition. It hits all firms of the same sector which have to survive without subsidies and mostly those at the margin.

Investment is partly financed by the cash flow of the firms. But we do not consider the financial side in this context.

Government gets its income from GDP and spends it for consumption, investment, subsidies and unemployment reliefs. The more subsidies are paid the less are the unemployment reliefs, but the less also the expenditure on government consumption and investment.

This is a short sketch of those parts of the model which are not standard. Details may be found in the paper Krelle (1993). The results are the following. It can be shown that - judged from the fiscal point of view - there is an optimal amount $\bar{x}_{opt}$ of capacity to be preserved by subsidies of the government which minimize the total burden of government expenditures for subsidies and for unemployment reliefs. From this point of view it is always advisable to keep some firms alive by subsidies (of course those with the smalles negative cash flow). Of course, higher subsidies increase employment. But from the point of view of GDP-maximization things are different: the optimal size of subsidies which maximize GDP may lie between zero and the maximum amount, according to the assumed value of the parameters. But the border solutions seem to be very unlikely. Thus we may say: in general there is an optimal amount of subsidies which maximizes GDP in the short run. In the long run things are different. The long term effect of subsidies on the growth rate of GDP is negative. The two time paths for GDP are shown in Fig. 3. They illustrate that there is a public choice problem involved. Shortsighted societies with a high discount rate for the future will prefer subsidization, farsighted governments and societies

will choose the opposite, of course under the assumption that the society will stand the hardships of a fast transition. Politicians who usually have a short time horizon, as does the majority of the population, will prefer subsidies. Economists who usually consider the long-run welfare of the population as their principle of recommendation prefer zero or very limited subsidies.

The former GDR is a special case. The policy of zero subsidies could be pursued if the transfer payments to unemployed households are large enough and if the social and political problems connected with such a policy could be overcome. But nevertheless, to grant subsidies to some firms in order to keep capacity alive could be defended.

This analysis is not a general equilibrium approach but is a partial analysis for disequilibirum states. It covers only some aspects of the problem, but the results hold also in a complete model as we shall see now.

2.3 The Time it Takes till Equalization of Standards of Life is Reached, if Growth Rates are Constant

In the following we present some general procedures of estimating the time this transition period will take till the economy in transition reaches the "normal" market economies and the optimal way of doing so. We exemplify this mostly by the example of the former GDR, because our information of the situation there is best and, of course, we have been interested in this to a large extent. The following results are the outcome of a research on the optimal transition of the new states (the former GDR) to a market economy which was carried out at Bonn University, see Ackermann [1997]. The theoretical base of this research is growth theory: long-term trends are analysed, not short term influences. The simplest approach is to take the growth rate w_{trans} of GDP per capita of an economy in the transitional state and the growth rate w_{market} of GDP per capita in a market economy as given and constant and start with a GDP per capita y_{trans} wich is smaller at time zero than the GDP per capita y_{market} in a market economy. Of course, we assume $w_{trans} > w_{market}$, otherwise the former planned economy will never reach the level of the comparable market economy. Thus we assume

$$y_{k,t} = y_{k,0} e^{w_k t},$$

$$k \in \{trans, market\}, \quad y_{k,0} > 0, \quad w_{trans} > w_{market}, \quad y_{trans} < y_{market}$$

The time it takes an economy in transtition to reach the level of a market economy is easily estimated by equalizing $y_{trans,t} = y_{market,t}$ and solving for t. This yields:

$$t = \frac{lny_{market} - lny_{trans}}{w_{trans} - w_{mark}}$$

As an example Fig. 4 shows the time till the new Länder (the former GDR) will reach the level of the old Federal Republic of Germany. It is assumed that the long term equilibirum

rate of growth of GDP per capita in a market economy is 1.5% and that the GDP per capita in the market economy at time zero is 85.000 DM and in the economy in transition 29.000 DM (which conforms approximately with the situation of the FRG and the GDR in 1989). If this growth rate in an economy of transition would only be 2% one sees that it will take more than 100 years until the level of the market economy is reached. For a constant growth rate of 5% it will take about 35 years - still a long time.

This surely is an oversimplified approach: growth rates are not "given from the outside" and not constant. Thus this cannot be the last word. Nevertheless this simple approach may be extended into different directions (as an example, see Ackermann, 1997, p.12 ff.), without changing the basic result: there is always a finite time in which the economy in transition reaches the old market economy as far as the GDP per capita is concerned.

2.4 Infinite Time to Reach the Old Market Economy Completely

We get totally different results if we admit variable growth rates and explain them by different functions. The characteristic of this approach is that the economy in transition will only asymptotically reach the GDP per capita of an old market economy, that means: never in finite time. Thus we could only ask e. g. at which time t the economy in transition will reach the rate $r_t = \frac{y_{trans,t}}{y_{market,t}}$ of the GDP per capita of the market economy. We present only some models of this kind (for other models, see Ackermann (1997, p. 17 ff)). Assume that the velocity of closing the gap between the market economy and the economy in transition depends on the size of this gap. Thus we may assume:

$$\dot{y}_{trans,t} = \beta(\frac{\beta+\lambda}{\beta} y_{market,0} \cdot e^{\lambda t} - y_{trans,t})$$

where the market economy grows with the fixed rate λ and β is the velocity of equalization. Integration from 0 to t yields:

$$y_{trans,t} = y_{market,0} e^{\lambda t} - (y_{market,0} - y_{trans,0}) e^{-\beta t}$$

Fig. 5 shows this function for different coefficients β. As one sees, the economy in transition will never reach the level of the old market economy. La mezzo giorno in Italy may serve as an example of this type of development.

Econometric estimations of the parameters β and λ for West and East Germany yield unsufficient results. Thus we have to proceed to more sophisticated functions of adaptation. We only present one of these models here (for others: see Ackermann (1998), p. 23ff).

The simple logistic growth function

$$y_t = \frac{\delta}{1 + e^{\alpha - \beta t}}, \quad \alpha, \beta, \delta > 0,$$

is not very convincing since it leads to a fixed $y = \delta$ for $t \to \infty$. A steady growth may be reached by the assumption

$$\dot{y}_t = \beta \cdot y_t[1 - \frac{y_t}{\delta e^{\lambda t}}], \quad \beta > \lambda > 0, \quad \delta > 0$$

Integration yields:

$$(*) \quad y_t = \frac{\frac{\beta-\lambda}{\beta}\delta \cdot e^{\lambda t}}{1 + e^{-(\beta-\lambda)t}(\frac{\beta-\lambda}{\beta}\frac{\delta}{y_0} - 1)}$$

Assume that the market economy follows the equilibrium path:

$$(**) \quad y_{market,t} = \frac{\beta - \lambda}{\beta}\delta e^{\lambda t}.$$

When will the economy in transition reach this equilibrium growth path?

The denominator of $(*)$ goes asymptotically to 1. Thus the economy in transition approaches the equilibrium growth path only asymptotically. We estimated the parameters $\delta, \beta, \lambda, \rho$ for the West German economy for the period 1960-1994 correcting for autocorrelated error terms by the method of nonlinear minimal squares procedure and got the following results:[4]

Variable	Estimation	Standard deviation	t-value
δ	66302.51	13323.1	4.09
β	0.123400	0.05057	2.44
λ	0.014606	0.0052166	2.80
ρ	0.759145	0.13256	5.73

$$DF = 30, \ \bar{R}^2 = 0.9964, \ DW1.563, \ RMSE = 985.04$$

With these parameters the actual growth path of the West German Economy is quite well reproduced, see Fig. 6.

Of course, there are also other approaches of this kind to be found in the literature (see Ackermann, 1998, p.25ff), but they yield basically the same pessimistic results: the economies in transition never reach the developed market economies in finite time. This result is due to the general approach: the advanced and the backward economy use the same production function which yields a stable equilibrium growth path. If an economy is off this equilibrium path, there are forces which drive it back to it. The economies in transition are considered as those which are below the equilibrium path and approach it from below but do not surpass it.

I think that these models leave out important features:

1. The economies in transition have to rebuild their capital stock. If they invest the newest machines they have a comparative advantage compared to the "old" market economy with an equilibrium age distribution of the machines.

[4] See Ackermann, (1998), p.21

2. As a rule, the drive to work and to accomplish something is larger if one has to catch up with somebody who runs in front of one than if one is among the first. Then there is a tendency to take it easy and to enjoy the easier life.

3. Those who run first have to find new ways, mostly by trial and error. The second knows the results; to imitate is easier than to invent.

4. As a rule, wages could be kept low in an economy in transition. This may lead to a higher profit rate which attracts foreign captial and increases the rate of investment.

Thus to be the second is not a hopeless situation. East Asian countries like Taiwan, South Corea, Singapur and others have proved the contrary. But for other countries and regions (like Southern Italy) models of the above type are not so bad.

2.5 Control Theoretic Approaches

Other approaches, especially those which use dynamic programming (for models in discrete time) or control theory (for models in continuous time) come to other results. They show that it is always possible to equalize the living conditions (measured by GDP per capita) of a backward and an advanced country in a finite time by allocating the total means available for investment in both countries appropriately to the two countries. In Ackermann (1998) many models of this kind may be found. We reproduce only two here.

1. The model of Intriligator (1964), corrected by Takayama (1967), in the version of Ackermann (1998) p. 63 ff. It supposes one government for the two countries which decides on the rate $\beta,\ 0 \leq \beta \leq 1$, where βI of total investment is allocated to the backward country 1 and $(1-\beta)I$ to the advanced country 2. There are constant capital intensities $b_i,\ i = 1, 2:$

   $$Y_i(t) = b_i K_i(t)$$

   and constant saving ratios s_i such that

   $$(\star) \quad I(t) = s_1 Y_1(t) + s_2 Y_2(t) = s_1 b_1 K_1(t) + s_2 b_2 K_2(t)$$

   Thus the capital stock in both countries develops by:

   $$(\star\star) \quad \dot{K}_1(t) = \beta_1 I(t), \quad \dot{K}_2(t) = (1-\beta) I_t \tag{1}$$

   It is supposed that the governments want to achieve the maximal GDP in a predetermined time T by an appropriate choice of β. Thus the problem is:

   $$\max_{0 \leq \beta_t \leq 1} \quad Y_1(T) + Y_2(T)$$

   s.t. $(*)$ and $(**)$ under the initial conditions $K_1(0) = K_1^0,\ K_2(0) = K_2^0$.

The Hamilton function of this control problem is

$$H = p_1(t)\beta_t[s_1 b_1 K_1(t) + s_2 b_2 K_2(t)] + p_2(t)(1-\beta)[s_1 b_1 K_1(t) + s_2 b_2 K_2(t)]$$

where $p_i(t)$ are the adjoined (dual) variables which in this context have the economic meaning of the shadow price of the investments. Thus in the backward country 1 the shadow price p_1 is (at least in the beginning) larger than p_2. The transversality condition is

$$p_i(T) = b_i$$

The solution is of the type bang-bang:

$$\beta_t^* = \begin{cases} 1 \text{ if } p_1(t) > p_2(t) \\ 0 \text{ if } p_1(t) < p_2(t) \end{cases}$$

This may be transformed after some calculations to:

$\beta_t^* = 1$, if $s_1 b_1 \geq s_2 b_2$ and $s_1 \leq s_2$

and if $s_1 b_1 > s_2 b_2$ and $s_1 > s_2$ and if $b_1 > b_2$

$$\beta_t^* = \begin{cases} 1 \text{ if } b_1 < b_2,\ T > t^* \text{ and } t \leq t^* \\ 0 \text{ if } b_1 < b_2,\ t^* < t < T \text{ or } T \leq t^* \end{cases}$$

t^* is the time of switching from complete investment in the backward country to the advanced country. It may be calculated from the Hamilton function.[5]

The solution says that all available investment should be directed to the country in transition to help it to reach a comparable level of GDP. After that has been accomplished total investment should be switched to the advanced country - surely not a policy which can be pursued literally. The reason for this result are the assumed maximization of the common GP in a predetermined time T and the fixed production coefficients.

2. The second model we want to present follows another line. Here the time where equal living conditions are realized (which are understood as an equal amount of capital per capita) should be minimized. The existence of a neoclassical production function is assumed. The relation of the two populations is $\rho = \frac{L_1}{L_2}$. The instrument variables for the common government of the two countries are the allocation ratio β of the tax income of the government to the two countries and a tax rate τ on the total real income (which equals total production), equal in both countries, where $\tau_t \in [0, \bar{\tau}]$ and $0 < \bar{\tau} < 1$[6]. The tax rate may be concieved as a special rate to finance the aid for the country in transition, not as total tax income.

   The tax income of the government is

$$T(t) = \tau_t L_1(t) f[k_1(t)] + \tau_t L_2 f[k_2(t)]$$

[5] We do not reproduce all formulae here. For the details, see Ackermann (1998),p.62-70

[6] details, see Ackermann (1998), p.106-127.

where $Y = F(K, L)$ linear homogenuous, thus:

$$\frac{Y}{L} = F(\frac{K}{L}, 1) =: f(k), \quad k =: \frac{K}{L},$$

K = capital, L = labor in efficiency units.

The tax incomes per capita of the government in the two countries are:

$$(\bullet) \quad t_1(t) = \frac{T(t)}{L_1(t)} = \tau_t f[k_1(t)] + \tau_t \frac{1}{\rho} f[k_2(t)]$$

$$(\bullet\bullet) \quad t_2(t) = \frac{T(t)}{L_2(t)} = \rho \left[\tau_t f[k_1(t)] + \tau_t \frac{1}{\rho} f[k_2(t)] \right]$$

The accumulation of capital per capita follows from saving (savings ratio s) in each country and from the allocation of the tax income for investment:

$$(\bullet\,\bullet\,\bullet) \quad \dot{k}_1(t) = \beta_t t_1(t) + s(1-\tau_t) f[k_1(t)] - (\delta + n) k_1(t)$$

$$(\bullet\,\bullet\,\bullet\bullet) \quad \dot{k}_2(t) = (1-\beta_t) t_2(t) + s(1-\tau_t) f[k_2(t)] - (\delta + n) k_2(t),$$

where δ = rate of depreciation, n = rate of growth of the population, equal in both countries.

Now the control problem may be formulated as:

$$\min_{\substack{0 \le \tau_t \le \overline{\tau} \\ 0 \le \beta \le 1}} T$$

s.t. $(\bullet\,\bullet\,\bullet)$ where $(\bullet)$ has to be substituted

and $(\bullet\,\bullet\,\bullet\bullet)$ where $(\bullet\bullet)$ has to be substituted

and subject to the initial conditions

$k_1(0) = k_1^0, \quad k_2(0) = k_2^0, \quad k_1^0 < k_2^0 < \overline{k}$

and the final condition

$k_1(T) = k_2(T) = \overline{k}$

$\overline{k}$ is the equilibrium capital labor relation known from neoclassical growth theory. The associated Hamilton-function is:

$$H = -p_0 + p_1 \left[\beta_t [\tau_t f(k_1) + \tau_t \frac{1}{\rho} f(k_2)] + s(1-\tau_t) f(k_1) - (\delta + n) k_1 \right]$$

$$+ p_2 \left[(1-\beta_t) \rho \tau_t \left[f(k_1) + \frac{1}{\rho} f(k_2) \right] + s(1-\tau_t) f(k_2) - (\delta + n) k_2 \right]$$

We omit the details[7]. Let $\tilde{t}$ be the time when the economy in transition at first reaches the capital intensity of the market economy, and T^* the time when the capital intensity

[7] The necessary conditions from the Pontryagin maximum principle may be found in any text book on control theory, see e. g. Takayama (1985) p. 613 ff. or Seierstad/Sydsaeter (1986), p.143 ff. or applied to the above problem in Ackermann (1998), p.109

of both countries reaches the predetermined value $\overline{k}$. Then

$$\beta_t = \begin{cases} 1 & \forall t \in [0, \tilde{t}) \\ \frac{\rho}{1+\rho} & \forall t \in [\tilde{t}, T^*] \end{cases}$$

$$\text{and } \tau_t = \overline{\tau} \quad \forall t \in [0, T^*]$$

That means: at first all tax income of the government should be allocated in the economy in transition till it reaches the capital intensity of the market economy. Afterwards the tax income should be devided between the two countries according to the population ratio. The tax rate should always be the highest possible. This yields the following development of the state variables:

$\dot{k}_1 > \dot{k}_2 \qquad \forall\ t \in (0, \tilde{t}),$ where country 1 is the country in transition

$k_1 = k_2 \qquad t = \tilde{t}$

$\dot{k}_1 = \dot{k}_2 \qquad \forall t \in (\tilde{t}, T^*)$

$k_1 = k_2 = \overline{k} \qquad t = T^*$

There is a time $\tilde{t}$ where the gap between the economy in transition and the market economy is closed (the capital intensity in the economy in transition increases faster than that in the market economy). From that time on both economies march parallel.

To illustrate the result numerically we have to specify the production function. Let us assume identical Cobb-Douglas-production-functions in both countries but different capital-labor ratios (or capital intensities) in the beginning:

$$Y = A \cdot e^{\lambda t} K^{\alpha} A^{1-\alpha}$$

$$i.\ e. \quad \frac{Y}{A} =: y = A \cdot e^{\lambda t} \cdot k^{\alpha} \quad \text{, where } k = \frac{K}{A}$$

$k_1 =$ capital intensity of country 1 (the country in transition)

$k_2 =$ capital intensity of country 2 (the market economy)

Then we get for the capital accumulation during the phase where the economy of transition closes the gap to the market economy, i. e. for $t \in [0, \tilde{t}]$ and $\beta = 1$ and $\tau = \bar{\tau}$:

$$(*)\dot{k}_1 = A \cdot e^{\lambda t}(\overline{\tau} k_1^{\alpha} + \overline{\tau}\frac{1}{\rho} k_2^{\alpha}) + s(1-\overline{\tau}) A \cdot e^{\lambda t} k_1^{\alpha} - (\delta + n) k_1(t)$$

$$(*)(*)\dot{k}_2 = s(1-\overline{\tau}) A \cdot e^{\lambda t} k_2^{\alpha} - (\delta + n) k_2(t),$$

During the phase where both economies have reached the same capital intensity, i. e. for $t \in [\tilde{t}, T^*]$ and $k_1 = k_2$ for $t \in [\tilde{t}, T^*]$ the equations for capital accumulations are:

$$\dot{k}_i = [\bar{\tau}(1-s) + s] f(k_i) - (\delta + n) k_i, \ i = 1, 2$$

This equation may be integrated analytically, but the integration of $(*)$ and $(*)(*)$ is only possible numerically. Fig. 7 shows the trajectories of the capital intensities of both countries. It can be seen that (with these numerical assumptions) the transition period is

rather short (5, 5 years), and the equilibrium path is reached in 6, 3 years. The sacrifices of the market economy (illustrated by the vertical differency of the lines $\cdots$ and - - - in Fig. 7) are not very large, if one only takes the difference in each year.

Of course, these results are not very realistic but they indicate that the economy in transition may very well reach the standard of life of an old market economy and not always stay behind as suggested by the models of the type dealt with in the beginning.

It is interesting to consider the time T^* of adaption as a function of the tax rate τ, see Fig. 8.

Of course, the market economy which pays for the faster development of the economy in transition suffers from this transaction. We may quantify this sacrifice as the discounted loss $l(\bar{\tau})$ as a function of the tax rate $\bar{\tau}$. Let the discount rate be ν. Thus:

$$l(\bar{\tau}) = \int_0^{T^*(\bar{\tau})} e^{-\nu t}[y(t) - y^{\bar{\tau}}(t)]dt$$

Numerical integration yields a result as shown in Fig. 9. The loss increases fast if $\bar{\tau}$ increases.

This concludes the section where growth theory is used to estimate the situation during the transition process. The results must be handled with care: too many features of this process are disregarded. Nevertheless, the control-theoretical approach shows that the economy in transition may very well reach the level of the old market economy and not always stay behind as the pure neoclassical growth theories suggest.

3 Other Problems of Transition: An Overview

In the foregoing sections we concentrated on two important problems in the process of transition of a planned to a market economy: the necessity of structural change and the macroeconomic conditions for catching up with the market economies with higher standards of life. But they are by no means the only problems. There are a lot of others which are of equal importance but less accessible to economic theory.

3.1 General Principles for Joining the Club of Developed Market Economies

The community of market economies of western style rests ultimately on common convictions on how countries should be organized and which principles should determine their behavior. The so-called "Copenhague-criteria" for joining the EC formulate them as follows:

democracy, rule of law, human rights and protection of minorities.

These are principles which go far beyond the limits of economics but show the general spirits in which a market economy of this and the following century should be embedded.

3.2 The Legal Framework for a Market Economy

A market economy needs a firm legal framework in order to function adequately. Private property should be guaranteed as well as freedom of trade, freedom of price formation, free movement of capital and labor. Private contracts must be enforced by law, rules of bankruptcy established. From the start of the transition on there must be laws against monopolization and collusion and these laws - as all others - must be enforced. This is of great importance especially at the beginning when public property is privatized. There is a great temptation for fraud and illegal enrichment in this period. There must be a legal framework for the running of firms: rules on cost accounting, on balance sheets, on the relation to labor. The degree of codetermination of labor must be regulated by law. For an economy in transition the size of investments is of great importance. Thus all constitutional and legal regulations should be directed to promote growth and investment. The narrow net of regulations of economic activities in advanced western saturated economies is not a good model for an economy in transition. Not everything of the advanced economies should be copied.

3.3 Privatization

Private property on the means of production is the base of a market economy. But how to privatize public property? And should all public wealth invested in agriculture and industry be privatized? There are limits of privatization: roads, courts, police, the army, money supply and other institutions which if privatized may be used against the general welfare in the interest of the owner. Assets of this kind should not be privatized. There are questionable cases: should public utilities be private or not? Perhaps government supervision of private natural or local monopolies is a better solution. There is an extended literature on this point and we refer to it[8] without going into details here. The problem of land ownership is a special case. In the 19th and in the beginning of the 20th century there was a whole movement of "Land reform", whose advocates blame the private property of land ownership for the bad social and economic situation of the workers. They ask for the socialization of all land; see (as an example) Gossen (1954) and Henry George (1871, 1879). There are others who blame not the private property as an institution but the concentration of land ownership for all social evils and ask for subdividing the big estates and giving the land to peasants, see Damaschke (1923) and Oppenheimer (1895 and 1898). In any case, private property on land conforms to a market economy. Under the pressure

[8] See e. g. De Fraja (1993), Schmidt, K. (1996), Shleifer (1998).

of competition it leads to more efficiency. But the transition is difficult and not easy to accomplish if the land has been socialized for 70 or more years. People are accustomed to it. A public poll among the population employed in agriculture in Russia showed that almost 90 % of it prefered public property on land. There are countries like Poland where private property in agriculture has been preserved under the communist regime, but the lots are small, production is inefficient. People have to move out of agriculture into industry and services. Many people will leave the country side under these conditions. The problem is: they must find employment outside agriculture, and this is a question of the rate of growth of GDP. For countries with socialized land property a system of distribution of vouchers to people in agriculture which represent certain land property may be a possibility. They must be negotiable and (after some time and under well defined conditions) also redemptable in kind, i. e. payable by private ownership of pieces of land. The danger of this voucher system is that people sell these vouchers soon such that after a while land property is concentrated in the hands of banks or tycoons. In any case, one has to proceed with care in order to preserve political stability and finally to come to a decent property distribution as far as agriculture is concerned. Since the initial conditions are different from country to country, there is not a unique way of privatization.

As far as industry is concerned we find the example of a "crash policy" and of different kinds of smoother transition paths. The extrem "crash policy" has been performed in Germany with respect to the socialist industry in the former GDR. A special body has been formed (the so-called "Treuhand") which acted as preliminary owner of all socialist plants and which was obliged by law to sell the plants to that person or company which offers the highest price and guarantees the future of the plant in certain limits. The idea was that by this way an experienced management, the newest technology and the marketing organization would be acquired as fast as possible. Unfortunatelly, the trade union system of West Germany was also transferred to East Germany. The trade unions enforced wages in the East which were much too high and without proportion to the low labor productivity in the East (due to the old machinery and to a much too large labor force in the plants.) This lead to a very high rate of bankruptcies: the firms in the East could not endure the competition from the West, i. e. from West German firms and from the world market. Very high subsidies from West Germany (in the beginning around 200 bill. DM per year) kept the standard of life in the Eastern states rising nevertheless. But the sad remainder of this policy is a high indebtness of the government (which financed the subsidies to the East mostly by loans) and a high rate of unemployment in the East. Thus one may say: such a "crash policy" is not a responsible way of transition if the country does not have a "big brother" which pays for the high cost of such a fast transition. In Russia something similar has been tried in the beginning of the transition period, but there was no "big brother", and the transition process has been stopped not even at half way. Thus only a slow transition is feasible for most countries. That means: subsidizing the old socialized firms, but at a decreasing rate and selling them over a long period after

it has been modernized to the most promising bidder who offers the highest price and guarantees the further development of the plant. This would be a long process in order to avoid high rates of unemployment and in order to get a decent price. If one wants to sell something at once, one usually gets only a low price, and public property should not be wasted.

3.4 Prices

The prices in the planned economy are (as a rule) not in relation to the marginal cost but more or less arbitrary, i. e. according to the judgement of the planning office and of the politburo on what are "decent" or "just" prices. Since in a market economy demand and factor allocation depends on prices, it is of great importance to establish commodity markets and to leave the prices free. As already said, there must be an office to supervise monopolies and to prevent collusion. Socialized firms which run losses under these conditions should be subsidized for a certain period in order to give them the opportunity to keep up with their more efficient competitors. There must be a social insurance system or a system of social aid ("Sozialhilfe" in German) which takes care of persons and households which otherwise would fall below the poverty line. In order keep the general price level reasonably stable, the central bank should be independent of the government and obliged to pursue a monetary policy which ensures price stability.

3.5 Wages

There will be trade unions to look after the interests of the common workers who sometimes (or often) as single persons do not have a chance in a dispute with their employer. But as experience shows: the trade unions pursue the interests of their members, that means: of the persons employed, but not the interest of the unemployed.Thus it is advisable not to delegate the wage formation to trade unions and employers associations but to leave it to the individual persons. Hence unemployed persons may offer their labor at a lower price and therefore find employment. A system of social aid may help those who do not get a decent pay this way. An economy in transition is well advised not simply to copy everything from the "old" market economies but to consider their weak points and thus to reach better a better solution.

3.6 Interest Rates. The Capital Markets

When there is private property on the factors of production, there must be banks in order to channel savings to investors and a capital market in order to ensure the negotiability of the financial assets, to get a rational evaluation of the capital stock and to direct the capital

flows to the most profitable use. The interes rates will be formed on these capital markets, under the influence of the discount rate policy of the Central Bank. This facilitates also the international capital movements, which will be capital imports for the economy in transition if the international financial community has confidence in the stability of the country and in the success of the transition procedure and if the profit rate and therefore also the general rate of interest is higher in this country (with a higher scarcety of capital) than in the "old" market economies (with generally relatively higher capital intensity of labor). The far eastern countries are a good example of it though this transition was of another kind (from backward developing countries to successfull market economies) or the USA and Argentina in the 19th century. But if the country is considered as politically unstable or if the financial community does not have confidence in the success of the transition process the opposite is true: there will be capital flight in different forms which lead to a steady pressure on the exchange rate of the country in transition. Thus it lies in the interest of the country to accomplish the transition process in good order without big crashes and political turmoil. This will attract foreign capital which accelerates the transition process.

3.7 Foreign Trade and the Exchange Rate

Since Ricardo it is well known that free foreign trade is to the advantage of all countries – but not necessarily to the advantage of each sector or each person in the economy. To take the famous example of Ricardo: if England will concentrate on the production of cloth and Portugal on the production of wine (where each country has a comparative advantage) and if they will exchange cloth and wine to a certain extent according to domestic demand both countries will be better off in terms of the consumption of clothes and wine. But, of course, if there were viniculture in England and production of cloth in Portugal before free trade between the countries, the wine grower in England and the cloth producer in Portugal would not be happy to lose their job. Thus free foreign trade is to the advantage of the consumers but not to the advantage of those domestic producers which cannot stand foreign competition and must go out of business. Of course, if the exchange rate adjusts according the rule that the value of exports equals the value of imports (which means that the capital flows are only induced by the in- and outflow of commodities) there always will be winners of the free trade regime, namely: those firms which (due to modern equipment and low wages) are fully competitive on the world market. But this does not help those workers which become unemployed due to the decline of other sectors of the econmy. Exports of raw materials or energy resources, like oil, gas and coal alone might not be in the long term interest of the country: there are adverse effects known as the "Dutch Disease", see e. g. Eismont (1999). There is another argument in favor of transitional protection of sectors from superior foreign competition put forward by Friedrich List (1841), the "infant industry" argument. A country which wants to catch

up with another further progressed country (as Germany in the 19th century wanted to catch up with Great Britain in industrial production) has, as a rule, no chance to produce commodities of the same quality as the leading country. Thus it cannot stand competition, and the country always remains behind. But this is a weak argument: goods of lower quality find their markets, too, if they are cheap enough, one could hire foreign well trained labor and get the information on superior production methods. But, more important: the isolation from the world market usually does not lead to "letting the infant industry grow", but to indolence, laziness and always more reliance on the shielding of foreign competition. Thus it may be preferable to open up the country for exports and imports, to pursue an exchange rate policy which gives a chance to those sectors where the country has a comparative advantage and to subsidize for a limited time those firms which may reach the international standard after a while or which must be sustained for a while in order to maintain social stability. This, of course, prolongs the phase of transition but it seems to be better to run slower and to reach the goal than to start too fast and break down half the way.

3.8 The Spirit of a Market Economy

A market economy rests ultimately on the assumption that there is enough initiative and willingness to accept risks within the society such that one can rely on the activities of the citizens, that everybody knows best his own interests and that one can construct a social system so that the pursuing of private interest leads also to the best results for all. Such a system is that of perfect competition, full information and freedom of action in concluding contracts in mutual interest. For somebody who is grown up in a market economy this is almost self evident. In contrast, a planned economy rests on the assumption that a small group (called politburo) which is at the top of a party organisation knows best what is good for the society, and everybody has to follow their orders. Own interests are only tolerated as far as they do not interfere with the plan but their pursuits are considered with suspicion and insulted as "selfishness". As an ideal, everybody should suppress his own inclinations and find his reward in the fulfillment of the plan given to him "from above". Own initiative is only welcomed if it conforms to the plan and does not disturb its coherence. Risks should be avoided, they may make it impossible to fulfill the plan.

Somebody who has lived in such a system for 50 or more years developes quite another sort of behavior than somebody who lived the same time in a market economy. He waits for directives, for general instructions and rules which are given to him but (as a rule) does not think that he himself is responsible for these rules, that he himself has to develop initiatives and not sit down and wait till somebody else tells him what to do. These people are usually very good, very carefull and reliable in carrying out orders without much ado, whereas the typical product of a market society makes trouble by suggesting

other solutions and in general not simply accepting the authority of his superiors. He looks after his own interests and does not wait for order.

This, of course, is a simplified picture. But it hints at an important point in the transition process to a market economy: to change the general outlook, the way of behavior and the concept of a society and a person's position in it.

4 Annex 1: The Basic Model of a Market Economy

A market economy[9] is structured according to the demand. Let

$$D_i^h = D_i^h(p_1, \ldots, p_n, Y^h) \quad , i = 1, \ldots, n$$

be the final demand of household h (private or government or in general of an institution h) for commodity i which is a function of all prices $p_1, \ldots, p_n$ (equal for all households) and of its disposable money Y^h. The household is free to choose a bundle of commodities $(D_1^k, \ldots, D_n^h)$ within the limit of its budget:

$$\sum_{i=1}^{n} p_i D_i^h \leq Y^h$$

If there are H households total final demand for commodity i is:

$$D_i = \sum_{h=1}^{H} D_i^h =: D_i(p_1, \ldots, p_n, Y^1, \ldots, Y^H)$$

Usually it is assumed that the household determines its demand by maximizing a utility function. But this is not necessary. We shall not formalize that.

The final demand D_i is satisfied by production which in turn needs secondary inputs SI_i, which sum up to total demand X_i^d. We formalize it as follows. A firm i which produces the commodity i may be equipped with capital goods $K_{i,-\tau}$ of different vintages $-\tau$. The eldest "machine" in use dates T_i periods back. Thus total capital K_i is a vector

$$K_i = (K_{i,-T_i}, K_{i,-T_i+1}, \ldots, K_{i,0})$$

$K_{i,-\tau}$ may be thought of as the number of "machines" of age τ and of the technology of time $-\tau$. Machines of age τ produce $x_{i,-\tau}$ units of commodity i, if used at full capacity. Thus:

$$x_{i,-\tau} = b_{i,-\tau} K_{i,-\tau}, \quad b_{i,-\tau} > 0^{10}, \quad \text{a constant}$$

Each production needs secondary inputs of kind j:

$$SI_{ji,-\tau} = a_{ji,-\tau} x_{i,-\tau}, \quad j = 1, \ldots, n, \quad a_{ji,-\tau} \geq 0, \quad \text{a constant}$$

[9] This model considers only those parts of the economy which we need for comparison to a planned economy. That means: the financial sector and the capital market are neglected since the planned economy as we know it does not have one. Since the planning procedure uses production coefficients we have modeled the market economy also on the base of these coefficients. For simplicity we left out foreign trade. Since only parts of the economy are considered, the circulation relation of a market economy is not fully covered. Nevertheless, I think that the model gives some insight into the functioning of a market economy in a way that allows a direct comparison with a planned economy.

[10] The machines may not be fully used. But in our context we assume that always the newer capacities are fully used, and if the demand is smaller, the eldest machines are put out of service. Thus (for simplification), we assume that up to a vintage $-T_i$ all machines in sector i are fully used and all machines elder of that are left unused.

Total secondary demand for commodity i is:

$$SI_i = \sum_{j=1}^{n} \sum_{\tau=0}^{T_j} SI_{ji,-\tau} = SI_i(x_{1,-T_1}, \dots, x_{1,0}, \dots, x_{n,-T_n}, \dots, x_{n,0}),$$

where T_j is the age of the eldest machine used in sector j. Thus total demand for commodity i (which is produced by firm i) is:

$$X_i^d = D_i(p_1, \dots, p_n, Y^1, \dots, Y^H) + SI_i(x_{1,-T_1}, \dots, x_{n,0})$$

Let there be N kinds of labor. The production $x_{i,-\tau}$ at machines of age τ needs labor in proportion to it:

$$L_{\nu i,-\tau} = c_{\nu i,-\tau} \cdot x_{i,-\tau}, \quad c_{\nu i,-\tau} \geq 0, \quad \nu = 1, \dots, N$$

We assume that the efficiency of the machines increases in time: younger machines are more efficient, i. e. :

$$c_{\nu i,-\tau} > c_{\nu i,-\tau+1}, \quad b_{i,-\tau} < b_{i,-\tau+1}, \quad a_{ji,-\tau} \geq a_{ji,-\tau+1}, \quad \tau = 1, \dots, T_i$$

Thus the cost per unit of output at the eldest machinge (of age T_i) in firm i is the highest. This implies that in order to produce a certain amount X_i^s first the younger machines are used; the eldest machines are those which are still necessary to satisfy demand. That means: the eldest vintages T_i of machines still in use are determined by

$$X_i^d = X_i^s, \quad X_i^s = \sum_{\tau=0}^{T_i} x_{i,-\tau}$$

The costs $k_{i,-T_i}$ per unit of output at the eldest machine are the marginal costs from the point of view of the firm:

$$k_{i,-T_i} = \sum_{j=1}^{n} a_{ji,-T_i} \cdot p_j + \sum_{\nu=1}^{N} c_{\nu i,-T_i} w_{\nu i} + C_{i,-T_i} \cdot r + t_i$$

where

$w_{\nu i}$ =wage rate for labor of type ν in firm i[11]

$C_{i,-T_i}$ =value of capital invested in machinery of age T_i,

per unit of output of this machinery

t_i =rate of indirect taxation per unit of output

The wage rate $w_{\nu i}$ is determined by the value of the marginal product of labor of kind ν in firm i, i. e. of the net value of the contribution of labor of kind ν to the total product

[11] We allow different payments for the same type of labor at different firms.

of firm i which at the margin exhausts the value of the product. Thus from $p_i - k_{i,-T_i} = 0$ we get for the contribution of labor of kind 1:

$$p_{1i}^{net} := [p_i - \sum_{j=1}^{n} a_{ji,-T_i} p_j - \sum_{\nu=2}^{N} c_{\nu i,-T_i} w_{\nu i} - C_{i,-t_i} \cdot r - t_i] = c_{1i,-T_i} \cdot w_{1i}$$

Thus

$$w_{1i} = \frac{1}{c_{1i,-T_i}} \cdot p_{1i}^{net}$$

where $\frac{1}{c_{1i,-T_i}} = \frac{x_{i,-T_i}}{L_{1i,-T_i}}$ = product i per unit of labor of kind 1

and $\frac{p_{1i}^{net}}{c_{1i,-T_i}}$ = net value of this product. We may only determine one wage rate from the definitional equation for $p_{\nu i}^{net}$, if all other wage rates are known. We may get the other $N-1$ equations by considering the "rank" of the persons employed at machines of age $-T_i$, see Beckmann (1978). Let $\nu = 1$ be the labor of the "rank and file", the majority of the workers who do the job, called workers of rank 0. For $3-10$ of these workers one needs a supervisor, a person of rank 1 with type $\nu = 2$, and so on. The upper types of labor get higher wages, but these are fewer people. Thus we may put

$$\frac{w_{\nu i}}{w_{1i}} = d_{\nu i} \cdot \frac{c_{1i,-T_i}}{c_{\nu i,-T_i}}, \quad \nu = 2, \dots, N, \quad d_{\nu i} > 0,$$ [12]

This determines all wage rates of all firms[13] such that the cost of producing one unit of the final product at the eldest machines just equals the price.[14] Of course, the causal relation runs actually the other way round: a certain price p_i determines the age of the machines which could be used for production without running losses and thus the total amount of production.

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[12] This surely is a simplified approach. Otherwise we would have to make the productivity coefficients $b_{i,-\tau}$ a function of the different types of labor working with the machines of age τ. But this is an unnecessary complication in our context.

[13] The wage rates for the same type of labor may be different at different firms. Our approach may be reformulated as follows. Rewrite the equation for p_{1i}^{net} as follows:

$$p_i - d_i - \sum_{\nu=1}^{N} c_{\nu i,-T_i} \cdot w_{\nu i} = 0,$$

$$\text{where} \quad d_i = \sum_{j=1}^{n} a_{ji,-T_i} p_j - C_{i,-T_i} r - t_i$$

and the equation for the wage relations as follows:

$$w_{\nu i} = e_{\nu i} \cdot w_{1i}, \quad \text{where} \quad e_{\nu i} = d_{\nu i} \frac{c_{1i,-T_i}}{c_{\nu i,-T_i}}, \quad \nu = 2, \dots, N$$

By substituting the second equation into the first and solving for w_{1i} we get

$$w_{1i} = \frac{p_i - d_i}{\sum_{\nu=1}^{N} c_{\nu i,-T_i} \cdot e_{\nu i}}, \quad \text{where} \quad e_{1i} := 1$$

[14] To simplify the exposition we assume that the demand for each commodity i is sufficient to operate the eldest machines (when the profits are zero) at full capacity. The younger machines are operated at full capacity anyway. The profits are made there, see below.

In our model the price p_i of product i ist determined by firm i such that it covers the marginal cost of the period before. This connects the different periods in this model. It implies that the entrepreneur has no knowledge of the situation in the next period, and the best thing to do is to base the pricing behavior on the cost situation of the period before. Thus

$$p_i = k_{i,-T_i}(-1)$$

where (-1) indicates the former period.

Now we have to determine the capital investment in the different sectors of the economy, i. e. $K_{1,0}, \ldots, K_{n,0}$. The size of the elder capital is given. As defined earlier, the capital costs per unit of production in sector i at machines of age zero are $C_{i,0} \cdot x_{i,0}$. In this model total investment capital I will be directed to the different sectors of the economcy such that the profit rate π is equal for all investments:

$$\frac{p_1 - k_{1,0}}{C_{1,0}} = \frac{p_2 - k_{2,0}}{C_{2,0}} = \cdots = \frac{p_n - k_{n,0}}{C_{n,0}} = \pi$$

and

$$I = C_{1,0} \cdot x_{1,0} + \cdots + C_{n,0} x_{n,0}$$

$$\text{where} \quad x_{i,0} = \alpha \cdot X_i^d$$

This means: the available investment I limits the amount X_i^d of demand which may be satisfied by production on the newest machines. This determines α:

$$\alpha = \frac{I}{C_{1,0}X_1^d + \ldots + C_{n,0}X_n^d}$$

and thus $x_{i,0}, \quad i = 1, \ldots, n$.

The profit rate (equal to all investments) is

$$\pi = \frac{1}{I}[(p_1 - k_{1,0})x_{1,0} + \cdots + (p_n - k_{n,0})x_{n,o}]$$

$$\text{and} \quad C_{i0} = \frac{p_i - k_{i,0}}{\pi}, \quad i = 1, \ldots, n$$

Let $\bar{p}_{i,0}$ be the price of a unit of capital in sector i in period 0. Then $C_{i,0} \cdot x_{i,0} = K_{i,0} \cdot \bar{p}_{i,0}$.[15] After x_{i0} is determined we get for K_{i0}:

$$K_{i0} = \frac{c_{i0}x_{i0}}{\bar{p}_{i0}}, \quad i = 1, \ldots, n$$

Thus capital in sector i invested in period 0 depends on demand X_i^d for commodity i, on the profit C_{i0} of production in this sector and in all other sectors and on the price $\bar{p}_{i0}$ of the machine. The total profits Π_i in sector i are:

$$\Pi_i = \sum_{\tau=1}^{T_i} (p_i - k_{i,-\tau})x_{i,-\tau}$$

[15] The machines $K_{i,0}$ actually consist of different investment goods $x^I_{1i,0}, \ldots, x^I_{ni,0}$. Thus $K_{i0}\bar{p}_{i0} = \sum_{\nu=1}^{n} x^I_{\nu i,0} \cdot p_\nu$. They are part of the final demand D_i. We shall not model this relationship.

The profit rate is equal for the newly invested capital and thus there is a tendency for that also for total capital. Total employment of type ν is:

$$L_\nu = \sum_{i=1}^{n} \sum_{\tau=0}^{T_i} c_{\nu i,-\tau} \cdot b_{i,-\tau} \cdot K_{i,-\tau}, \quad \nu = 1, \ldots, n$$

Whereas a market economy equalizes supply and demand on the commodity markets, there is no such strict relation for employment. Production follows demand and employment follows production. With fixed production coefficients and exogenous demand (as in this model) there is no law wich guarantees full employment. If we follow the neoclassical line we would assume production coefficients which depend on real wages such that lower real wages would increase the labor intensity of production. If we follow the Keynesian line higher demand will do the job. In the limits of this model we have to assume that demand is on the appropriate level to reach full employment and that the structure of the labor force (the sizes of the different kinds of labor) conform to the demand structure (which means that there is enough retraining in the society). Thus we may conclude: a market economy produces according to the demand of the people. It determines prices, wages, profits, employment and capital structure endogenously on the base of demand functions and production functions which in this approach are approximated by production coefficients.

5 Annex 2: The Basic Model of a Planned Economy

For comparison of the two orders of an economy we assume that the technology is equal in both cases:

$$x_{i,-\tau} = b_{i,-\tau} \cdot K_{i,-\tau}$$

but the amounts of secondary inputs and of labor used per unit of output are larger:

$$SI_{ji,-\tau} = a^*_{ji,-\tau} x_{i,-\tau}, \quad a^*_{ji,-\tau} = a_{ji,-\tau}(1 + \alpha_{ji}), \quad \alpha_{ji} > 0$$

$$L_{\nu i,-\tau} = c^*_{\nu i,-\tau} x_{i,-\tau}, \quad c^*_{\nu i,-\tau} = c^*_{\nu i,-\tau}(1 + \gamma_{ji}), \quad \gamma_{ji} > 0$$

The reason ist that a planned economy as we know it is connected with the rule of a communist party. Thus the workers are sure that they are not given a notice to leave even if they work slowly, and management is not interested in risking a conflict with labor; it is interested in fulfilling and overfulfilling the plans, and that is easier if there are more workers and more secondary inputs than necessary.

The $K_{i,-\tau}$ may also be different. We come to this later. Let $\hat{X}_i$ be the target of production of plant i which is also the planned supply. It must cover the secondary inputs SI_{ij} of kind i of all other plants ($j = 1, \ldots, n$) and the planned final demand $\hat{D}_i, \quad i = 1, \ldots, n$. This final demand is subject to the decision of the politburo or some other high authority. It must cover the necessary consumption goods for the population and for the government and the investment according to the preference of the leading personalities. We take it as

exogenous. The politburo does not care for the allocation of production to machines of different age within the firm but assigns the secondary inputs in total proportional to the target of production: Thus the planning office must schedule the production targets for plant i as:

$$\hat{X}_i = a_{i1}\hat{X}_1 + \ldots + a_{in}\hat{X}_n + \hat{D}_i \quad , i = 1, \ldots, n$$

where at the plant level:

$$a_{ij}\hat{X}_j = a^*_{ij,-T_j}x_{j,-T_j} + a^*_{ij,-T_j+1}x_{j,-T_j+1} + \ldots + a^*_{ij,0}x_{j,0}$$

$$\text{and} \quad \hat{X}_j = \sum_{\tau=0}^{T_j} x_{j,-\tau}$$

T_j is the age of the eldest machine which still must be used to fulfill the plan. From the above equation follows

$$a_{ij} = a^*_{ij,-T_j} \cdot \xi_{j,-T_j} + \ldots + a^*_{ij,0} \cdot \xi_{j,0},$$

$$\text{where} \quad \xi_{j,-\tau} = \frac{x_{j,-\tau}}{\hat{X}_j}$$

the proportion of production which is carried out at machines of age τ. $\xi_{j,-\tau}$ may be considered as constant. Then also the a_{ij} are constant. Then the planning office may calculate the targets of production from the planned "final demand" $\hat{D}_i$ (a demand of the politburo) and the input coefficients a_{ij} which must be delivered by the plants. In matrix notation we get

$$\hat{x} = A\hat{x} + \hat{d}, \quad \hat{x} = \begin{pmatrix} \hat{X}_1 \\ \vdots \\ \hat{X}_n \end{pmatrix}, \quad A = \begin{pmatrix} a_{11} & \ldots & a_{1n} \\ \vdots & & \vdots \\ a_{n1} & \ldots & a_{nn} \end{pmatrix}, \quad \hat{d} = \begin{pmatrix} \hat{D}_1 \\ \vdots \\ \hat{D}_n \end{pmatrix}$$

which yields

$$\hat{x} = (I - A)^{-1}\hat{d}.$$

These are the production targets which must be given to the managers at the plants. Since the a^*_{ij} in a planned economy are larger than the corresponding a_{ij} in a market economy the production targets $\hat{X}_i$ will be larger than the X^s_i in a market economy would be if the final demand $\hat{D}_1, \ldots, \hat{D}_n$ would be the same (which of course, is not the case).

But a production plan $\hat{X}_i$ is only feasible if the necessary labor is available. For labor of kind ν at plant i we get

$$L_{\nu i} = \sum_{\tau=0}^{T_i} c^*_{\nu i,-\tau}\xi_{i,-\tau}\hat{X}_i \quad , \nu = 1, \ldots, N$$

Since in a plannned economy labor may be ordered to work at a specific plant, only total labor of kind ν counts:

$$L_\nu = \sum_{i=1}^{n} L_{\nu i}$$

In an ideal planned economy we may assume that the education system is also planned such that the relation of persons with qualification ν in the population corresponds to necessities of production. Let $\#L_\nu$ be the number of workers which represent the labor L_ν. Then the total labor demand in terms of workers is

$$\#L = \sum_{\nu=1}^{n} \#L_\nu \quad \text{and in proportions:} \quad \lambda_\nu = \frac{\#L_\nu}{\#L},$$

Let total labor be $\#L^s$: thus $0 \leq \lambda_\nu \leq 1, \sum_{\nu=1}^{n} \lambda_\nu = 1$

$$\#L^s = \sum_{\nu=1}^{n} \#L_\nu, \quad \lambda_\nu^s = \frac{\#L_\nu^s}{\#L^s}$$

Then in an ideal planned economy: $\lambda_\nu^s = \lambda_\nu$

If $\#L_\nu > \#L_\nu^s = \lambda_\nu \cdot \#L^s$, the plan is not feasible and cannot be fulfilled. If $\#L_\nu < \#L_\nu^s = \lambda_\nu \cdot \#L^s$ the plan figures are too low, there would be unemployment. But usually there are premiums for overfulfillment of the plan; and anyway: in the next period the $\hat{D}_i$ and thus the $\hat{X}_i$ will be increased such that there is full employment.

Thus a planned economy has no difficulties to guarantee full employment, also if the labor force $\#L^s$ is (as a rule) larger in a planned economy than in a market economy. Usually there is an obligation to work in the law or even in the constitution of a society with a planned economy. In the Stalin–constitution of the USSR it is expressed by a phrase like: "Who does not work does not eat". On the other hand: wages are low, there is no unemployment insurance, thus there is an inducement for all persons to work.

The capital structure in a planned economy is also different from that of a market econmy. The new investments $K_{10}, \ldots, K_{n0}$ in the different sectors of the econmy are also determinded by the politburo with the help of a planning office. In an ideal planned economy this is done such that the capacities conform the production targets. Since $x_{i,0} = \xi_{i,0}\hat{X}_i$ and $x_{i,0} = b_{i,0} \cdot K_{i,0}$ we get

$$K_{i,0} = \frac{\xi_{i,0}}{b_{i,0}} \hat{X}_i$$

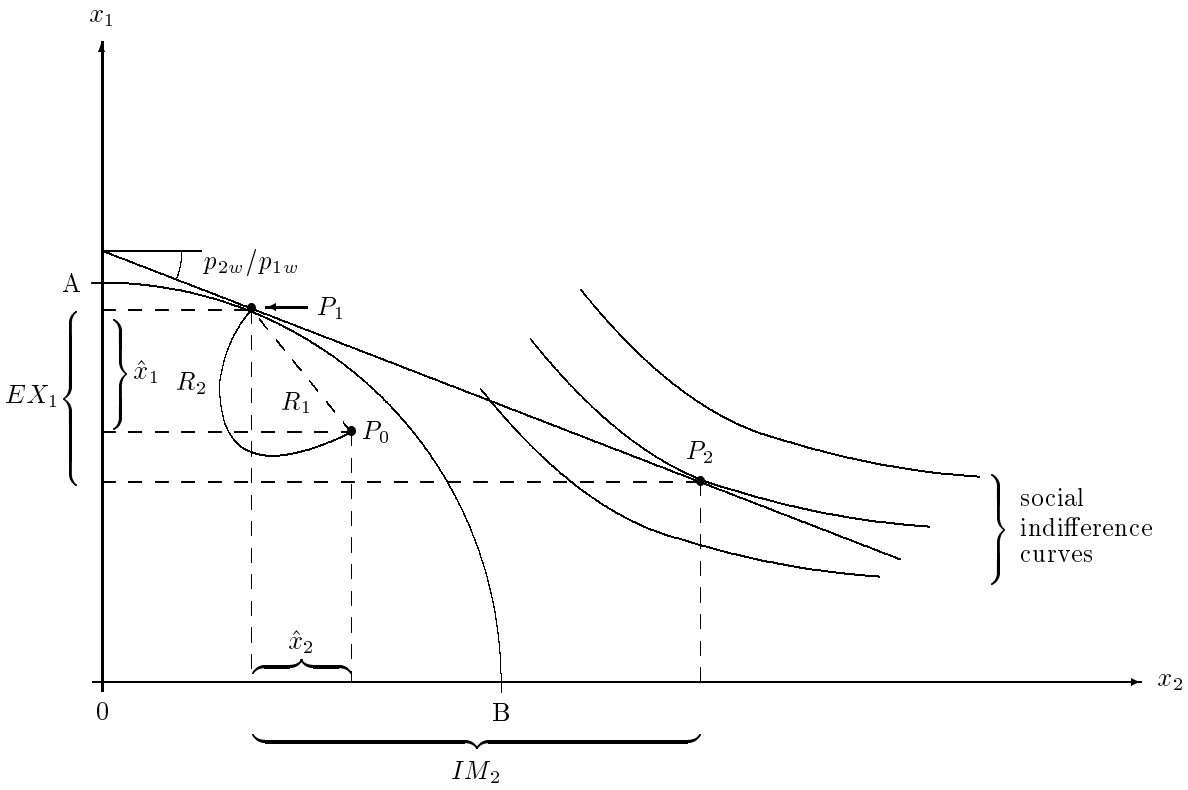
That means: from the production targets $\hat{X}_1, \ldots, \hat{X}_n$ follow the capital investments $K_{1,0}, \ldots, K_{n,0}$. The "final demand" $\hat{D}_1, \ldots, \hat{D}_n$ must comprise these investments in order that the plan can be fulfilled. Of course, these investments are different from those in a market economy.

All this goes without prices, wages and interest rates. They are of secondary importance in the planning procedure but not without importance for the population. Wages and prices determine the personal distribution of real income. Wages are fixed by a wage board according to their judgement on equity. Prices are fixed by a price board usually such that the majority of firms do not run losses and such that the price of the necessary foodstuffs and other essentials may be bought from the lowest wage income of a person.

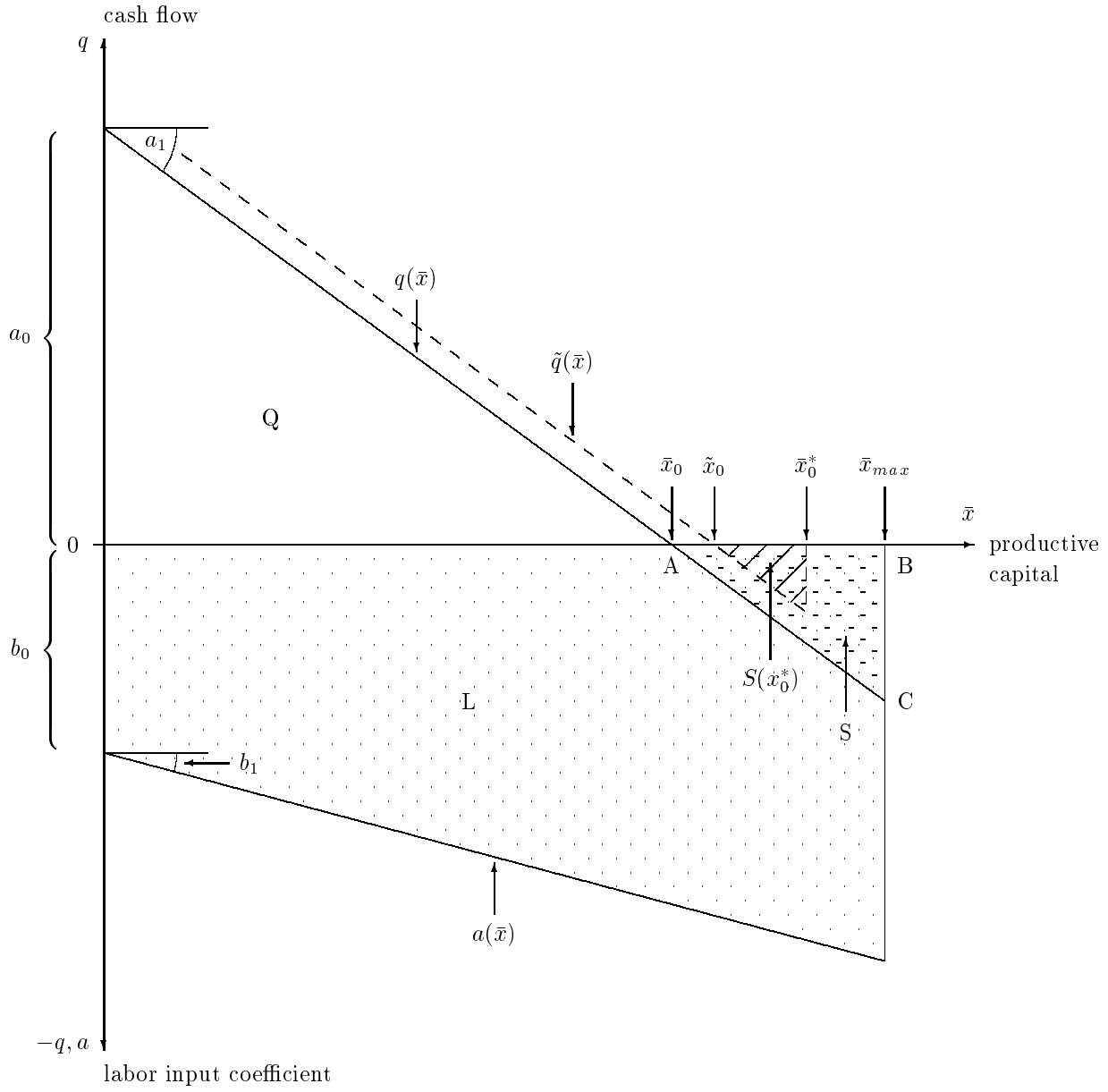
Thus many prices are not related to the cost of production and wages not to the marginal product of a worker.

The consequences of this are stated in the text.

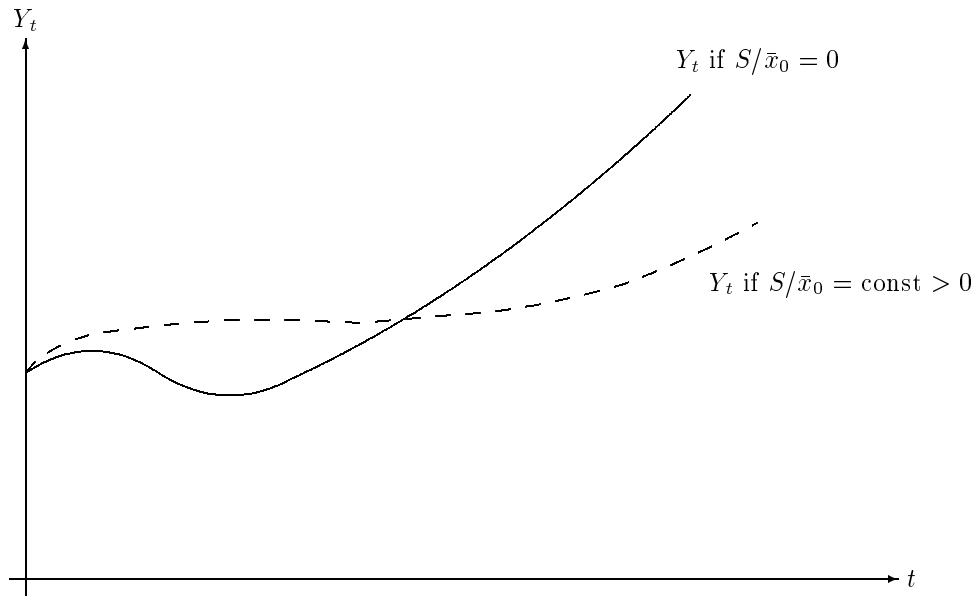
Figur 1: The production possibility curve, and possible transition paths from P_0 to P_1



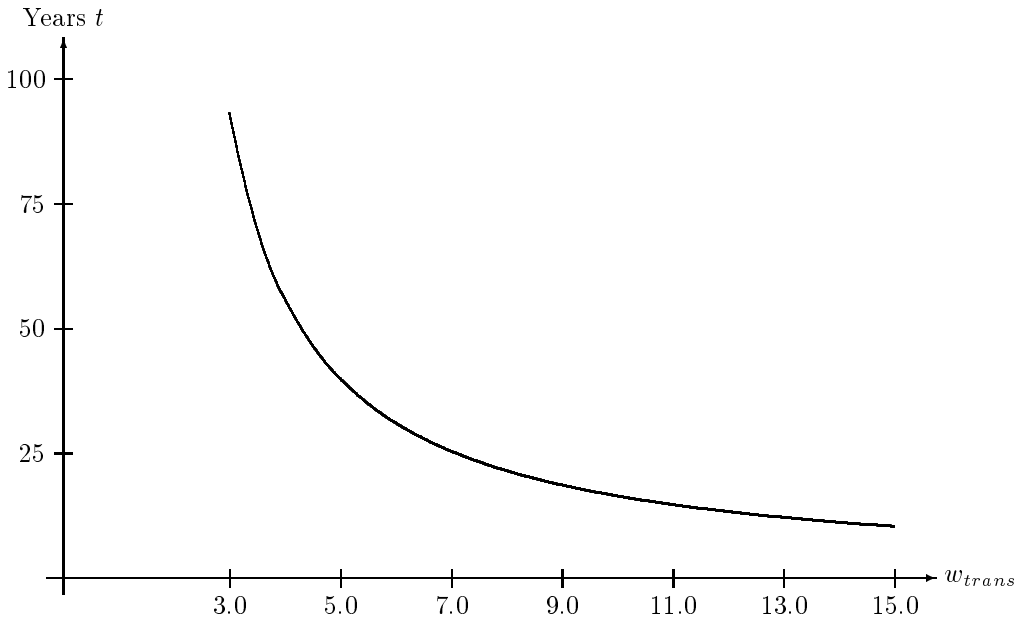
Figur 2: The linearized liquidity and labor distribution functions



Figur 3: Development of GDP as a function of subsidies

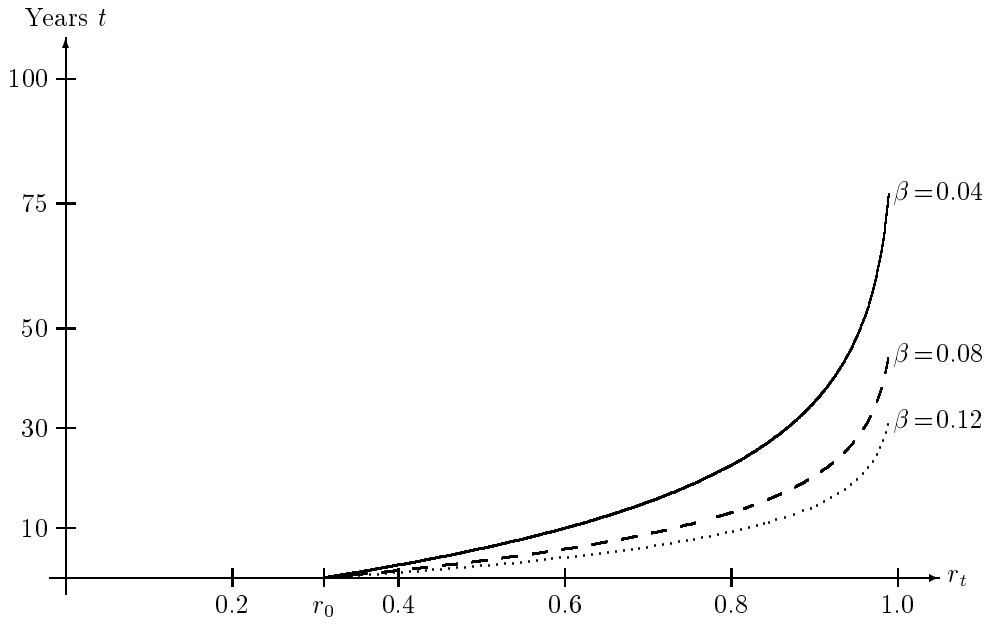


Figur 4: The time it takes till an economy in transition starting with a GDP per capita of $y_{trans,0} = 21\,000$ reaches the GDP per capita of a market economy with $y_{market,0}$ growing at $1,5\%$ per year



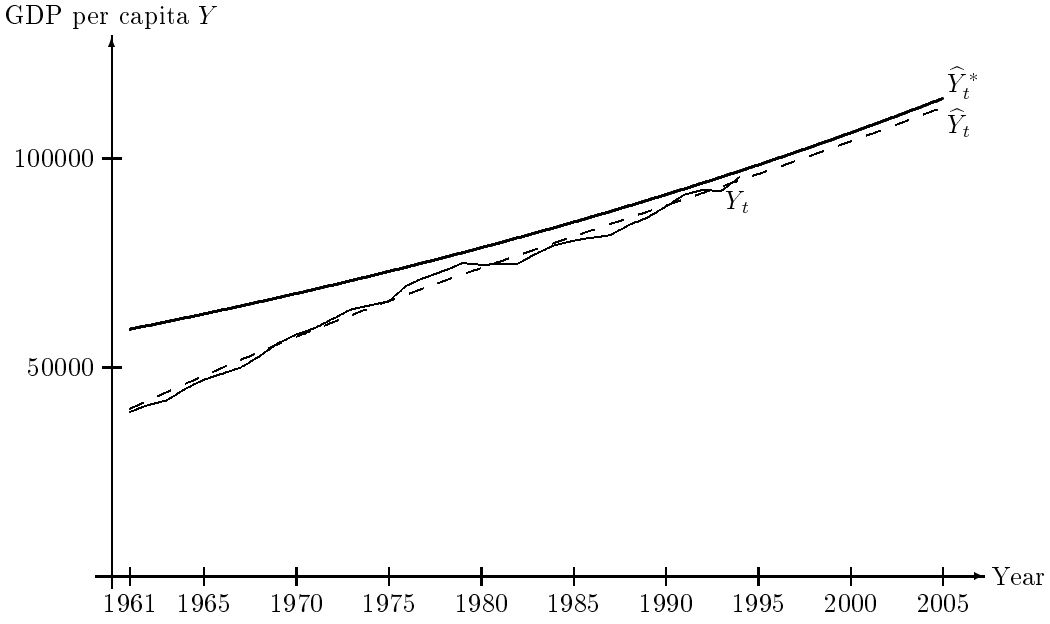
Source: own calculations, taken from Ackermann (1998), p. 12. Assumptions on the parameters: $w_{market} = 1,5\%, y_{market,0} = 85\,000, y_{trans,0} = 21\,000$.

Figur 5: Time t of reaching a rate r_t of GDP per capita of a market economy by an economy in transition



Own calculation, see Ackermann (1998), p. 16. The parameters used in the calculation are the same as those used in Fig. 4.

Figur 6:



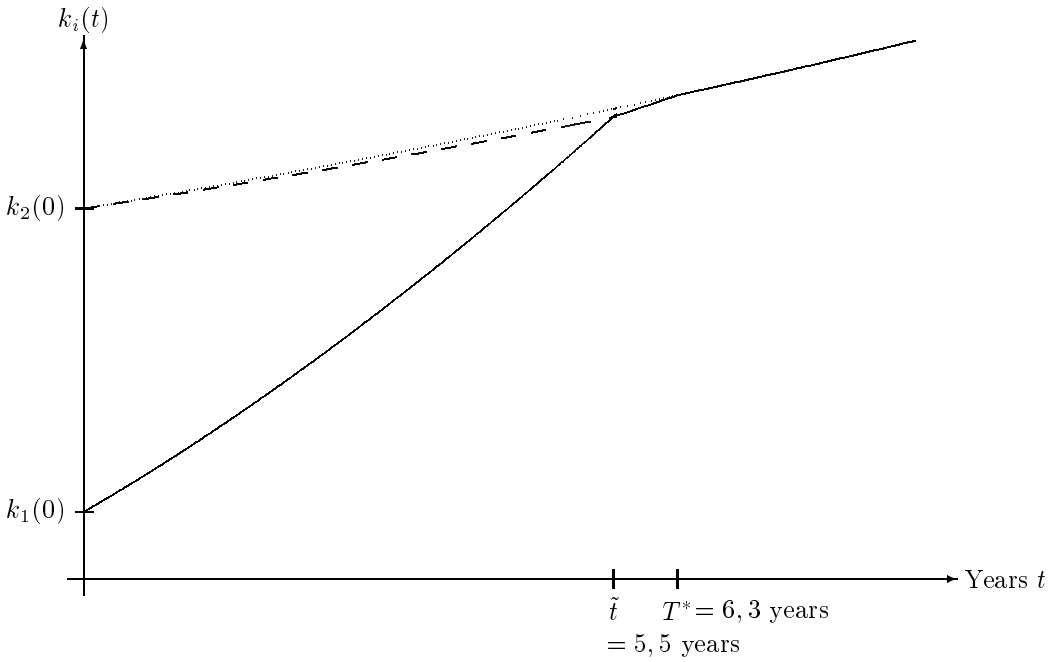
——— = equilibrium growth path (according to the theory, equation (**)

– – – = estimated development, equation (*)

——— = actual development

Source: Ackermann (1998), p. 22.

Figur 7: Trajectories of the capital intensities in both countries



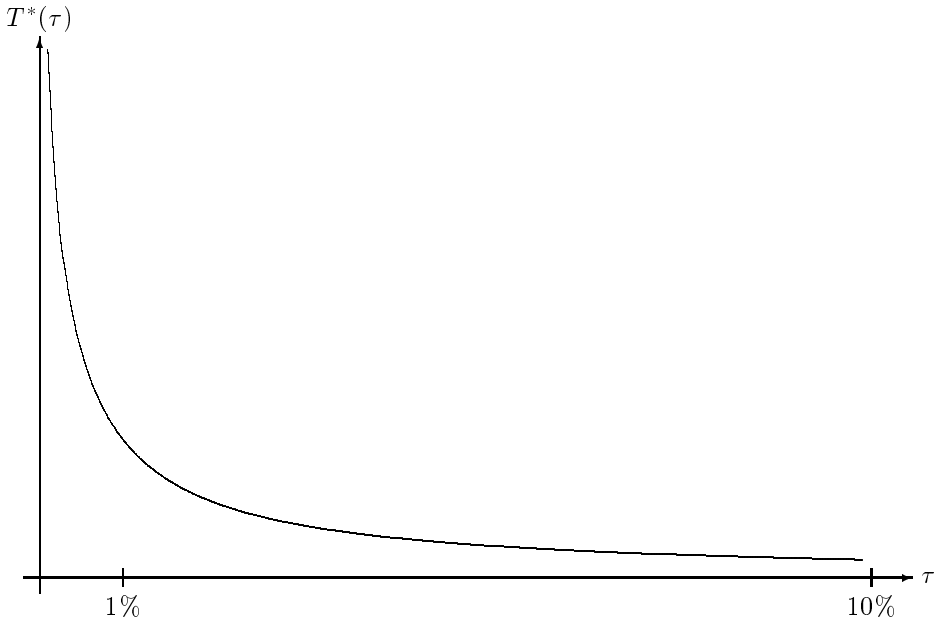
——— = capital intensity of the country in transition

– – – = capital intensity of the market economy

····· = hypothetical isolated development of the market economy on the equilibrium path

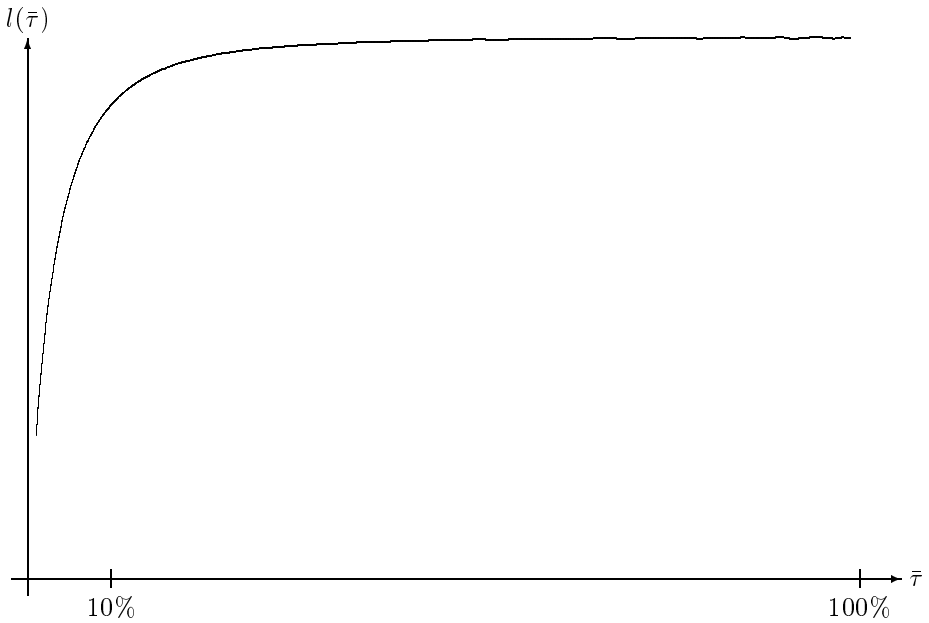
Assumptions: tax rate $\overline{\tau} = 0.03$, technical progress: $\lambda = 0.015$, production elasticity of capital: $\alpha = 0.65$, ratio of the population: $\rho = 0.25$, savings ratio: $s = 0.123$, rate of depreciation: $\delta = 0.06$, rate of growth of the population: $n = 0.005$, GDP per capita at time 0: $y_1(0) = 28\,000$, $y_2(0) = 85\,000$. Source: Ackermann (1998), p. 125.

Figur 8: The time T^* of adaption as a function of the size of the tax rate τ when taxes are used for investment in the country in transition



Source: Ackermann (1998), p.126.

Figur 9: Total loss (discounted to the presence) of disposible income by the market economy as a function of the tax rate $\bar{\tau}$ in favor of the economy in transition. A discount rate of $\nu = 5\%$ and a Harrod-neutral rate of technical progress of 1.5% are assumed



Source: Ackermann (1998), p.127.

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