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The Blind Man's Subsidies
Output, Inflation and Unemployment in Transition
Economies – A General Framework

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Abstract

We model the introduction of hard budget constraints in a transition economy. The model, set in continuous time, is designed to address the interaction between the hardening of such constraints and the speed of restructuring in the industrial sector. We emphasize the impact policy changes will have on the old capital stock with respect to the rate of firm's bankruptcies on the one hand, and to increases in aggregate labor productivity on the other. We then extend the analysis to study the speed with which 'de novo' investment will take place, under alternative government policies.

Contents

1 Introduction

This paper presents a general macroeconomic model, designed to explain the different growth trajectories observed in transition economies in Europe and the former Soviet Union. It is thus based on the belief that these differences in performance can be explained as alternative configurations of one set of parameters.

This premise is derived from the history of economic reforms observed so far. First, the initial conditions, i.e. the characteristics of the centrally planned economies considered here, are sufficiently similar to justify a common classification with respect to the starting point of reforms, despite differences in the degree to which the stylized features of central planning were operative at the moment when a country engaged in irreversible reforms. Second, the basic measures designed to set in motion these reform were so similar that (relative) success or failure can be depicted within the same framework. Third, after the initial measures setting the economies on the path of systemic reform had been implemented, performance across countries started to differ along that path - not only as a function of the initial conditions and the decisiveness with which a set of fairly common measures was implemented (the first two points just addressed), but in all cases also as the result of the rate of accumulation of "new" capital.

The performance measures we are interested in are the rate of growth of per capita output, the rate of change of unemployment, and the rate of inflation. The parameters which are taken to determine these growth rates are

(i) The extent to which centralized subsidization has to be eliminated in order to impose hard budget constraints. On the assumption that soft budget constraints are in place to prevent employment (and perhaps output) from falling, we can postulate that a relatively high level of subsidization will reflect a bad state of the stock of capital inherited from the regime of central planning: The more subsidies are needed, the higher the expected social costs of restructuring and of the bankruptcies needed to adjust the *aggregate productivity* of that part of the capital stock to market requirements. Thus, the (hypothetical) amount of subsidies necessary to maintain the former output and employment levels after the onset of reform is the parameter serving to capture alternative initial conditions.

(ii) Contrasting social costs and governmental latitude, the second parameter is the rate of unemployment which the agents in any particular economy deem the maximum rate tolerable. It is designed to capture the degree to which governments are free to pursue economic reforms, if social costs are incurred. Unemployment above the tolerable rate will threaten the democratically legitimized government to be forced out of office, and will therefore not be tolerated. Hence, this parameter, in combination with (i), tells us the limits a reformist government will face as it attempts to alleviate the inherited situation (alternatively, it may tell us the degree to which a particular government is committed to reform). It thus captures the different degrees of *decisiveness* observed when reforms are first brought on the way, by means of implementing a similar, agreed-upon blueprint across the countries in

question – the size of the "big bang", so to speak. Under "decisiveness" we subsume both, the willingness or the ability of governments to pursue reform. The extent of the initial cuts out of the given level of subsidization (i) delivers the second determinant of the different growth characterizing reality.

(iii) The third parameter is the *accumulation* of private capital – i.e. the determinants of the rate of growth of new productive capacity. It captures the fact that the decline of the old, inherited capital stock will be compensated for over time contingent on the rate at which new capacity is created. The rate of growth of the new capital stock is the single most decisive influence on the aggregate growth rate of the systems under consideration, once (i) and (ii) are given. It is thus taken to reflect the third determinant of the economy's trajectory, operative once the transition is irreversibly under way.

Note that capital accumulation, at least initially, will to a large extent be the result of foreign direct investment. Though considering saving rates explicitly does not alter the argument, we will concentrate on that aspect in what follows.

Together, the three parameters are used to model alternative growth paths starting from central planning – with varying initial conditions, non-identical decisiveness to push for reforms, and different degrees of growth of the new sector. While the first two can be taken as given, with alternative values for alternative cases, the third has to be derived endogenously and in more detail.

We first develop the general theoretical model (part II), then narrow down the assumptions to make it analytically tractable. We then use this simplified model to show that a unique and stable optimal growth path exists in general (part III). We proceed to include preliminary computer simulations (part III.6), portraying the different growth trajectories observed in the world we live in.

2 The Economy

2.1 The Problem and its Setting

2.1.1 Output, Inflation and Unemployment in Transition Economies

The economies which have emerged five years after the sudden implosion of the system constituting the former *Council of Mutual Economic Assistance* in Europe and the former Soviet Union represent a rather heterogeneous group – surely more so than expected, when the transition toward market coordination first began. In all cases, the transformation has proceeded disappointingly slowly and, measured against the usual macroeconomic yardsticks, rather painful as well.

The transition from central planning to some extent defied professional expectations: Neither the observed degree of heterogeneity, nor the degree of difficulties, or the time consuming nature of the process have been forecast correctly.

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By the time of this writing, the performance of some countries has improved to the point where growth rates have been positive for quite some time, while others remain in a state of decline. Often, this situation is referred to as a "three tier society" – with countries at the Western fringes of the former empire performing comparatively well, large sections at the (geographic) heart of that old empire considered economic disaster zones and, further East, with the disaster often no longer measurable in purely economic categories, as regions are ripped apart by ethnic strive and civil war.

And, as if in an unconscious reaction, a tendency to emphasize the differences has taken hold – the differences between countries, to be sure, but also a concentration on single aspects of the transformation, or on the analysis of single markets in transition economies. Articles on the macroeconomics of the process, especially those emphasizing similarities among (groups of) countries are, after the initial glut in devising "blueprints" of universal validity, somewhat out of fashion.

There are, however, more similarities to be found among the different economies than disappointed expectations, based on the early focus on initial conditions, would suggest. These similarities do date back to the legacy of central planning, but they are perpetuated by the similar characteristics of the initial steps toward macroeconomic reform, and they are now reflected in the identity of the key parameters determining growth, and thereby the degree of success after reforms have settled in.[1]

Despite numerous differences in institutional detail, all of the economies engaged in the first steps toward market coordination shared the principle need for price liberalization, for the introduction of hard budget constraints, and for mass-privatization. The extent to which these steps had to be implemented differed across the CMEA countries, as did the speed at which this implementation occurred. But as the principle steps, the early "blueprints" of reforms all emphasized this same triangle.[2]

2.1.1.1. The Triangle of Economic Reform

It is easy to see, how this particular emphasis would emerge, once the legacy of central planning was encountered by the Western trained economist: *Price liberalization*, as complete as possible was the necessary first step. The removal of the arbitrary fixed price system is a necessary condition for systemic reform. Two things were hoped for as an immediate result. One was the establishment of the correct set of relative prices, as these were set free to move toward a configuration determined by market forces. The second was the removal of the "monetary overhang" which had become a characteristic of the shortage economy. The nominal price level would finally match the quantity of money in circulation with the number of goods traded, and this was expected to result in a one-time jump of the price level, as it adjusted to normal. Thus, as a beneficial side effect, this

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[1]"Transition" is a somewhat unfortunate term for it implies knowledge of the starting and the endpoint of a process. Transformation, for example, does not. The first term has settled in, however, and we will use it, for that reason. Note that we refer only to the former CMEA members in what follows, i.e. China, Vietnam and other Asian nations, following a different path of reforms, remain excluded.

[2]Cf. Lipton and Sachs (1990) for the earliest and perhaps most influential publication emphasizing that approach.

adjustment would remove the inflationary pressure stemming from the excess demand due to nominal wealth accumulated under an economic regime which afforded itself the luxury of setting, over time, aggregate nominal income in excess of the quantity of goods produced at the going prices, by means of an arbitrary fixed price system *cum* quantity rationing.

The second step has to be seen against this backdrop of safeguarding against perceived inflation. Commonly referred to as *corporatization* or "marketization", to turn still state-owned enterprises into joint stock companies has been associated with a host of side effects; and different writers, in this context, have tended to emphasize different side aspects. However, it really is the imposition of hard budget constraints, connecting the macro- with the enterprise level, which lies at the heart of this measure.[3]

On the one hand, hard budget constraints were seen as essential to avoid inflationary pressures, and to secure the establishment of market pricing. They would also help solving the evaluation problem raised by step three, the introduction of mass privatization programs: As long as they are subject to centralized subsidization, firms net worth is hard to calculate. But on the other hand, next to macroeconomic issues and the function of a hinge linking all three steps, the hardening of budget constraints was conceived of as necessary for an altogether different task: to enforce industrial restructuring at the enterprise level. Eliminating the subsidization emanating from the political center ought to split the good firms from the bad and the ugly. It would weed out those not viable under market conditions, force others to streamline production processes in order to arrive at competitive levels of productivity, leaving unaffected only those whose products and production processes proved capable of surviving the test of competition.

The importance which corporatization, through this route, acquires for the performance of the economy as a whole is inseparable from two basic premises. First that, post-central planning, a degree of subsidization is present in the aggregate that has to be eliminated in order to provide monetary stability during the transition; and second that a number of enterprises are incapable of survival under competitive conditions, whereas others will be found in need of restructuring in order to ensure that survival, once the economy is open.[4]

Privatization ("top-down", i.e. with emphasis on existing assets) as the third step was

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[3]Lipton and Sachs (1990), for example, expressly refer to the first step (price liberalization) as the "end (of) excess demand". The second stands for the need "to increase competition".

[4]Corporatization was also seen to alleviate a host of other problems, mostly connected to the sort of institutional change more often than not conspicuously absent from the early grand schemes of reform. Important among them was the believe that corporatization, as it enforced competition before mass privatization, would change firms' behavior (leading to marketing, new distribution channels, etc.); that it would help triggering the emergence of much needed financial institutions (banks, insurance companies and secondary markets, up to the emergence of stock markets); that it would shore up legal institutions (the establishment of business codes, enhanced contractual arrangements and reliable enforcement), and finally, that it would change firms organizational patterns (foster the switch to proper accounting methods, modifying the nature of labor contracts, etc.) – expressions of the trust, in short, that much of the legal, financial, and institutional setting connected with corporate business in the West would spring into existence, once the form of a joint stock company was established and firms were put "out in the cold", i.e. left to fend for themselves.

meant to conclude the process. The establishment of private property rights to productive capacity was considered essential for the final goal of economic reform; and to this end, a variety of methods were proposed and debated. It was inherent in most of the early proposals that the two measures previously discussed were necessary preliminaries toward that goal.[5]

A general blueprint can thus be identified, the logic of which is derived from common characteristics of the economies under consideration. These included the acknowledgment of the need for enterprise restructuring as well as the existence of soft constraints for the economy as a whole.

2.1.1.2. Transformational Recession

The blueprint involves a well defined sequencing of reform measures. One of its characteristics is an emphasis of liberalization over stabilization policies, with monetary stabilization initially envisaged as a safeguard. Opening the transition economies to the free flow of tradeables, capital, and investment was part of the emphasis on liberalization; it should accompany the first step, as should the freeing of exchange rates.

Taken together, the steps of the proposal would result in the often mentioned J-curve: Over time, aggregate output (and employment) would fall, as non-competitive enterprises are forced into bankruptcy and others engage in corporate restructuring; to then rise over and above the old level achieved under central planning, as enterprise's restructuring activities generate results and as new investment, domestic and from abroad, takes hold, building up a new stock of productive capacity.

The depth of the "transformational recession" (Kornai 1993) was seen as contingent on the initial conditions, i.e. the degree to which the inherited capital stock proves competitive under open market conditions and without the aid of central subsidization; the length of the recession becomes, given the initial conditions, a function ultimately of the speed with which liberalization policies are implemented (Rühl 1995).

It is now easy to see how the degree of these otherwise identical measures will differ for different economies, contingent on their initial conditions, and despite the fact that the measures themselves were tailored to identifiable general characteristics of the previous economic regime. The extent of price liberalization, for example, will depend on the ratio of fix- to flex prices at the start of systemic reform; and the adjustment of relative prices will be less dramatic in economies where a comparatively large number of goods are already subject to market pricing (such as Poland) than in countries in which this ratio is extremely low (e.g. most republics of the former Soviet Union). The initial jump of the price level, on the other hand, is a function of the monetary overhang present in the system at time zero, that is, of the stocks representing the accumulated mismatch between nominal income flows and quantities times prices under central planning.[6] The same, obviously, holds true for the extent of privatization, contingent not only on the

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[5]In the early discussions, the Coase theorem never seriously became an issue.

[6]Czechoslovakia, for example, prided itself with having achieved "global equilibrium" under socialism; meant by this phrase was a minor mismatch with the associated appearance of comparatively little quantity rationing (queuing) and relatively low excess holdings of cash and demand deposits on part

desired share of the state sector but also on the extent to which private production took place when the decision toward irrevocable systemic reform was first made.

The difficulties of introducing a hard constraint by eliminating centralized subsidization, however, will not only depend on the degree to which such subsidization was present in the aggregate. It will also depend on the competitiveness of domestic industries after the initial steps toward liberalization (including the exposure of the economy to international competition) have taken place.

2.1.1.3 Subsidy Cuts and the Nature of the Old Capital Stock

We are now in a position to draw first inferences about the factors determining the differences in country performance, and to relate them to the initial conditions. Because of the similar starting position and the similarities in measures to undertake reforms, an identifiable set of parameters can be taken to determine output, employment, and inflation throughout the "valley of tears", i.e. the first part of reform. A central role is assumed by the degree to which subsidization is tackled in the aggregate: The larger the required cuts, the higher the rate of potential bankruptcies. Hence, the steeper the decline in output and the increase in the rate of unemployment if the cuts are actually made; and the bigger inflationary pressures as well as actual inflation rates if they are not carried out successfully.

"Top down" privatization, as opposed to the accumulation of new capital, enters this picture only in so far as a connection between successful enterprise restructuring and privatization can be assumed. In what follows, we neglect the role the privatization of existing assets may play in streamlining their productivity. Instead, we concentrate on the role the imposition of hard budget constraints will play in enforcing restructuring, that is, on the quality of the capital stock inherited from central planning,[7] and on the feedback effects successful restructuring may have in enticing investment.

However, to demonstrate which set of parameters determines the development of output, unemployment and inflation on a fundamental level takes more than to point at similarities in initial conditions, including the measures designed to implement reform. It also requests to account for differences in implementing these measures which appear

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of the public. In other countries, for example the German Democratic Republic, the situation was characterized by extremely high ratios of money holdings to nominal income. An even more extreme case, in terms of the competitive initial positions, is the interruption of trade flows between, but also within, the former CMEA members. Some of the Asian republics of the former Soviet Union, for example, relied on heavy subsidization from the political center before the Union broke up (Kazakhstan almost 30, the Kirgyz Republic almost 40 percent of GNP), which was either lost or had to be replaced, at the expense of making them potential targets for political blackmail at the hands of their old supporters.

[7]One way of legitimizing that procedure would be to point at the inconsistencies observed with respect to the role "top down" privatization of existing capacity has played in actively enforcing restructuring. Whether blamed on the evils of a lack of corporate control following insider privatization (as in Russia), or the lack of initiative on part of holders of large and concentrated equity positions (as in the Czech Republic), the evidence for privatization alone being *the* decisive factor improving performance on the enterprise level is far from conclusive (cf. Rühl 1994). The phrase that top down privatization in many instances amounted to little more than a "change in name tags" emphasizes that problem.

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to be unrelated to the magnitude of the initial shock). Finally, it requires the introduction of additional determinants to account for the observed growth differentials over time. The first refers to the variety of results that the attempts at hardening aggregate budget constraints through monetary and fiscal policies in fact generated across a variety of countries; the second to the accumulation of a new capital stock.

It is in connection with attempts at subjecting different economies to hard constraints by cutting central subsidization, where reformers were set to encounter the most surprises. In some cases (e.g. the Czech Republic), balancing the federal budget did not seem to represent much of a problem. In other cases it was possible after considerable costs were born, either in terms of external debt forgiveness (Poland) or socially, in the form of a brief escalation in the rates of unemployment (Estonia, and also the special case of East Germany after unification). Sometimes, however, the attempt had to be considered a failure for years (Russia), or it was never seriously undertaken to begin with (Romania or the Ukraine). Three main factors share responsibility for these differences: The nature of the old capital stock, in particular its degree of concentration; the political ability of governments to push for austerity; and the rate of new capital creation, in particular foreign direct investment.

The state and the nature of the capital stock as it emerges under central planning is a factor most seriously underestimated by Western observers (or domestic governments, for that matter). "State" here refers to the number and the size of single enterprises with rates of labor productivity below what is necessary to compete at living wages, let alone the old real wage level, once the economy is open. On average, the inherited capital stock was in much worse shape by this measure alone than could have been expected. Partly, this fact may account for the disappointing performance and the slow recovery in many countriesn. However, to monitor and organize a centrally planned economy also creates a second characteristic. It becomes rational to operate a highly concentrated industrial setting. Wile the capital stock is vertically integrated (comprised of firms delivering intermediates to each other), it typically consists to a large extent of bilateral monopsonies and monopolies. The phrase "nature" of the capital stock refers to a particular high degree of concentration in the industrial sector.

What is rational under central planning now becomes an important impediment to economic reform, with the discipline of central commands removed: Interruptions of the system at single points, necessitated for example by the need to shut down a particular production facility, may now trigger system-wide repercussions. If a particular plant happens to be the sole provider of an input essential for others to continue production, its closure causes bottlenecks for the system as a whole. Output and employment losses may cascade throughout the economy: The further downstream a loss-making facility is located, and the higher the degree of monopolization, the more severe the losses to be expected.[8] In such a setting of vertically integrated bilateral monopolies or monopsonies a unique equilibrium price vector need not exist and the demands of single units, trying

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[8]It goes without saying that the break-up of the division of labor arranged for in the CMEA trade agreements, and that of the Soviet Union in particular, already created losses in output and employment before the purely economic effects discussed above became visible.

to exploit their position, need not converge toward a stable equilibrium. On the contrary, once the units in such a setting are allowed to enter into a bargaining game with each other, the game may have an empty core (cf. Leijonhufvud 1985, 1993).

Something very similar has taken place in Russia, where attempts to introduce hard budget constraints on the enterprise level have been thwarted for quite some time now by what is often perceived as an unholy alliance of industrialists, members of parliament, and the Central Bank. Here, enterprises survived initial budget announcements by running up IOU's among each other, precipitating a bail out by extending central bank credit, i.e. by inflationary means. The infamous inter enterprise arrear crises or, to be precise, the financing of inter enterprise debt by the political center is generally agreed upon as the leading cause of inflation in Russia (as well as other countries, such as the Ukraine).[9]

Part of the explanation of why it was possible for the old industrial sector to abort a measure originally designed to enhance aggregate economic performance lies in firms' capability to threaten large scale interruptions of the structure of production or, to put the underlying cause in more gentle terms, in the fact that carrying out the proposed cuts in subsidization would have resulted in socially intolerable output and employment losses, imposing political costs certain governments were not prepared to shoulder. (To see why some consider the action of Russian "industrialists" as self-defense on part of the industrial sector rather than blackmail designed to stop reforms, a comparison of the rate of decline in industrial output with the actual rate of unemployment is instructive. The gap is too enormous for unreliable statistics to matter much. The picture does not only point at the origin of inflation, it also gives a taste of the consequences the sudden reduction of centralized subsidization may have for the aggregate in extreme cases.)[10]

Another lesson of aborted attempts at cutting subsidies is worth bearing in mind: Firms were better informed about the consequences of eliminating subsidization, and hence about the precise nature of the inherited capital stock, than was the government. This is not surprising, considering the pervasive argument that the planning bureaucracy under central planning (remnants of which survived at the enterprise level) was better informed about the true structure of the economy than the political elite (which by and large still comprises the government). For our purposes, the conclusion is to expect the political center to possess less information about the true structure of the economy than the managers running the old enterprises (Rühl, 1995).

The legacy of central planning, however, is just the first among three major determinants of the ability to impose hard budget constraints in an "economy in transition".

1. Despite the importance industrial concentration, resulting from rationally optimizing the central plan, had for the trajectories of the variables considered here, we will

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[9]Note that this process took place quite independently from the extent to which enterprises had been privatized.

[10]The absence of a social safety net and the fact that many of the necessary social services are still provided at the enterprise level, together with the tendency for enterprises to be "oversized" (larger than justified by economies of scale under competitive conditions), together with a spatial concentration of enterprises where whole cities or oblasts may depend on single firms, of course leads to a further aggravation of these consequences.

not, at this point, pursue the issue further - because that particular structure has been discussed and formalized elsewhere (Rühl, Serwin and Kejak 1995) and because in the present model we need not rely on a highly concentrated capital stock. Instead, we model the old capital stock as characterized by very low efficiency. In terms of substance, the analysis remains motivated by the observation that large segments of the inherited capital stock in transition economies have turned out to be redundant, and that this economic obsolescence is deeply tied indeed to the degree of concentration just discussed.

2. The second parameter useful in explaining the differences in country performance follows from the first. It is the ability of a government to impose austerity measures to guarantee stabilization and to enforce the necessary changes on the enterprise level. A variety of governmental reactions to the need of cutting the existing level of state support can be observed. One way to discuss these differences would be to point out that different governments are committed to systemic reform in different degrees. In a day and age, however, in which almost all the governments in question face the need of democratic legitimization by means of (re-)elections, and in which political groups campaigning in favor of rolling back reforms to the extent of re-establishing the socialist economy have not succeeded anywhere, it seems more appropriate to concentrate on the different *abilities* of governments which in principle are committed to reform, to impose painful measures on the electorate. No variable expresses this constraint better than the rate of unemployment – especially in economies in which unemployment may threaten the physical capacity to survive.

3. Finally, the rate of new capital creation will influence the willingness and ability to impose hard constraints. The higher the rate of capital accumulation, the higher the rate at which labor set free in the old sector can be absorbed by the new sector, and the less severe therefore the unemployment constraint limiting the ability to enact step two on the original list. Again, circumstantial evidence is quite clear on this issue: Neither East Germany nor, for example, Estonia could have imposed the deep cuts they implemented without the inflow of foreign direct investment which resulted from their peculiar situation. The Czech Republic has benefited form that effect, as has Poland, generating the capacity to finance the growth of the new sector increasingly out of their domestic saving rates. Others, from Romania to the Ukraine and Russia have suffered form an inability to attract foreign direct investment, coupled with a lack of domestic savings under conditions of high inflation, or with capital flight – again induced by inflation and a mix of policies leading to pessimistic attitudes of potential foreign as well as domestic investors. Note, that a large proportion of new investment at least initially has to come from abroad in any case, since domestic savings to a large extent (their "forced" part) have been eliminated, following price liberalization. Moreover, domestic saving rates are bound to remain negligible for some time, subsequent to the fall in real income associated with dismantling the old system.

2.1.1.4 Stratification of Economic Growth

The growth rate of new productive capital, besides influencing the degree of (sustainable) subsidy cuts, also plays an independent part in determining the growth rates of output and employment. Evidence clearly supports Kornai's (1993) conclusion that it is the interplay between the (declining) old sector and the (growing) new sector which determines the overall growth rates of transition economies. Note again, that the term "new" sector need not be taken to imply "privatized" sector. It literally refers to productive capacity created post-socialism; capacity, that is, which we take to be competitive at world market prices and which does not suffer from any of the calamities associated with the inherited sector, be they connected to the structural problem of over-concentration or simply to a lack of productivity at the enterprise level, prior or post privatization.

The J-curve can thus be decomposed into two components, one dominated by the negative growth rates the old sector is prone to exhibit, the other the result of the economy's ability to attract new investment; with the latter initially dominated by the inflow of foreign direct investment. The overly optimistic expectations addressed at the beginning of this section can now be traced to overestimating the net worth (i.e. the productivity or even "malleability") of the old capital stock, as well as to underestimating the need to rely on foreign capital inflows (as well as overestimating the extent to which those materialized). The need for foreign capital is largely a consequence of the initial decline in real incomes expressing the state of the inherited "old" capital stock.

The growth rate of new productive capacity thus ultimately determines when the J-curve will enter its positive segment, i.e. when growth rates will become positive in the aggregate – as long as the old sector is still declining or can be considered beyond repair. However, some noteworthy peculiarities are associated with the prominence the formation of new capital acquires in determining success or failure of the transition. For once, as much as it determines success, it is a function of success itself – success of a country in transition, as perceived in the eyes of the (foreign) investor. In other words, what has come to be known as self fulfilling prophecies will play a large role. But foreign direct investment can be expected to cluster for other reasons as well.

In general, those who have are likely to get more, while those who are less successful initially may remain so as long as they are unable to create improvements on the macro-level (and not only microeconomic incentives signaling opportunity), or at last the believe that such improvements are immanent. The process, therefore, is very much reminiscent of the cumulative causation argument and of Verdorn's law, topics which more than thirty years ago where discussed in relation to the process of industrialization faced by less developed nations (e.g. Kaldor 1980). A host of issues becomes relevant such as location, borders with the West, size of the country, etc., – no strangers to contemporary growth and foreign trade theory. The success rates of individual transition economies have to be compared along the lines of these criteria.

The growth trajectory of economies in transition clearly is a path dependent process. A point distribution of probable outcomes can not be formulated *ex ante*. But the differences in country performance observed in reality can still be explained (and modeled) by relying

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on a set of parameters mirroring the most important characteristics of these economies. These are the structural similarities in terms of their initial situation; similarities in the nature and sequencing of macroeconomic reform proposals resulting from that situation; and the role the new sector plays once the fact is acknowledged that the old capital stock turned out to be more of a hindrance to reform than suggested by the easy logic of low wage arguments.

The performance of the former CMEA economies can thus be reduced to the interplay of a common set of parameters; and this interplay can be captured on the macroeconomic level by abstracting from the degree to which the formal transfer of state owned productive capacity into private hands has taken place. The determinants of the growth trajectories of output, inflation and employment over time are: (i) the extent to which the old capital stock is economically obsolete (alternatively, the degree of centralized subsidization necessary to maintain the politically tolerable rate of unemployment), i.e. initial capital endowments. (ii) The willingness to endure or, on part of the government, to impose the socially undesirable consequences of large scale restructuring, including the bankruptcies necessary to adjust the old sector (alternatively, the ability to push for reforms), denoting also an extent to which (i) itself varies across different economies. And, capable of alleviating (i) and (ii) as well as gaining importance as time goes by, (iii) the growth rate of new capital formation.

To model the interplay of these forces in a way which explains the outcome of alternative constellation is the purpose of what follows.

2.1.2 Central Assumptions

Analogous to real world events, we perceive the onset of the transition period as a sudden disruption, changing the previous order for good. Time $t = t_0$ denotes the beginning of reforms.

We assume that at this point in time the essential characteristics of a market economy have been introduced as if by decree, i.e. in one strike. They mirror the requirements set forth in the early blueprints for reform. For our purposes, the most important among them are complete price liberalization, the transfer of all existing firms into private ownership, the opening of the economy for the unregulated exchange of goods, services and capital, and the announcement of a government budget.

The liberalization of prices, close to reality, is seen to affect all relative prices, including factor prices and the exchange rate. Privatization, though proceeding surprisingly rapidly in many instances, is a cumbersome process in reality. Often, it has resulted in the discussion of when and under which circumstances mass-privatization merely denotes a "change in name tag" – the very discussion which helped bringing the relative importance of the "old" and "new" shares of the aggregate capital stock to the forefront of attention. In this paper we wish to abstract from the intricacies of that process itself, in order to concentrate on the importance of the composition of productive capacity. We therefore proceed under the assumption that the complete inherited capital stock has, at t_0, been

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successfully transferred into private hands. We exclude government production.[11]

The economy is open and capital movements are not restricted. We do not explicitly consider the transfer of physical capital; and neither the popular issue of capital flight. (To incorporated either one would not force the analytical framework). Domestic savings at t_0, after the initial jump in the domestic price level associated with eliminating the monetary overhang, will be low. To take account of these stylized facts, the discussion in our model will concentrate on the determinants of net capital inflows, i.e. foreign direct investment. We do not explicitly model domestic saving rates (again, they could be incorporated without forcing the analytical framework).

The fact that the transition period arrived without warning means that the economy starts from an initial position of full employment. The number of existing ("old") firms is known to everyone, including the government, as is the size of the (fully employed) work force. We do not consider changes in the size of that workforce. Productivity levels across the segment of old firms are allowed to vary. Many of them are not productive enough to compete at living wages and world market prices. It is a central characteristic of our model that we allow for labor productivity to differ across firms, while we do not assume that the government knows this productivity distribution.

Under central planning non-profitable firms were subsidized, while profitable firms were subject to exhaustive profit taxation.[12] We assume that the government is aware of the fact that many of the inherited "old" firms are not competitive.[13] Since it does not know which firms would have to close without support, t_0 will be characterized by the existence of the old level of aggregate subsidies on the one hand, and by the break down of the mechanism to distribute subsidies (the old price system) on the other. It seems close to reality to translate this fact into the assumption that centralized subsidies will initially be distributed equally across the existing firms (for example through the old branch ministries).

As the transition gets under way, some firms will prove to be capable of "restructuring", i.e. of raising productivity by reorganizing the production process (though they need not automatically prove to be "willing" to do so). Others will enter the domestic economy's new markets for the first time.

The government's main objectives in this situation are easily defined, once we assume that it takes an active interest in the success of the transition. The desire to raise aggregate productivity to world market levels translates into the attempt to maximize aggregate output over time. Doing so, however, may be associated with considerable social costs. The authorities have to announce a budget which will make known the extent to which they intend to cut subsidization. But they can not be certain about the factual impact of

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[11]The approach may be conceptualized as the free transfer of all existing firms to insiders at t_0.

[12]At the arbitrary system of relative prices, meaning that those operating with a book-profit (loss) under central planning need not be identical to those which turn out to be competitive (or not) after the regime change.

[13]This is to assume that, because it knows the level of subsidization as well as aggregate output at t_0, the government knows the aggregate data relating to its economy's performance, but can not track this data on the micro level.

that announcement, since the initial distribution of productivities is not known. Subsidies can be cut on a sliding scale (from the initial hundred percent to zero), and some of the old firms may have to close down, while others raise their productivity by "restructuring", almost inevitably associated with shedding parts of the old labor force.

To secure its own political survival, the government has to be conscious of the level of unemployment resulting from its policy. Repercussions on the rate at which firms chose to restructure as well as effects on the rate of new investment have to be taken into account.

The main decision variable at the disposal of the central authorities is the latitude they have in scaling up or down the level of subsidies. However, governmental actions are subject to the constraint that the outcomes of its actions can not be calculated with certainty because it is less than completely informed about the structure of the economy. It may therefore have to "learn" by trial and error, while trying not to endanger its political survival.

To model this situation requests a precise definition of the agents and their options.

2.2 Firms

2.2.1 The Capital Stock: Old, Restructured and New Firms

As discussed, we distinguish three classes of firms:

- F_O denotes previously state owned and non-restructured "old" firms;

- F_R stands for previously state owned, but successfully "restructured" firms;

- F_N denotes the results of new (post-t_0) private investment, i.e. a segment of "new" private firms.

$F_O(t)$, $F_R(t)$ and $F_N(t)$ denotes the number of old, restructured and new firms at time t, with $t \geq t_0$, and
$$F_R(t_0) = F_N(t_0) = 0,$$
reflecting the assumption that the economy starts out with the complete capital stock inherited from central planning. $F(t)$ stands for the total number of firms at time t, such that
$$F(t) = F_O(t) + F_R(t) + F_N(t),$$
F^* denotes the initial number of firms at t_0,
$$F_O(t_0) = F^*,$$
and $F_O^{SD}(t)$ the number of old firms shut down at any point in time, denoting, together with $F_R(t)$, the "exit rate" out of the pool of old firms.

Let $L(t)$ denote aggregate employment at time t, and L^* the full employment of labor. Under the assumption of an unchanging labor force, we define

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$$L^* = L(t_0) \stackrel{\text{def}}{=} \sum_{i=1}^{F^*} L_O^i,$$

where L_O^i represents the labor force employed by the ith old firm. In general, we get

$$L(t) = \sum_{i=1}^{F_O(t)} L_O^i + \sum_{i=1}^{F_R(t)} L_R^i + \sum_{i=1}^{F_N(t)} L_N^i, \qquad (1)$$

denoting employment at any point in time t, where L_R^i and L_N^i signify the labor employed by restructured and new firms, respectively.

Putting to use the assumption of an unchanging total labor force, unemployment at time t is defined straightforward as the difference between L^* and $L(t)$,

$$UE(t) = L^* - L(t).$$

2.2.2 The Productivity Distribution Across Firms

The central characteristic distinguishing the three classes of firms is the productivity range associated with each class. We assume that the set of old firms in general will exhibit lower labor productivity levels than the set of restructured firms, although a range of productivity levels is attached to the firms comprising each class. We do allow for an overlap of productivity levels between both classes. It is reasonable to extend the assumption of differentiated productivities within each class of firms also to the set of new firms. We will further assume that the productivity of new firms in general is higher than that of the restructured (and old) firms, though we again allow for an overlap.

With ρ denoting the productivity of labor, we can formalize the ranking of the three classes of firms and the position of each firm within its class as follows:

1. Each firm is characterized, within its class, by its own productivity of labor, i.e.
   $\rho_O(i)$, $i = 1 \ldots F_O(t)$,
   $\rho_R(i)$, $i = 1 \ldots F_R(t)$,
   $\rho_N(i)$, $i = 1 \ldots F_N(t)$.

2. Firms are ranked with respect to their productivity within each class, i.e.
   $\rho_O(1) \leq \rho_O(2) \leq \ldots \leq \rho_O(F_O(t))$;
   $\rho_R(1) \leq \rho_R(2) \leq \ldots \leq \rho_R(F_R(t))$;
   $\rho_N(1) \leq \rho_N(2) \leq \ldots \leq \rho_N(F_N(t))$.

3. The classes themselves are ranked in the following way:
   $\rho_O(1) < \rho_R(1) < \rho_N(1)$.

The schedule below gives an idea of the distribution of productivities across all firms as it may result at any point in time after t_0, while the ranking of the three classes is maintained.
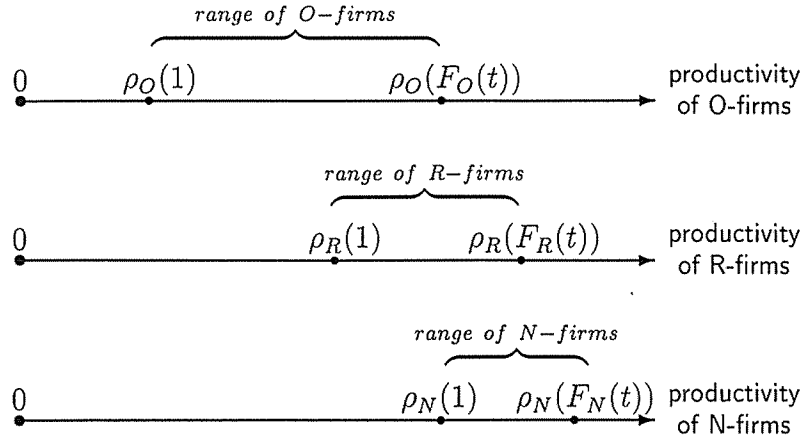
14

range of O−firms

$0 \qquad \rho_O(1) \qquad\qquad \rho_O(F_O(t)) \qquad$ productivity of O-firms

range of R−firms

$0 \qquad\qquad \rho_R(1) \quad \rho_R(F_R(t)) \qquad$ productivity of R-firms

range of N−firms

$0 \qquad\qquad\qquad \rho_N(1) \quad \rho_N(F_N(t)) \qquad$ productivity of N-firms

Fig.1. *Possible productivity distribution across firms after t_0.*

In line with the assumption that they are privately owned, firm's behavior will follow a pattern dictated ultimately by the maximization of profits. Before discussing the underlying technology or the range of options on which this behavior is based, aggregate output for he economy can be determined at any point in time:

$$Y(t) = \sum_{i=1}^{F_O(t)} \rho_O(i)L_O^i + \sum_{i=1}^{F_R(t)} \rho_R(i)L_R^i + \sum_{i=1}^{F_N(t)} \rho_N(i)L_N^i. \qquad (2)$$

2.2.3 The Decision to Restructure: A Simple Illustration

2.2.3.1 Production Technology

In order to clarify what exactly is implied by the notion of "restructuring", and also to take account of the peculiar structure of the capital stock under central planning, the production technology of old and of restructured firms is best described by a Leontief-type production function. Effective capital–labor ratios under this technology remain constant at alternative activity levels; firm size may vary. Capital goods, as well as output in general, can be understood as vectors of heterogeneous goods. For any firm under consideration, restructuring implies that the productivity of labor increases while firm size decreases. The decision rule is simple: Restructuring will take place if the present value of the stream of future profits after restructuring is larger than what would have accrued to the firm without restructuring, including the eventual loss of subsidy payments. If profitability is expressed simply in terms of output minus costs, and if firms are assumed to be risk-averse (i.e. they do not restructure if profitability is equal in both

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cases), we get for any firm i the condition

$$\int_t^\infty (Y_O^i - \text{Costs}_O^i + S(t))e^{-rt}dt < \int_t^\infty (Y_R^i - \text{Costs}_R^i)e^{-rt}dt.$$

A simple illustration helps to clarify the point. Suppose there exists a class of old and one of new firms, F_O and F_N where, just as described above, the productivity of the old firms is lower than that of new firms. The wage rate (w) is uniform, labor costs per unit firm size are given as (wc), output prices per unit firm size are defined as (pa). Firms, different in size, operate under a Leontief technology, i.e. the (effective) capital–labor ratio stays constant. They maximize output according to $y = a \min(\bar{K}, \frac{1}{c}\bar{L})$, such that $y = a\bar{K}$ and $L = c\bar{K}$. The capital unit can be normalized to one, i.e. $\bar{K} = 1$. In fig. 2, the coefficient denoting the inverse of the productivity of labor, c, is normalized to 1 as well.

The upper half of figure 2 depicts old (in the left segment) and new firms (in the right segment), ranked by their revenues. The left segment shows revenues increasing for old firms, as firms are ranked in order of increasing productivity per unit firm size; revenues per unit firm size decrease for new firms, ranked in order of decreasing productivity (right segment).[14]
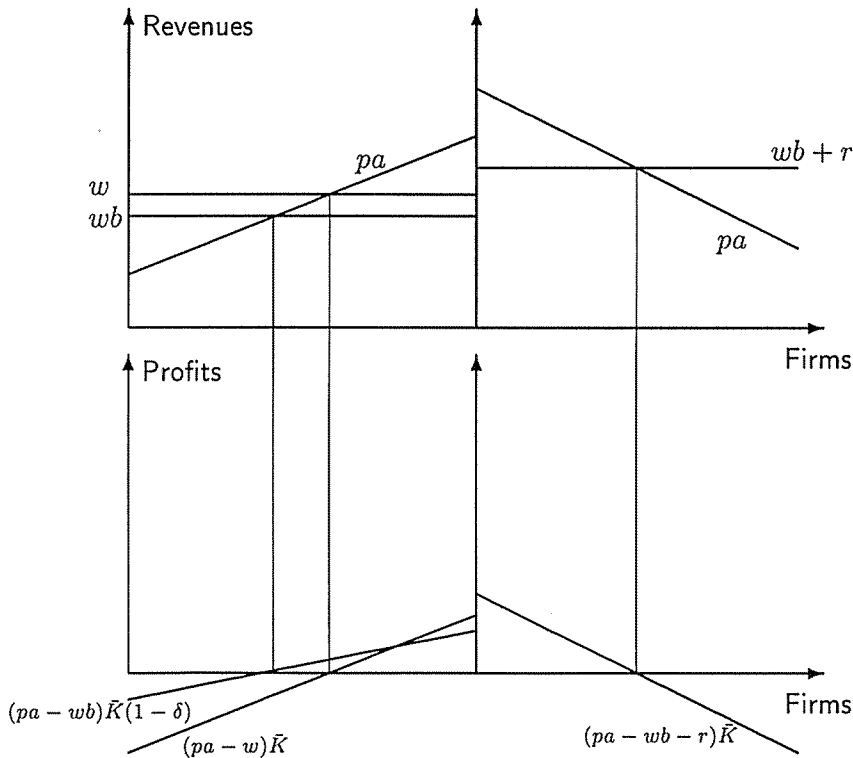

Fig. 2. Decision to restructure under Leontief technology.

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[14]To depict the ranking as a linear relationship is a matter of convenience, into that the productivity of old firms increases while that of new firms decreases along the horizontal axis.

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Successful restructuring can be depicted as the increase in output per unit firm size, associated with a decline in firm size. Subsidy payments alone would have to be conceived of as lowering unit wage costs to some extent b_s (not depicted in our figure, but with $b_s < 1$), while a remains constant. The left half of the lower segment, relating profits per unit firm size to firms ranked by their productivity, clarifies the simple effect subsidy payments alone would have on the old firms F_O, capable to survive in the market place: $(pa - w)\bar{K}$ depicts the profitability of these firms ranked in the same order as before (as a parallel line to pa). The introduction of subsidies would simply shift this line to the left, without changing its slope. The extent of this shift, expressing the increment of firms who's production now turns out to be profitable, would be determined by the degree to which the intersection wb_s/pa has shifted to the left of the old intersection w/pa. Another way of stating this same relationship is to lower the horizontal axis in the lower segment in figure 2, demonstrating the effect of cost-lowering *via* subsidization on the profitability of the non-restructured old firms.

$(pa - w)\bar{K}$ denotes the payoff function for old firms per unit firm size. Having inherited their capital stock from the centrally planned economy, and not being engaged in any restructuring activities, their costs are assumed to be comprised only of the wage bill.[15] However, this discussion merely captures the difference between F_O firms with and without subsidization, with subsidization denoted simply as a decrease in unit costs, affecting wages as the relevant cost factor. It does not capture the effects of restructuring as switching from one class of firms, F_O's, to another class, F_R's, with firms in this second class having successfully increased their productivity, while decreasing their size.

Restructuring as a change in firm size, associated with an increase in productivity per unit firm size (a change in effective output), is equivalent to a decrease in unit wage costs, which (in the upper left segment of figure 2) fall to wb (with $b < 1$). A depreciation rate measures the effect of the decline in firm size. Just as before, however, we assume that the existing capital stock has been inherited from the former economic regime, i.e. is available without cost. Thus, δ measures the depreciation rate of the old capital stock, or the scrapping rate, associated with the size adjustments necessary for restructuring. The pay-off function of restructured firms F_R then becomes $(pa - wb)\bar{K}(1 - \delta)$. The slope of the linear relationship between profits and firms productivities has decreased, reflecting the impact of capital scrapping, while the function has shifted to the left, reflecting the increase in the productivity of labor (the latter in the same fashion previously discussed for the case of subsidization).

In the same vain new firms F_N (right half of figure 2) have to be depicted not only as endowed with superior productivity per unit firm size, but also as having to occur capital costs – their capital stock, created by new investment, is subject to a rental rate r, which results in the pay-off function $(pa - wb - r)\bar{K}$ for that segment.

Thus, the profit functions for the three classes of firms are:

$\Pi_O = (pa - w)\bar{K}$,

$\Pi_R = (pa - wb)\bar{K}(1 - \delta)$,

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[15]Recall that w would have been changed to wb_s, i.e. amended by ($b_s < 1$), would subsidies be considered.

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$$\Pi_N = (pa - wb)\bar{K} - r\bar{K}.$$

2.2.3.2 Informational Requirements

The difficulties of depicting the "right" degree of subsidization can be illustrated within the same framework. To acknowledge the informational prerequisites, we mirror centralized subsidy payments as before, i.e. by shifting the horizontal axis of the lower half of figure 2 (left segment) downwards. We assume that only the non-restructured firms are eligible to receive subsidy payments and that subsidies are uniformly distributed across these eligible firms. Even in a comparative static exercise, the informational requirements to determine the optimal distribution of centralized subsidy payments across the old firms are, indeed, substantial (figure 3).
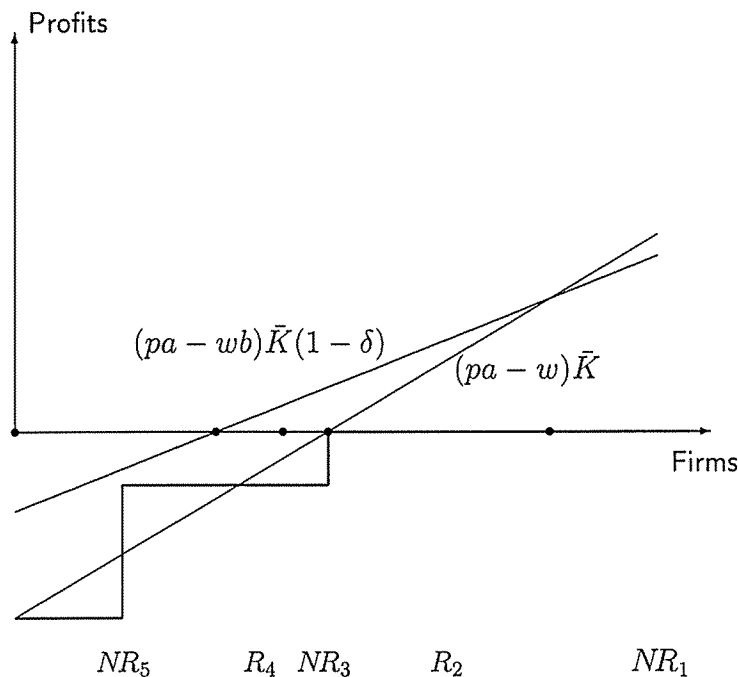
Fig.3. *Optimizing Restructuring under perfect information.*

Moving from right to left along the horizontal axis yields two segments where restructuring will at first not occur, and then will take place (NR_1), (R_2) – regardless of the level of subsidization: First old, non-restructured firms F_O are more profitable than their counterparts even without subsidies, and later the same holds true for the restructured firms F_R. After that we enter an interesting segment (NR_3) in which, even though restructuring would have been not only feasible but the preferred option were it not for the lure of subsidization, it will not take place *if* centralized support payments are present: Within that segment, firms reap higher benefits from accepting subsidy payments than economic profits had they engaged in restructuring activities, and therefore forgone these

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claims (recall that the slope of $(pa - w)\bar{K}$ is steeper than that of $(pa - wb)\bar{K}(1 - \delta)$). This situation reverses itself only at (R_4), and from some point onwards (the point of no return at which $(pa - wb)\bar{K}(1 - \delta)$ intersects the horizontal axis), the manipulation of subsidy payments will under no circumstances trigger additional restructuring (NR_5). Should, to the left of that cut-off point, the government decide to support certain firms, it will have to do so by subsidizing firms which would in no way be able to survive under free market conditions, and presumably at a rate higher than that paid in the rest of the economy.

This discussion does not address the role investment subsidies (i.e. the support of F_N firms) could play in terms of securing high output and employment levels without sacrificing productivity. But even without that complication, the illustration allows a glimpse on just how difficult it is to sustain the assumption that a government under "transition conditions" is, *even in the static context*, sufficiently well informed to optimize subsidy payments in a meaningful sense.

Much less ought the availability of the necessary information be assumed in the dynamic context. Here, strategic behavior can not be excluded. Strategic behavior on part of the firms can lead to results not qualitatively different from modeling a government which is less than perfectly informed (or which needs time to gather the information which in principle is available from the behavior of the agents in the the economy). The static example therefore does not only help to clarify the notion of restructuring employed in this paper; it also displays some of the reasons why we argue that the government should not be assumed to know the productivity differentials within different classes of firms.

2.2.4 To Shut Down or to Restructure: The Growth Rates of Old and of Restructured Firms

2.2.4.1. Subsidies and Expected Subsidies

In reality, restructuring is a costly and time-consuming process. To incorporate this fact into our framework without loosing the principle ideas discussed by means of figures 2 and 3, we depict the essential characteristics as follows.

First, the decision to restructure can be observed by the government and leads to the loss of all subsidy payments. Second, firms decide to restructure only if the discounted sum of future profits after restructuring exceeds what they believe would have accrued to them without restructuring (including anticipated subsidy payments). In the framework of our model, the decisive variable is the firm's labor productivity (ρ). In continuous time, the condition that has to be met for any single (old) firm i to engage in restructuring implies that labor productivity in the future is higher than it would have been without restructuring:

$$\rho_O(i) < \rho_R(i) \text{ at any time } t$$

(with subsidies being heeded in the manner previously discussed). Third, the fact that restructuring is costly has to be examined. The process of restructuring itself will not only take time but will also divert resources as the firm is preoccupied carrying out the

tasks of reorganization. Labor productivity should therefore be expected to first decline over some limited time horizon $\Delta_r t$, before it rises over and above the previous level $\rho_O(i)$:

$$\rho_O(i) < \rho_R(i) \text{ at any time } t > t^r + \Delta_r t,$$

where t^r stands for the moment in time when the decision to restructure is made. Note that in the general case $\Delta_r t$ itself will also be firm specific (but not necessarily related to initial productivity levels in any clear cut way). We assume firms to be risk averse, i.e. restructuring will only take place if the above statement is fulfilled.

It becomes clear now that individual firms' decisions to restructure will crucially depend on the level of subsidies dispensed by the political center – especially so under our assumption that only old firms will receive centralized support: Recall that the government, though unable to distinguish among F_O's, can observe preparations to restructure and will act to cut off all F_R's from centralized subsidization.

However, the level of subsidies is not the only variable that matters for the decision to restructure. Modeling the conditions of an economy in transition realistically requires to take account of the fact that present economic conditions may lead to adjustments of the pre-announced level of subsidies, that is to a *reversal* of the original budget announcement. Whether this is perceived as a result of successful pressure exercised by old firms *versus* the central government (an example would be the arrears crisis in Russia), or whether it is perceived as the government jockeying for public support by means of loosening its monetary or fiscal policies (as, for example, seems to have been the case in Hungary), does hardly matter: readjusting the previous level of subsidies upwards will almost always be the result of socially undesirable by-products of the movement toward a market economy. Most significant among them is an increase in the rate of unemployment over and above what is deemed politically tolerable.

Firms will therefore base their decision also on *expected* subsidies. The key observable variable determining these expectations will be the rate of unemployment. More precisely, it will be the interplay between the rate actually prevailing in the economy at any point in time, and the rate of unemployment which is deemed tolerable with respect to the political survival of those deciding about subsidization. The interplay between both rates will signal the extent to which the economy approaches problems which have the potential of triggering an (upward) *reversal* in centralized subsidization. The allotment of support will relate positively to a rate of aggregate unemployment approaching (and exceeding) the "tolerable" rate; firm's decisions to restructure, on the other hand, will be adversely affected by such an extent of open unemployment in the economy.

The shut down rate of old firms thus becomes a function of expected as well as actual subsidies

$$\dot{F}_O^{SD}(t) = f(ES(t), S(t)).$$

$S(t)$ is given at any moment in time by the last (the currently valid) government budget announcement $BA(t)$, and includes any eventual revisions of subsidy payments made in the course of earlier policy readjustments $S^{REV}(t)$. Expected subsidies depend positively on the difference between what we refer to as the rate of tolerable unemployment $UE^*(t)$

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and the rate of actual unemployment $UE(t)$. They diverge from actual subsidies to the extent that the rate of unemployment triggered by a particular level of subsidization differs from what is deemed politically tolerable. The judgment is made by the segment of F_O firms. The exact nature of this relationship, however, deserves a somewhat more elaborate analysis.

We first define the notion of expected subsidies employed in this paper, and then, by way of a short digression, discuss a possible extension. With respect to the first purpose, only the two notions of unemployment mentioned above need to be distinguished:

- $UE^*(t)$ is the *maximal tolerable rate of unemployment* at any moment in time. Note that, by making this rate a function of time, we explicitly allow for the fact that it may vary. We retain, however, the notion that the maximal tolerable rate of unemployment is known by all agents: Beliefs as to what is politically feasible in this respect develop in lockstep between firms and the government.

- $UE(t)$ is the *actual rate of unemployment*, as it exists in the system at any moment in time, simply demarcating the results of past developments, of current subsidies, and the degree to which, at any point in time, existing unemployment is absorbed by the growing segment of new firms, $F_N(t)$.

We define as the *latitude* of unemployment the degree to which actual unemployment diverges at any point in time from its maximum tolerable level:

$$U(t) = UE^*(t) - UE(t),$$

where $UE^*(t)$ is exogenous, i.e. $UE^*(t) = \bar{UE}^*(t)$, and $UE(t)$ is as previously defined, i.e. $UE(t) = UE\left[(S(t), \bar{UE}(t)), L_{FN}(t)\right]$ (with $L_{FN}(t)$ denoting the labor demanded by the increment of new firms F_N at time t).

Consequently, $U(t)$ becomes a function of the same parameters.

If $U(t)$ is negative, actual unemployment exceeds what is ruled tolerable. Consequently, actual and expected subsidies at time t will differ: Firm's expect future subsidy payments in excess of the current level, $((S(t) < ES(t))$. Under our specifications, firms expectations will be correct in the sense that the government is not able to sustain $U(t)$. Hence, if firms expectations *truly* reflect the nature of that constraint and if they know the structure of the economy as well, their expectations prove correct. The situation immediately translates expected future subsidy payments in excess of the currently valid amount into actual payments, i.e. into *an upward revision* of subsidization of exactly the expected magnitude.

Firms, which would be forced into bankruptcy by the initial level of subsidization will have all incentives to delay that bankruptcy in order to resume activities, if they have means to do so.

If, on the other hand, $U(t)$ is positive, the government has missed to implement the full array of cuts it could afford to make. Given its objective function, any situation in which the government does not experience problems stemming from the labor market in response

to actual cuts will be characterized by attempts to re-maximize, or by governmental attempts to "test the limits": It will reduce subsidies further in order to foster aggregate productivity by directly increasing the shut down rate of F_O's and the growth rate of F_R's and, albeit indirectly, that of $F_N(t)$ as well. Firms, knowing the government's objective function, will take account of that fact, and again expected subsidies will differ from actual subsidies at any point in time, in a well defined direction, namely $(S(t) > ES(t))$. Under our specifications (excluding cheating), firm's exceptions will again prove correct, and the currently valid subsidy level will be revised downwards to exactly the expected extent.[16]

Firms forced to close or to restructure under the currently valid rate of subsidization will have no incentives to delay.

Only if there is no room left to maneuver either way, will subsidies expected by firms at any point in time be in line with actual subsidy payments for that same period. As an equilibrium condition, we therefore get

$$ES(t) = S(t) \text{ if and only if } U(t) = 0.$$

Figure 4 depicts these relations.
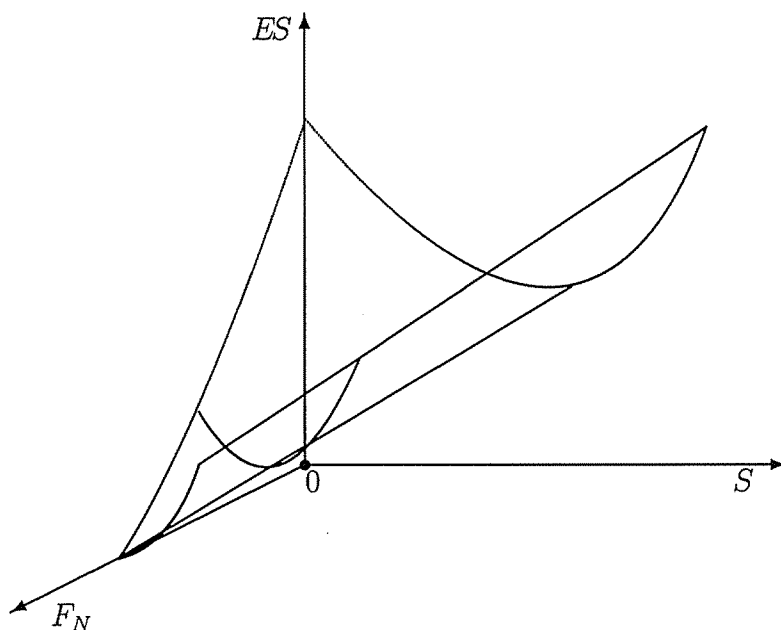
Fig.4. *The expected subsidies twofold.*

Expected subsidies have previously been defined as a function of current subsidies and

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[16]This, of course, is not meant to suggest that the adjustment will always be instantaneously. How many iterations it will take for the government to hit the right target will depend on the specification of the government' learning function. Note also, that the target might be "moving" itself – if $U(t)$ changes over time.

the latitude of the rate of unemployment:

$$ES(t) = ES(S(t), U(t)).$$

Since $U(t)$ is a positive function of $S(t)$ and of parameters either unrelated (past unemployment) to the current subsidy level or themselves a function of that level ($L_{FN}(t)$), we can now assert the precise nature of this relationship: Expected subsidies are monotonously decreasing in $U(t)$, and they will be a U-shaped function, first decreasing and then increasing, with respect to the second argument, $S(t)$ (see figure 5).
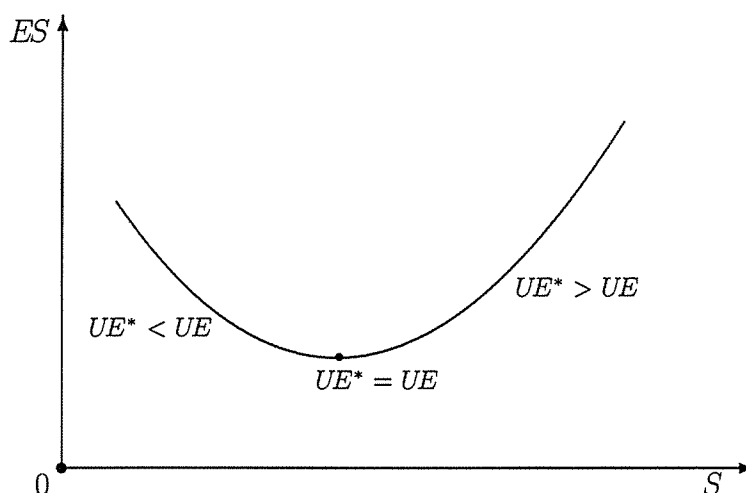
Fig.5. *Expected as a function of actual subsidies.*

The difference between expected and actual subsidies will first decrease and then increase as current subsidy payments become smaller: A decrease in the budget first increases the government's credibility to impose hard budget constraints and beyond some point weakens this credibility again due to the associated rise in unemployment.[17]

2.2.4.2 A Digression: Expectations and Tolerable Unemployment

It is also of interest to examine firm's expectations if they are forward looking, i.e. not based on the outcome of given government policies but themselves the result of having to forecast these policies – predictions, on which real variables in turn may depend. Two ways are conceivable: One, in which firms have forward looking expectations over an

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[17]The relationship between expected and current subsidies is discussed in more detail in Rühl, Serwin and Kejak (1995).

infinite time horizon, fixed at t; the other, where present outcomes may, along the way, interfere with past expectations, so that these have to be revised.

We maintain the notion of the "latitude" of unemployment $U(t)$; but now this variable also depends on *expected unemployment* at any point in time, $UE^{EXP}(t)$. Again, expected subsidies are a function of present subsidies and the latitude of unemployment.

But the latter is now defined as

$$U(t) = UE^*(t) + (UE(t) - UE^{EXP}(t)). \tag{3}$$

The first case just mentioned requires to conceive of expected unemployment as a function of the expected future impact associated with present subsidy cuts, corrected by the expected future impact of new investment. Relating to a single point in time, this translates into $UE^{EXP}(t) = UE^{EXP}(S(t), L_{FN}(t))$. To capture the notion that the whole interval has to be covered, that relation has to be transferred into

$$UE^{EXP}(t) = \int_t^\infty f(\dot{S}(t), \dot{L}_{FN}(t))dt.$$

The behavior of $U(t)$ can then be discussed as above.

However, it is not clear what the advantage of this formulation would be outside the expectational equilibrium (the correct forecast), and without an explicit mechanism relating firm's expectation formation to the government's reaction function. Without these additions, the argument tastes of circularity: expected subsidies depend on expected unemployment, and *vice versa*.[18]

The second approach is more promising. Analogous to macroeconomic models, expected unemployment ($UE^{EXP}(t)$) can be conceived as determined by past forecasts of present day's subsidies $S(t)$ and their interplay with the tolerable rate of unemployment today, $UE^*(t)$:

$$UE^{EXP}(t) = UE(t) - \lambda[(S(t) - S^{EXP}(t)) + (L_{FN}(t) - L_{FN}^{EXP}(t))].$$

[18]Re-writing the relation such as to cover the complete time horizon does not alter the argument. It does, however, represent problems, if firms expectations are specified as correct with respect to the level of subsidization currently announced, whereas the expectations of the future stream of subsidies (including possible re-adjustments on part of the authorities) depend on the government's reaction function. To specify the link to the reaction function (over the whole time horizon) becomes necessary. In addition, such a formulation requires the specification of the estimate old firms make with respect to the rate of new capital creation ($\dot{F}_N$). Only if firms have complete knowledge about the governmental reaction function (i.e. the government's up-dating procedure) and perfect foresight with respect to future capital accumulation will their anticipation over time ever be correct. But this is hardly convincing, given that the government may find it appropriate to proceed by trial and error. In all other cases a process of expectation formation for the old firms has to be specified.

It is, in our opinion, not obvious what would be gained from such an attempt, whereas it appears clear that realism suffers if correct expectations were to be legitimized for intertemporal predictions far into the future. In addition, the tractability of the model would be seriously impaired: yet another specification how firm's (in the case of less than perfect) expectations are formed would have to be introduced, without being able to avoid running into the problem of circular reasoning brought up in the text. In summa, the effort outweighs the benefits.

It follows that $UE^{EXP}(t) > UE(t)$ if $S(t) > S^{EXP}(t)$, and *vice versa*. Hence again, $U(t) < U^*$ in one case, and $U(t) > U^*$ in the other. (That subsidies and new investment are related by the same coefficient λ is not a necessary condition.)

An equilibrium position for $U(t)$ can thus again be established, at which $S(t) \overset{\text{def}}{=} S^{EXP}(t)$ and $L_{FN}(t) \overset{\text{def}}{=} L_{FN}^{EXP}(t)$: If expected subsidies are higher than actual subsidies, the latitude of unemployment is above the tolerable rate, hence unemployment is expected to increase, and *vice versa*. Expected unemployment now is a function of expected subsidies and new investment, while these expectations were formed in the past. The formulation has plenty of room for the usual assumptions about expectation formation – be they adaptive or rational.

However, for the peculiar coordination failures addressed in this paper, the formulation discussed by means of figure 5 appears superior, because it is more robust.

2.2.4.3 The Growth Rates of F_O and F_R

We also assume that a positive "market externality" is created by the presence of new and of restructured firms in the system. More precisely, the decision to restructure will be positively influenced by the share of already restructured firms, as well as by the number of new firms which have entered the economy.

Next to bankruptcies, the rate at which old firms decide to restructure determines the exit rate diminishing the pool of old firms. As briefly elaborated above, this rate again depends on expected subsidies on the one hand, and on the positive market externality created by new and already restructured firms on the other. We express this market externality as the share of the new and restructured firms out of the total:

$$\dot{F}_R(t) = f\left(ES(t), \frac{F_R(t) + F_N(t)}{F(t)} \right).$$

However, a *gradual* decline of the old sector, even in the face of allegedly fixed constraints, is a well known feature of transition economies. As a rule, and especially if alternative employment opportunities are absent, the employees of the old sector will prolong the necessary adjustment as long as possible. "Unemployment on the job" emerges as a common phenomenon under these conditions.[19] Experience seems to indicate that it remains possible to reactivate firms in the old sector for some time *after* the initial cuts (and the bankruptcies) have been announced, even if these cuts are of a magnitude which, if sustained, would force the enterprises in question to close down eventually.

We capture this tendency of the old sector to remain operative for some time after the shut down announcement has been made, i.e. the possibility of being *reactivated*, by allowing the segments in question to reopen over a limited time interval $\Delta_s t$. The extent to which this possibility will be used depends on whether bankrupt enterprises expect to become again eligible for subsidization.

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[19]The problem in reality is greatly aggravated by the fact that much of the "social safety net" – in fact, large parts of the tertiary sector – are provided by firms to their employees. Hospitals, day care centers, shops, even housing are but a few examples.

Restructured firms, subject to competitive behavior and cut off from subsidies for good, have no such possibility. By allowing for the possibility to revive old firms by means of reissuing governmental subsidization, we also have to allow for the possibility that this reversal of governmental policies may drive some of the firms out of business which, in response to the original budget announcement, have restructured successfully. But we do not allow the restructured firms to survive such an attack. However, if some of the old firms which had ceased operations effectively can be revived by a reversal of governmental subsidization policy, this reversal may force some of the newly restructured firms out of business, due to the new competition of heavily (higher than anticipated) subsidized old firms. Let, in this case of surprising policy variations, F_O^{REV} stand for the revived "old" firms. Then the growth rate of this segment is given by

$$\dot{F}_O^{REV}(t) = f\left(S(t), F_O^{SD}(t) - F_O^{SD}(t - \Delta_s t)\right),$$

and the rate at which restructured firms have to close down becomes a function of current subsidies

$$\dot{F}_R^{SD}(t) = f(S(t)).$$

New firms, on the other hand, which might be subject to the same competitive pressures than the restructured firms, following a reversal of governmental policies, are assumed to be kept alive by their owners: They are prepared to accept temporary losses to stay in the market, i.e. they can afford to consider the associated changes in subsidization a temporary phenomenon.

Collecting the different elements, we can derive the growth rate of the old sector as a positive function of actual subsidies, the rate of unemployment and the number of old firms capable of revival. Again actual subsidies and the rate of unemployment are understood to be the observable variables which determine expected subsidies from the point of view of the old sector:

$$\dot{F}_O(t) = f\left(S(t), UE(t), F_O^{SD}(t) - F_O^{SD}(t - \Delta_s t)\right). \tag{4}$$

Maintaining the notion that expected subsidies are a function of the observable variables $UE(t)$ and $S(t)$, the growth rate of the restructured sector is, next to these two variables, contingent only on the positive "market externality":

$$\dot{F}_R(t) = f\left(S(t), UE(t), \frac{F_R(t) + F_N(t)}{F(t)}\right). \tag{5}$$

The growth rate of F_R depends negatively on $ES(t)$ which increases with $UE(t)$. The difference between expected and actual subsidies will first decrease and then increase as the announced budget decreases, and it depends positively on the share of new and restructured firms.[20]

To sum up, any time the government announces its budget (the current value of $S(t)$), old firms have to choose among one of the following options.

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[20] As long as there is either unemployment or old firms which are less productive than the restructured firms (see the discussion of new firms below).

1. To continue operating without restructuring (i.e. to remain in the class of F_O firms without any change in ρ);

2. To restructure (move into the class of F_R firms by increasing ρ and decreasing employment and perhaps capital);

3. To shut down and cease operating (F_O^{SD});

4. To reopen and start operating again if they are still in the time interval where this is possible (if they are part of $\left(F_O^{SD}(t) - F_O^{SD}(t - \Delta_s t)\right)$ and if the announcement entails an increase in subsidization).

Restructured firms can only choose to continue operating or to shut down. Closure of a F_R firm is irreversible, even if it is the result of "temporary" competition by revitalized and heavily subsidized old firms.

The following figure illustrates the reversal of announced cuts in subsidization (with the segment of F_R's forced to shut down equivalent to those old firms which would have preferred not to restructure, had S_2 been announced at t_1).
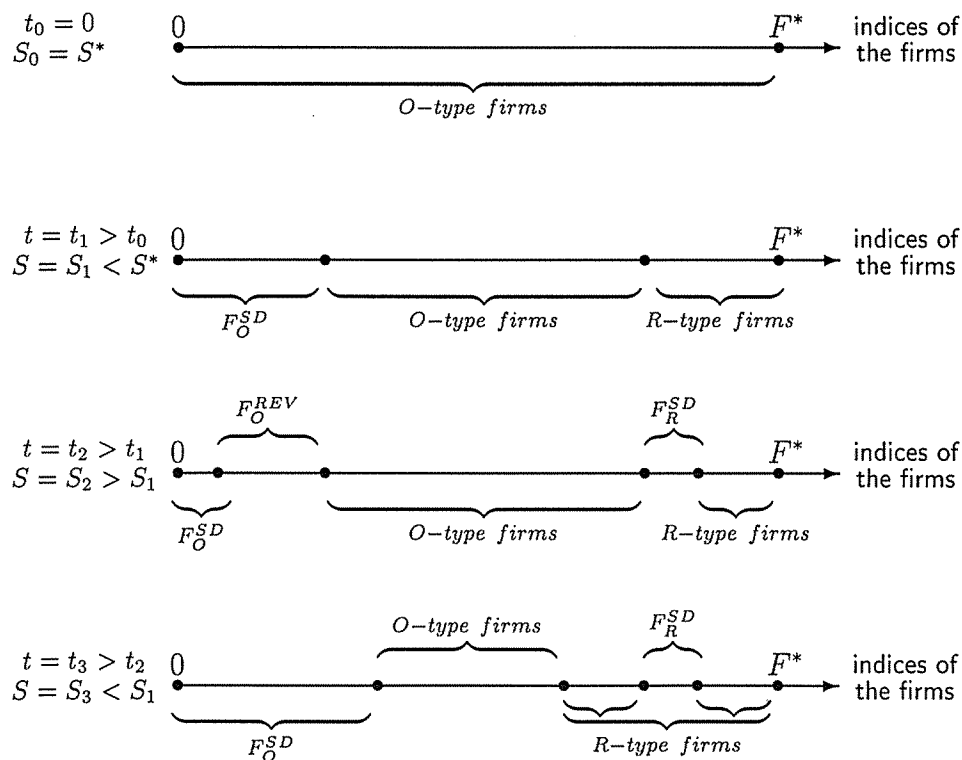

Fig.6. *Structure and possible dynamics of sectors F_O and F_R, following a reversal in subsidy payments.*

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2.2.5 The Growth Rate of New Firms

Finally we have to determine the growth rate of new private firms F_N. We conceive of new capital formation in the early stages of the transition as the result of capital inflows. Foreign investors, however, have limited information about the actual state of the transition economy. In particular, foreign (as well as domestic) investors have to form opinions about the credibility of reform. To do so, they have to rely on observable signals.

We assume that the decision about the rate of net investment is driven in the main by three different considerations:

a. The profitability of the investment;

b. The credibility of reform (which may include, for example, the protection of foreign assets);

c. Clustering, i.e. we assume that the amount of *other* foreign investors willing to enter the country in question matters for the individual investor's decision to do so likewise (we allow for the possibility of an "imitation" effect as providing a positive signal with respect to safety and profitability of the developing market).

The signals determining the growth rate of the new private sector are set accordingly.

Foreign direct investment is depicted, first, as a monotonously increasing function of the interest rate differential $(i - i^*)$, where i^* denotes the world interest rate and i the domestic interest rate, adjusted for a risk premium. It is, second, a function of the credibility of reform, i.e. the determination with which the government will stick to its announced budget in order to impose hard constraints. Outside investors may not be able to accurately observe eventual discrepancies between the actual level of subsidization and previous budget announcement. Hence they will choose the most likely (observable) proxy indicating government's reliability in this respect and this, we suspect, is the inflation rate π. Furthermore, the proportion of restructured firms $\frac{F_R}{F_O}$ ought to provide an observable indicator for the determination with which market reforms are pursued (it also, just as for F_R firms themselves, provides a positive market externality in that it helps expanding the market environment in which new firms can thrive).

But the willingness of new investment to enter the domestic economy will also depend on the number of other competitive firms acting likewise. Here two effects have to be distinguished: according to our hypothesis, any increase in the number of new private firms will at first tend to attract more private investment; on the other hand, the resulting increase in the new capital stock will decrease the marginal productivity of that investment and will therefore slow down the growth rate of the new private sector beyond some point.

The growth rate of F_N as a function of F_N thus can be depicted as follows:
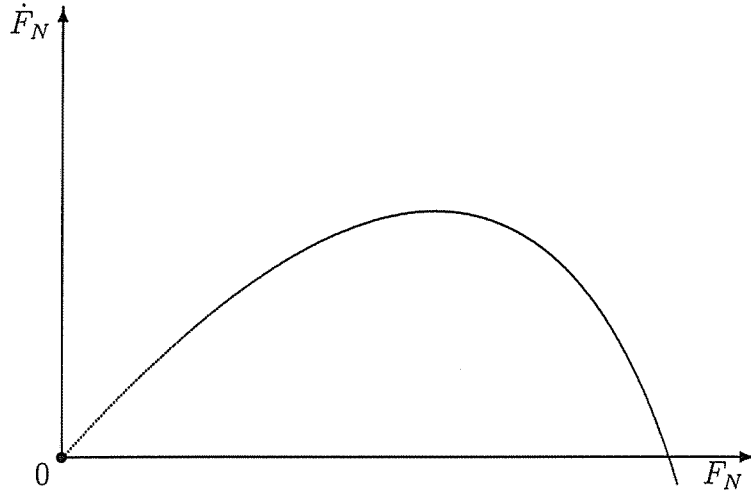
Fig.7. *Logistic-type growth rate of F_N as a function of F_N.*

It can be summarized as:

$$\dot{F}_N(t) = f\left(i - i^*, \pi, \frac{F_R(t)}{F_O(t)}, F_N(t)\right). \tag{6}$$

This function will be monotonously increasing with respect to the first and the third arguments, monotonously decreasing in the second, and first increasing and then decreasing in the last argument.

The growth rate of new firms is not exogenously bounded as long as there is unemployment in the system. If full employment has been reached but the new capital stock continues to grow, it can do so only at the expense of firms in the F_O or F_R sectors. Their profitability, in turn, depends on the government's subsidization policies.

2.2.6 Objective Functions of the Private Sector

We are now in a position to define the objective functions for the three classes of firms. All of them maximize profits over time, at any time t. In the most general form, this can be written as:

$$\max \int_t^\infty \left(\tilde{S} + P\tilde{p}\tilde{L} - w\tilde{L} - \tilde{K}\tilde{C}\right) e^{-rt} dt,$$

with respect to the quadruple $(\tilde{S}, \tilde{p}, \tilde{L}, \tilde{K}\tilde{C})$, the elements of which denote subsidies, productivities, labor and capital costs. The feasible set, again denoting the most general case, is limited to the four options available for the different classes of firms, namely

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1. – to remain an old firm:

$$\mathcal{O} : (\tilde{S} = S(t), \tilde{\rho} = \rho_O(i), \tilde{L} = L_0^i, \tilde{KC} \equiv 0), \text{– old firm}$$

2. – to join the class of restructured firms:

$$\mathcal{R} : \left(\tilde{S} \equiv 0, \tilde{\rho} = \left\{ \begin{array}{l} 0, \text{if } t \in [t, t + \Delta_r t] \\ \rho_R(i), \text{ otherwise} \end{array} \right. , \tilde{L} = L_R^i, \tilde{KC} = \delta K \right) \text{– restructured firm,}$$

3. – to start as a new firm:

$$\mathcal{N} : (\tilde{S} \equiv 0, \tilde{\rho} = \rho_N(i), \tilde{L} = L_N^i, \tilde{KC} = rK) \text{– new firm,}$$

4. – to join the group of firms to shut down:

$$\mathcal{S} : (\tilde{S} \equiv 0, \tilde{\rho} \equiv 0, \tilde{L} \equiv 0, \tilde{KC} \equiv 0) \text{– shut down firm,}$$

i indexes a firm within its class; and r is the interest rate.

Given this notation, the maximization problem for each type of firms can be expressed in the following way:

old firms $\max_{\tilde{S}, \tilde{\rho}, \tilde{L}, \tilde{KC}} \int_t^\infty \left(\tilde{S} + P\tilde{\rho}\tilde{L} - w\tilde{L} - \tilde{KC} \right) e^{-rt} dt,$

$$\text{s.t. } (\tilde{S}, \tilde{\rho}, \tilde{L}, \tilde{KC}) \in \mathcal{O} \cup \mathcal{R} \cup \mathcal{S};$$

restructured firms $\max_{\tilde{S}, \tilde{\rho}, \tilde{L}, \tilde{KC}} \int_t^\infty \left(\tilde{S} + P\tilde{\rho}\tilde{L} - w\tilde{L} - \tilde{KC} \right) e^{-rt} dt,$

$$\text{s.t. } (\tilde{S}, \tilde{\rho}, \tilde{L}, \tilde{KC}) \in \mathcal{R} \cup \mathcal{S};$$

new firms $\max_{\tilde{S}, \tilde{\rho}, \tilde{L}, \tilde{KC}} \int_t^\infty \left(\tilde{S} + P\tilde{\rho}\tilde{L} - w\tilde{L} - \tilde{KC} \right) e^{-rt} dt,$

$$\text{s.t. } (\tilde{S}, \tilde{\rho}, \tilde{L}, \tilde{KC}) \in \mathcal{N} \cup \mathcal{S};$$

shut down firms $\max_{\tilde{S}, \tilde{\rho}, \tilde{L}, \tilde{KC}} \int_t^\infty \left(\tilde{S} + P\tilde{\rho}\tilde{L} - w\tilde{L} - \tilde{KC} \right) e^{-rt} dt,$

$$\text{s.t. } (\tilde{S}, \tilde{\rho}, \tilde{L}, \tilde{KC}) \in \mathcal{O} \cup \mathcal{S}, \text{ if } t \in [t, t + \Delta_s t];$$

2.3 The Government

2.3.1 Information and Objectives

Two features have to be kept in mind when discussing the role the government plays during the transition to a market economy. The first relates to the fact that we discuss a "transition from above", i.e. the government is understood to be the player which drives the process. It's objective function implies that it uses all available tools to lift the economy into the warranted state of productivity. At the same time, it faces limitations created by the social consequences its action have for the electorate.[21] Under the hypothesis, central in this paper, that the government is badly informed, these consequences

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[21]This is to say that a government came into place that (a) realized that a centrally planned economy will exhibit productivity levels inferior to those achievable under competitive conditions; (b) that at t_0 this same government started to act accordingly, no matter what the general economic situation (or public opinion); while (c) we maintain the assumption that it is non dictatorial, i.e. has to take account of the repercussions its economic policies have for its own survival.

have to be relayed to it. More precisely, if the government is less than perfectly informed about the structure of the economy, it has to gather much of its information by gauging the results of past activities as the process unfolds.

The most important tool at the hands of the government to influence the relative shares of the three classes of firms is the amount of subsidies it pays to one of them. These subsidies, in turn, are collected through a variety of taxes, thus turning two classes of firms into net supporters of the least productive segment. Subsidization determines aggregate output, employment and productivity levels and therefore influences alternative growth trajectories once the transition has been started.

But while the government uses the subsidization tool to maximize output subject to the constraint of keeping unemployment at a tolerable level, it faces an informational problem, in that it doesn't know the exact productivity distribution across firms.

It knows the number of all firms F^* at the beginning of reforms t_0, but not the productivity ranking of any individual firm $\rho_O(i)$. It also knows the aggregate subsidies paid to firms under central planning. We denote that amount of subsidies as $S(t_0)$: at the beginning of reforms the economy is characterized by a certain amount of transfer payments the real value of which becomes obvious only once market pricing has been established (and the monetary overhanging eliminated).[22]

While thus, at t_0, the true value of the support required to maintain the old structure of production, as well as the level of (full!) employment associated with, is revealed, it is an indicator of the government's determination to carry through with reforms that it will not tolerate this amount of subsidies in the future.

We denote by $S(t)$ the amount of subsidies at time t, with $S(t) < S(t_0)$ for all $t > t_0$, indicating that the government is not willing to pay subsidies higher than $S(t_0)$ ever again: Subsidy payments will not increase above the initial amount once the transition is under way.

Though the government is able to observe preparations of firms to restructure or to shut down, and though it can track the number of new private firms, it is unable to recognize productivity differentials within the set of restructured firms F_R, once this segment starts to build up, just as it is unable to distinguish productivity differentials across the set of F_O firms. By the same token, it is unable to distinguish productivity differentials across new firms within the set F_N, once its policy starts to attract new private investment. But it knows that the productivity of F_R firms is generally higher than that of F_O firms, and the productivity of F_N firms higher than both of these, and it also knows the number of firms in each set (including the number of F_O firms which have shut down but can be revitalized).

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[22]Another way of buttressing this statement is to say that in a supply constraint shortage economy (with an arbitrary fix-price system) the real value of transfer payments can not be calculated, just as it is by no means obvious that under such a system real profits and losses (as opposed to mere accounting values) could ever be unambiguously established.

2.3.2 The Budget Constraint

Subsidies are paid to non-restructured "old" firms. Since their productivity distribution is not known, subsidies are uniformly distributed across these firms.[23] Let $s(t)$ stand for the sum of subsidies per firm, $s(t) \stackrel{\text{def}}{=} \frac{S(t)}{F_O(t)}$. Next to subsidy payments, the government faces expenditures only in the form of benefit payments to the unemployed. These aggregate welfare payments (or social costs) are denoted as $SC(t)$. They can be calculated as a fraction of the going wage rate w times the number of unemployed workers at any point in time $UE(t)$. In propelling the transition forward, attempts to minimize transfer payments $SC(t) + S(t)$ will help to balance the budget.

On the revenue side the government raises an income tax $\tau Y(t)$, where τ is a flat rate taxing the output of all firms to the same extent. We assume that the tax rate τ can not be increased any further, and that it will not be decreased as long as the rate of inflation is positive.

However, the government also has the possibility to finance part of its expenditures through seignorage, where $IT(t)$ denotes the inflation tax leveled at any moment in time, πm (with π denoting the rate of inflation and m real money balances). We do not exclude *a priori* the possibility that the government, when announcing its budget, plans to cover parts of its expenditures by means of the inflation tax $IT(t)$. We neglect, however, the time lag which in reality exists between the monetization of a government deficit and the observable inflationary consequences of the increase in the money supply. This implies that the inflationary effects will occur instantaneously, no matter whether parts of the deficit are monetized by design or whether an *ex-post* adjustment in subsidy payments or welfare expenditures has to be covered by an inflation tax higher than anticipated in the original budget announcement. It also implies that the amount of seignorage which can be collected has an upper bound.[24]

Seignorage and the inflation tax $IT(t)$, if positive, will be composed in part of anticipated expenditures and, whenever these occur, in part of unanticipated adjustments to the original budget. The linear relationship between government expenditures financed by printing money ($\frac{\dot{M}}{M} m$) and the costs in terms of inflation (πm) is assumed to be known to all agents.

Allowing for the possibility of a government surplus, the government's budget constraint in its most general form can be written as

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[23] The assumption of uniformly (if not randomly) distributed subsidies comes close to reality where, as for example in Russia, subsidies are still distributed *via* the branch ministries or if restructuring can be equated with successful privatization. In both cases subsidies will be paid more or less exclusively to "old" (i.e. non-restructured) firms and their distribution resembles a more or less uniform (random) process, disconnected from the productivity differentials across firms. But the assumptions made in the text, of course, can only begin to approximate the complicated bargaining processes which characterizes reality.

[24] $\pi m \stackrel{\text{def}}{=} \frac{\dot{M}}{M} m$ or, in continuous time, $\pi m = \frac{\dot{M}}{P}$, hence $\frac{\dot{M}}{M} = \frac{\dot{P}}{P}$, i.e the percentage rate of growth rate of the money supply equals the rate of inflation, or inflation tax and seignorage are equal. In the spirit of Cagan's model, inflation tax and seignorage are leveled in the steady state. In terms of the textbook "Laffer curve", we exclude situations to the right of the maximum seignorage possible.

$$S(t) + SC(t) \leq \tau Y(t) + IT(t).$$

The rate of inflation π thus is a monotonously increasing function of subsidies, and the nature of this relationship is known to everyone. The government observes only aggregate output, aggregate employment and the number of firms in each class. It can vary these magnitudes by varying subsidies, which in turn will result in observable changes of the remaining components of revenues and expenditures.

2.3.3 Competing Ends

Against this background, a government willing to support the transition is confronted with several competing ends.

1. It will first attempt to impose hard budget constraints, a task with two components: it has at any point in time to balance its budget as closely as possible to avoid the negative impact of high rates of inflation (among other things on new capital formation), while it attempts to decrease the amount of subsidization in the system to pursue its ultimate goal of increasing aggregate productivity. To this end it will have to minimize subsidies in the long run.

2. It has to minimize social costs, i.e. the welfare payments, associated with the transition for two reasons. First, there is the desire again to minimize expenditures and the inflationary impact of monetizing the deficit. Second, and of major importance, there is the effect large number of unemployed workers will have on its capacity to survive: we have assumed a non-dictatorial government, subject to periodic re-elections. It is central to this model that unemployment beyond some level will not be tolerated by the electorate, and that *everybody in the system knows that.*

   The government, in other words, faces a real constraint in its pursuit of improvement in that it can not allow the rate of unemployment to increase beyond the tolerable limit. Everybody else knows the fact *and* the limit. Because it is ill informed with respect to the productivity differentials within each class of firms, it can not gauge the impact of its policies with certainty. Firms, on the other hand, do not only know the employment constraint faced by the political center. They also know the structure of the economy in detail, i.e. the productivity differentials unknown to their counterpart. They can estimate the precise impact of any governmental action with certainty (safe for the growth rate of F_N).

   The decisive variable in this setting becomes the consequence of variations in subsidization on aggregate productivity, that is, on the relative weights of the different categories of firms and, by the same token, on the rate of unemployment in the economy as a whole. The informational differences between firms and the government lead to interaction on two distinct levels, driving the strategic behavior of both groups: Firms of the F_O and F_R classes anticipate correctly the impact any

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variation in subsidy payments will have on the two exit rates out of the pool of F_O's (and later also on the survival rate of F_R's and, therefore, on the unemployment rate). Clearly, a cut in subsidies associated with employment consequences close to what is deemed improbable for governmental survival, will result in the knowledge that this policy is not sustainable and will have to be reversed: One of the immediate consequences is a refusal to engage in restructuring on part of those F_O firms who could do so but will not, in the light of the expected upward adjustment of subsidization. The government, on the other hand, will have no choice but to follow up on his initial estimate at t_0, in a trial and error procedure. It has to implement policies (using the variations in centralized subsidies as its strategic tool) and has to update its prior as the results come in, to implement further steps conducive to its goal.

That is to say that even before introducing the complications of *new* capital formation, the situation is characterized by informational asymmetry, understandable also as an asymmetry in goals (with the government maximizing output and firms interested in employment) which might ring familiar: the hardening of budget constraints shows at its heart a conflict of interests.

3. In principle, this leads to a problem which we have avoided by assuming that the government is accountable to democratic legitimization: it is conceivable that under different circumstances different governments will maximize output with respect to different time horizons. While this could be addressed by attaching different weights to the government's objective function, accounting for different segments of the time horizon, we will instead assume that the government maximizes output *at each point in time*, starting from t_0 until the transition process is concluded.

4. It hardly deserves mention that output, in this scenario, becomes the variable to be maximized by a government interested in supporting the transition to a market economy. If this interest is derived from the higher productivity levels attainable under a competitive regime of private ownership than output, given the size of the work force, becomes the variable of choice. The inducement to restructure, the closing down of non-competitive enterprises, to attract new private enterprises as well as the productivity enhancements these imply can be subsumed under the objective of output maximization. The constraints of this maximization are derived from the interests of those likely to be the victims of too rapid a pursuit of reforms – at least as long as no sudden and unexplained burst of capital accumulation occurs, over and above what the impoverished domestic economy is able to accomplish by means of its own resource allocation.

We derive the government's objective function as

$$\max Y(t)$$
$$\text{s.t.} \quad S(t) + SC(t) \leq \tau Y(t) + IT(t).$$

2.4 Intertemporal Coordination

2.4.1 The Unemployment Constraint

To model the conflicting interests inflicting upon economic policies aimed at supporting the transition calls for a formulation of the interaction between governmental subsidization, the pre-announced budget, and the reaction of the government if it discovers that its policies did not generate the warranted results.

The budget is always "balanced", if only in the sense that expenditures in excess of output tax revenues are compensated for by seignorage. Let us also suppose that the ability to raise seignorage has not yet been exhausted (the economy is below the upper bound limiting the capacity to tax by raising the rate of inflation). The income tax rate τ is fixed, and so is b, the fraction of the going wage rate paid out as unemployment compensation. In line with our earlier assumptions, subsidies are distributed uniformly across old firms; real money balances are constant. Under these circumstances we can reformulate the governmental budget constraints as follows:

$$
\begin{aligned}
S(t) &= s(t)F_O(t) \\
&= \pi(t)\frac{M}{P} + \tau \left(\sum_{i=1}^{F_O(t)} \rho_O(i)L_O^i + \sum_{i=1}^{F_R(t)} \rho_R(i)L_R^i + \sum_{i=1}^{F_N(t)} \rho_N(i)L_N^i \right) \\
&\quad - bUE(t).
\end{aligned}
\tag{7}
$$

This formulation allows for a first and preliminary discussion of the dynamics of intertemporal coordination. With $\frac{M}{P}$, τ and b fixed, the interaction triggered by the behavior with respect to $S(t)$ will affect the rate of inflation, the relative weights of F_O, F_R and F_N, and, through shifts in these weights, unemployment $UE(t)$ and aggregate output $Y(t)$ *before* possible repercussions on the rate of inflation, the entry of new firms, and therefore again on aggregate output and unemployment have to be considered.

Any change in subsidies will directly affect the number of old firms: A decline in subsidies will lead to the closure of some and the decision to restructure of others (just as an increase, once the transition is under way, may lead to the re-activation of old firms in the segment $[t, t + \Delta_s t]$ and the closure of a fraction of the restructured firms F_R). Concentrating on the decline in subsidies, the further consequences are straightforward: Both the closure of some firms and the restructuring decision of others will increase unemployment, but the associated losses in output are at least partially compensated for by productivity increases derived from the increase in the number of F_R's. The final outcome will be contingent on the growth of the class of new firms F_N, which follows its own laws of motion: Foreign direct investment depends on the inflation rate determined by the initial budget, the credibility of reforms (the weight of F_R) and the overall perception of success (the total number of F_N's willing to enter the market). Note the element of path-dependency even in this preliminary discussion: those who have will gain more – a successful economy in transition (relatively many restructured firms and attractive to foreign investors) will benefit from additional capital accumulation unrelated to its initial conditions.

Tension arises if the government miscalculates the effect of its policies. Suppose the announced budget would lead to a rate of unemployment deemed non-sustainable. Consequently, the share of old firms willing to shut down or restructure will decline, in proportion to the extent to which they (correctly) anticipate that the government will have to back track. The process is best depicted in terms of the infamous arrear crisis, with firms accumulating inter-enterprise debt in order to sustain production, knowing or anticipating a government directed bail out, usually by means of extending central bank credit, i.e. by money creation.

However, we also allow for firms who can not sustain operation in the long run without governmental support to temporarily maintain their existence without such support, if they anticipate a reversal of subsidy payments. In a real world scenario, this segment may continue low level production without restructuring, so that the resulting increase in unemployment will be lower and output higher from what both would have been, had the cuts effectively materialized. Indirect consequences with respect to new capital formation are present as well.

As time goes by, the government corrects initial mistakes by re-adjusting subsidy payments – in the most obvious example by re-adjusting upwards until it hits the tolerable unemployment level. By virtue of the simplicity of our underlying assumptions, this is congruent with old firms' expectations. We maintain the assumption that old firms possess complete knowledge about the old economic structure, but will later investigate alternative possibilities with respect to the government's – the "blind man's" – ability to learn.

By bailing out some of the firms which have refused to close or to restructure (or closed down within the relevant period $[t, t + \Delta_s t]$) the political authorities trigger a chain of events upsetting their previous plans: the inflation rate will go up, affecting the increase in the number of new firms, the number of restructuring firms may decrease (and the number of "active" old firms increase), the rate of new firms will change.

2.4.2 The Growth Rate of Subsidization

The basic elements of the process just discussed will not change, once it is depicted as taking place in real time:

$$
\dot{S}(t) = \dot{\pi}(t)\frac{M}{P} + \tau\frac{d}{dt}\left(\sum_{i=1}^{F_O(t)} \rho_O(i)L_O^i + \sum_{i=1}^{F_R(t)} \rho_R(i)L_R^i + \sum_{i=1}^{F_N(t)} \rho_N(i)L_N^i\right) - b\dot{U}E(t). \tag{8}
$$

Note the central role of one signal in particular. Old firms will decide on whether to "obey" the proposed policies , i.e. will base their decision about the credibility of the government's policy on the potential impact of this policy on the rate of unemployment. That is to say that both exit rates out of F_O are based on the potential impact of the budget on the rate of unemployment. At the same time, the potential threat stemming from a "wrong" level of unemployment ultimately induces the government to change course. The entry rate of new firms seems not directly affected by all this, but it obviously

is affected by changes in variables which are themselves the result of policies based on the impact of unemployment. The rational for the indirect relation is straightforward: new firms' knowledge of the existing economic structure as well as of the behavior of economic agents is limited. Inferences have to be drawn from observable signals, such as the inflation rate and the relative weight of the restructured sector. These signals are the result of the interaction just described and they therefore mirror the importance attached to the level of employment. In this sense, the new firms' entry rate at any point in time is more than a determinant of (un)employment: it depends on the prior development of employment as well.

We summarize that importance in a preliminary way by emphasizing the level of subsidies as the tool used by the most important player pushing for reform, the government. We shorten the dynamic version of (7) and bring it into a form expressing the dependency of the centralized decisions to subsidize on the unemployment rate, and also capturing the speed with which the government is capable of re-adjusting its policies. This yields:

$$\dot{S}(t) = -\alpha S(t)[UE^*(t) - (UE(t) + UE^{EXP}(t))]. \tag{9}$$

The growth rate of centralized subsidies $\dot{S}(t)$ is contingent on the difference between $UE^*(t)$ and $UE(t)$. α (with $0 \leq \alpha \leq 1$) is a coefficient capturing the speed with which the government is capable of adjustment (setting it equal to one would depict the immediate adjustment characteristic for a government operating under rational expectations and complete information); $UE(t)$ is the rate of unemployment at time t; $UE^{EXP}(t)$ is the rate of unemployment expected to result from the current budget announcement (which, under previous assumptions, coincides with the rate resulting from that announcement); $UE^*(t)$ is the rate of unemployment deemed tolerable at time t. The subscript t denotes the fact that, even if this estimate is always shared by firms and the government, there is no reason to believe that it will remain invariant over time. Much evidence suggests that what may be judged a "natural" rate of unemployment by the public differs widely over time, contingent on the general state of the economy as well as on other factors.[25]

There are essentially three ways in which policy, understood as attempts to derive the output maximizing subsidy level, will effect the system as a whole. It may be designed in such a way as to exactly hit the upper bound, i.e. the rate of unemployment deemed tolerable. It may undercut UE^* in such a way that the subsidy payments entailed in the budget announcement are "too high", thus affecting negatively the objective of output maximization by limiting the amount of restructuring in the system. Or it may be "too low", with the opposite consequences. Only in the first case will subsidies be paid which are optimal in that they obey objective function, including its options to attract new capital formation.

This case, however, seems highly unlikely – especially if the more realistic assumption is introduced that the "blind man" learns gradually and that this process may never be

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[25]However, $UE^*(t)$ should not b taken as simply another variant of the NAIRU concept. Under conditions typical of transition economies (the absence of developed capital markets) even a hefty cut in the budget may be accompanied by inflationary financing of the remaining expenditures.

quite complete. As the result of a less-than-perfect error correction mechanism, or of information processing facilities short of perfection, the allotment of subsidies is likely to overshoot or to fall short. The subsequent adjustment itself may again be subject to under- or overshooting, creating unforeseen consequences for the aggregate, and repercussions which may render the development of the system instable.

Both cases can be discussed under the assumption that the transition is already under way, i.e. the aggregate capital stock is composed of firms of the F_O, F_R, and F_N types. Suppose first that the announced subsidy payments fall short of what is deemed politically tolerable.

In this case, the number of F_O's threatened with foreclosure is associated with an intolerably high rate of unemployment. Combined with whatever unemployment already exists at that moment, firms draw the (correct) conclusion that the announced cuts can not be sustained $((UE(t) + UE^{EXP}(t)) > UE^*)$. Consequently, a number of F_O's continues to operate temporarily, and without governmental support (F_O^{SD}). The resulting political pressure leads to bail-outs and, assuming that the government has exhausted it tax revenues (i.e. kept the planned budget balanced) and can be forced to make concessions, it will lead to money creation as soon as the threat of social unrest is made transparent.

Two sub-cases have to be distinguished, allowing for a government either slow in processing the correct information, or unable to access all information completely. The not-budgeted *ex-post* increase in subsidies may be higher or lower than what is required to satisfy firms' (still correct) expectations. Each case will trigger repercussions capable of altering the growth path of the economy.

In both subcases inflation increases, though at different magnitudes, hampering the growth rate of new firms. If the adjustment is characterized by undershooting, some of the F_O's holding on so far will have to go out of business. More will be forced to restructure than would have otherwise, leading to the need of further re-adjustment on part of the government.[26]. The increase in the ratio of restructured to old firms, as long as the net-effect is positive indeed, will lead to increased investment of new capital. The consequences of "overshooting", following an initial overestimation of the extent to which subsidies can be cut, can be modeled analogously.[27]

Any decline in subsidy payments along the way will result initially in an increase of the segment of restructured firms. Together with the proviso that, opposed to their non-restructured "old" colleagues, these firms are not capable of temporarily surviving bankruptcy, this leads to the result that the government will, under conditions of unemployment, *never* be capable of re-approaching the level of employment prevalent when the "too low" budget announcement was made, no matter how high the subsequent upward

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[26]Note that this effect may partially be compensated for by the possibility that some F_O's which shut down prior to the currently valid budget are revived; it may be hampered by the possibility that some of the already restructured F_R's may be forced out of business

[27]They are: direct effects on aggregate productivity and employment contingent on the number of revitalized F_O's (and, possibly, the number of eliminated F_R's) as well as on the rate of inflation; followed by the indirect effects which the new ratio of restructured to old firms, the inflation rate, and potentially the risk premium, will have on the growth rate of new firms.

readjustment: Even if all the F_O^{SD}'s could be revived in time, some F_R's will remain as a result of the initial cut. They can not reverse themselves back into F_O's. As a consequence, any attempt at starting the transition by hardening the constraints of the economy will lead to a level of unemployment which can not be compensated for *by the segment of inherited firms alone.*

A government steering the economy toward free market structures, and maximizing output as the means to achieve this end, will *nolens volens* end up with creating unemployment – just as a government under central planning, maximizing employment, ended up with less output than it could have gotten under the opposite economic regime. The old saying that, under socialism, "we pretended to work while they pretended to pay us" is as correct as its modern add-on, presumably associated with an insufficient endowment of capital in transition economies – the "now, no one is pretending anymore" variant one hears today.

The only variable capable of rectifying this dilemma is the growth rate of new private firms F_N. It is conceivable, that even under conditions such as just sketched, a large inflow of new capital comes to the rescue in the sense that the unemployment created by the policies of cutting subsidization will be absorbed by new capital formation. Note, that this case intuitively becomes the more likely the lower the existing degree of unemployment: Given the rates of output taxation and welfare compensation, a tough budget policy is most likely to have desirable effects on most of the variables which determine the growth rate of new firms: It stabilizes the rate of inflation, increases the $\frac{F_R}{F_O}$ ratio, and does not unduly depress the perceived profitability of the transition economy, aside from the effect an extension of the new capital stock has on its marginal productivity.[28] The contingency of new investment on the total number of investors planning to enter the respective market, finally, just re-confirms the experience that transition economies already on the road to substantially renewing their capital stock are, everything else equal, also most likely to profit from the self-enforcing feedback mechanisms governing the course of events. The better off in terms of attracting new private investment they are, the more likely, *ceteris paribus*, that they will continue to outperform others.

However, to conclude from the foregoing the advocacy of a simple policy of minimizing subsidization as radically as possible would be a misperception. For the above statement is subject to a most decisive caveat: It can be supported only as long as governmental policies are not subject to continuous realignments. If they are, the more often such readjustments occur, the more unpredictable the outcome also for the creation of new capital formation, along the more or less indirect lines previously discussed, with potentially destabilizing and conceivably even devastating consequences for economic growth.

The case in which the government cuts subsidies "too little" can now be discussed in quite an analogous fashion. Again, the first consequence stems from the impact such a policy has on the shift of firms between their respective categories: Not only would the growth rate of F_R's be adversely affected, while the number of F_O's would remain

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[28] In the short run, such a policy might reasonably well be expected to lead to an increase in profitability by diminishing the risk premium attached to any such investment, whereas the marginal productivity problem presumably becomes important at a much later stage.

comparatively speaking "too large"; but this composition, viewed in isolation, would in turn trigger adverse effects with respect to the growth rate of new firms so essential for success – through the route of a relatively low $\frac{F_R}{F_O}$ ratio, and through potential side effects on the rate of inflation, if changes in the income tax rate are exhausted. As a consequence, not only aggregate productivity but also aggregate output will suffer. Overall, targeting subsidies "too high" has the following immediate effects: A diminished exit rate (to both possible destinations) from the pool of F_O's; a higher rate of inflation than otherwise; and indirectly, adverse effects on the growth rate of new capital formation. Then effects prompt the government into "testing the limits" again, i.e. into tightening the budgetary reign.

2.4.3 Alternative Growth Trajectories

In a world as complicated as the one depicted here, it proves helpful to classify alternative growth trajectories by means of alternative scenarios. The option becomes all the more attractive in anticipating the simulations, aimed at calibrating alternative outcomes, to which this model easily subjects itself.

We thus define the following benchmark scenarios, distinguished by the "attitude" of the government, or by its degree of decisiveness. These scenarios can be extended to capture differences with respect to the speed with which the government learns, or the degree to which it is capable of collecting the relevant information from the behavior of the private agents it observes. Three scenarios may provide the background for such an exercise:

1. An *aggressive* government, willing or capable of taking a high risk in order to push forward with reforms. As in any other variant of our model, it will maximize output. However, the constraints in terms of the rate of unemployment it is willing or able to tolerate are relatively minor. Consequently, starting from the same initial situation, it will act by imposing hard constraints faster and cutting subsidies deeper than in scenarios 2 and 3 – though it may be subject to the same probability of over- or undershooting (also of correcting its mistakes) as in the others scenarios.

   The familiar J-curve trajectory, as a result, ought to look steeper, while the process of transformation at the same time will end faster.

2. A *neutral* government, representing a degree of tolerable unemployment in between scenarios 1 and 3.

3. A government which is *risk averse* or faced with very low tolerance levels as far as the unemployment rate is concerned which results from its policies.

Note that the economic systems can be identical in all three cases, including their initial situation and the government's objective function. The only observable difference is the numerical value computed for UE^*.

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To conclude this experiment, however, also requires the computation of alternative reaction functions. These functions (or what above has loosely been denoted as α) may differ

1. With respect to the speed with which the available information is processed (the speed of adjustment, i.e. the number of iterations necessary to correct any given mistake).

2. With respect to the amount of information the government is able to collect from the behavior of private agents in any given situation (i.e. the degree of its ignorance when updating its beliefs).

It is possible to combine different degrees of governmental learning, information gathering or updating with each of the three scenarios. But this would defy one preliminary but important aspect of the broader questions we are interested in. This aspect asks whether the situation a government finds itself in (e.g. the extent to which its population is prepared to suffer or the degree of freedom it has in exercising more or less restraint) will significantly alter the path of reform if its capability to gather and to process information are the same. One question, in short, is whether and to what extent alternative degrees of governmental independence account for the alternative outcomes we observe in the world we live in.

3 A Simple Mathematical Treatment

3.1 Central Assumptions

To investigate the dynamics discussed we specify a highly simplified version of the basic model. The state variables of the system are: $S(t)$, $F_N(t)$, $F_R(t)$, $F_O(t)$.

However, $F_O(t)$ is defined by using the number of shut down firms F_O^{SD} of that sector, such that, given F_N, F_R, F_O^{SD} and F^*, F_O can be determined as the residual.

To simplify the analysis, while keeping track of the qualitative properties of the model, we introduce several simplifications:

- We reduce the set of firms within each class to one representative firm. These three representative firms are denominated in terms of employment.[29] We denote the labor size of each representative firm as $L_O(t)$, $L_R(t)$ and $L_N(t)$. $L_O^{SD}(t)$ stands for the size of the fraction of the representative old firm which shuts down, with $UE^{SD}(t) = L_O^{SD}(t)$ denoting the unemployment created by shutting down that fraction.

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[29] With respect to the general notation of the previous section, i.e.

$$L_O(t) = \sum_{i=1}^{F_O(t)} L_O^i, \quad L_R(t) = \sum_{i=1}^{F_R(t)} L_R^i, \quad L_N(t) = \sum_{i=1}^{F_N(t)} L_N^i,$$

we can switch from analyzing the dynamics of any number of firms F_O, F_R, F_N to the analysis of the labor size of one representative firm in each class, without affecting the properties of the model.

- We assume that within the class of F_O the ranking of firms with respect to their productivity is linear, i.e. the productivity differentials across firms in the old sector are the same. That also implies that restructuring results in a fixed improvement of productivity such that the productivities of all restructured firms are changed by the same coefficient.

- Productivities of the old, restructured and the new representative firm each vary with the size of the firm. This is, because ρ_O is a monotonously decreasing function of the difference between L_R and L_O^{SD} (shutting down the least productive segment of the representative firm increases the average productivity of the remaining part of that firm, and restructuring of the most productive segment decreases it). In mathematical terms, $\rho_O = \rho_O(L_R - L_O^{SD})$, $\rho_O'(L_R - L_O^{SD}) < 0$.

  The productivity of the representative restructured and the representative new firm is also a decreasing function of the size of that firm due to decreasing marginal productivity in the case of the new firm, and, in case of the restructured firm, because, as parts of the old capital stock are forced to restructure, less productive segments are added, i.e. $\rho_R = \rho_R(L_R)$, $\rho_R'(L_R) < 0$ and $\rho_N = \rho_N(L_N)$, $\rho_N'(L_N) < 0$.

  However, we maintain the general characteristic that

  $$\rho_O(L_R - L_O^{SD}) < \rho_R(L_R) < \rho_N(L_N),$$

  without allowing for productivity overlaps between the three representative firms.

- The old as well as the restructured firm possess perfect information about the structure of the economy. Therefore, expected subsidies will not diverge from actual subsidies ($ES(t) \equiv S(t)$), and firms notion of the tolerable rate of unemployment ($EU^*(t)$) will be correct. So will be their translation of current subsidies into unemployment. Furthermore, we assume that the tolerable rate of unemployment is exogenously given at t_0 and that it does not change over time.

- Restructuring will never take place over and above the limit set by calculating the amount of restructuring forthcoming if subsidy cuts lead exactly to UE^*: The old representative firm is supposed to estimate the consequences of subsidies at any point in time correctly, so that restructuring can not be enforced over and above that limit. As a consequence, reversals in subsidy payments, no matter of which magnitude, can never yield the shut down of the firms which took the decision to restructure. The possibility of a negative growth rate of the F_R sector thus remains excluded.

- The time horizon $\Delta_s t$ within which the revitalization of the shut down segments of the old capital stock was deemed possible, is extended to infinity. The time horizon necessary for the benefits of restructuring to occur, $\Delta_r t$, is set to zero: all shut down segments of the old sector can re-open, all restructuring becomes effective immediately, and the restructuring segment will not shrink.

- Finally, making the rate of inflation π a monotonously increasing function of subsidy payments leads to a drastic reduction of the model's complexity. This way, any influence exercised by the social costs $SC(t)$ (a function of unemployment) and the output tax rate τ (with the sum of tax revenues a function of output) on the budget and hence on the rate of inflation is neglected.[30] The assumption also leads to the exclusion of any potential *negative* impact that high rates of inflation may in reality exercise on the growth rate of the accumulation of new capital. In fact, the budget constraint depicted in part 2.3.2. now becomes effectively replaced by the tolerable rate of unemployment, acting as the constraint on governmental behavior.

  This approach deprives the model of one possibility of oscillating behavior. It also deprives us, for the moment, of the possibility to discuss in detail one of the three variables which we used to denote the performance of transition economies. However, as a first approximation it seems preferable to sketch the basic dynamics of the model as clearly as possible, i.e. to focus on J-curve type growth paths to discuss alternative governmental policies.

- All function used below are assumed to be continuously differentiable.

Output produced by the three representative firms, and unemployment created by shifts in their size can now be expressed as follows:

$$Y(t) = \rho_O(L_R(t) - L_O^{SD}(t))L_O(t) + \rho_R(L_R)L_R(t) + \rho_N(L_N)L_N(t),$$

$$UE(t) = L^* - L_O(t) - L_R(t) - L_N(t).$$

3.2 Firms

3.2.1 The Shut Down Rate of the Old Sector

The labor employed in the segment of the old capital stock sentenced to shut down, L_O^{SD}, increases in proportion with the decline in subsidies, i.e $L_O^{SD} = L_O^{SD}(S)$.

Since the subsidy level prevalent at the beginning of reform (just after price liberalization) was exactly sufficient to keep the old sector alive, subsidies equal to this level, S^*, are perceived sufficient to keep the size of the segment of L_O forced to shut down exactly equal to zero, i.e.

$$L_O^{SD}(S^*) = 0.$$

Without subsidies, on the other hand, no part of the old capital stock is considered capable of survival. Under this condition the size of the segment of the old capital stock which shuts down is at its maximum, equal to L_O^{SDmax}. This maximum, which can be calculated from

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[30]In fact, this assumption acts as if the output tax rate would continuously adapt to balance the need for unemployment benefit payments.

$$L_O^{SD_{max}} = L^* - \frac{\rho_R(L_R^*)}{\rho_O(L_R^* - L_O^{SD_{max}})} L_R^*,$$

translates into the statement that $L_O^{SD}(0) = L_O^{SD_{max}}$.

Note that this expression is equivalent to

$$L_O^{SD_{max}} = L^* - L_R^* - \beta(L_R^*, L_O^{SD_{max}}) L_R^*$$

(where β denotes the proportion of labor released due to restructuring (see section 3.2.2)).[31]

Maintaining the assumption of a linear relationship between the part of the representative firm which shuts down and the decline in subsidies, we can express the size of that segment as a function of current subsidies:

$$L_O^{SD}(S) = L_O^{SD_{max}} \frac{S^* - S}{S^*}. \tag{10}$$

3.2.2 The Rate of Growth of Restructured firms

The second exit rate from the representative old firm is the growth rate of the part of that firm which will restructure. The growth rate of the restructuring segment is a function of the rate of growth (and decline) of subsidies, and immediately contingent on the latitude of unemployment, U, on the one hand, and the positive market externality on the other. Recall, that the latitude of unemployment is defined as the difference between the tolerable and the actual rate of unemployment, whereas the market externality is defined as the share of the new and the restructured parts of the old capital stock out of the total.

As the size of the restructured sector approaches the limit determined by the maximum size of the segment capable of restructuring (as subsidies approach zero), its growth rate asymptotically approaches zero but remains positive (since we excluded the possibility of a negative growth rate of the F_R segment).

This limit (which can be calculated, given the old sector's objective function and $S(t) = 0$, as well as $UE(t) = 0$), is denoted as L_R^*. The growth rate of the restructured sector is proportional to the decline in the growth rate of subsidies; it becomes zero if subsidies temporarily grow at a positive rate.

The market externality, on the other hand, is captured by:

$$\frac{L_R(t) + L_N(t)}{L^*}(L_R^* - L_R(t)).$$

Total unemployment is composed of unemployment due to restructuring, UE^{restr}, plus unemployment due to shut downs, L_O^{SD}. Recall that unemployment is rising as a linear function of increases in productivity. Unemployment due to restructuring can therefore be expressed as

$$UE^{restr} = \beta L_R, \text{ where } \beta = \frac{\rho_R(L_R)}{\rho_O(L_R - L_O^{SD})} - 1.$$

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[31] We assume that we have chosen ρ_O such that the uniqueness of a solution for $L_O^{SD_{max}}$ is guaranteed.

Note that, because firms know the structure of the economy, they will correctly expect subsidies to increase again, if unemployment happens to rise over the tolerable level. The restructuring segment is therefore growing only as long as the total unemployment created by restructuring plus shut downs remains below the tolerable level of unemployment.

The growth rate of the restructuring segment can therefore be denoted as a function of the rate of change of subsidies: $\psi(\dot{S})$. Since the sign of $\dot{S}$ coincides with the sign of $UE^* - UE(t)$, ψ can also be defined as a function of $(UE^* - UE(t))$. For example,

$$\psi(UE^* - UE(t)) = \begin{cases} \gamma(UE^* - UE(t))^2 & \text{if } \beta L_R(t) + L_O^{SP}(S(t)) \leq UE^* + L_N(t), \\ 0 & \text{otherwise .} \end{cases}$$

with γ as a positive constant measuring the sensitivity of the restructuring sector.

To complete the discussion of the determinants of industrial restructuring, we need to define the very first move of the restructuring segment, after the initial budget announcement has been made (or the first cut in subsidies $S(t_0)$ has been carried through). We assume that this segment reacts in the following way: Since all firms of the old sector are linearly ranked with respect to their productivity, the size of the restructuring segment becomes a linear function of the initial cut in subsidies.

Given alternative budget announcements, the size of the restructuring segment will increase as lower subsidies are announced, but only up to the point where unemployment due to restructuring plus unemployment resulting from shut downs equals the tolerable level. This number remains the same for all cuts in subsidies which are larger. We denote this level of subsidies as $\bar{S}(t_0)$ and the size of the restructuring segment at this level of subsidies as $\bar{L}_R(t_0)$. Since no one is willing to restructure if $S = S^*$, the initial size of the restructuring segment as a function of the initial budget announcement is, by linear approximation, defined as

$$L_R(t_0) = \begin{cases} \frac{\bar{S}(t_0) - S(t_0)}{S^* - \bar{S}(t_0)} \bar{L}_R(t_0) + \bar{L}_R(t_0), & \text{if } S(t_0) \geq \bar{S}(t_0), \\ \bar{L}_R(t_0), & \text{otherwise .} \end{cases}$$

The growth rate of the restructuring segment, can therefore be expressed as the following equation

$$\dot{L}_R = \psi(UE^* - UE(t)) \frac{L_R(t) + L_N(t)}{L^*} (L_R^* - L_R(t)). \tag{11}$$

3.2.3 The Rate of Growth of New Private Firms

Since the growth rate of the new capital stock will only asymptotically approach zero as inflation increases, it will always be non negative.

The only limit to the rate of growth of the new private sector is the maximum possible employment, L_N^*, which corresponds to the case of full employment in the economy and the disappearance of the old sector, i.e. $UE \equiv 0$, $L_O \equiv 0$.[32]

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[32]We can define this situation as the (successful) end of the transition. Labor market equilibrium now

For reasons of convenience we now denote the new sector as an increasing function of the restructuring segment out of the initial capital stock $\frac{L_R}{L^*}$ (instead of using the fraction $\frac{F_R}{F_O}$, which is possible without qualitatively changing the results).

The growth rate of the new sector is a decreasing function of inflation in the manner previously discussed. Taking account of the monotonous dependency of inflation on subsidies, the relationship between the growth rate of the new sector and the level of subsidies is expressed by the function $\varphi(S)$, with the following properties:

$$\varphi(S) > 0, \quad \varphi'(S) < 0, \quad \lim_{S \to \infty} \varphi(S) = 0, \quad \varphi''(0) < 0.$$

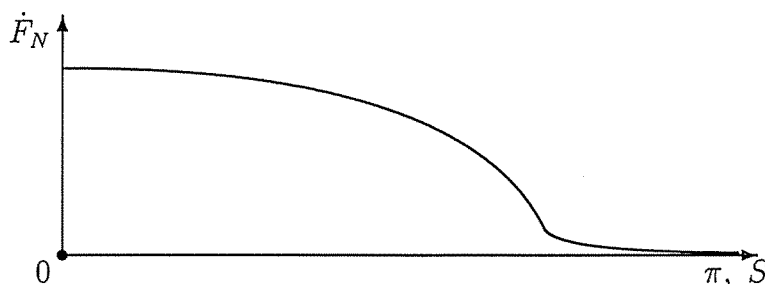Recall that the growth rate of the new capital stock as a function of the rate of inflation is always positive.[33]

Fig.8. *The growth rate of the new capital stock as a function of subsidies.*

Finally, the growth rate of the new capital stock is a logistic-type function of the size of that capital stock. This is due to the fact that this growth rate is an increasing function of the difference between the domestic and the world interest rate (adjusted for the risk premium). As that sector grows, the risk premium will fall, increasing the interest rate differential. However, the increase in the size of the new capital stock will also cause the marginal productivity of capital to decline. Further growth of this segment will decrease the interest rate differential further, while the increase in the quantity of capital acts in the opposite direction.

· A logistic type growth function also expresses appropriately the network effect which steer new investment in productive capital.

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is given by $L_R^* + L_N^* = L^*$. In general, since the productivity level of the new capital stock is higher than that of the restructured sector, the growth rate of the new sector may remain positive at the expense of closing down less productive restructured firms. The analysis of this process is beyond the scope of this paper.

[33] Hence, the growth rate of the new capital stock increases at a decreasing rate as subsidies decline to zero from a moderate level, and decreases at a decreasing rate as subsidies approach the highest possible level (and as inflation turns into hyperinflation).

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Collecting terms, we get the following equation determining the growth rate of the new representative firm

$$\dot{L}_N = \varphi(S(t)) \left(L_N(t) + \frac{L_R(t)}{L^*} \right) (L_N^* - L_N(t)) . \qquad (12)$$

3.3 The Government

As previously discussed, the growth rate of subsidies is given by the equation

$$\dot{S}(t) = -\alpha S(t) \left(UE^*(t) - (UE(t) + UE^{EXP}(t)) \right) .$$

The government tries to accomplish its objectives by targeting the tolerable level of unemployment (which is assumed to remain constant), i.e. $UE^*(t) \equiv UE^* = const$ for all $t \geq t_0$.

As previously discussed, all influence of expected subsidies is excluded in this first approach at modelling the properties of the simplified system. The growth rate of government distributed subsidy payments therefore is given by the expression:

$$\dot{S}(t) = -\alpha S(t) \left(UE^* - UE(t) \right) . \qquad (13)$$

3.4 Formalizing the model

We can now translate the basic version of the dynamic model, taking account of all simplifications introduced in this section, into a three dimensional system of ordinary differential equations:

$$\dot{S}(t) = -\alpha S(t) \left(UE^* - UE(t) \right) ,$$
$$\dot{L}_N(t) = \varphi(S(t)) \left(L_N(t) + \frac{L_R(t)}{L^*} \right) (L_N^* - L_N(t)) ,$$
$$\dot{L}_R(t) = \psi(UE^* - UE(t)) \frac{L_R(t) + L_N(t)}{L^*} (L_R^* - L_R(t)),$$

with

$$L_O^{SD}(S(t)) = L_O^{SD max} \frac{S^* - S(t)}{S^*},$$
$$UE(t) = L^* - L_O(t) - L_R(t) - L_N(t) = L_O^{SD}(S(t)) + \beta L_R(t) - L_N(t).$$

3.5 Equilibrium analysis

It has to be noted that without new capital (i.e. $L_N(t) \equiv 0$), the economy can have one or two equilibria. The first one, given by $UE(t) = UE^*$, always exists. The second is given

by $S(t) = 0$. It is conditional; and its existence together with the stability (or instability) properties of both equilibria depends on the inequality $L_O^{SD_{max}} \leq UE^*$ which has to be fulfilled.

We can now investigate the complete system. The model's equilibrium is defined by the following system of three equations which have to be solved simultaneously:

$$\begin{cases} \alpha S(t) \left(UE^* - UE(t) \right) = 0, \\ \varphi(S) \left(L_N(t) + \frac{L_R(t)}{L^*} \right) (L_N^* - L_N(t)) = 0, \\ \psi(UE^* - UE(t)) \frac{L_R(t) + L_N(t)}{L^*} (L_R^* - L_R(t)) = 0. \end{cases}$$

The function $\varphi(S)$ is not equal to zero and remains positive for all S. Unemployment can not stabilize at the level UE^*, once the initial cut in subsidies has been made, thus providing for the restructuring of parts of the old capital stock and inducing the creation of new private capital. The positive growth rate of L_N will diminish unemployment over time. Thus the only possible equilibrium existent in the system is

$$S = 0, \quad L_N = L_N^*, \quad L_R = L_R^*, \qquad \text{with } L_O = 0 \text{ and } UE = 0.$$

The Jacobian matrix of the system evaluated at the equilibrium is given by

$$\mathcal{J} = \begin{pmatrix} -\alpha UE^* & 0 & 0 \\ 0 & -\varphi(0) \left(L_N^* + \frac{L_R^*}{L^*} \right) & 0 \\ 0 & 0 & -\psi(UE^*) \end{pmatrix}.$$

All eigenvalues of $\mathcal{J}$ are negative, therefore the equilibrium is locally stable. Nevertheless, different initial values of $S(t_0)$ and, related to this, of $L_R(t_0)$ and $L_O^{SD}(t_0)$ (assuming $L_N(t_0) = 0$ for all budget announcements), create different time paths of output and unemployment, all converging to the steady state.[34] These growth paths are affected by the (exogenous) level of tolerable unemployment.

3.6 Simulating Alternative Growth Trajectories

The following computer simulations were designed essentially to get a grasp of the alternative scenarios depicted earlier in the paper. Recall, that we intended to compare three scenarios.

One in which the government is "aggressive" in the sense either that it embarks on the path of reforms with drastic cuts in subsidization, or in the sense that it has a relatively large degree of freedom with respect to the rate of unemployment deemed tolerable.

The second scenario was designed to depict a "soft" government, i.e. a government which is either scrupulously careful in exercising the initial cuts aimed at landing the

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[34]Since trajectories with the initial values $(S(t_0), 0, L_R(t_0))$, $S(t_0) \in (0, S^*)$ and $L_R(t_0) > 0$, are bounded for all $t \geq t_0$ and the growth rate of $L_N(t)$ remains positive, the ω-limit set coincides with the equilibrium, i.e. all these trajectories converge to it.

economy on the reform path, or which faces severe constraints in terms of the tolerable rate of unemployment.

In addition, we investigated a scenario in which the actual rate of unemployment has been endogenized as good as possible, given the severe limitations which we ourselves imposed in order to keep the basic model as simple as possible. This was done by enforcing a balanced budget in the sense that the output tax rate always adjusts such as to exactly cover the social costs.

Next to these three approaches we also experimented with various developments of the new sector, by assuming extremely low rates of tolerable unemployment in order to investigate the response of new capital formation, initially triggered by the resulting low inflation rates.

Figures 9 and 10 exemplify the results. As expected, an "aggressive" government will generally end up creating a recession *deeper* than its counterparts. However, it also converges to the equilibrium growth path *faster* than in the other scenarios. The "soft" approach, on the other hand, creates less of an output decline (and lower rates of unemployment), but the misery will last longer. Hence there is a clear trade off between the two approaches.

Incorporating a quasi-automatically balanced budget creates, surprisingly only on the surface, more instability in the system than the two other approaches. The adaptation to the balanced growth path exhibits a pattern of fluctuating behavior. On a second look, however, the reasons are plain: far from acting as an internal stabilizer, the balance budget condition causes adjustment processes to become more frequently.
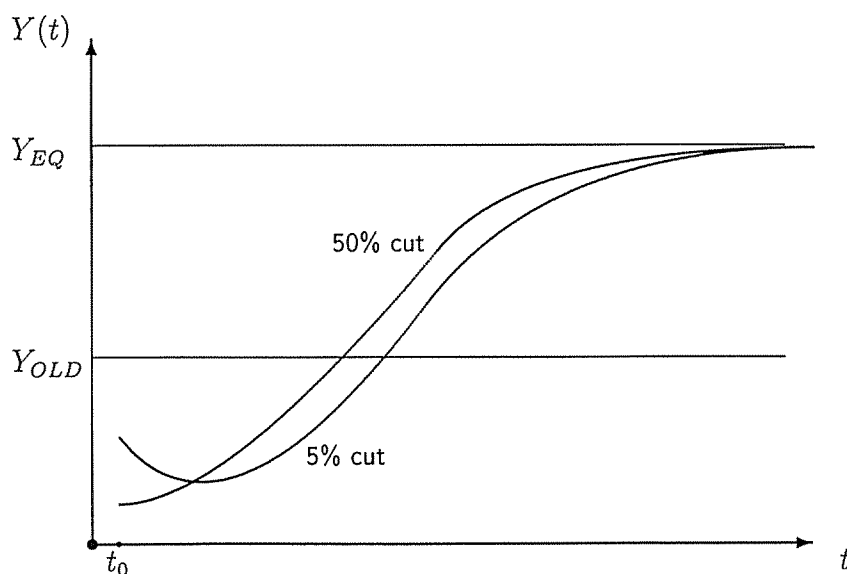

Fig.9. *Output growth paths as a result of different initial cuts in subsidy payments. Tolerable level of unemployment is 30%.*
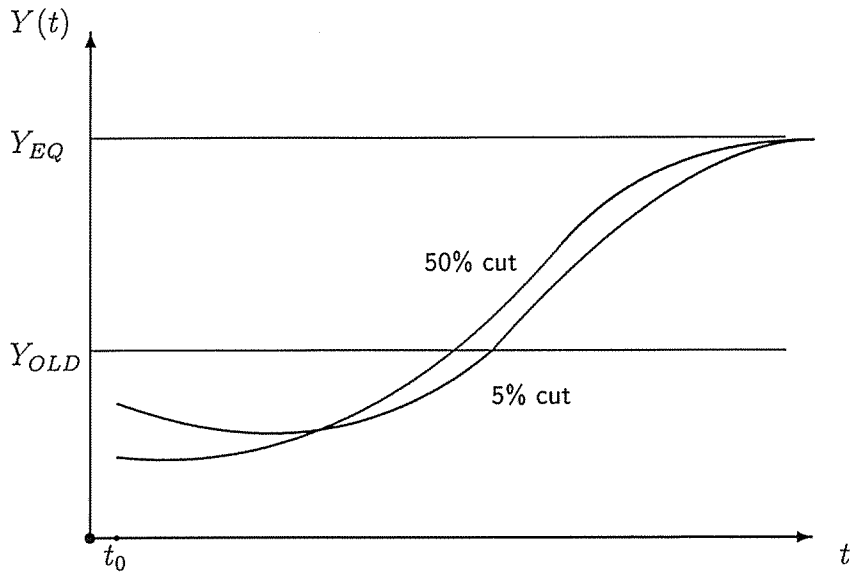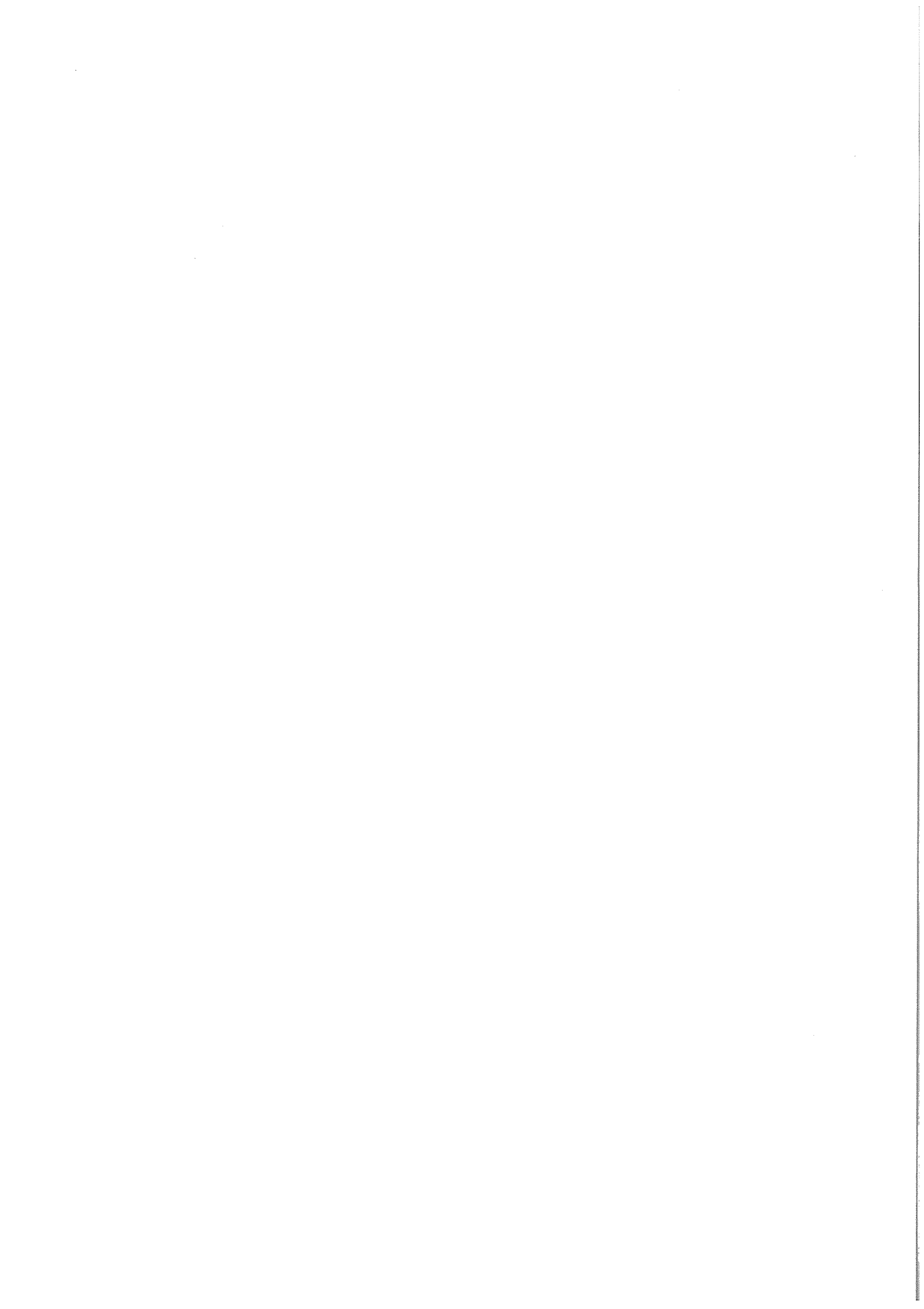
49

Fig.10. *Output growth paths as a result of different initial cuts in subsidy payments. Tolerable level of unemployment is 15%.*

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