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Simulated economic and social futures of the late German Democratic Republic by means of a system dynamics model

by

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1. Introduction

The transition of the socialist countries to market economy is the subject of numerous economic analyses. In East Germany this process develops much faster than in the other former socialist countries where the preconditions for such a transition have to be created arduously before. The German union and the ongoing changes hasten this transition enormously. For all involved it is of high interest at which results this development will arrive. To analyze the transition process of the former GDR (German Democratic Republic) economy a mathematical simulation model "TRANSIT-DDR"² has been created within

¹Apart from us the research team consisted of Hans Biebler, Hannelore Böhme, Dietmar Dathe, Udo Ludwig, Walter Oelschlägel and Peter Nick. The paper was forwarded to the editors in October 1990. Therefore the content and the simulations of this paper reflect the knowledge available at that time. On the basis of his updated knowledge two years later the reader can assess the forecasting power of such simulation models.

²The model is available on disk under MS-DOS (DYNAMOTM is needed) as well as for the Apple Macintosh (STELLATM is needed) for non-commercial purposes. For technical details see our German book (Fleissner, 1992), which was published in the FRG.

an international cooperation framework between Germany and Austria. The model revives and applies Forrester's classical method of System Dynamics (Forrester, 1961; 1968a; 1968b; 1971; 1975). For a detailed description of DYNAMO, a simulation language on mainframes and MS-DOS personal computers, see: (Richardson, 1981); for a detailed description of STELLA, a user friendly simulation software for the Apple Macintosh, see: (Richmond, Peterson and Vescuso 1987); for a combined approach of Econometrics and System Dynamics applied to the Austrian economy see: (Bruckmann, 1989). It may be used as a tool to simulate the economic, social, and demographic effects of the different policy proposals actually under public discussion.

We believe that the model may be viewed as a useful interactive tool to accompany the transition process towards market economy in a scientific way, allowing for simulations of socio-economic alternatives and for step by step adaptations of the parameters according to the actual behavior of the economy.

The paper consists of three parts. First a short description of the contemporary transition process is presented, second the basics of the simulation model are given, and, finally, essential results and scenarios are illustrated by the original graphic output of the model.

2. The end of the GDR

In 1989 those radical changes began which had further significant impact on the societal development in the Eastern part of Germany. Already in summer that year the discontent of many citizens grew to such an extent that thousands of them left the GDR, most of them via Hungary. With the unexpected opening of the borders in November 1989 emigration, for some time, increased further.

At the beginning of 1990 GDR had its first unemployed. About the same time factories were closed down now here and there, mainly for ecological reason. Later on the growing unemployment resulted out of the fact that institutions and enterprises tried to get rid of the hidden unemployment existing everywhere since long. This was mainly observed in the field of administration. Only after the date of the currency union, July 1st, 1990, more and more factories had to be closed down for economic reasons. On the one hand this was due to the unlimited invasion of Western consumer goods. The big trade organizations in the GDR made agreements with FRG retail trade companies. Due to this the marketing of GDR goods became more and more difficult. Most of the domestic

producers had no sales organizations of their own, and that is why they could not sell their products under the new circumstances, and many of them could not avoid insolvency. On the other hand foreign trade connections existing since long were no longer respected which resulted in part-time work and unemployment in other factories. Credits to bridge this gap were not available in the necessary amount.

The abundance of Western investments did not turn up. This is likely due to the underutilization of production capacities in the FRG so that an increase of production within short time was possible there. In future, low levels of wages in East Germany could surely improve the readiness to invest especially as government promotion of investments are implemented.

In GDR the labour intensity is very high compared with the FRG. Shut-downs particularly will occur in such branches where the labour-intensity (jobs per unit of fixed capital) is higher than average. Modern investments bear a labour intensity well below actual average. By this capital stock will be modernized and labour productivity will increase. We think by an increase in East Germany of up to about 75 per cent of the average labour productivity in FRG one could live with, for in some regions of FRG the level is not higher than that.

During the past decades the depreciation of capital stock in GDR was very low and the life span of capital was prolonged artificially. On the basis of official data we found a life span of about 150 years! After the currency union profound changes took place. Experts of East and West agreed more or less to one common opinion: One third of the factories is able to face successfully the market economy, one third has to be supported by loans, and about one third is not in the position to survive. Thus scraps will increase considerably.

As a matter of fact quite a number of small new enterprises were founded, mainly restaurants and services, but not to this enormous extent as it was expected. And the number of jobs created by them was much lower than foreseen. Very often they were not able to withstand the Western competition, so many of them had to give up within a short time.

Up to now (September 1990) the number of unemployed and part-time workers increased continuously. In September already nearly half a million people were unemployed and one and a half million workers were on part-time. But this number does not express the full seriousness of the situation, because the vast number of those who had to agree to early retirement is not included. At the moment the rate of unemployment is declared to be at 6-7 per cent (there is some difference over the new districts) but this number will certainly

increase, for many of the part-time workers will join the unemployed within the next months. After the union of the two German states many which have been employed in the administration of GDR will lose their jobs, too.

It was expected that a run on consumer goods will take place after July, 2nd. But in reality it was quite different. People restrained to spend their money, much more than expected. On the one hand this is due to the general uncertainty, on the other hand to the fact that after the currency union the price level in GDR was remarkable higher than in FRG, and the difference was narrowed very slowly. Especially technical consumer goods, particularly cars, are bought in West Germany frequently.

In the past no increase of price index was admitted officially. But in the time when the currency union was already announced one could observe serious fluctuations of prices. Durable consumer goods had always been very expensive in GDR, whereas food and tariffs had been subsidized to a high degree. Already in May 1990 the prices for textiles and technical consumer goods had been reduced to FRG level, in June even more. Only this way GDR products could still be sold. By this the trade corporations aimed at clearing their stocks so as to bring themselves to the position to take over Western goods to be sold after the currency union. Starting with July the subsidies for nearly all products were withdrawn. The prices became freely calculated in all fields but in housing and tariffs. According to official announcements house rents and prices for services will be raised in dependence from the development of wages early next year.

As long as the level of wages in the Eastern part of Germany is substantially below the Western part and the level of unemployment is that high, one has to expect still more migrations to the West.

In the past, the GDR economy was strongly oriented on exports to the West in order to get hard currency needed for imports. Comparative advantages did not play the first role but everything saleable was exported even if the demanded price was lower than the costs of production. This resulted in shortages on the domestic market. After the opening of the borders industrial goods from the FRG swamped the market of GDR nearly without any limitation. It was not so much due to the fact that GDR goods were not able to meet competition of Western goods but buyers preferred Western goods regarded to be better. That is why such a large increase of imports was possible. One can take for granted that the import from the Western territories will be remarkable in future, particularly regarding capital goods, although the official statistics will cease to count it as imports.

3. The simulation model

3.1. The structure of the model

The sudden step from command economy to market economy, the currency union and all features connected to it, as well as the transition in the accounting system, from the Material Product System (MPS) to the System of National Accounts (SNA), all these phenomena have to be considered when constructing an appropriate simulation model. In order to deal with these features in more detail we created a highly aggregated economic-demographic, one-commodity model which consists of the following subsystems:

- production function,
- labour market,
- final demand,
- government,
- demography, and
- a few variables of the money and credit sector.

To take into account the discrepancies which are unavoidably brought up by this radical transition, the structure of the model was designed in a way which should be able to reflect disequilibrium in the market and the behavioral adaptation processes connected with it.

3.2. The sources of information

We were confident we have to refer to facts and figures of the past to model the economy of the former GDR, and of course we used analyses of her social and economic institutions. But we were as certain that to a large extent we are not allowed to use past data to derive parameters and equations for the simulation of the future. With one exception (the consumption equation) econometric methods are not applicable to generate reliable parameters for the future behavior of the model. So we took additional information out of scientific papers, bills and acts of the parliaments in East and West Germany, the daily press, expert opinions and assessments, and — last not least — common sense.

Facts and figures of the economy of the past FRG have served as parameters for comparison and for assumptions about future behavior of the former GDR economy. One main difficulty with data results from the fact that official statistics were based on the MPS system and a backward revaluation of the MPS data according to the SNA system became necessary.

3.3. The diachronic structure

The model describes two qualitatively different economic regimes and mirrors the transition of the one into the other. The first phase deals with the economic system before first of July, 1990, the date the currency union was introduced, the second one the time after that. The currency union made it necessary to change the unit of measurement of all the variables at current and fixed prices from East Marks to West Marks. Therefore we had to reevaluate all the stocks (savings, fixed capital, stocks, and full capacity output etc.) and some of the flows in the model. This also met the realities, for the capital stock of the enterprises actually was devaluated by 1:2 or 1:3.

There is a change in the behavior of the economic subjects, too. This fact is taken into account by replacing old behavioral equations by new ones at the date of the currency union.

3.4. Some details of the model

Capital formation is assumed as the essential process driving the economy. Capital stocks are increased by gross capital investments, they are decreased by depreciation and shut-downs. Unlike the usual production functions of Cobb-Douglas or CES-type, we distinguish in the model the marginal and average parameters (capital output ratio, labour-intensity) to reflect real processes of capital formation in a more realistic way. On the one hand gross private investment creates new jobs after some delay (quantitatively controlled by the parameter "marginal labour intensity"), increasing the demand for labour. On the other hand it increases production capacity (potential output, controlled by the parameter "capital output ratio"). Actual production (gross domestic product) depends directly on potential output and the (variable) utilization rate only. Of course, there are indirect reductions in potential output and labour demanded via depreciation and shut-downs.

In the past the value of investments was a more or less constant fraction of GDP. Due to the great influence of investments on employment their value was regarded to be one of those variables of the model which are used as instrumental variable for the future.

In the model the number of unemployed results from the difference between demand and supply for labour. The number of unemployed increases as more factories are shut down, whereas part-time workers result from underutilization of production capacities (utilization rate smaller than one).

Assumptions about the percentage of surviving enterprises may be covered in the model by the scrap rate. This is one of the variables which essentially influence the behavior of the model. In the respective scenarios (see the next section) the scrap rate had been fixed differently in each case. It was assumed that heavy shut-downs will occur within a limited period of time only. During this period the competitiveness of the economy in the Eastern region of Germany will improve and surviving factories will have been adjusted to the new conditions. Within short time the rate of depreciation of the capital stock will reach the level of FRG, for the Eastern economic area can no longer be looked upon separately. The higher the scrap rate was assumed for the next two years, the more numerous is unemployment and the less the number of jobs computed by the model.

The submodel of final demand contains private and public consumption, gross capital investment, and foreign trade. Private consumption depends on the disposable income of the population, on savings, and on the price index. The introduction of DM as official currency brought about revaluation of savings deposits. According to age each citizen could change a fixed sum between 2 and 6 thousands marks at 1:1. All deposits surmounting this limit were devaluated at the rate of 1:2. Wages were paid after July at the same amount as before, but in new currency.

There is a striking difference between East and West Germany in both labour productivity and wage level. In the model the development of wages was connected with the development of labour productivity to reflect the probable activities of trade unions demanding higher wages with growing productivity. In reality there might be additional factors, too, which will influence wage increases. We observe that in reality some trade unions stand for an early equalization of wages irrespective of economic performance.

Roughly speaking, the main object of public investments is the creation of infrastructure. That is why the model separates private from public investments. Whereas productive investments create jobs in greater dimensions after a gestation period only, for realization of investments in the field of infrastructure labour is needed from the very beginning and may fade out after completion (road construction, telecommunication etc.).

The submodel of public budget has been included, although somewhat sketchy, into the model in order to be able to estimate tendencies of the public balance in dependence from respective input conditions. Different types of tax and levy, transfers from FRG, and contributions to social insurance belong

to government receipts. Government expenditures are subsidies, transfers, unemployment benefits, and support of part-time workers, public consumption, public investments, and interests on government debt. Obviously a high rate of unemployment is a burden to the budget, for higher expenditures for unemployment benefits face smaller receipts of wage-tax.

Migration processes are anticipated by assuming that the number of migrants is related to the number of unemployed. This does not necessarily mean that the unemployed are those who migrate actually, it could be as well that the best skilled workers try to find a better paid job in West Germany.

4. Scenarios

Given the political and economic realities as they are, the question to be asked is not **whether** or not a transformation towards market economy is necessary, but **how** this transition shall take place. In our opinion there exist two essential goals, which are unfortunately contradictory within the contemporary political framework and in medium term: high productivity of labour and low rate of unemployment. Economic and social policy has to navigate in such a way that the social disaster of the transition is minimized and the competitiveness of the Eastern region of Germany is increased as fast as possible. The following scenarios represent characteristic transition paths as a consequence of different assumptions about shut-downs on the one hand and on capital investments on the other. Of course, we give only one example on how the model can be used. By the simulation of different variants the user will get a more comprehensive picture of the transformation, and a kind of intuitive feeling about the transition process may be created.

4.1. Scenario 1: SOFT LANDING

Assuming a 20% shut-down of total capital stock within the time period between April 1990 and the middle of 1992, unemployment will peak at about 3.5 million and will gradually decrease by more than one million until the end of 1994. Short term labour has to be added to the "official" unemployment figures (see Fig.1). The peak value of this sum will reach about 4.3 million in July, 1992. After the revaluation point (July 1st, 1990) it will take two years until the Gross Domestic Product (GDP) and capital stock will reach their levels again (see Fig. 2). Due to capital investments with lower labour intensities than in the old GDR (after

a period of shut-downs and a corresponding loss of jobs) the number of jobs (L_{actual}) will remain more or less constant, although there will be considerable investment activity. The number of unemployed will decrease at the same time because of emigration of potential workers. The hidden assumption behind this effect is that a number equal to 20 per cent of the number of the unemployed will leave the country after an average delay of one year.

There will be a sharp increase of public deficit during 1992 (see Fig.3). To explain the strange shape of the deficit curve, a short technical remark has to be made: Because the model aims at the approximation of the continuous flow of time — in fact a time step dt of $1/20$ of a year is used — a special method to compute discrete annual values from the approximated continuous ones had to be developed. As an auxiliary variable a “saw tooth” was constructed which can perform a piecewise integration into a stock variable over one year. After one year (at the peak of the saw tooth) the stock is emptied, and the integration process starts anew. The correct annual value has to be read at the end of each year, and usually it is an extreme value.

Later on, the annual deficit will slightly rise from a level of more than 100 million DM, that is more than three times higher than in July, 1990. Of course, this deficit will not appear in the official statistical data because it is hidden inside the public balance of the new and enlarged FRG. The difference of productivity between Eastern and Western Germany decreases (see Fig.4), but in this scenario Eastern productivity increases more slowly than in the case of a higher scrap rate as in the following scenario, and it will reach 53% of the West at the beginning of 1995. After a peak around the end of 1991, relative unit costs based on the value of the Western part of the country (= 100%) will come down, thus partly compensating for the low quality of the products of the East.

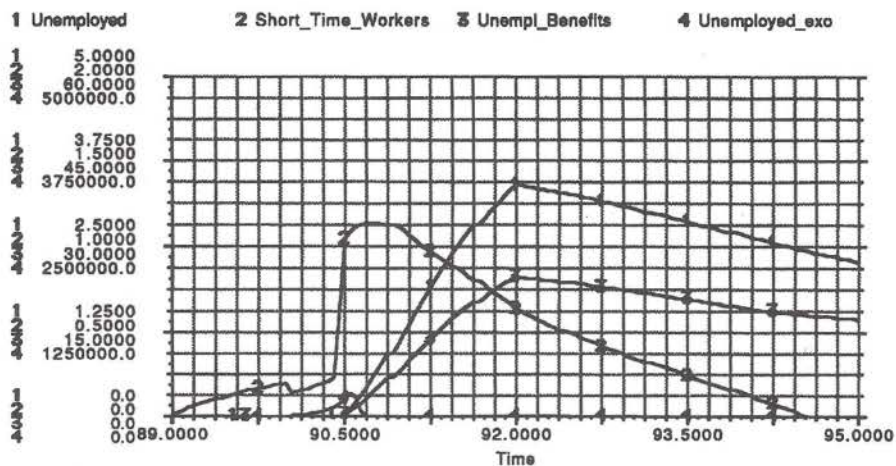


Figure 1. SOFT LANDING: Unemployment and Short-Term Labour

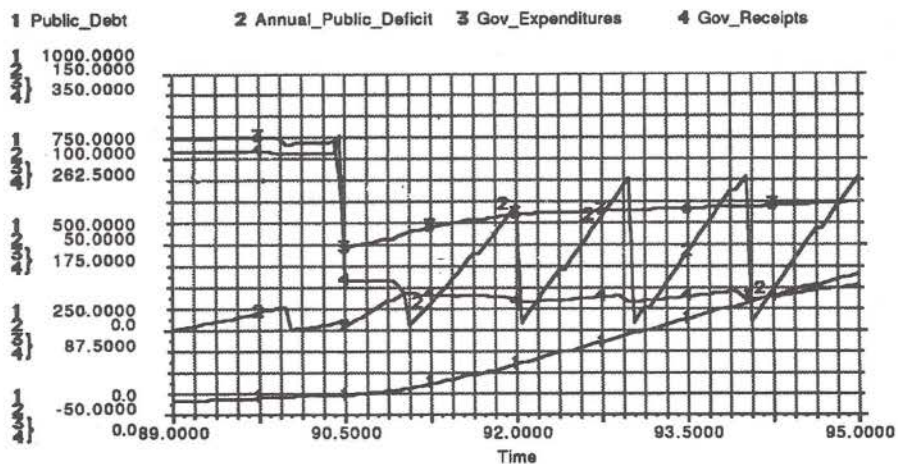


Figure 2. SOFT LANDING: Public Sector and Annual Deficit

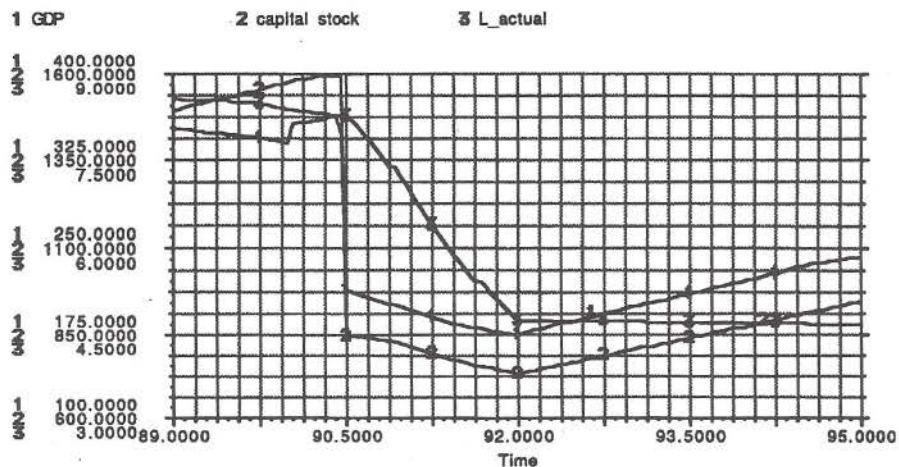


Figure 3. SOFT LANDING: Main Economic Indicators

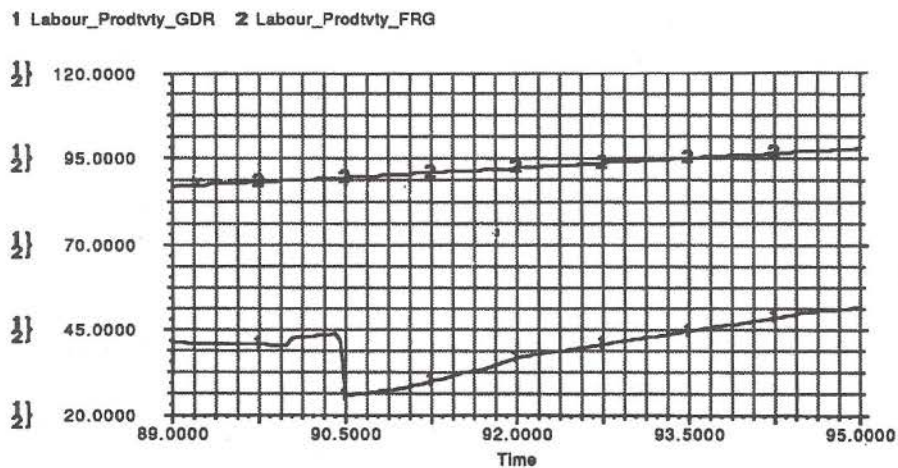


Figure 4. SOFT LANDING: Labour Productivities in West and East Germany

4.2. Scenario 2: CRASH

By means of the second scenario a path of economic development of the East German region is illustrated which is aimed at a fast increase in productivity of labour. To reach this goal we assumed heavy shut-downs of about 45 per cent of the total capital stock within the next two years. Without additional investments the model computes a maximum of unemployment of over 4 million at the end of 1991. Later, until the beginning of 1995, it will drop down to the level of 3 million (see Fig.5). Compared with the above scenario the amount and dynamics of short-time workers remain nearly unchanged.

This is the scenario in which the public budget is burdened most. Up to 1995 we can observe an increasing deficit (see Fig.6). It starts with a level of about 85 billion DM (German marks) at the end of 1991, growing each year and ending up at 115 billion DM at the end of 1994. This is due to the high expenditures for unemployment benefits, lower tax income and higher expenditures for interests on government debts which has increased at the end of our simulation period up to 500 billion DM. There will be some difficulty to finance such a high deficit of the East German budget by credits. A more plausible policy could be to increase taxes for all citizens of the new FRG. Because of the reduced tax rentability of the East the Western taxpayers will have to bear the main burden.

Only in 1992 the GDP will start to grow again, but from a very low level compared with the scenario above. In the beginning of 1995 it could reach the level of July 1990 (see Fig.7). Fixed capital will behave in proportion to GDP. The level of employment is down to 3.5 million people, recovering very slowly.

The competitiveness (that means the Eastern labour productivity in relation to the Western one) will increase from 30 per cent in July 1990 up to 60 per cent in the beginning of 1995 (see Fig.8). In the second half of the nineties a high productivity of labour will promote exports and, if trade unions fight for higher wages in proportion with productivity gains and are successful, domestic demand will be increased. Thus a higher rate of economic growth may be expected, although the price is high: every other person in the working age will be unemployed temporarily. The social and political consequences of such an extraordinary situation cannot be foreseen precisely, but probably social unrest, maybe riots may happen.

Figure 5. CRASH: Unemployment and Short-Term Labour

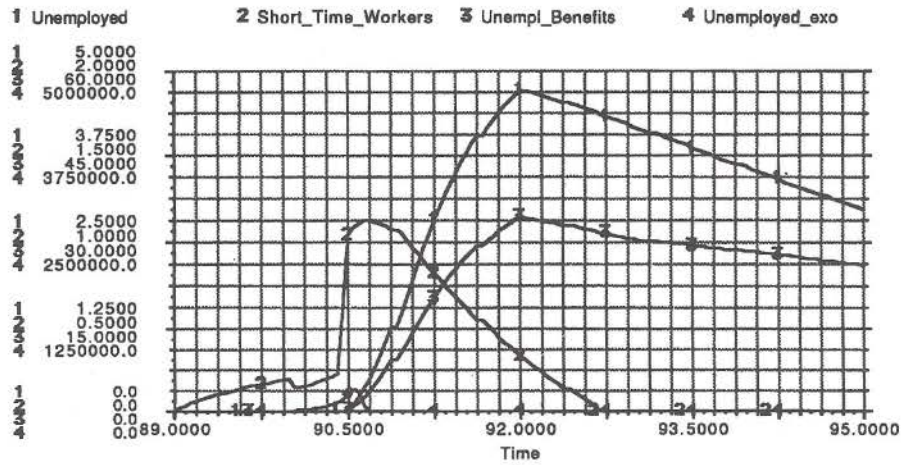


Figure 5. CRASH: Unemployment and Short-Term Labour

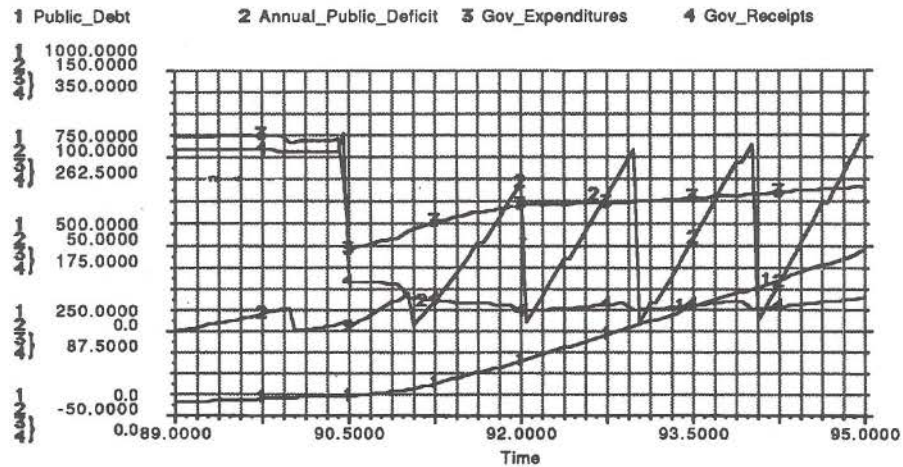


Figure 6. CRASH: Public Sector and Annual Deficit

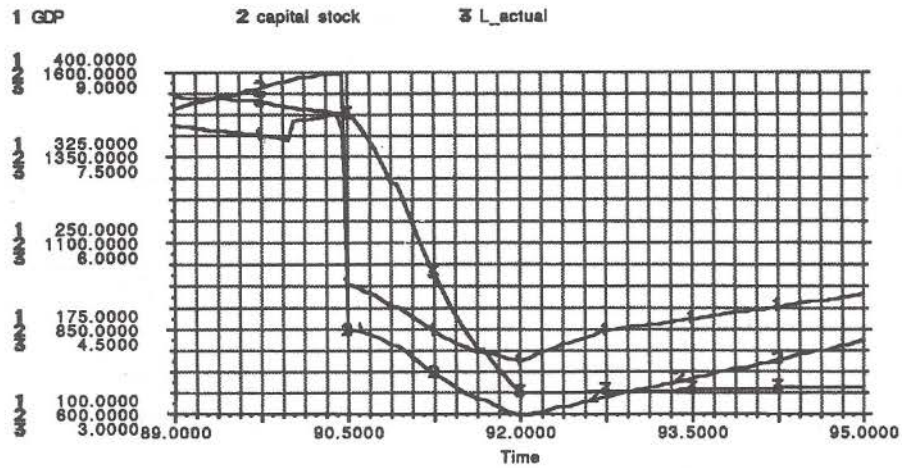


Figure 7. CRASH: Main Economic Indicators

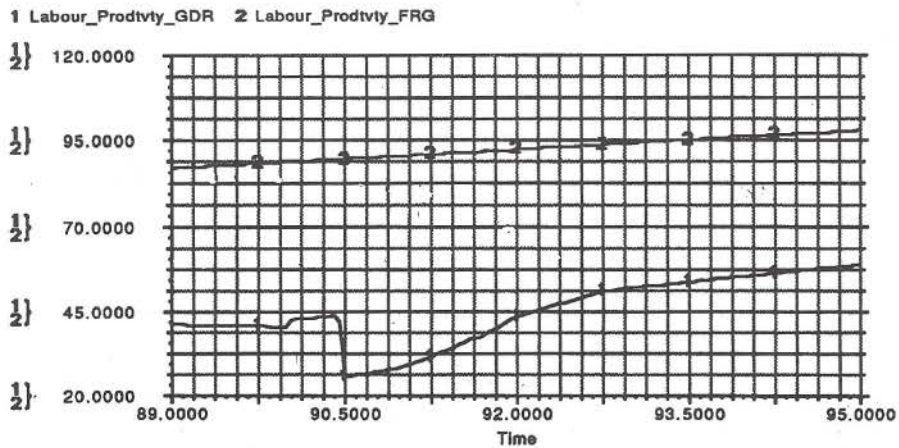


Figure 8. CRASH: Labour Productivities in West and East Germany

4.3. Scenario 3: INVESTMENT PUSH

The second feature of investigation was the impact of investments on the economy and the labour market. As a result of a considerable increase in investments applied to "soft landing", the model shows slightly reduced unemployment only, but a rather fast reduction of short time labour (see Fig.9). There is a favourable development of government spending, a faster increase in the level of productivity of labour, and a faster recovery of the economy as a whole. But, apart from the model, one has to state clearly that increases in investment in manufacturing which will substitute for the worn out and unproductive fixed capital will not improve the situation on the labour market immediately, on the contrary, they will result in a net loss of jobs. The reason for this may be seen easily: old capital in place is connected with much higher labour-intensity (i.e. one unit of old fixed capital bears more than double of number of jobs) than new investments of the same value. Thus the more new investments replace the old capital stock the less the number of jobs available. And once they show up the gestation period will delay positive effects on output and employment. This fact emphasizes the necessity to look for policies to create additional jobs in the service sector and/or by encouraging the foundation of small enterprise by self-employed. The remaining labour force, of course, is producing at a higher rate of productivity.

Additional investment will bring an earlier recovery of the economy such that the deficit of the public budget after its peak in 1992 of less than 100 billion will be lowered by one quarter (see Fig.10).

5. Summary

All the simulation runs show a maximum of unemployment at the end of rapid shut-downs. In concordance with the aggravated elimination of non profitable enterprises domestic production decreases initially. Supposed there is a push of investment within the next two years the peak of unemployment will not be substantially lower than without additional investments. It will be about more than 4 million in case of a scrap rate of 45 per cent, and 3.2 million with a scrap rate of 25 per cent. Only after 1992 additional investments will show positive effects, and the economy will recover earlier than without a push of investments. Mass unemployment and short time labour will show up for a reduced period.

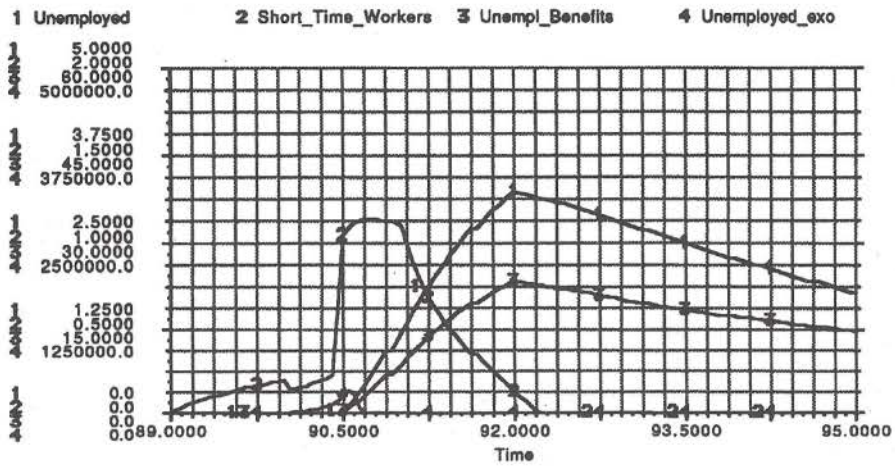


Figure 9. INVESTMENT PUSH: Unemployment and Short-Term Labour

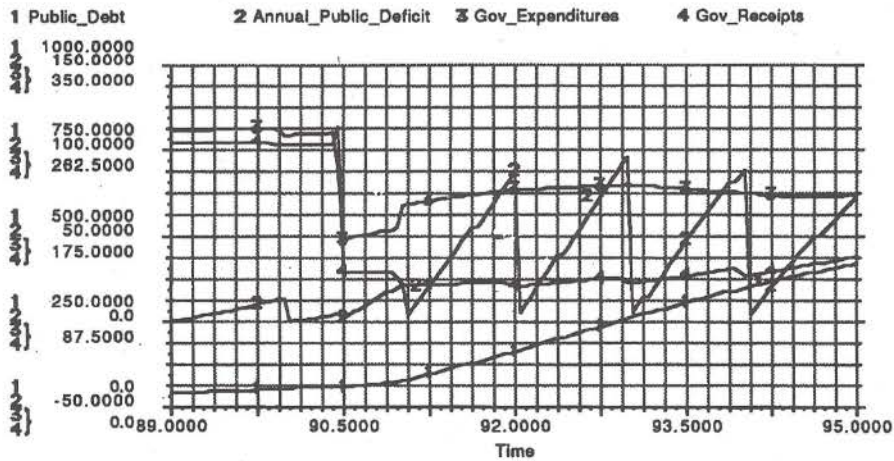


Figure 10. INVESTMENT PUSH: Public Sector and Annual Deficit

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