ECONOMICS OF PLANNING

THEORY AND PRACTICE OF CENTRALLY PLANNED ECONOMIES AND THEIR RELATIONS WITH MARKET ECONOMIES

CONTENTS

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Plan sounding

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In the summer of 1971 our research group initiated practical calculations to examine several important ratios and trends in economic development.[1]

Our main objective was to provide practical aid to perspective planning with a small sized, easily handled, dynamic model. We did not endeavour to attain theoretical conclusions of general validity with our research. With our calculations we would like to contribute to clearing up *topical Hungarian* perspective planning problems.

MAJOR QUESTIONS OF THE EXAMINATION AND THE METHOD OF CALCULATION

With our calculations we endeavoured to analyze several *economy-wide interrelationships,* several economic *basic issues.* These were the following:

[1] The research took place in the Institute for Economic Planning on commission from the National Planning Office. The following division of labour developed among the members of the work group completing the research:

János Kornai worked out the first model outline serving as the starting off point for the work, and then coordinated and guided the work.

Anna Jónás collected a significant part of the data, worked out the computer programme for the calculation, and directed the numerical calculations.

Zsuzsa Dániel participated in the data collection and evaluation, and ensured the connection between our work and the topical prescriptions of perspective planning.

Béla Martos did the mathematical work connected with the research.

Distinction between the spheres of activities outlined here were not rigid and the research was collective in nature.

Aside from those already listed, also participating were *József Sivák* (forecasting data, regression calculations), *Ede Lovas* (international data), and *Mrs. László Lackó* (manual calculations). The computation was completed in the Computer Centre of the National Planning Office under the leadership of *Attila Fölsz.*

1. For a long time now *the ratio of consumption and accumulation* in Hungary has changed comparatively little. What would be the consequences of rigidification of the ratio, or of changing it in any direction? With our calculations we sought a reply to the manner in which the *growth rate of consumption* is related to other national economic indicators, to other major national economic processes.

2. Today it already seems a platitude to state that we are backward in so-called *infrastructural* development. What is the rate with which we should advance the development we have postponed for so long? If we increase or decrease the capital invested into infrastructural development, how would this affect the general growth of the national economy?

3. The development of the national economy depends to a great extent on whether or not we are successful in achieving a change in the use of our resources, or whether *efficiency* will stagnate, or even deteriorate. What is the manner in which efficiency, and first of all the efficiency in the use of the production basis, is related to other growth indicators?

4. There has been a shortage economy in Hungary for 20–25 years now. Even today there are keen shortage phenomena. At the same time it is true that the form of appearance of shortage has changed significantly. The consumer must stand in line for commodities and services on comparatively rare occasions only although there is still a serious shortage of certain services (e.g. housing) even today. One of the major topical form of the shortage is so-called investment tension. Do we wish to eliminate the shortage in the coming 15 years? If so, how is this related to other growth processes?

We by no means state that with the four issues mentioned we have grasped all essential national economic problems of perspective planning. To mention only a single example: we have not dealt with the international division of labour, with foreign trade despite the fact that we know its outstanding importance. In a similar manner, in the first stage of research, now come to a close we have not taken into consideration the role of the division of total available manpower despite the fact that it of course has a tremendous effect on the development of the national economy.[1]

[1] Some other projects, including a large dynamic linear programming model for the period 1970–90, have shown that our main economic policy conclusions elaborated in this paper are realistic even when labor requirements are taken into account.

In the next phase of our research, now in progress, we will include manpower balances into our model.

At any rate we feel that the problems listed are among the eight to ten issues which, without exception, all economists view as the basic issues of Hungarian development.

With regard to our form of calculation, our model belongs to the family of «simulation models» which describe the time path of the systems, and with regard to economic content, it is an aggregated «growth model». With respect to the basic assumptions, it is most closely related to the well-known Harrod-Domar models, although it deviates from them (and other growth models) in many respects.[1]

A mathematical description[2] of the problem is comparatively simple. We combined the interrelations we wanted to examine for each year into an equation system of about 50 equations. We solved the equations one after the other by substitution, and year after year we calculated those indices which would then form the initial data for the next year.

In the calculations we divided the national economy into 12 sectors. The division is adjusted to the branch-organizational structure of the national economy with the sole deviation that the "industry" and "construction" sectors were split into two sectors each. The division was according to whether or not they produce capital goods, or whether the building industry was or was not constructing for investment. The output of the various sectors was determined by the stock of fixed capital at the beginning of the year and the efficiency in the use of fixed capital. We treated the quantity of fixed capital needed for a unit of output as a *technical parameter*. We approached their numerical values and temporal changes using statistical time series, the analysis of international data, extrapolation and expert estimate.

The utilization of the products determined by fixed capital stock and fixed capital coefficients are partly influenced by more or less determined technological interactions, and partly by economic policy decision. We calculated current inputs with the aid of technical parameters estimated on the basis of I–O coefficients. We also determined the part devoted to inventory increases in accordance with inventory norms estimated by sectors, which also includes the stock of incompleted investments alongside the material inventories. The share of consumption and the sectoral allocation of investments are regulated by *economic policy parameters*.

The fixed capital stock of each sector rises with the value of the new investments minus the assets withdrawn from use each year, and this

[1] We would mention the works of András Bródy, G. A. Feldman, B. Horvat, P. C. Mahalanobis, Jenő Rácz and György Szakolczay, from among our literary sources.

[2] See the Appendix.

determines the production level of the sector for the following year. On the material-technical composition of investments we give a separate sector by sector picture of the ratio of industrial and construction capital goods, and compare demands for these capital goods with the output of the investment sectors.

Based on 1968 factual data the calculations were carried on til 1985. Therefore each calculation describes an 18 year growth path. The various calculations deviate from one another in initial data and the different numerical values of the parameters. Each growth path is characterized by the annual and sectoral data of fixed and of working capital stock, and by trends in consumption on national economic level, also in a year-by-year breakdown.

THE BASIS PATH

With the aid of our model we first of all calculated a perspective plan of economic growth, which we termed the *basis path*. Within the framework of our *series of calculations* we calculated a total of 40 paths and the basis path was marked by No. 23.

The basis path is an estimate of how the major indices of the Hungarian national economy will move to 1985 if the trends of the past decade in economic policy as well as technical parameters and efficiency indices continue to hold.

The major features of the basis path are the following:

— In the past decade a slight shift in the ratio of consumption and accumulation has taken place in favour of accumulation. We assumed that this shift would continue in a similar, slight manner.

— There was a slow structural reallocation in the intersectoral breakdown of investment resources. In this way, for example, if only to a slight extent, there was a rise in the share of the infrastructural sectors in total investments. We assumed that this reallocation would continue at a slow rate similar to the present one.

— In several sectors the efficiency of fixed capital declined, while in others it grew. We are dealing with a complex phenomenon here, on which many factors have a joint effect. In calculating the basis path we did not simply lengthen the past trends in fixed capital efficiency, but we endeavoured to forecast the directions characteristic of the various sectors, and the trends which are expected to be realized in the future. In other words, in this respect we took prognostic calculations as the basis. We accepted a similar point of view in determining the parameters of the

discarding of fixed assets, and the parameters describing the material-technical composition of the investments. In contrast with this, in the case of several other technical parameters, in which the trends of the past appeared more stable, we built the trends on extrapolation.

On the basis of the assumptions listed we determined the input data of our model and completed the calculations. On the basis path the annual average production growth rate is 4.7 per cent, while that of consumption is 4.3 per cent. Therefore the rate shows a slight slow-down in comparison to the 5.5 per cent production and 4.6 per cent consumption growth rate of 1950–1969. In connection with this we would particularly like to call attention to the fact that the growth data characterizing our basis path were not simply formed by an extrapolation of the trends fitted to past production and consumption time series. It can be assumed that trend extrapolation must show a similar slight slow-down in the rates. We, however, made separate extrapolations of the various economic policy and technical parameters of the national economy, or forecast in other ways, and it was from these that the model itself calculated the expected production and consumption growth rates.

The basis path is not a *prophecy* of our research group, it is not a prognosis. We do not claim that it is most likely that the basis path will be realized, for at present management has the means to shift the economy from that path. The basis path is to be viewed even less as the *proposal* of our research group. We do not believe that it would be desirable to move on this path. The basis path is no more than the starting off point of a series of experiments, a basis with which we can compare other calculated paths. Its role is nothing more than, say, that of zero degree, in measuring temperature. Zero is not considered either a «probable» or a «desirable» temperature, but simply a point marked out with which current temperature can be compared.

PLAN SOUNDING

> "But we, Holy Father are given great strength in not knowing precisely what we want. Amazing freedom in manouvering is born of deep uncertainty of intent...."
> Jean ANOUILH: Becket ou l'amour de Dieu.

As already mentioned we calculated a total of 40 paths in the first phase of research. Each represents an experiment with an idea. The

name of our research, «plan sounding», refers to this experimental nature. In the same way as a medical sounding device takes a sample from the million cells of tissue, or a meteorological sounding device takes a sample of the atmosphere, we are sounding the economic future of the country. We have taken different characteristic samples from the multitude of possible future paths and on these we are examining the problems of growth and perspective planning.

In some cases we modified but a single factor, and in others a number of factors in comparison with the input data of the basis path with the objective of observing the effects of the modifications. In some cases the modification was comparatively small in extent, and in others it was more daring, more radical. We wanted to explore the vicinity of the basis path at a broad angle. *Decision making management and economist public opinion can only truly take a stand on fundamental economic issues if a comparison is made of sharply different perspective plan variants, and what is more, they must be different with regard to the fundamental great national economic interrelationships.*

The quote we have used as our motto (in which the advisor, the political "planner" speaks to the pope) was of course, halfway intended as a joke, but at the same time we take it halfway seriously. In the beginning of perspective planning we do not yet know and we cannot yet know precisely what we want, for this is the era of clearing up possibilities, and together with it, intentions and resolutions. This is why we must make use of plannings "freedom to manouver".

In preparing annual or even five year plans the narrow degree of freedom in choice puts the hobbles on thinking. The actions already underway which for the most part cannot be interrupted, or could only be interrupted with serious loss, to a great extent determine the next steps. We are on a fixed track from which it is just about impossible to switch off in the coming few years. If, however, we are thinking fifteen years ahead the switches can appear in our fantasies, enabling us to switch from one track to another. But in order to do this we must truly liberate our fantasies. The "inertia" which is understandable on short or medium term is an inforgivable sin on the long term and makes all of perspective planning superfluous and senseless.

The basis path represents roughly the following: what happens if we continue on the same track. The other 39 paths contain switches leading to other tracks. In each calculation either the change in the ratio of consumption and accumulation, or another type of allocation of investments, or another factor is the switch or combination of switches bringing about

the change in track. The value of plan sounding is precisely that it makes it clear: which switch leads to which change in track.

We would not like to create overexpectations regarding the series of experiments completed. Our numerical results must be received with great caution. Our model contains very strong simplifications and there is great uncertainty in the data used. In fact, with our work we feel that the *asking of the questions* was far more essential than the actual answers which we are capable of giving with our small model. We hope that it was worth thinking about them, but prior to any use, they must be carefully compared with the results of calculations using different approaches.

THE RATIO OF ACCUMULATION AND CONSUMPTION

In speaking on the ratios of accumulation and consumption we based ourselves on value added (the GDP). This is divided into two major parts: consumption which includes consumption by both the population and the community and accumulation which includes gross investments (that is the rise, replacement and renewal of fixed capital stock) and increment in inventories. We have termed the consumption/ GDP ratio the *consumption ratio.*

In the past decade the consumption ratio showed a declining trend, even if it was very slight in extent. In order to examine the question we first compared three paths. All three start out from an identical situation in 1968. At that time the consumption ratio was 69.7 per cent. In comparison with this, a gradual shift took place in all three paths to 1985, the end of the perspective planning period. The "middle" column is the No. 23 basis path which in 1985, continuing the present trend ends with a 68 per cent consumption ratio. In comparison to this path No. 28 shifts in the direction of increasing the consumption ratio, and in 1985 it is 75 per cent. Path No. 30 modifies in the opposite direction: it calls for a 60 per cent consumption ratio in 1985.

The three paths are compared in table No. 1 and Figure 1. The solid curve in the figure is the No. 23 basis path, the broken curve is path No. 30 which sharply reduced the consumption ratio and the dotted curve is path No. 27 which sharply increased the consumption ratio.

With regard to the average growth rate of consumption over the *entire* perspective plan period the growth is rather insensitive to changes in the consumption ratio. A difference as radical as the pushing up of the ratio

Table No. 1. *Consumption ratio and consumption path*

1. No. of path	27	23	30
2. Name of path	Sharp rise in consumption ratio	Basis path	Sharp decline in consumption ratio
3. Consumption ratio in 1985	75	68	60
4. Consumption index 1968 = 100			
1969	105.5	105.5	105.5
1970	112.6	112.2	111.5
1971	118.3	117.3	115.7
1972	123.3	121.9	119.7
1973	128.6	126.7	124.1
1974	133.6	131.5	128.4
1975	136.9	134.5	131.3
1976	142.4	140.2	136.7
1977	148.3	145.5	142.8
1978	154.1	151.5	149.4
1979	160.3	158.1	156.6
1980	165.5	163.8	162.8
1981	172.5	171.4	171.3
1982	179.3	179.2	180.2
1983	187.0	187.7	188.9
1984	194.7	196.3	198.0
1985	202.7	205.5	208.1
5. Average annual growth rate of production (%) between 1968–1985	4.0	4.7	5.6
6. Annual average growth rate of consumption (%) between 1968–1985	4.2	4.3	4.4
7. Annual average growth rate of consumption (%) between 1971–1979	3.8	3.8	3.8

to 75 per cent, or pulling it down to 60 per cent causes no more than 2 tenths of a per cent change in the annual average rate.

It is not sufficient only to keep in mind the average growth rate of consumption for the long term, but we also had to examine how it changes over time. This comparison, in which, in accordance with the "ceteris paribus" principle, all other factors were left unchanged, experimented solely with the modification of the consumption ratio, the "present-future" dilemma of economics appears in pure form. It can be clearly seen in Figure 1. that the curves of the consumption paths intersect in about 1981–1982. In the 1970's the higher consumption ratio

CONSUMPTION INDICES

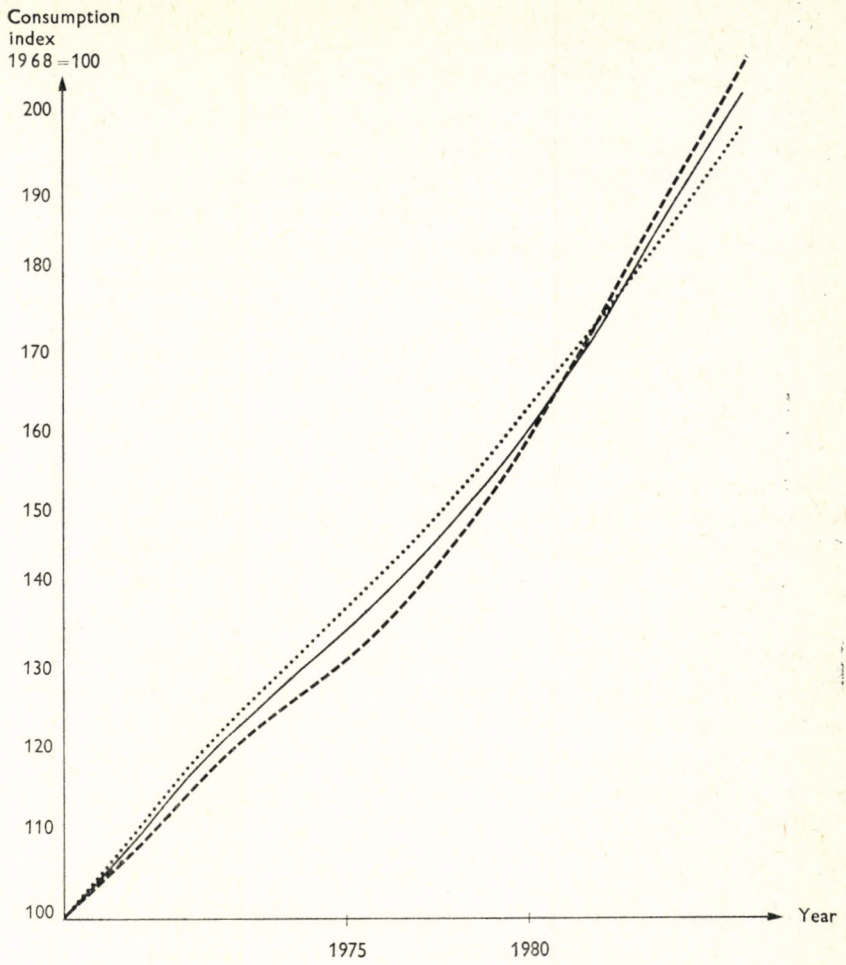

Figure 1

truly results in a larger consumption volume than the low consumption ratio. However, the accumulation of the 1970's accelerates the growth in production and as a result in the 1980's the volume of consumption is higher even on the path where the ratio of consumption is lower. It is so much higher that by 1985 it shows a slight advantage in the cumulative consumption of the period lasting until then (and with that in the annual average growth rate of consumption for the entire period, too). And if we were to lengthen the planning horizon to beyond 1985 this effect would prove even more.

It is worth while supplementing the analysis of consumption with a further point of view. In the comparison mentioned we assumed the efficiency of fixed capital to be identical in all three paths. It is not likely however, that with a significant modification in the accumulation ratio the efficiency of investments would remain the same. If investments are increased at an exaggeratedly rapid rate it is to be feared that their use will be less organized, more scattered and that tensions would arise on the market for capital goods. In order to examine the problem we completed a further study. We assumed that if the accumulation ratio is reduced then we could better concentrated the qualifications and ability to organize needed to execute investments. This can be expressed in favourable trends in capital coefficients. If the consumption ratio increased to 75 per cent is matched with a greater efficiency of fixed capital then the growth in production and consumption accelerates in comparison with the basis path.

Therefore, we can draw the conclusion that *the growth of the national economy depends far more on capital coefficients and the use and efficiency of resources than on modifications in the consumption and accumulation ratio.*

We can also support this conclusion by studies of international data, and in fact the results of calculations under other assumptions also lead to similar conclusions. Therefore, if we are dissatisfied with the growth of the national economy we should not see the key to solution in changing the ratio of consumption and accumulation. Development can be accelerated with an unchanged and even a reduced accumulation ratio if we promote it through other means.

THE RATE OF ECONOMIC DEVELOPMENT AND INFRASTRUCTURAL INVESTMENTS

We divided the sectors of our model into two groups:

Economic development sectors, group G for short: industry, building industry, agriculture, commerce.

Infrastructural sectors, group I for short:[1] water economy, transportation, telecommunications, personal and business services, housing supply, health and cultural services, public administration and other services.

[1] Our research group has theoretical reservations with this classification, and against the expression "infrastructure". For the sake of comparisons with National Planning Office calculations we have put aside these reservations and have simply taken over the categorization.

We know the problem that in past decades the development of group I has dropped behind group G, and postponed tasks have piled up. However, opinions deviate regarding the rate with which the infrastructural sector should be developed.

In order to reply to the question we compared the basis path with three others. The results of the analysis are contained in Table No. 2. On the rest of the paths all input data are identical with that of the basis path and differs from it only in the manner in which total investment funds were divided between groups G and I. Taking the total investments for each year as 100, we receive the *G:I allocation ratio.* In the initial year 1968, the ratio was 60:40. The four paths compared created four terminal ratios for 1985, gradually moving from the common 1968 ratio to the deviating 1985 ratios.

The basis path departs comparatively slightly from the initial ratio.

Table No. 2. *The effects of the G:I allocation ratio*

1. Path No.	32	29	23	28
2. Name of path	Strong shift to group I	Medium shift to group I	Basis path	Shift at expense of group I
3. G: I allocation ratio in 1958[1]	33:67	41:59	57.5:42.5	64:36
4. Annual growth rate of production (%)	3.5	4.0	4.7	5.2
5. Annual growth rate of consumption (%)	3.2	3.6	4.3	4.8
Index of fixed capital stock in certain I sectors in terminal year				
6. Water economy	176.2	192.3	160.8	133.1
7. Transportation and telecommunications	209.6	182.7	168.9	162.3
8. Housing supply	252.0	238.3	203.0	198.9
9. Health and cultural services	212.3	226.3	200.0	195.0
10. The G:I production ratio in 1985[2]	83.7:16.3	85:15	88:12	89.6:10.4
11. Economy-wide volume of fixed assets	2.039	1.9	1.689	1.576

[1] By comparison: the 1968 ratio was 60:40
[2] By comparison: the 1968 ratio was 85:15

In lengthening the present trend a shade of shift took place in favour of group I. Here the 1985 G:I allocation ratio is 57.5:42.2. In comparison with this, on the other three paths we experimented in both directions. Path No. 28 is an experiment at the expense of group I, and paths Nos. 29 and 32 are in favour of group I.

Several important conclusions can be drawn from Table No. 2 which presents the results.

The production and together with it, the consumption growth rate reacts most sensitively to the G:I allocation ratio. It is far more sensitive to the division of investments between groups G and I within the given ratio of consumption and accumulation than it is to how the whole GDP is divided into consumption and accumulation.

We would like to particularly call attention to the 10th line in Table No. 2. In line 3. of the table we have described the *input* ratio of investments in groups G and I. In contrast, in the 10th line of the table we have taken note of the *output* production ratio of the two groups. This ratio was 85:15 in 1968. If we want only to maintain this ratio, even then a shift is needed in the break-down of investments, at the expense of group G and in favour of group I, and this shift must be greater than the extrapolation of the present trend (the basis path) ensures. If we gradually increase the share of 40 per cent of 1968 to 59 per cent by 1985, even then we are "right where we started from"; in other words with an 85:15 production ratio. This is not a paradox but can be explained by the deviating dynamics to the capital coefficients of groups G and I. In group G this coefficient increases less than in group I. It stems from this that, if we want to achieve a tangable shift in production in favour of group I, then a much stronger reallocation of investments is needed.

One of the members of our research group, János Kornai wrote a study a few months ago on the problems of harmonic growth[1]. In this, among other things he discussed the following concept:

In past decades the Hungarian national economy has developed on a disharmonic path from many points of view. One of the consequences is the relative backlog in transportation, water economy, housing supply, health and several other servicing sectors behind the general growth of the national economy. *If we want to catch up with this relative lag it will slow down the growth rate of total national economic production.*

Our calculations fully prove this conclusion.

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[1] *János Kornai:* Rush versus harmonic growth. North-Holland, Amsterdam, 1972.

A significant part of infrastructural investments are direct contributions to improving the living conditions of the population. At the same time the shift in the G:I ratio in favour of group I slows down production and the growth rate of consumption. This means that we are facing a "flow vs. stock"[1] problem of choice. The question is of course not to reduce either consumption flow or to increase infrastructural stock in absolute terms, but in terms of the rate of growth of the two types of growth processes. *We can be satisfied with a slower consumption flow increase and in return will receive a more rapid infrastructural stock rise. Or vice versa: we may prescribe a more rapid rise in consumption flow, but then in return we must be satisfied with a slower growth in infrastructural stock.* In our wiew this is one of the fundamental problems in the economics of the Hungarian fifteen year plan. It is our impression that it is a problem of economic interdependence which growth theory has not yet given sufficient attention.

EXAMINATION OF THE CAPITAL COEFFICIENT

One of the decisive issues in national economic perspective development: how will capital intensity of production develop. Often we hear oversimplified assumptions regarding the future trends in the economy-wide capital output ratio. For instance it is simply stated: the coefficient does not change in time. Often we come accross cases in which trends in the index are qualified too off-handely: if the capital/output ratio declines this is "improvement", if it increases this is "deterioration".

In reality the question is far more complicated. The capital/output ratio (or more precisely: the major component of it which we have analyzed here at length, the fixed capital/output ratio, the *fixed capital coefficient*) is a *synthetic* index and its changes are formed by a combination of many factors. To list only the five most important factors:

1. As a result of their technical nature the different sectors have different demands for capital. The economy-wide coefficient reflects the proportion of sectors within the country. If, therefore, the economy-wide fixed capital coefficient rises, this does not unquestionably mean a "deterioration" in efficiency, but it can simply indicate a shift in favour

[1] In connection with the living standard, by consumption flow we mean the continuous consumption of commodities and services. By the infrastructural stock, meant to contrast it, we mean the part of the national wealth tied down in the infrastructural sectors, for instance the stock of housing, hospitals, personal means of transport, etc.

of the capital intense sectors. And vice versa: the reduction in the ratio does not unquestionably mean a change in a favourable direction.

2. A phenomenon similar to the one described in Point 1. also appears in connection with the *intrasectoral structure.* If there are shifts in the proportion of concrete activities, of the sub-sectors within the sectors, this can also effect the average fixed capital requirements of the sector, and in the final analysis, the economy-wide capital/output ratio as well.

3. The utilization of the existing fixed capital is also reflected in the fixed capital coefficient. The ratio increases if utilization declines. This again does not unquestionably mean "deterioration". If, for example, fewer patients are packed into a hospital ward, this can be expressed in a rise in the capital/output ratio of the health sector. In other words, where the fixed assets of a sector are used excessively, there "improvement" is indicated by a *decline* in the ratio.

4. In certain branches *technical development* runs concomitant with the increase in capital intensity and may set free other production factors and live labour. In other sectors technical development shows the opposite trend.

5. Production *price ratios,* as well as the ratios for the evaluation of fixed assets have a far-reaching effect on the capital/output ratio. It is true, in dynamic examinations we calculate in unchanged prices. But the numerical expressions of the effects of the three factors already listed are effected by the price ratios and the ratios of evaluating fixed assets.

One of the objectives of our series of calculations was precisely to analyze the above inter-actions. *We endeavoured to attain a certain separation of the effects listed above.* This was made easier by the fact that we did not consider the average fixed capital/output ratio for the whole of the national economy to be one of the input data in our model, but received the estimate on this as one of the most important *results* calculated from the model. However we did treat the fixed capital coefficients of the 12 sectors of the model, or more precisely the changes in the coefficients along the path to 1985 as input data. Above and beyond this another means to separate the effects was that we elaborated alternative estimates for the coefficients of the sectors.

Let us review our results in the order of the five factors listed.

Factor 1.*: Inter-sectoral structural shift.*

The examination described earlier referring to the shift in the G:I ratio contributed among other things to analyzing the economy-wide

fixed capital coefficient. Here let us return to Table No. 2. We find a comparison of four paths here. In calculating all of them we used the same fixed capital coefficients for each *sector* (more precisely: the estimated fixed coefficients projected to 1985). Despite this the economy-wide fixed capital coefficient deviates sharply in the four paths: it reacts in a highly sensitive manner to the large changes in the inter-sectoral structure. This was shown in line 11 of Table No. 2. As the share of group I in investments rises from 36 per cent in order, to 42.5, 59 and 67 per cent, the value of economy-wide fixed capital coefficient rises from 1.576 to 1.689, 1.9 and finally to 2.039. Bringing the infrastructural sectors to the forefront increases the average capital intensity of the national economy.

Factors 2, 3 *and* 4*: Modification of sectoral coefficients.*

In the above we have reviewed a comparison in which factor 1. the effects of inter-sectoral regrouping appears "chemically pure". From now on, unfortunately we cannot separate factor 2 (regrouping within the sector), factor 3. (utilization of capital), or factor 4. (technical changes) with similar purity. We analyzed their joint influence in such a way – as already mentioned – that we worked out alternative estimates for future trends in the fixed asset coefficients of the sectors.

One group of the estimates extrapolates the trend of the 1960–1969 time series. It does not give a single lengthened trend line but a zone. The upper boundary of the zone is the *pessimistic value of the extrapolation* while the lower boundary is the *optimistic value of the extrapolation* and the mid-point between the two is the *middle value of the extrapolation.*

This estimate draws conclusions on the future, relying on the past alone. However, we called on experts in the National Planning Office to give us a prognosis in such a way that they take into consideration not only past statistical factors but realistically take into account a future shift in the structure of the sector, and the effects of these on the fixed asset coefficients. In other words, we asked that they also take into consideration those factors which the above analysis summarized into points 2 and 4. As a result of the estimate received in this way, we received a second zone which again includes three curves: *the optimistic value, medium value and pessimistic value of expert estimate.* In "the degree of optimism-pessimism" we endeavoured to express the factors appering in point 3 of the above analysis, in other words the alternative hypotheses regarding the utilization of capital.

We are showing the part of our series of calculations in which we ex-

Table No. 3. *The effects of fixed asset coefficients*

1. No. of path	18	12	17	34	23	36	35
2. Name of path (at same time: hypothesis on fixed capital coefficient)	Extrapolation optimistic value	Extrapolation middle value	Extrapolation pessimistic value	Expert estimate optimistic value	Expert estimate middle value= basis path	Expert estimate middle value (group G), pessimistic value (Group I)	Expert estimate pessimisti value
3. Economy-wide fixed asset coefficient(1985)	1.299	1.353	1.43	1.57	1.69	1.71	1.91
4. Economy-wide production/ fixed asset stock ratio in 1985[1]	0.77	0.74	0.7	0.64	0.592	0.584	0.523
5. Annual average production growth rate (%)	7.4	6.9	6.2	5.4	4.7	4.6	3.7

[1] Data in line 4. is reciprocal of line 3.

perimented with hypotheses regarding fixed capital coefficients in Table No. 3. This shows seven paths. The basis path which was calculated on the basis of the middle values of expert estimates is in the center. We received lower capital coefficients in the case of the optimistic value expert estimate and on all three degrees of the extrapolation estimate. However, the capital coefficients are higher if we take the pessimistic expert estimate as the basis.

Table No. 3. and figure No. 2. illustrate the interactions between the hypotheses on fixed capital coefficients and the growth rate. In the figure we have placed the reciprocal of the fixed capital coefficient on the horizontal axis, and the growth rate on the vertical axis.

We fitted a straight line to the points on Figure 2. using the least square method. The equation of the straight line is the following:

$$/1/ \qquad r = 12.73\, k - 2.66$$

where r = the annual growth rate of production, k = the output/fixed capital ratio (the reciprocal of the fixed asset coefficient).

The straight line fits well to the points.

THE PRODUCTION GROWTH RATE AS A FUNCTION OF THE OUTPUT/FIXED CAPITAL RATIO

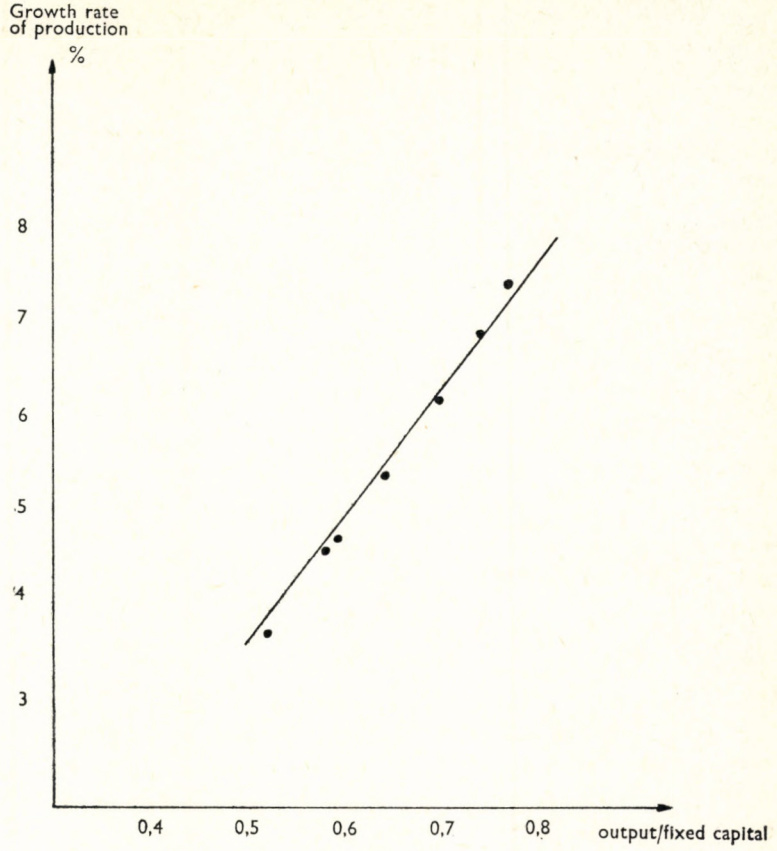

Figure 2

The regression equation expresses the following rule: if the output/fixed capital ratio rises by one tenth of a point, in other words if it increases from 0.6 to 0.7 then the growth rate rises in accordance with 1.25 points, in other words from 5 per cent to 6.25 per cent.

It is also worth a separate comparison of paths Nos. 23. and 36. If all factors (including the fixed asset coefficients of group G) are left unchanged but we reduce the overtense use of fixed capital stock in group I (which would be expressed in a volume of 10 per cent rise) then the growth rate would be reduced by a shade. The reduction is not too large, so we might ponder on whether it would not be worth while undertaking it.

In Table No. 3 we reviewed a *ceteris paribus* experiment. We have

compared seven paths in which only the fixed asset coefficients differ from one another. However, we also completed an examination in which we deliberately deviated from the principle of "ceteris paribus". We took 31 out of the 40 calculations those which met certain requirements for comparison.[1] The 31 paths deviate from one another in fixed capital

THE RELATIONSHIP BETWEEN THE OUTPUT/FIXED CAPITAL RATIOS AND THE GROWTH RATE

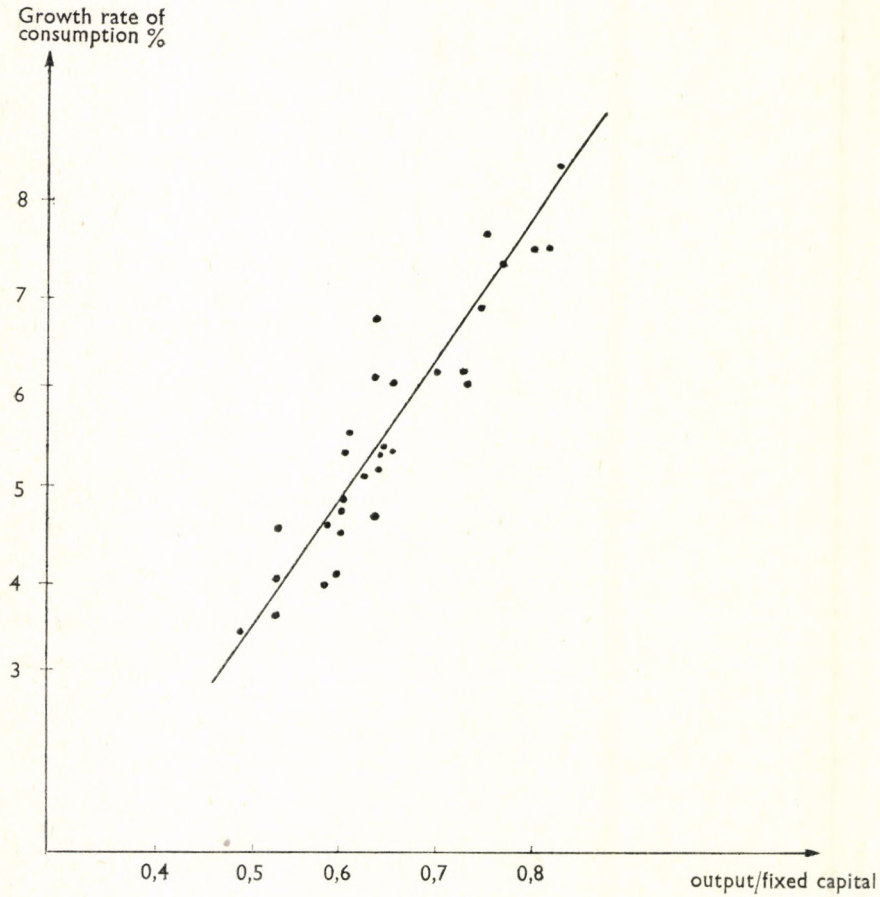

Figure 3

[1] From this point of view we only required that the starting off data of the 31 paths coincide. We have 9 paths in which the initial data deviate. The reason for calculating these 9 paths was that there is statistical uncertainty regarding certain starting off data, or certain sectoral breakdown criteria are problematic. We wanted to complete a sensitivity analysis on the effects of these.

coefficients but they are also different with regard to other input data, e.g. the share of consumption, the G:I allocation ratio, etc. During the time of planning the truth is that the planner can select from among infinitely many paths. Using plan sounding we lifted out a tiny, 31 element sample from this multitude. The calling of this sample is to represent this multitude to a certain extent. We of course know that this sample is too small, but it is suitable for illustrating our concept nonetheless.

We ranked the paths according to the reciprocal of the 1985 economy-wide fixed asset coefficient, in other words in a rising order of the production/capital ratio and the data are illustrated in Figure No. 3.

We fitted a linear regression to the points on the figure. The equation is the following:

/2/ $$r = 14.34 \quad k - 3.18$$

As we can see the parameters of the straight line deviate slightly from equation /1/. In a case when the ratio rises from 0.6 to 0.7 the growth rate does not rise from 5 per cent to 6.25 per cent but to 6.36 per cent. However, the deviation is insignificant.

The fitting is of course, less close than in the case of equation /1/.

This is because regression /2/ is not based on a series of "ceteris paribus" experiments, but on a larger, (and at least partially random) sample.

Of course the actual parameters of the equation always depend on the special data of the country in question (among other things, on the price ratios and the concrete system for the evaluation of capital). However, the type of interaction reflects a regularity that holds more generally. *There is a close linear dependence between the output/capital ratio and the growth rate.*

Factor 4: Technical change

Of the factors mentioned at the beginning of the chapter, the changes in capital requirements stemming from technical change was number 4. We were in general unable to separate it from factors 2 and 3, and in the above we discussed them together. We only made a single special study in which we assumed the separate influence of this factor. This calculation was related to the analysis of the *discarding of fixed assets.*

In the majority of our calculations, including in the determination of the basis path we started off on an "extrapolated" discarding ratio of fixed assets. This corresponded to the earlier actual ratio (with the ex-

ception of several sectors where the statistical data appeared too uncertain, and where the estimates here were corrected).

For sake of comparison we calculated path No. 37. Here every input data was identical with those of the basis path, except for the discarding ratio. Now we prescribed *accelerated discarding*. At the same time we assumed that as a result of the accelerated discarding of obsolete fixed assets the efficiency of those remaining would improve, which is expressed in a lower fixed capital coefficient. (The latter is represented by the optimistic value of expert estimate.)

In comparing the two paths we can conclude the following:

The annual average growth rate of production on the basis path is 4.7 per cent, in the accelerated discarding path it is 5.1 per cent.

The economy-wide fixed capital coefficient on the basis path is 1.689, on the accelerated discarding path is 1.608.

Factor 5: Fixed asset valuation

In the examinations reviewed so far we considered price ratios given as well as the valuation of fixed assets. However, we completed an experiment related to factor 5, an analysis of the fixed capital valuation of the housing sector.

A problem arose in the fact that the Central Statistical Office gives a much lower figure for the value of fixed asset stocks in the housing sector for 1968 than the one taken into account by the National Planning Office for perspective planning. We did not consider it our job to decide who is right. We took most of our figures from Central Statistical Office data since the majority of the data input of the model, and above all, all the other starting off values originate from Central Statistical Office sources. The starting off 1968 value of the housing sector fixed asset stock also had to conform to this data. However, for the sake of control we calculated several paths in such a way that we used National Planning Office instead of the Central Statistical Office figure.

This is the single input data in which path No. 39. differs from basis path No. 23. It appeared that the course of the path, with respect to the dynamics of production and consumption, is hardly modified. (In path 39 the growth rate of production is 4.8 per cent instead of 4.7 per cent.) However the economy-wide fixed capital coefficient is considerably higher, since in the beginning of the path the initial housing capital appears with a considerably higher value. Instead of the 1.689 value econo-

my-wide fixed capital coefficient of the basis path for 1985, as a result of the modification in housing value, we received a economy-wide index of 1.833 in value.

The above described experiment is only an example to illustrate the influence of pricing on the long-term growth path. The problem of interdependence between price structure and growth pattern is much wider, and requires careful studies in our further research.

EQUILIBRIUM OF THE INVESTMENT MARKET

As already indicated one of the basic problems of the Hungarian national economy is the permanent disequilibrium. In recent years it has appeared in particularly keen form in the market for capital goods. We considered a thorough examination of this issue to be one of the major tasks of our research. However, for the time being we have only completed first calculations in this connection and we ourselves do not consider them to be sufficient. Nevertheless, we would like to report on some of our experiences.

We concentrated our analysis principally on construction, precisely on that larger part of the building industry which produces new fixed assets. We have termed this the investment construction sector.[1] Industry, examined with our aggregate model abstracting from foreign trade, is less interesting from this point of view for through foreign trade there are broad scale substitution possibilities. The surplus of capital goods produced by industry can possibly be sold abroad, and the shortage may be filled in with imports. However, the activities of the building industry cannot be substituted by import as a rule.

If we were now to examine the investment construction market we can conclude that there is hardly a path in our series of calculations in which a smaller or larger construction shortage does not appear. This reflects the phenonemon of the Hungarian national economy which has really appeared till now. Therefore the question to which we wanted to reply is: what are the factors which affect the rise or decline in the building shortage. In reality it is always the combined, interweaved effects of more than one factor. We do not simply want to «put the balance in order» in the

[1] In our model we divided both industry and construction industry into two sectors apiece: investment and non-investment industry, and investment and non-investment construction.

final analysis that would not be too difficult at least not on an electronic computer. We rather wanted to undo the different factors, to separate them from one another in an abstract manner.

Factor 1. One of the basic factors which forms demand on the investment construction is *total demand for capital goods*. Since our model describes the real sphere of the economy and does not deal with its control mechanism, and within this with the financial and credit system, the price system, etc. we have avoided the financial background of demand. Even then the joint effect of complicated factors forms total demand for capital goods. Total demand depends:

a/ on the rise in production,
b/ on the ratio of consumption and accumulation within production,
c/ on the ratio of fixed and of working capital stock expansion compared to one another within given accumulation.

Factor c/ is comparatively less important and therefore we will not even discuss it alone. However factors a/ and b/ are most important and for this reason we will deal with them in more detail. Our experience can be seen in Table No. 4. Here we have used six paths. In general they were calculated according to identical assumptions. However, each pair has a deviating consumption and accumulation ratio. Aside from this, within each pair of paths the hypotheses on the fixed capital coefficient differ from one another.

From Table No. 4 we can see the following:

There is no simple relation between the production growth rate and the building shortage. A high rate (7.7 per cent) runs concomitant with a comparatively small building shortage, while a significantly lower rate (5.4 per cent) runs together with a larger shortage. The interaction cannot be seen in *general* form between rate and shortage, but depends *concretely* on the factors affecting the rate.

If the reason the rate accelerates is that the fixed capital coefficient shows a more favourable trend this does not cause an increase in the shortage, and in fact can even reduce it. In the B paths which take a lower fixed capital coefficient into account there is generally a significantly smaller shortage than in the paired A path. The latter are built on data identical with their B pairs in every single way, and only take into account a less encouraging fixed capital coefficient.

In contrast the building shortage reacts quite sensitively to the ratio of accumulation and consumption. If, to clear this up, we compare the three

Table No. 4. *Building shortage and investment funds*

Name	First Pair		Second Pair		Third Pair	
	A	B	A	B	A	B
1. Number of path	26	13	23 basis path	12	27	14
2. Consumption ratio in 1985 (%)	60	60	68.1	68.1	75	75
3. Estimation variant used to determine fixed capital coefficient	Expert estimate (higher coefficient)	Extrapolation middle value (lower coefficient)	Expert estimate middle value (higher coefficient)	Extrapolation middle value (lower coefficient)	Expert estimate middle value (higher coefficient)	Extrapolation middle value (lower coefficient)
4. Average annual production growth rate (%)	5.4	7.7	4.7	6.9	4.0	6.1
5. Building shortage for entire period calculated cumulatively (%)	26	5	18	1	9	1

pairs of paths we can see: *the higher the accumulation ratio the larger the building shortage*. We find this interaction whether we compare the three A paths or the three B ones.

Factor 2. The following factor affecting the equilibrium of the investment construction market is *the sectoral structure of total investment demand*. We receive an interesting point of support for analysis if we examine the variants of the G:I allocation ratio. The results are summarized in Table No. 5.

The interaction appearing in Table No. 5. is quite simple. *The shift in favour of group I at the expense of all of group G runs concomitant with a greater shortage*. This conclusion is of course only true "ceteris paribus". In other words in the case when the sectors' allocation ratios within the G group are not modified.

Table No. 5. *The building shortage and the G:I allocation ratio*

1. No. of path	32	29	23 basis path	28
2. The G:I allocation ratio in 1985	33:67	41:59	57.5:42.5	64:36
3. Building shortage for entire period cumulatively calculated (%)	26	24	18	9

Factor 3. Alongside the total investment demand and the given sectoral ratios already discussed the equilibrium of the investment construction market is also affected by *the material–technical composition of investment input*. In this connection it is worth comparing paths Nos. 23 and 22. All input data is identical with the exception of the sector by sector investment input columns, which express the material–technical composition of the investments. In determining path No. 22 we compiled these parameters on the basis of 1968 factual data. For path No. 22, however, we used forecast data, plan figures. Path No. 23 is less construction demanding than path No. 22. This deviation has a significant effect on the degree of building shortage.

We must emphasize that the material–technical composition of the investments cannot be considered a purely technical given feature, but it is strongly influenced by economic policy decision as well. For example, it is effected by the system of discarding fixed assets, the determination of the ratio of reconstruction and new establishments, the selection among investment alternatives differing in material–technical composition, etc.

Factor 4. While factors 1., 2., and 3 affect the investment construction market from the demand side, we must also deal with the supply side. This can be significantly influenced by *investments given to the investment sectors,* and within this to the ratio of funds given the investment industrial sector and the investment construction sector. From this point of view we made a comparison of two pairs of paths in Table No. 6.

It can be clearly seen from the table that it is sufficient to increase the allocation ratio of the investment construction by about one and a half-fold for the shortage to disappear for all practical purposes. In reality most likely the problem is not that simple for the major bottleneck of the building industry is not in fixed assets but much more so in live labour.

Table No. 6. *Building shortage and allocation ratio for the investment sectors*

1. No. of path	23 basis path	25	27	31
2. Consumption ratio in 1985 (%)	68	68	75	75
3. Allocation ratio of investment in construction 1985 (%)	1.6	3.1	1.6	3.1
4. Building shortage calculated cumulatively for entire period (%)	18	2	9	2

At any rate, however, regrouping investments might contribute to eliminating the building shortage.

In the 1960's the allocation ratio of the building industry showed a slightly declining trend. In the basis year of our calculations, 1968 it was only about 2 per cent, and in extrapolating the declining trend we called for 1.6 per cent in the basis path for 1985. *Continuation of the declining trend would lead to the preservation of the building shortage.*

The examination of factor 4. leads to a more general economic interdependence. *The sectors which directly serve the material–technical supply of investments, the investment industry and the investment construction in fact receive a very small part of the national economic investment funds, together about 6 per cent, while they have the lion's share in the realization of the investments. It is worth giving increased support to their development for this would have an important accelerating effect on the development of the whole of the national economy.* There is no need to fear that oversupply on the market for capital goods will appear in the plan, the producers will be able to find their markets.

The examination of tension on the investment market is one which we would like to continue, partly with the aid of newer calculations, and partly through other methodological ways. We will try to find more balanced growth paths by simultaneous solution to the equation system and replacement of some important economic policy parameters with endogeneous variables.

In the present stage of research we devoted our major attention to examination of the efficiency of fixed assets and their distribution among the sectors. We did not examine the effects of the use of live labour on production, or the trends in the ratios of live and materialized labour. Later in this work we will also continue research in this direction, and will control our conclusions from the manpower side as well.

APPENDIX

NOTATION

The economy consists of n sectors, the first m being those producing investment goods (briefly: investment sectors). We refer by the subscript i to an investment sector, by subscript h to a non-investment sector and by subscript j to any sector. The model extends to T periods of time (year). The superscript t marks the year. In the calculations reported in the paper we had $n=12$, $m=2$, $T=18$.

The variables of the model are as follows:

X_j^t = gross product of sector j
Y^t = gross domestic product (GDP)
K_j^t = stock of fixed assets in sector j at the beginning of year t
I_j^t = gross investment into sector j
I^t = gross investment fund of the economy as a whole
S_j^t = stock of circulating assets in sector j at the beginning of year t
C^t = consumption
Q_i^t = product surplus (+) or shortage (–) in the investment sector i.

The initial stocks of fixed and working capital: K_j^1, S_j^1 are supposed to be given for all sectors.

We are also given the following coefficients:

a_j^t = net output (contribution to GDP)/gross product ratio
q_j^t = withholding ratio (one minus discarding ratio) of fixed assets at the end of year t
k_j^t = fixed capital/gross product ratio (fixed asset coefficient)
s_j^t = circulating assets/gross product ratio (norm of inventory)
c^t = consumption/GDP ratio
d_j^t = investment allocation coefficient, the relative share of the j-*th* sector from the investment fund:

$$\sum_j d_j^t = 1$$

b_{ij}^t = investment input coefficient, the product of the investment sector i needed for a unit investment into sector j

($\sum_i b_{ij} \leqq 1$, since a part of the investment goods may also be produced by the noninvestment sectors).

All these coefficients are positive by definition, moreover the a, q, c, d, b coefficients are less than 1. The a, k, s, b are technological coefficients while c and d embody an economic policy. q bears both features.

THE MODEL

/1/ $$Y^t = \sum_j a_j{}^t X_j{}^t$$

The production of the GDP.

/2/ $$K_j{}^{t+1} = q_j{}^t K_j{}^t + I_j{}^t \qquad \forall j$$

The formation of the next year's fixed capital from the withheld part of this year's fixed capital plus investments

/3/ $$Y^t = C^t + I^t + \sum (S_j{}^{t+1} - S_j{}^t)$$

The distribution of the GDP among consumption, investment and inventory change of circulating assets.

/4/ $$K_j{}^t = k_j{}^t X_j{}^t \qquad \forall j, \qquad t \neq 1$$

/5/ $$S_j{}^t = s_j{}^t X_j{}^t \qquad \forall j, \qquad t \neq 1$$

The stock of fixed and circulating assets are fit to the needs of production. In the first year they need not be balanced, thus the production must comply with the bottleneck.

$(4^1\text{–}5^1)$ $$X_j{}^1 = \min \left\{ \frac{K_j{}^1}{k_j{}^1}, \frac{S_j{}^1}{s_j{}^1} \right\} \qquad \forall j, t=1$$

/6/ $$C^t = c^t Y^t$$

Splitting out the consumption from the GDP.

/7/ $$I_j{}^t = d_j{}^t I^t \qquad \forall j$$

The allocation of investments among sectors.

$$/8/ \qquad Q_i^t = X_i^t - \sum_j b_{ij}^t I_j^t \qquad \forall i = \text{investment sector}$$

Registration of the product surplus or shortage in the investment sectors.

All the variables but Q_i^t are restricted to non-negative values.

THE SOLUTION

The solution of the above model consists of simply calculating the variables one after the other by substitution. For doing this the equations should be put in an appropriate order and some of them transformed by simple substitutions. The order of the equation is the following:

At the beginning of the calculation of year t we have the initial stocks K_j^t, S_j^t at hand.

We calculate X_j^t from /4/ if $t \neq 1$, from /4[1]–5[1]/ if $t = 1$.

Then Y^t from /1/, C^t from (6) and I^t from:

$$I^t = \frac{Y^t - C^t + \sum_j \left(S_j^t - \frac{q_j^t \; s_j^{t+1}}{k_j^{t+1}} \quad K_j^t \right)}{1 + \sum_j \frac{d_j^t \; s^t{}_j{}^{+1}}{k_j^{t+1}}}$$

that easily proves to be a transform of /3/ using equations /4/, /5/, /6/ and /2/. Then we calculate I_j^t from /7/, Q_i^t from /8/, K_j^{t+1} from /2/ and S_j^{t+1} from

$$S_j^{t+1} = \frac{s_j^{t+1}}{k_j^{t+1}} K_j^{t+1}$$

that is a consequence of equations /4/ and /5/ when applied to the year $t+1$.

It is easy to show that under rather reasonable assumptions I^t will allways turn out to be positive, and hereby all the other variables take non-negative values (except Q_i^t). It also follows that a solution of the model always exist and is produced by the above procedure. It is to be kept in mind, however, that this way of solving the system admits disequilibrium in the investment good markets.

In our further research we elaborated other variants of the model, where disequilibria appear in an other, more acceptable form and can also be diminished or made disappear. These, however, have not been applied in the present calculations and will be reported in another paper.