2

THE RELIABILITY OF THE POLICY MODEL USED BY THE CENTRAL PLANNING BUREAU OF THE NETHERLANDS

by J. Lips and D. B. J. Schouten[1]

I. INTRODUCTION

FOR a number of years the Central Planning Bureau (C.P.B.) has used a system of equations to forecast part of the economic flows. This system of equations or model describes the main economic relations and the inter-dependency of the various economic flows. It has been designed to forecast economic changes in the short run.

The model makes a clear distinction between exogenous and endogenous variables. The exogenous variables, or data, are governed by developments which the model does not describe. Forecasts for the data are made directly and without reference to the model.

The endogenous variables are determined by the relations of the model if the values of the exogenous variables are given.

An inquiry into the overall success of forecasts, covering both exogenous and endogenous variables, has been made elsewhere.[2] This paper presents the results of a reliability test which is mainly restricted to the endogenous variables.

Errors in the forecast values of the endogenous variables may be caused by:

(i) errors in the values of the exogenous variables (data);
(ii) imperfection of the model used.

This paper investigates the reliability of the results given by the model. It happens that in the past errors in the data have been made and therefore a comparison between the real outcomes of the endogenous variables and the forecasts actually made would not produce information on the reliability of the

[1] The authors would like to express their appreciation for the assistance and suggestions received from A. Russchen, C. J. van Eijk and J. S. Cramer, all officials of the Central Planning Bureau.

[2] Monograph of the C.P.B. *Een vergelijking van de ramingen van het Centraal Planbureau met de feitelijke economische ontwikkeling*, 1949-53 (A comparison of the forecasts of the C.P.B. with the actual economic development 1949–53).

model as such. A correct answer to the question requires that the effect of wrong assumptions for the exogenous variables should be eliminated.

II. THE METHOD

The reliability of the model can be tested in two different ways:

(*a*) Each relevant equation can be taken separately. In that case the explanatory variables of a particular equation to be tested appear as data. It may happen that in the model both the explanatory variables and the one to be explained are in fact endogenous. Private consumption, for example, is a function of private disposable income. In the model both aggregates appear as endogenous variables. By taking the ex post figures for private disposable income and by applying the assumed function one arrives at certain values for private consumption. The computed values can be compared with the ex post figures for private consumption. This method may be called the partial method.

(*b*) In the integral method all exogenous variables of the model are taken from the statistical sources and the various equations are solved simultaneously. The values of the endogenous variables then arrived at are compared with the real outcomes. Returning to the example given above, a deviation of the computed consumption from the actual consumption does not necessarily mean that the applied consumption function is wrong. It is quite well possible that the deviation is caused by a wrong estimate of the disposable income, which also appears as an endogenous variable in the model.

In the paper presented here the integral method has been applied because it throws light on the reliability of a technique by which interdependent economic flows are forecast. The adoption of this method implies that the findings given below do not always provide information on the quality of the individual equations.

Models for planning purposes have been used since 1951.

Since then the model has been continuously under revision. By means of analysing economic behaviour, technical and institutional relations, attempts are made to give each of the relevant equations a better theoretical and statistical basis. The model whose reliability has been tested in this paper, was used in 1955 for the Central Economic Plan 1956. It is reproduced in full detail in the Appendix to this paper.

The testing of the model has been carried out as follows. For the years 1949 to 1954 inclusive the values of exogenous variables were taken from either final or preliminary national accounts and other statistical sources. On the basis of these data and with the help of the model the endogenous variables were computed. The computed values were then compared with the real outcomes.

In the previous paragraph it has already been said that the 1956 model has been applied. This implies that in computing the values of the endogenous variables for the whole period 1949–54 a set of equations has been used whose shape and coefficients have been kept unchanged. Insofar as the coefficients are concerned there is, however, one exception, viz. the equations determining the tax receivables. The coefficients of these equations had to be adjusted since the tax rates have changed over time and it would not make sense to apply, for example, the 1949 rates to 1953.

Some attention should be paid to the coefficients of the import equations. In the model the change in the volume of commodity imports depends on the change in the volume of the various components of the national output. If, for example, private consumption increases by Dfl. 100 million commodity imports are assumed to rise by about Dfl. 40 million, i.e. about 40 per cent. The exact value of this coefficient may change over time because of different price movements in commodity imports and in consumer goods. If, for example, import prices go up by 10 per cent and prices of consumption by 4 per cent the marginal import content increases to $\frac{110}{104} \times 0{,}40 = 0{,}423$. Since for each year the changes in volume have been computed at prices of the previous year the marginal import content had to be adjusted from year to year but at constant prices it remains unchanged.

III. YARDSTICKS OF RELIABILITY

For a correct judgement of the results it should be borne in mind that the model tries to explain the *changes* in the endogenous variables by the *changes* in the exogenous variables. In practice the absolute values of the variables are much greater than the changes, which are year-to-year movements. It therefore happens that the errors as a percentage of the absolute values are generally much smaller than those as a percentage of the change. An example may illustrate this.

Taxes in the base year . .	5,000 millions
Forecast for the next year .	5,250 millions
Real outcome . . .	5,125 millions
Error as a percentage of the absolute real outcome .	2½ per cent
Error as a percentage of the actual change . . .	100 per cent

In the paragraphs below computed changes are compared with actual changes. A rather high percentage in the margin of error is therefore admissible.

It is a matter of subjective judgement whether the above assumed error of 100 per cent should be regarded as serious or not. It cannot be denied, however, that an error of the same size in employment would be more serious. In the first place because employment is one of major objectives of economic policy. In the second place because the variations in employment, in general, are smaller than those in tax returns.

There is a third reason why errors of the same size are not equally serious. If the computed values include exogenous variables to a large extent the admissible margin of error should be correspondingly small. If on the other hand the computed value is completely composed of endogenous variables a greater deviation from the real outcome is admitted. The admissible margin of error varies with the extent to which the computed values are exogenous or endogenous. Gross output, for example, includes two exogenous variables (exports and sales to the government), but also sales to households which are completely endogenous. Therefore the errors in gross output should be smaller than those in private consumption.

It follows from the above that strictly speaking, each variable

should be judged individually. With some exceptions, common standards have, however, been applied to all variables.

Four indicators by which the reliability of the model can be judged have been adopted. First, the frequency with which the sign of the computed change was the same as that of the actual change was calculated. At first sight the usefulness of this information may be subject to doubt since during the period under review, 1948–54, the economy has expanded continuously. It is often argued that under such circumstances the direction of movements is easy to forecast. In fact, however, over 20 per cent of the investigated endogenous variables moved downwards in that period and over 15 per cent of the changes were 1 per cent or zero. This being so, the model must have some merits if it is able to forecast the direction of the movements with a degree of accuracy which is sufficiently high.

Secondly an admissible margin of error has been constructed. Although the exogenous variables are given it would be unreasonable to expect a perfect correspondence between the computed values of the endogenous variables and the actual ones. The changes actually observed are composed of the following components:

(i) a part that may be regarded as the effect of the most important behaviouristic, institutional and technical factors;
(ii) a part attributable to less important systematic factors and to disturbances; by the latter are meant accidental changes in economic behaviour;
(iii) a part attributable to errors in the statistical measurement.

As the model tries to explain the year-to-year changes attributable to the main systematic factors enumerated in (i), perfect agreement between computed values and statistically observed changes can hardly be expected. In a reliability test of the model errors due to disturbances and to imperfection in the measurement of the actual changes should be excluded. The question now arises which margin of error seems admissible. The greater this margin the greater is the chance that the computed values can be regarded as correct. As to the statistical imperfection an objective standard could be obtained from information the Central Bureau of Statistics of the Netherlands made available to the Organization for European Economi

Cooperation. The following table appears in a publication of this organization:[1]

TABLE I

Margins of Error in the National Accounts Estimates

	1938, 1946 1947 and 1948	1949
	percentage range	
1. National income:		
(*a*) generated in enterprise. . . .	2– 5	5–10
(*b*) generated in government . . .	2– 5	5–10
(*c*) from abroad	2– 5	5–10
(*d*) total	2– 5	5–10
2. Total net national product . . .	2– 5	5–10
3. Depreciation allowances	10–20	>20
4. Net lending abroad	5–10	10–20
5. National current expenditure:		
(*a*) by households	2– 5	5–10
(*b*) by government	5–10	10–20
6. Gross asset formation:		
(*a*) by enterprises	5–10	10–20
(*b*) by government	5–10	10–20
7. Changes in inventories	10–20	>20
8. Net domestic additions to wealth . .	10–20	>20
9. Saving of households	10–20	>20
10. Saving of government:		
(*a*) government proper	5–10	10–20
(*b*) insurance funds	2– 5	5–10

These percentage ranges are intended to indicate that the true (unknown) values of the flows are within a range which is believed to have its lower limit equal to the estimate minus a percentage within the range and its upper limit equal to the estimates plus the same percentage. The first column refers to final estimates and the second column refers to preliminary estimates.

The standard adopted in the reliability test of the model is equal to the *minimum* percentage of the final estimates, although 50 per cent of the actual changes in the national accounts flows are based on preliminary estimates. In most cases errors in the measurement are therefore assumed to be 2 per cent of the absolute base value. For prices the same standard has been adopted, and for employment the errors are assumed to be even

[1] O.E.E.C.: *National Accounts Studies*, Netherlands, 1951, page 71.

lower, viz. 1 per cent. If some or all variables are taken together a standard of 2 per cent is reckoned with.

No objective standard could be found for errors due to the fact that less important relations are absent in the model. The principle adopted here as well was to avoid a mild judgment of the model. In the light of what has been said at the beginning of this section a margin equal to 20 per cent of the actual changes seems to be a rigorous standard. In the comparison between computed and actual changes this percentage has been invariably applied.

The admissible margin of error (E) that, with a few exceptions, has been adopted, can be written as:

$$E = \pm(0.02\,B + 0.2\,R)$$

where B=the base value of the variable and R=the actual change.

With the help of the correlation technique a study was made of the extent to which the computed values and the actual changes agree. In a number of diagrams the computed increases and decreases measured as a percentage of the base value have been put on the Y-axis, and the actual changes on the X-axis. If the point of intersection lies just on the 45° line, perfect agreement between the computed values and the actual ones exists. In general there will be no perfect agreement.

The method of least squares has been used to compute the regression line.[1] It should be emphasized that for each variable individually the regression line can not be regarded as a standard of probability. The number of observations is only six; one observation more may change the slope and the situation of the regression line completely. Nevertheless this line has been used as a convenient way of describing the known facts concerning each variable. They may also reveal any regularity in the results the model produces for variables of the same character, for example prices or volumes.

The correlation coefficients of the regressions have also been computed. If the regression coefficients show a general tendency of the model to overestimate the changes in volume, high correlation coefficients may support more definite conclusions

[1] In connection with the remarks made on page 28, it is assumed that the computed values are correct and that the actual changes are distributed around the computed values. As the computed values are put on the Y-axis and the actual changes on the X-axis the second regression line has been computed.

in this respect. Here, too, the number of observations should not be neglected.

IV. THE VARIABLES CHOSEN

Only endogenous variables have been tested. It has already been stated that these endogenous variables may include exogenous variables (cf. page 24 above). If the exogenous part in the computed values predominates an inquiry into the size of the errors becomes less interesting. Therefore only those variables which are mainly endogenous in character have been tested.

In economic analyses prices and volumes are most relevant and, in general, more interesting than the changes in monetary terms. Therefore, the test will be concentrated mainly on prices and volumes. In fact the changes in tax returns are available in monetary terms only and the same is true for profits.

V. PRICES

In Table II both the computed changes in the price level and the actual changes are given.

In Table III and in Graph 1 the findings have been arranged according to the four indicators by which the reliability of the model has been tested.

Prices of inventories (p_n). In five out of the six cases the sign of the computed change was correct. The error occurred when the actual change was only +1 per cent and the computed value amounted to −0.4 per cent. It will be seen that three of the actual changes were positive, and that the others were negative. None of the computed values overstepped the admissible margin of error.

Export prices (p_{eg}). The computed values of export prices are least in line with the actual movements. The sign was wrong in only one case, but two-thirds of the deviations were greater than the admissible margin of error. Here, the errors in the sign were more serious than for prices of inventories.

When judging these results the following factors should be taken into account. The statistics of export prices are by no means ideal; they are in fact unit values. The error due to

imperfect measurement is probably greater than the adopted 2 per cent. Secondly, the computed value is a weighted average of domestic cost elements and world market prices. The latter are also subject to sizable errors in the measurement.

Prices of consumer goods (p_c). In the one case the signs were different, and this again occurred when the actual change was

TABLE II

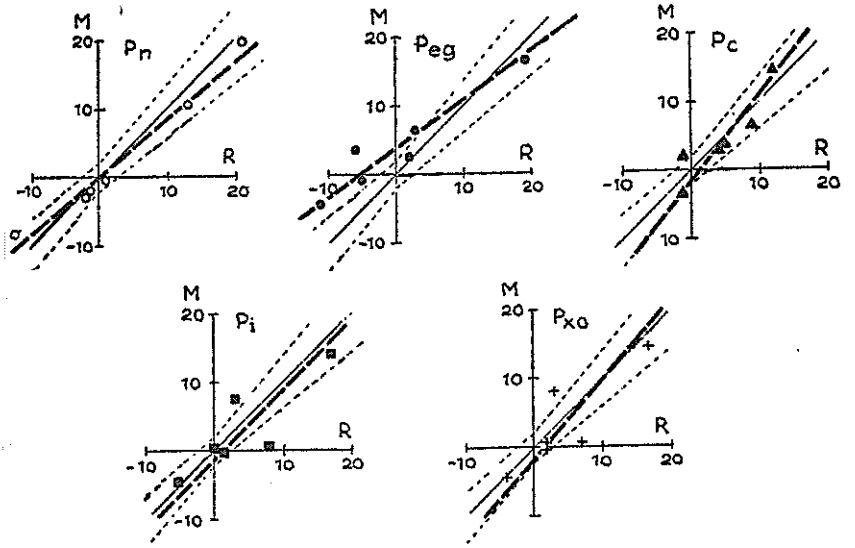
Computed Price Changes and Actual Price Changes

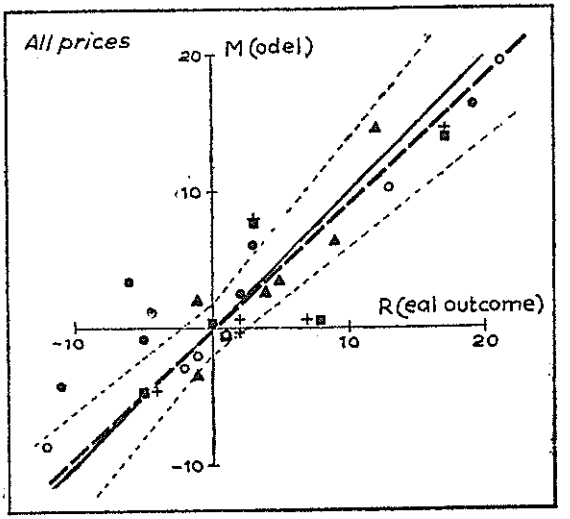
Variables		Computed change	Actual change
		percentage of the preceding year[1]	
Prices of inventories (p_n)	1949	− 2.0	− 1.0
	1950	+10.3	+13.0
	1951	+19.4	+21.0
	1952	− 0.4	+ 1.0
	1953	− 8.5	−12.0
	1954	− 2.9	− 2.0
Export prices (p_{eg})	1949	+ 3.4	− 6.0
	1950	+ 6.2	+ 3.0
	1951	+16.5	+19.0
	1952	+ 2.6	+ 2.0
	1953	− 4.2	−11.0
	1954	− 0.8	− 5.0
Prices of consumer goods (p_c)	1949	+ 3.6	+ 5.0
	1950	+ 6.3	+ 9.0
	1951	+14.6	+12.0
	1952	+ 2.0	− 1.0
	1953	− 3.5	− 1.0
	1954	+ 2.9	+ 4.0
Prices of capital goods (p_i)	1949	− 0.5	+ 1.0
	1950	+ 7.8	+ 3.0
	1951	+14.0	+17.0
	1952	+ 0.5	+ 8.0
	1953	− 4.8	− 5.0
	1954	+ 0.3	+ 0.0
Prices of government expenditure, salaries excluded (p_{xo})	1949	− 0.3	+ 2.0
	1950	+ 8.1	+ 3.0
	1951	+14.5	+17.0
	1952	+ 0.7	+ 7.0
	1953	− 4.6	− 4.0
	1954	+ 0.8	+ 2.0

[1] The preceding year has been taken because the model tries to estimate short-term changes. In the forecasts published by the C.P.B. the changes sometimes cover a period of two years.

GRAPH 1

Prices





——— = perfect forecast
— — — = regression line
------ = admissible margin of error

TABLE III

Computed Price Changes as Compared to Real Outcome

Variables	Percentage with correct sign	Percentage within the admissible margin of error	Regression line[1]	Correlation coefficient
1. Prices of stocks (p_n) . .	83	100	0.88R−0.2	0.991
2. Export prices (p_{eg}) . .	83	33	0.70R+3.7	0.960
3. Prices of consumer goods (p_e)	83	67	1.26R−1.6	0.907
4. Prices of capital goods (p_i) .	83	67	1.05R−1.3	0.847
5. Prices of government expenditure (p_{xo})	83	67	1.13R−1.9	0.859
6. All prices	83	67	0.94R+0.2	0.943

[1] R=real outcome.

very small, viz. 1 per cent. Four times the deviations remained within the admissible margin of error.

Prices of capital goods (p_i). In all cases but one the signs were correct. The 1950 and 1952 estimates overstepped the admissible margin of error.

Prices of government expenditure on goods and services (salaries not included (p_{xo})). In five cases the signs of the computed values were correct, but twice the deviation from the actual change was greater than the admissible margin.

All prices. The percentage of the computations with a correct sign amounted to 83, and 67 per cent remained within the admissible margin of error. Counting a wrong sign and an overstepping of the admissible margin of error as errors, the computed values for domestic prices contain ten such errors, five of which occurred in 1952. This strong concentration of errors in 1952 may indicate that during a recession the price setting of domestic sales differs from what has been assumed in the model.

Looking at the regression line in the diagram for all prices, one gets the impression that the model slightly underestimates price movements. This seems in particular to be true for the prices of capital goods and stocks but also for other domestic prices if the movements are upwards and of a moderate size. It should, however, be remembered that the period of investigation is far too short to permit definite conclusions.

VI. VOLUMES

In the model changes in volume are assumed to depend partly or completely on other endogenous variables. The errors in the computed values are therefore not always due to wrongly assumed relations in the equations concerned. This explains why errors in one variable are often well reflected in other variables.

The results are summarized in tables and diagrams analogous to those used for prices (cf. Table IV and V, and Graph 2).

TABLE IV

Computed Changes and Actual Changes in Volume

Variables		Computed changes	Actual changes
		percentage of the preceding year[1]	
Private consumption (c)	1949	+ 1.3	− 0
	1950	+ 1.0	+ 1
	1951	− 6.4	− 4
	1952	− 0.1	+ 2
	1953	+ 9.1	+ 5
	1954	+ 6.9	+ 5
Gross fixed asset formation (i_{gross})	1949	+18.1	+11
	1950	+12.3	+12
	1951	+ 1.1	−10
	1952	− 1.3	+ 1
	1953	+ 6.8	+ 6
	1954	+11.7	+19
Commodity imports (m_g)	1949	+26.0	+10
	1950	+36.9	+33
	1951	− 0.6	+ 1
	1952	− 9.3	−13
	1953	+31.3	+19
	1954	+25.4	+28
Gross national product (v-m)	1949	+ 7.0	+10
	1950	+ 6.7	+ 8
	1951	+ 0.7	+ 0
	1952	− 0.3	+ 2
	1953	+ 8.5	+ 9
	1954	+ 6.0	+ 6
Employment (a)	1949	+ 2.8	+ 3
	1950	+ 2.7	+ 4
	1951	+ 0.3	+ 2
	1952	− 0.1	− 1
	1953	+ 3.4	+ 2.5
	1954	+ 2.4	+ 2.5

[1] See footnote to Table II.

Private consumption (c). The signs did not agree in 1949 and in 1952. The actual change in 1949 was almost zero. In 1952 when consumption rose by 2 per cent, the computed value amounted to −0.1 per cent. The wrong sign in the computed value is clearly associated with the result for prices of consumer goods in 1952. In that year the sign of the computed price was not correct either, but differed in the opposite way; the actual price change was negative and the estimate showed a rise. This implies that the computed value of private consumption in monetary terms was more in line with the actual change. It should be noted that the equation for private consumption tries to explain changes in money value. On one occasion the error overstepped the adopted margin.

A further interesting feature is that in four out of the six years the computed change exceeded the actual change. As a matter of fact for the past six years the overestimation was considerable. The regression shows that apart from the constant factor, the computed values were about 70 per cent too high on the average.

Gross fixed asset formation (i_{gross}). There are two errors in the signs. In one of these cases both the computed and the actual change are very small. Five of the computed changes remained with the admissible margin of error. It should, however, be noted that for reasons explained on page 28 above, the margin due to imperfect statistical measurement is assumed to be 5 per cent. In general there seems to be a tendency to overestimate the movements in gross investment slightly.

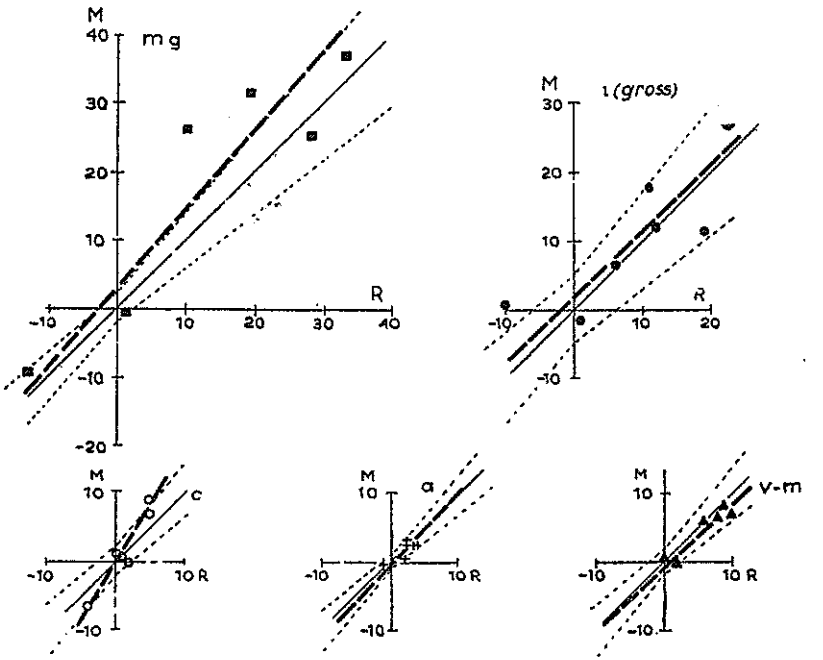
Commodity Imports (m_g). When judging the results it should be borne in mind that stock building is a datum in the model, and that the marginal import coefficient for stock building is high. Therefore the heavy stock piling resulting from the Korean war and the substantial destocking later did not cause deviations between the computed and the actual changes. In one case the signs were not the same, which again occurred when the actual and the computed change were small.

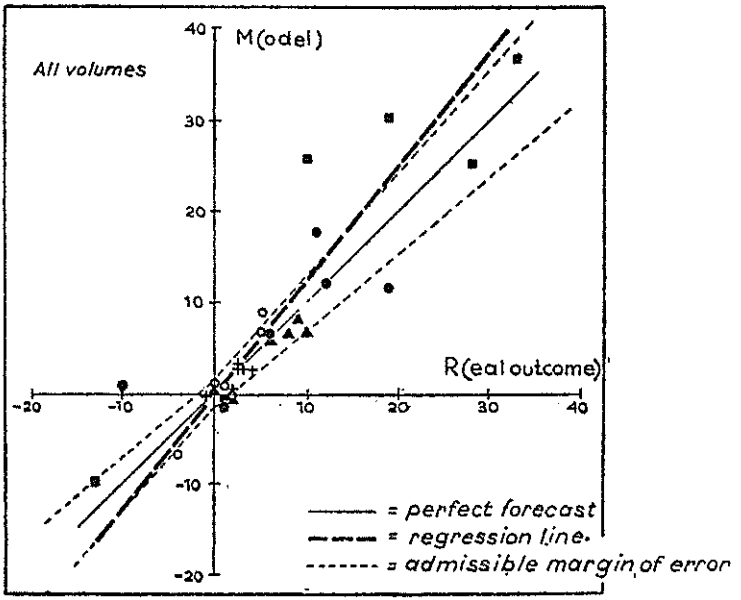
Although the actual changes varied from −13 per cent to +33 per cent, four computed values remained within the adopted margin of error. The fact that in general private consumption and gross fixed asset formation were overestimated, explains why the estimates for commodity imports show a tendency to surpass the actual changes.

Gross national product (v-m). On the whole the estimates

GRAPH 2

Volumes





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correspond fairly well to the real outcomes. In one year only the signs did not agree and none of the computed values was outside the adopted margin of error. The estimates are, in general, somewhat lower than realizations, which means that the overestimation of domestic expenditure (private consumption and fixed asset formation) is offset by a somewhat greater overestimation of commodity imports.

TABLE V

Computed Volumes as Compared to Real Outcome

Variables	Percentage with correct sign	Percentage within the admissible margin of error	Regression line[1]	Correlation coefficient
1. Commodity imports (m_g)	83	67	1.18R+3.0	0.917
2. Gross national product (v-m)	83	100	0.97R−0.9	0.937
3. Private consumption (c)	67	83	1.70R−0.6	0.952
4. Private fixed asset formation (i_{gross})	67	83	0.96R+1.9	0.758
5. Employment (a)	100	83	1.11R−0.5	0.773
6. All volumes	80	83	1.26R−0.3	0.891

[1] R=real outcome.

Employment (a). The admissible error due to imperfect measurement has been reduced to 1 per cent. First, because employment is important in economic policy; 1 per cent unemployment in excess of the usually adopted standard is regarded as a serious matter by policy makers. Secondly, because the variations in employment are usually small. Only one estimate surpassed the admissible error. All signs were correct.

All volumes. The percentage of wrong signs amounted to twenty, i.e. six cases out of thirty. In four of them a very small decline in volume was estimated, whereas the actual changes were slightly positive. From the two remaining cases the computed value of one was just over 1 per cent positive, while the actual value was slightly below zero. There were four cases, where the actual changes are negative up to 1 per cent or more. Three of the corresponding estimates were also negative.

Most of the regression lines lie above the 45° line. According

to the regression line for all variables the model produced estimates for the volumes which generally exceed realization. It will be remembered that prices are generally somewhat underestimated. The overestimation of volumes is more pronounced than the underestimation of prices.

In all years the differences between the computed and the actual changes for the volume of private consumption have signs opposite to those of the differences between the computed and actual price changes. It may therefore be concluded that the computed changes of private consumption in monetary terms are closer to the actual changes than the computed values of the volumes. This conclusion cannot be drawn for gross fixed asset formation. In contrast with the price variables the errors in the volumes do show a concentration in a specific year.

VII. TAXES

In the model changes in taxes depend to a large extent on other endogenous variables. The wage level is, however, a datum and therefore taxes on wage income are easiest to estimate. For the most recent years statistics for direct taxes are not available. The ex post figures given here are rough estimates of the tax receivables.

The findings have been summarized in the Tables VI and VII, and in Graph 3.

Indirect taxes. In five cases the signs are correct, and an equal number remained within the admissible margin of error. Looking at the figures, it will be seen that very substantial changes are estimated correctly. The errors are only of minor importance. The regression line is near to the 45° line and the correlation coefficient is high.

Direct taxes on wage income. The estimates of direct taxes on wages correspond closest to the actual changes. All signs are correct and none of the errors surpasses the adopted margin. The fact that in the model the wage level is an exogenous variable has certainly influenced the results, but on the other hand employment and the marginal tax coefficients are determining factors which are difficult to estimate.

Direct taxes on non-wage income. As compared to other taxes the estimates for direct taxes on non-wage income are least reliable. Two signs are wrong and the number of cases where the

error is greater than the admissible margin is four. The results should be considered in the light of the findings for non-wage income, which consists mainly of profits. In all cases where the estimates of profits exceed the real outcomes, the estimates of direct taxes on non-wage income are higher than real outcomes.

TABLE VI

Computed and Actual Changes in Taxes

Variables		Computed changes	Actual changes
		percentage of the preceding year[1]	
Indirect taxes (T_K)	1949	+36.5	+34.1
	1950	+19.7	+14.0
	1951	+27.9	+24.6
	1952	− 1.5	+ 0.0
	1953	+ 4.9	+ 2.8
	1954	+11.1	+12.5
Direct taxes on wage incomes (T_L)	1949	+ 6.7	+ 9.8
	1950	+13.2	+10.4
	1951	− 3.2	− 1.4
	1952	+ 3.2	+ 1.4
	1953	+ 8.0	+ 6.8
	1954	+ 5.6	+ 5.1
Direct taxes on non-wage income (T_Z)	1949	+ 1.5	+ 5.4
	1950	+18.7	+19.8
	1951	+ 4.6	− 2.8
	1952	+ 4.2	+ 7.3
	1953	+ 3.3	+ 8.1
	1954	+ 0.2	− 2.5

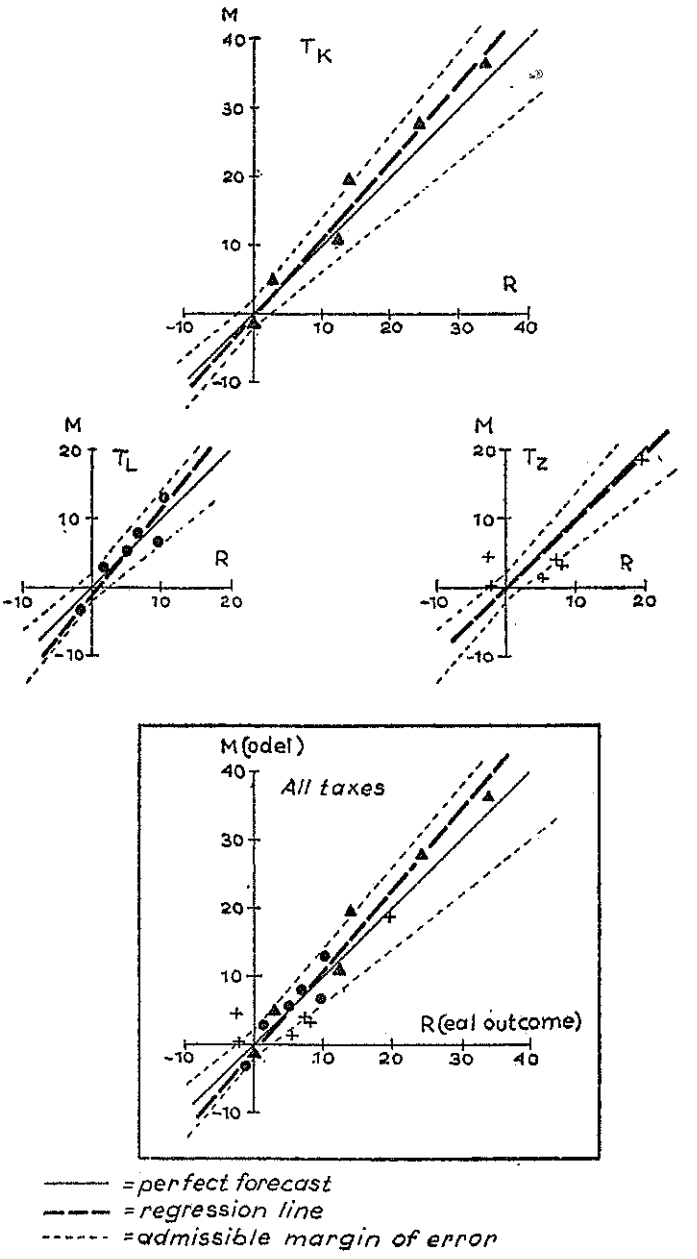
[1] See footnote to Table II.

the same parallelism can be observed if the estimates of profits are lower than realizations.

All taxes. The number of computed values with signs equal to those of the actual changes amounted to fifteen out of eighteen, i.e. 83 per cent. The percentage that remains within the admissible margin of error is 72. There seems to be some regularity in the overestimation of the tax returns. The computed values of indirect taxes and those of direct taxes on wage income were slightly higher than realizations on the average. For direct taxes on non-wage income, the deviation of the regression line from the line of perfect agreement is negligible. Total taxes are

GRAPH 3

Taxes



just as important for government as direct and indirect taxes separately. For none of the six computed changes was the sign wrong and four times the deviation remained within the admissible margin of error.

TABLE VII

Computed Taxes as Compared to Real Outcome

Variables	Percentage with correct sign	Percentage within the admissible margin of error	Regression line[1]	Correlation coefficient
Indirect taxes (T_K) . . .	83	83	1.13R−0.2	0.984
Direct taxes on wage income (T_L)	100	100	1.28R−1.3	0.912
Direct taxes on non-wage income (T_Z)	67	33	0.98R−0.4	0.827
All taxes individually . .	83	72	1.14R−0.7	0.948
Total tax returns . . .	100	67	1.42R−1.6	0.649

[1] R=real outcome.

VIII. NON-WAGE INCOME (Z)

All computed values were positive, as were realized values. In three years the error was greater than the admissible margin. It should, however, be borne in mind that in the model as well as in the national accounts profits are calculated as a residual. This may be a reason for widening the admissible margin of error.

TABLE VIII

Computed and Actual Changes in Non-Wage Income (Z)

Year	Computed changes	Actual changes
1949 . . .	+10.0	+14
1950 . . .	+ 9.7	+12
1951 . . .	+10.9	+ 5
1952 . . .	+ 1.8	+ 8
1953 . . .	+ 9.3	+10
1954 . . .	+ 7.8	+ 4

TABLE IX

Computed Changes in Non-Wage Income (Z) Compared with Actual Changes

Percentage with correct sign	100
Percentage within the admissible margin of error	50
Regression line	4.50R−31.3[1]
Correlation coefficient	0.188

[1] R=real outcome.

IX. ALL ENDOGENOUS VARIABLES

The number of investigated variables amounts to fourteen for a period of six years: which gives eighty-four observations; twenty-one of the actual changes are negative or zero. In fourteen cases, i.e. 17 per cent, the signs do not agree. In eleven of them either the computed change, or the actual change or both are 1 per cent or less.

If the signs of the actual values change from positive to negative or from negative to positve we may define such a change as a turning point in the trend. The actual changes show twenty-four such turning points; in six cases the model produced a different result, which means that the signs were wrong. Another four wrong signs were due to forecast turning points which did not materialize. The remaining four differences in signs occurred in 1949, the first year of the period investigated. It has not been checked whether these errors result from turning points in the actual figures which had not been forecast or the other way around.

The number of computed values that remain within the admissible margin of error is sixty-one, i.e. 73 per cent. This percentage falls to seventy if the error due to imperfect measurement is assumed to be 2 per cent for all variables.

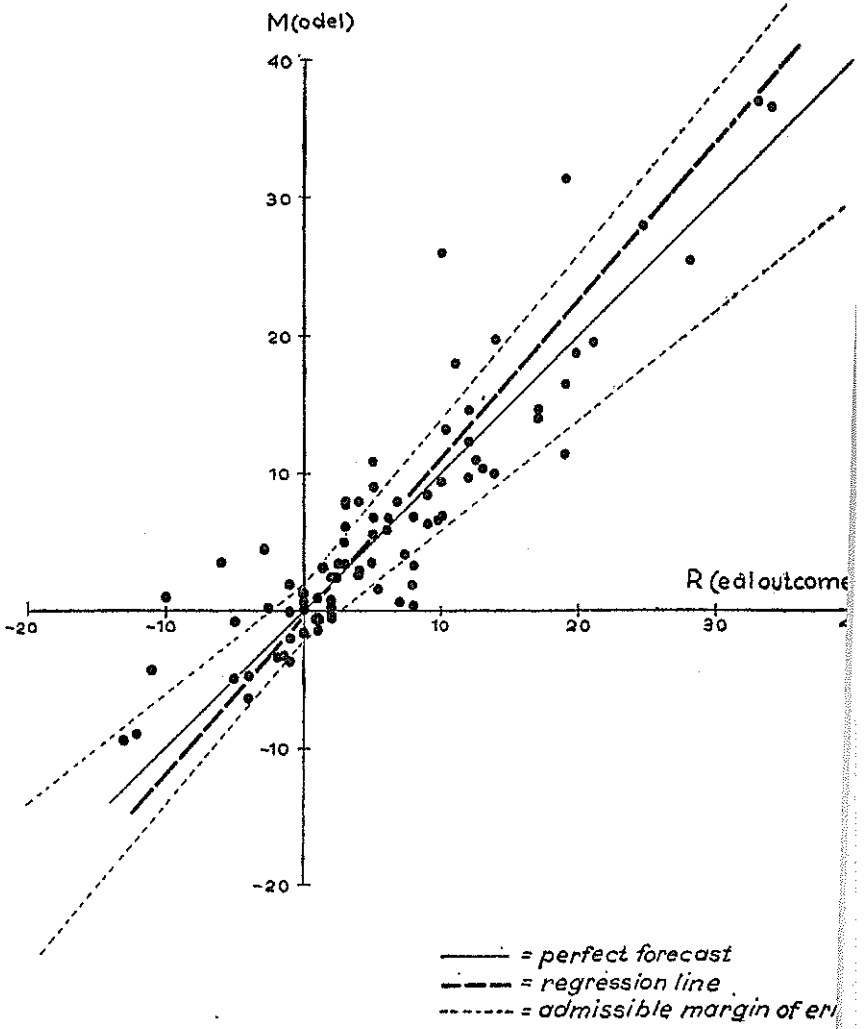
Graph 4 suggests that there was a tendency to overestimate the changes. The regression line of all variables reads:

$$M=1.15\,R-0.3$$

where M=computed change and R=actual change. The correlation coefficient is 0.899. It has been demonstrated that the computed changes in volume are responsible for this general tendency.

GRAPH 4

Endogenous Variables



It is difficult to compare the reliability of the model with that of other forecasting methods. The results obtained by extrapolation or by autoregression, etc., can hardly serve as a basis of comparison. The mechanical application of such methods to

TABLE X

Forecast and Actual Changes in Some Exogenous Variables

Variables		Forecast changes	Actual changes
		percentage of the preceding year[1]	
Commodity exports	1949	+24.0	+51
	1950	+23.0	+35
	1951	+27.0	+19
	1953	+ 4.0	+14
	1954	+ 6.0	+17
Exports of invisibles	1949	+ 2.0	+10
	1950	+ 8.0	+22
	1951	+15.0	+37
	1953	−11.0	+ 2
	1954	− 1.0	+ 5
Import prices	1949	− 3.0	− 3
	1950	+12.4	+12
	1951	+21.0	+23
	1953	−12.0	−12
	1954	− 6.7	− 5
Government wages and salaries	1949	− 0.7	− 7
	1950	− 3.2	+11
	1951	+ 5.4	+ 8
	1953	+ 7.3	+10
	1954	+11.5	+15
Government expenditure on goods and services	1949	+ 6.7	+24
	1950	+ 5.0	+13
	1951	+42.9	+21
	1953	+26.1	+23
	1954	− 0.5	+ 2
Depreciation allowances	1949	+ 4.7	+ 2
	1950	+ 2.8	+ 6
	1951	+ 2.9	+ 3
	1953	+ 3.2	+ 2
	1954	+ 3.0	+ 1
Labour force	1949	+ 1.1	+ 2.5
	1950	+ 0.6	+ 1.5
	1951	+ 1.0	+ 1.3
	1953	+ 1.1	+ 1.4
	1954	+ 1.3	+ 1.8

[1] See footnote to Table II

a variety of flows neglects the most elementary economic identities. Therefore the results obtained by any of such methods would require adjustments which in fact would mean that the methods are not applied. It may, however, be interesting to compare the reliability for the endogenous variables with the accuracy by which the main exogenous variables have been forecast in the past.

The forecasts of the following exogenous variables have been compared with real outcomes:

commodity exports;
exports of invisibles;
import prices;
government expenditure on goods and services;
government wages and salaries;
depreciation allowances;
labour force.

The comparison covers the same period, viz. 1949–54 inclusive; 1952 had, however, to be dropped, since the Central Economic Plan for that year contained eight alternatives for the most important exogenous variables. This implies that there are thirty-five observations. Applying the same standards of reliability as for the endogenous variables one arrives at the results shown in Tables X and XI and Graph 5.

TABLE XI

All Exogenous Variables as Compared With All Endogenous Variables

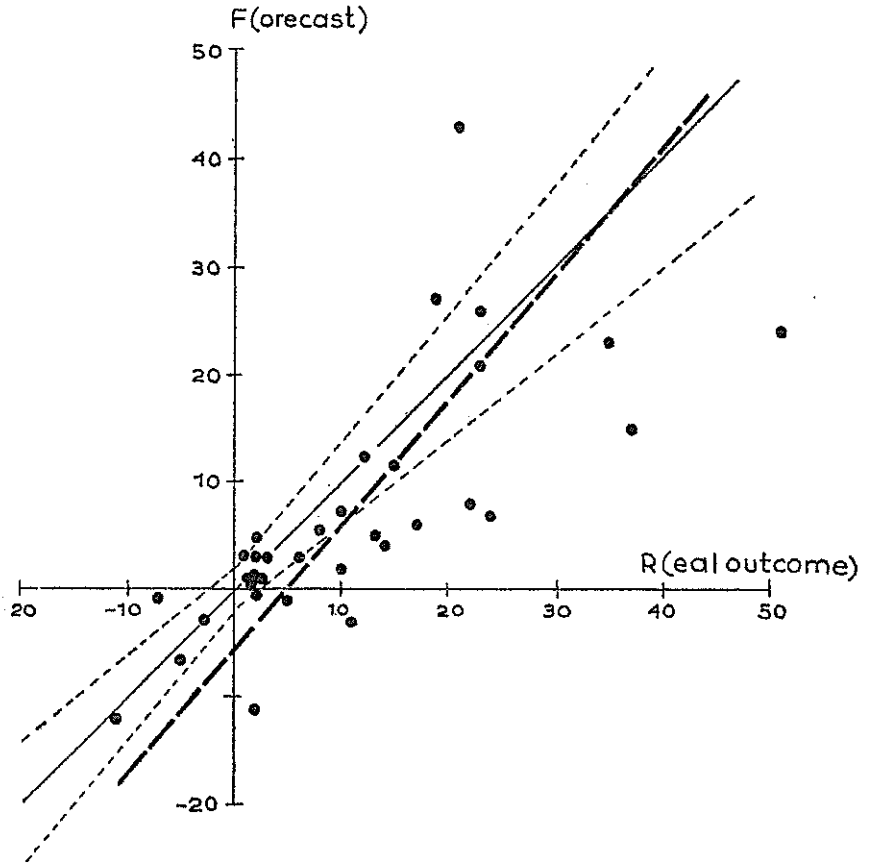
	Exogenous variables	Endogenous variables
Percentage with correct sign	89	83
Percentage within the admissible margin of error	56	70
Regression line	1.16R−5.7[1]	1.15R−0.3[1]
Correlation coefficient	0.746	0.899

[1] R = real outcome.

In judging the results it should be borne in mind that the values for the exogenous variables have been taken from plans which were often published rather late in the year. Therefore in estimating the changes from one year to another use could be

GRAPH 5

Exogenous Variables



made of statistical information on trends in the first part of the planning year.

It will be noted that the exogenous variables are, in general, underestimated insofar as upward movements are concerned while the model has a tendency to overestimate the changes. This would lead to the conclusion that the actually planned endogenous variables are more in line with reality. This, of course, is not necessarily true for all categories of variables discussed in this paper.

APPENDIX

THE MODEL USED

Definitions

(1) $L = \bar{L}(a+l+al)$

(2) $C = X_L + X_{ZC} - C_F - C_O$

(3) $C = c + \bar{c}p_c + cp_c$

(4) $X_o = x_o + \bar{x}p_{xo} + x_o p_{xo}$

(5) $I = i + \bar{i}p_i + ip_i$

(6) $N = n + \bar{n}p_n + np_n$

(7) $D = d + \bar{d}p_i + dp_i$

(8) $E = e_g + e_d + \bar{e}_g p_{eg} + \bar{e}_d p_{ed} + e_g p_{eg} + e_d p_{ed}$

(9) $V = v + \bar{c}p_c + \bar{x}_o p_{xo} + \bar{i}p_i + \bar{d}p_i + \bar{n}p_n + \bar{e}_g p_{eg} + \bar{e}_d p_{ed} + cp_c + x_o p_{xo} + ip_i + dp_i + np_n + e_g p_{eg} + e_d p_{ed}$

(10) $M = m + \bar{m}_g p_{mg} + \bar{m}_d p_{md} + m_g p_{mg} + m_d p_{md}$

(11) $Z = V - L - T_K - D - M$

(12) $C + X_o + I + D + N + E = V$

Institutional equations

(13) $W_L = \beta\bar{B}\,\bar{O}_{LW}(b-a)$

(14) $T_L = \tau_L(L + W_L + L_O + L_F + O_L + U_L - P_L - P_W) + T_{Lau}$

(15) $T_Z = \tau_Z(Z + Z_F + O_Z - P_Z) + T_{Zau}$

(16) $T_K = \tau_{K_1}L + \tau_{K_2}M + \tau K_3(V-E) + T_{Kau}$

Technical equations

(17) $m = \mu_1 c + \mu_2 e_g + \mu_3 x_o + \mu_4(i+d) + \mu_5 n + \mu_6 e_d + m_d$

(18) $a = \alpha\frac{v-m}{\bar{v}-\bar{m}}$

Behaviour equations

$$(19)\quad X_L = \gamma_L(L+W_L-T_L+L_O+L_F+O_L-U_L-P_L-P_W)$$

$$(20)\quad X_{ZC} = \gamma_Z(Z-T_Z+Z_F+O_Z-P_Z)$$

$$(21)\quad i = \delta\left\{\varrho\,\frac{(v-n-e_d-r)+(v-n-e_d-r)_{\cdot}}{2}-1\,(\tilde{i}-\bar{i}_h)\right\}+i_h$$

$$(22)\quad e_g = -\epsilon(p_{eg}-p_w)\bar{e}_g+e_{gau}$$

$$(23)\quad p_c = \lambda_1 l+v_1 p_{mg}+\frac{T_{Kau}}{\bar{c}}$$

$$(24)\quad p_{eg} = \eta(\lambda_2 l+v_2 p_{mg})+(1-\eta p)_w$$

$$(25)\quad p_{xo} = \lambda_3 l+v_3 p_{mg}$$

$$(26)\quad p_i = \lambda_4 l+v_4 p_{mg}$$

$$(27)\quad p_n = \lambda_5 l+v_5 p_{mg}$$

LIST OF SYMBOLS

Symbol	*Description*
e	exports of goods and services by enterprises
e_g	commodity exports by enterprises
e_{gau}	autonomous commodity exports by enterprises
e_d	exports of services by enterprises
m	imports of goods and services by enterprises
m_g	commodity imports by enterprises
m_d	imports of services by enterprises
i	net investments by enterprises
d	depreciation by enterprises
n	increase in commodity stocks
x_o	government expenditure on goods and services bought from enterprises
c	private consumption bought from enterprises
v	output of enterprises
x_L	consumption by the group 'wages, salaries and social benefits'
X_{ZC}	consumption by the group 'other income'
C_O	net government sales to households
C_F	private consumption in foreign countries
L	wage bill of enterprises, including contributions to social security systems
Z	income of the group 'other income'
W_L	social benefits from the unemployment insurance fund
O_{LW}	annual social benefits per unemployed paid by the unemployment insurance fund

Symbol	*Description*
L_O	wages and salaries, paid by the government
L_F	income from abroad of the group 'wages, salaries and social benefits'
Z_F	income from abroad of the group 'other income'
O_L	income transfers by government to the group 'wages, salaries and social benefits'
O_Z	income transfers by government to the group 'other income'
U_L	social benefits from insurance funds to the group 'wages, salaries and social benefits'
P_L	premiums to insurance funds from the group 'wages, salaries and social benefits'
P_Z	premiums to insurance funds from the group 'other income'
P_W	premiums to the unemployment insurance fund
T_L	direct taxes by the group 'wages, salaries and social benefits'
T_Z	direct taxes by the group 'other income'
T_{Lau}	autonomous changes in T_L
T_{Zau}	autonomous changes in T_Z
T_K	indirect taxes net of subsidies
$T_{Kau,c}$	autonomous changes in T_K on private consumption
T_{Kau}	autonomous changes in T_K
B	dependent working population in enterprises
p_{eg}	price index of commodity exports by enterprises
p_w	index of competing world market price level
p_{ed}	price index of exports of services by enterprises
p_{mg}	price index of commodity imports by enterprises
p_{md}	price index of imports of services by enterprises
p_c	price index of private consumption
p_{xo}	price index of government expenditure on goods and services bought from enterprises
p_i	price index of investment
p_n	price index of commodity stock building
l	wage rate in enterprises
a	employment in enterprises
b	dependent working population
r	rents
i_n	investments in housing
β	percentage of additional unemployed receiving benefits from the unemployment insurance fund
τ_L	marginal tax coefficient for the group 'wages, salaries and social benefits'
τ_Z	marginal tax coefficient for the group 'other income'
τ_{K_1}	marginal coefficient for indirect taxes on wages
τ_{K_2}	marginal coefficient for indirect taxes on imports

Symbol	*Description*
τK_3	marginal coefficient for indirect taxes on domestic expenditure
μ_1	marginal import coefficient for private consumption
μ_2	marginal import coefficient for commodity exports
μ_3	marginal import coefficient for government expenditure on goods and services
μ_4	marginal import coefficient for gross investment
μ_5	marginal import coefficient for commodity stock building
μ_6	marginal import coefficient for exports of services
a	elasticity of employment
γ_L	marginal propensity to consume for the group 'wages, salaries and social benefits'
γ_Z	marginal propensity to consume for the group 'other income'
λ_1	labour costs in the price setting of consumer goods
λ_1	import costs in the price setting of consumer goods
λ_2	labour costs in the price setting of consumer goods
v_2	import costs in the price setting of commodity exports
η	weight of domestic cost in the price setting of commodity exports
λ_3	labour costs in the price setting of government expenditure on goods and services
v_3	import costs in the price setting of government expenditure on goods and services
λ_4	labour costs in the price setting of capital goods
v_4	import costs in the price setting of capital goods
λ_5	labour costs in the price setting of commodity stock building
v_5	import costs in the price setting of commodity stock building
δ	reciprocal of the number of years, during which the gap between the necessary and the actual stock of capital goods must be bridged
ϱ	capital-output ratio
ϵ	elasticity of commodity exports

Capital with bar: values or numbers in 1954
Lower case with bar: values in 1954
Capital without bar: changes in values from 1954-level, current prices
Lower case without bar: changes in values from 1954-level, in 1954-prices, and changes of indices from 1954-level, 1954 being=1