CHAPTER 4

QUANTITATIVE POLICY (II) IN AN OPEN ECONOMY, AND IN SETS OF ECONOMIES

4.1. Methods of Regulating Employment, Monetary Equilibrium and Balance of Payments Equilibrium in an Open Economy

4.111 We shall discuss problems of quantitative economic policy in open economies in the same manner as before, by first discussing the current adaptation of such economies to changing circumstances. This may generally be considered to be the main object of the policies encompassed within the title of the present section. For obvious reasons the emphasis will be laid on that which distinguishes an open economy from a closed one. In a general way this is, of course, the dependence on foreign countries, due to the fact that part of the product has to be sold abroad and part of the factors of production have to be bought from foreign countries. The latter is particularly true for countries whose imports consist, in a large part, of raw materials, semi-manufactured products or equipment, and this is by far the most frequent case. Even if imports consist largely of consumer goods they will almost never be completely finished goods and usually form an element in some further production or trading process.

4.112 The dependence on foreign countries, therefore, applies both to the volume of demand (in which export demand is an element directly dependent on foreign conditions) and to prices, the foreign influence being even more important in the latter case. Prices of imported materials, as well as prices of competing foreign products, tend to keep internal prices in line with international prices, and special measures are required to isolate a country's price structure.

4.113 Some of these fundamental features of an open economy are brought out even in the simplest models of such an economy. The

influence of import prices on national prices is expressed by our supply or price setting equations. They therefore represent what we call the possibility of "importing inflation", meaning that an undesirable price rise due to inflationary policies abroad will make itself felt even if the economy under consideration is following a non-inflationary policy. It will also make itself felt in a rise in foreign demand.

The definition equation for national income

$$Y = X + E - I$$

expresses the dependence of Y on E; if written in the form

$$X - Y = I - E = D$$

it expresses a fundamental equality between a possible surplus of expenditure over income, on the one hand, and the deficit D on the current items of the balance of payments, on the other hand. This equality brings out the possibility of "exporting inflation". By this we mean the possibility of having expenditure in excess of income without causing changes in the national price level, so long as foreign credits or national reserves permit the financing of a deficit on the current items of the balance of payments.

4.114 The consequences of the "fundamental features", just discussed, for short-term economic policy will be considered in this §. We start this discussion by a somewhat more precise definition of the main targets usually involved in this policy of current adaptation. Instead of two, we will now consider three such targets, mentioned in the title of this section. Concerning the first, "full", or rather high and stable, employment, nothing needs to be added to the definition already given for a closed economy (cf. § 3.5). But the second, monetary equilibrium, certainly requires some further explanation. We have explained why we adhere to the definition of *"the realization of the most desirable price level"* and we have now to specify this definition for the case of an open economy. We do not now have the complete freedom in choosing the price level which existed in the case of a closed economy: the dependency of the open economy on other countries restricts our choice and it depends on the instruments we are willing (or permitted) to use, and their influence, whether we can

divorce the national price level from the international one. Here another important feature of the economic policy of open countries comes in: *much depends on the policies followed by other countries*. Where policies can be internationally co-ordinated, more possibilities exist than when they cannot. An open country can pursue a constant price level as the most desirable one, if other countries are doing the same; it will be much more difficult to do so if other countries have a fluctuating price level. It may then be possible to counteract such fluctuations by fluctuating exchange rates, or by fluctuations in home prices [1]. A less ambitious "desirable price level" may also be aimed at, for example, a price level which does not show more fluctuations than those caused by foreign prices.

4.115 As a third target for current economic policy, in addition to the other two, *balance of payments equilibrium* needs to be introduced. This, again, may have several different meanings; it may refer to the balance of payments as a whole; or to the current items of the balance of payments, or to still other aspects. The obvious raison d'être of this target is the necessity, for the country, of financing its imports and its other possible financial obligations. It depends on the reserves and on the credits available to the economy, therefore, what exact form the target will assume. The essential thing is, however, that some level of the balance of payments deficit or surplus will be a datum, and we shall, for simplicity's sake, sometimes assume that it must be zero.

We shall discuss our subject matter, as before, against the background of a number of clear-cut separate "problems" and try to summarize our findings at the end of this §.

4.121 PROBLEM 111. MODEL 11.

Target: full employment
Instrument: government expenditure
Comment: This problem is similar to problem 011 and will be discussed to show some implications of the dependence on foreign economies.

In this simple model the employment target will again need to be inter-

[1] The first of these proposals was made by, among others, Lindahl, B. Hansen and Metelius; the second, for smaller variations in import and export prices, by Lindahl. I am grateful to Professor Hansen for this information.

preted as a specific value Y^F attributed to Y; from equations (1), (2) and (3) we have now to eliminate X and I and we obtain:

$$X_0 = Y^F(1 - \xi_1 + \iota) - E \tag{4101}$$

The required increase in public expenditure will again be smaller than the increase needed in Y^F, since $1 - \xi_1 + \iota$ will usually be smaller than 1; but this is not necessarily the case any more. For very small countries imports may exceed national income and ι may then be > 1 even. In the inverted Keynesian form the formula is better known:

$$Y^F = \frac{X_0 + E}{1 - \xi_1 + \iota} \tag{4102}$$

and the multiplier is now smaller than for a closed economy. Another feature of our result (4101) is that the increase needed in X_0 will be, for obvious reasons, the smaller, the higher the value E of exports is; national income and employment will be changing with changes in exports.

There is no guarantee at all that with X_0 equal to (4101) there will be balance of payments equilibrium. If exports E happen to be relatively small, the imports corresponding with Y^F, namely $I^F = \iota\, Y^F$, may well surpass E. If therefore the economy concerned wants to follow a policy of full employment it has to have ways of financing a balance of payments deficit. This is the well-known problem facing countries that wish to maintain a policy of full employment during an international depression.

4.122 PROBLEM 112. MODEL 11.

Target: balance of payments equilibrium
Instrument: government expenditure
Comment: If only one instrument of economic policy is used, for which government expenditure is here chosen, only one target can be attained; problem 112 is an alternative to problem 111 therefore. From the target $D = 0$ it follows that $Y = X$ or

$$X_0 = (1 - \xi_1)\, Y \tag{4103}$$

and

$$E = \iota\, Y \tag{4104}$$

Since Y is now an irrelevant variable, we have to eliminate it and we find that

$$X_0 = \frac{1 - \xi_1}{\iota} E \tag{4105}$$

Both X_0 and Y will now have to be parallel to E; if E happens to show fluctuations, the economy has to follow these fluctuations. And Y need not coincide with full employment income Y^F; it is $\frac{E}{\iota}$, which may be quite different. The problem also illustrates some questions of development policies. If a country wants to expand its national income by, say, increasing public expenditure, but, because of lack of reserves or credits, is forced to maintain balance of payments equilibrium, it has to solve the problem just discussed. The amount X_0 it is able to spend without disequilibrating the balance of payments will also determine the extent to which deficit spending can be applied. The increase in monetary circulation must not exceed the amount which corresponds to the possible increase in national income; an amount that may be defined with the help of an equation of the type of equation (3526) in § 3.532.

4.123 PROBLEM 113. MODEL 11.

Target: the optimum combination between employment and the balance of payments situation

Instrument: public expenditure

Comment: As already stated, it is impossible to attain two quantitative targets with the aid of only one instrument. If no other instruments are admitted, the best that can be obtained is an optimum combination; presupposing that there is a way of evaluating the relative advantages of unit increases in employment and in balance of payments surplus. We are now dealing with a flexible target, according to our terminology. Assuming that the policy-maker (the government) is acting on the basis of a welfare function $\omega\,(Y, D)$ depending on the level of national income and the balance of payments surplus (represented, negatively, by D), it is possible to determine a maximum of ω, with the side condition that both Y and D can only be varied as a consequence of variations in X_0. In somewhat more practical terms we may say that an optimum situation can be found if the policy-maker has a scale of valuations for various combinations of Y and D.

Expressing Y and D in terms of X_0 we find (4102)

and
$$D = \frac{\iota X_0 - (1 - \xi_1)\, E}{1 - \xi_1 + \iota} \tag{4106}$$

from which it follows that a small increase ΔX_0 causes increases in Y and D given by the formulae:

$$\Delta\, Y = \frac{\Delta\, X_0}{1 - \xi_1 + \iota} \tag{4107}$$

$$\Delta D = \frac{\iota \Delta X_0}{1 - \xi_1 + \iota} \tag{4108}$$

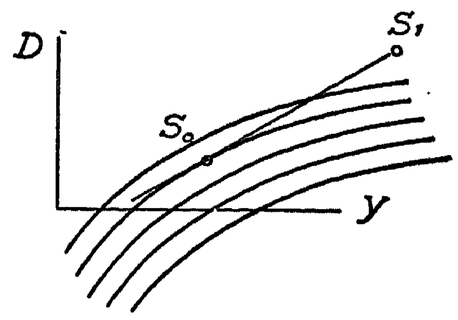
The corresponding increase in welfare will be

$$\Delta\omega = \frac{\partial \omega}{\partial Y}\Delta Y + \frac{\partial \omega}{\partial D}\Delta D \tag{4109}$$

and, under normal conditions as to the shape of ω, the optimum will be reached if $\Delta\omega = 0$, i.e. if:

$$\frac{\frac{\partial \omega}{\partial Y}}{\frac{\partial \omega}{\partial D}} = -\frac{\Delta D}{\Delta Y} = -\iota \tag{4110}$$

The increase in X_0 should therefore be stopped at the value of X_0 where the marginal value of a unit increase in national income Y is estimated to be ι times the marginal value of a unit increase in balance of payments surplus (being $-D$). In a practical way indifference curves with regard to Y and D may be constructed from interviews of the policy-maker; and (cf. graph 4.12) starting from the initial situation S_1 the optimum point will be found to be S_0, if S_1S_0 is a straight line with a slope ι.



Graph 4.12. Illustration of a method to determine an optimum position with the aid of indifference curves of a social welfare function depending on two variables D and Y. Initial situation: S_1; optimum situation: S_0. Slope of straight line S_1S_0 depends on nature of model.

4.131 PROBLEM 121. MODEL 12.

Target: "full" employment
Instrument: government expenditure
Comment: We give one more repetition of our simplest one-target-one-instrument problem for this somewhat more complicated model in order to show the complications in the field of prices arising in the case of an open economy. Since a general solution, i.e. one expressed in all the Greek coefficients, is difficult to interpret, we will discuss a number of numerical examples, as stated in the description of the model. (Cf. what is said about the numerical values of the coefficients at the end of the description of model 14.)

The general solution can be found with the aid of algebra applied to equations (1), (2) and (3), with the variables Y, X and v retained and the others eliminated with the aid of the other equations. The reader is invited to test the procedure.

4.132 The numerical result in case Csn, i.e. for a country of which imports are 50 % of national income, considering short-term reactions and a normal cyclical situation, are, for the most important variables:

$$v = 1.99\,X_0 - 1.06\,p^i + 1.39\,p^w \tag{4112}$$

$$Y = 1.57\,X_0 - 0.93\,p^i + 1.35\,p^w \tag{4113}$$

$$D = 0.71\,X_0 + 0.21\,p^i - 0.26\,p^w \tag{4114}$$

$$p^x = 0.20\,X_0 + 0.22\,p^i + 0.14\,p^w \tag{4115}$$

According to (4102) with $\xi_1 = 0.8$ and $\iota = 0.33$ the multiplier is 1.89; here it is 1.57 for nominal income and (since $v = 1.5$) $\frac{1.99}{1.5} = 1.3$ for the volume of production.

From (4113) and (4115) we may also calculate the change in real income:

$$Y - p^x = 1.37\,X_0 - 1.15\,p^i + 1.21\,p^w \tag{4116}$$

where approximately the same multiplier (1.37) appears to apply. As explained before (cf. § 3.522) the lower multiplier is due to the rise in prices, represented by (4115). At the same time there is an increase in the deficit D on the balance of payments (current items), which is considerable.

4.133 Our formulae also illustrate the influence exerted by foreign prices. As could be expected, a rise in import prices is unfavourable to production, income and the balance of payments and raises internal prices, though only by 22 % of the foreign price rise: the fall in internal demand being a counteracting force. The effects just indicated are usually described as the effects of the "terms of trade". This is not a very accurate terminology, since the terms of trade, if conceived of as the ratio of p^i to p^e, are not data, but partly dependent on the internal situation. Instead, p^w and p^i are data and it makes sense to speak of their influence on the national variables. Assuming for a while that the ratio $\overline{p}^i/\overline{p}^w$ is called terms of trade, it still appears that it is not exactly the ratio (whose variation would be $p^i - p^w$) which determines v, Y and D, but that in all three cases p^w's influence is relatively more important than p^i's.

4.134 Our results will be given some further perspective by comparing them with the results obtained for countries in different circumstances. Using the symbols explained in the description of model 14 (cf. Appendix 3) we have the following figures for Y:

$$
\left.\begin{array}{lll}
\text{Case} & \text{Formula} & \\
Asn & Y = 5.35\,X_0 & \\
Bsn & Y = 2.40\,X_0 - 0.625\,p^i + 0.97\,p^w & \\
Csn & Y = 1.58\,X_0 - 0.93\,p^i + 1.35\,p^w & \\
Dsn & Y = 0.95\,X_0 - 1.34\,p^i + 1.82\,p^w & \\
Csb & Y = 1.95\,X_0 - 1.13\,p^i + 1.62\,p^w & \\
C'sn & Y = 1.85\,X_0 - 1.12\,p^i + 1.59\,p^w & \\
C''sn & Y = 1.37\,X_0 - 1.00\,p^i + 1.18\,p^w & \\
Cln & Y = 1.81\,X_0 - 1.74\,p^i + 3.62\,p^w &
\end{array}\right\} \quad (4117)
$$

As might be expected, the multiplier falls and the influence of foreign prices rises with an increasing intensity of foreign trade. In case D the increase in income is even less already than the increase in X_0. Under boom conditions (Csb) the multiplier is larger than normally but this is a price effect. The multiplier again rises, but also in the physical sense, if the marginal propensity to spend is higher ($C'sn$); and it is lower for $\xi_1 = 0.7$ ($C''sn$). Long-term reactions (Cln) once more show a higher multiplier. In this case the influence of foreign prices is also considerably larger, evidently since the elasticity of demand for exports is now much higher. The influence would have been smaller if wage rates had been assumed to change. If they change, which is very probable in the case of rises in foreign prices, the resulting influence of the latter will be counteracted.

4.14 PROBLEM 131. MODEL 13.

Targets: "full" employment and balance of payments equilibrium
Instruments: public expenditure and the wage rate
Comments: Since some form of balance of payments equilibrium is a necessity for a number of countries, and full employment a very desirable target, and since, for two targets, two instruments are needed, a second instrument is now added. Preferably this should be an instrument from the price structure, since, evidently, the position of an open economy among the other economies is to a large extent dependent on its relative price level. In view of practical possibilities three instruments seem to stand out: indirect taxes, the wage rate and the exchange rate. Indirect taxes were already discussed in section 3.56. Model 13 has been constructed with a view to applying the wage rate.

4.142 The general solution to the analytical problem may be found in the same way as indicated for problem 121. It runs, for case Csn, i.e. for *short-term* reactions:

$$v = 1.99\,X_0 - 0.27\,l \tag{4118}$$

$$D = 0.71\,X_0 - 0.01\,l \tag{4119}$$

$$p^x = 0.20\,X_0 + 0.30\,l \tag{4120}$$

$$Y = 1.57\,X_0 + 0.20\,l \tag{4121}$$

The influence exerted by changes in wage rates appears to be quite modest. The influence on D is even negligible; the balance of payments situation will have to be regulated almost entirely with the help of public expenditure. If a reduction in expenditure would be required for this purpose, the only way of maintaining employment would be a fall in wage rates in order to attract foreign orders. The influence of wage rates on employment is somewhat more pronounced than in a closed economy (cf. § 3.5), but it is still very low: the elasticity being only $-\frac{0.27}{1.5} = -0.2$.

4.143 In the *long run*, however, this influence will be considerably larger, as the results for case *Cln* show:

$$v = 1.81\;X_0 - 1.88\;l \tag{4122}$$

$$D = 0.87\;X_0 + 0.105\,l \tag{4123}$$

$$p^x = 0.181\,X_0 + 0.482\,l \tag{4124}$$

$$Y = 1.48\;X_0 - 0.568\,l \tag{4125}$$

Again the influence of wage rates on the balance of payments situation is very modest: wage rates appear to be an inefficient regulator of the balance of payments; but now the influence on the volume of production is considerable: the elasticity being $-\frac{1.88}{1.5} = -1.25$. A closer analysis of the figures, based on the formulae obtained for the other variables, shows that this is due to (i) the greater influence now exerted by wage rates on the export price level and (ii) the larger elasticity of export demand. In the long run therefore the wage rate appears to be a fairly efficient regulator of employment.

4.144 This is illustrated by the solutions of the political problem listed below for the case where $e_0 = 0$:

Table 4.144 Some numerical solutions of problem 131 for $e_0 = 0$

Target values		Instrument values	
v	D	l	X_0
		Case *Csn* (short-term reactions)	
0	0	0	0
0.1	0	—0.39	—0.004
0	—0.1	—1.18	—0.16
0.1	—0.1	—1.57	—0.16
		Case *Cln* (long-term reactions)	
0	0	0	0
0.1	0	—0.05	+0.006
0	—0.1	—0.10	—0.103
0.1	—0.1	—0.15	—0.098

For a short-term increase of 0.1 in the volume of production a wage reduction of 39 %, for a short-term reduction of 0.1 in the balance of payments deficit a reduction of more than 100 %, would be necessary; figures which can only mean that no practical solution exists. In the long run the necessary reductions would be considerably more realistic, although even then not too easy.

4.151 PROBLEM 141. MODEL 14.

Targets: "full" employment and balance of payments equilibrium
Instruments: government expenditure and the wage rate
Comments: In order to make comparisons between the two instruments from the price structure, the wage rate and the exchange rate, we have constructed the somewhat more complicated model 14, which we are now going to apply in three problems, 141 to 143, inclusive; 141 and 142 show two instruments and 143 three. In problem 141 the wage rate is used to regulate the price structure, whereas in problem 142 the exchange rate is used. Comparisons between 141 and 142 will show the relative advantages and disadvantages of both. Problem 143 will be devoted to a three-target problem.

The formulae obtained here only differ from those of problem 131 in that foreign prices are included; therefore only the solutions of the policy problem may now be mentioned.

Table 4.151 Solutions to problem 141 for $e_0 = 0$

Target values		Instrument values	
v	D	l	X_0
		Case *Csn* (short-term reactions)	
0	0	$-6.9\,p^i + 8.8\,p^w$	$-0.39\,p^i + 0.49\,p^w$
0.1	0	$-0.39 - 6.9\,p^i + 8.8\,p^w$	$-0.004 - 0.39\,p^i + 0.49\,p^w$
0	−0.1	$-1.18 - 6.9\,p^i + 8.8\,p^w$	$-0.16 - 0.39\,p^i + 0.49\,p^w$
0.1	−0.1	$-1.57 - 6.9\,p^i + 8.8\,p^w$	$-0.16 - 0.39\,p^i + 0.49\,p^w$
		Case *Cln* (long-term reactions)	
0	0	$-0.99\,p^i + 1.99\,p^w$	$-0.067\,p^i + 0.067\,p^w$

The reader will understand why, in the first four lines, the terms with p^i and p^w are the same; for this reason the results for case *Cln* have only been given for $v = D = 0$; the solutions for the other values of v and D given in the upper half of the table may be obtained from this table and the previous one.

It is found, as a result, that the wage changes required to attain the targets set are heavily dependent on the simultaneous changes in foreign prices. One per cent rise in prices p^w without a change in p^i will permit a wage rise of 8.8 %; or will make a wage fall of 8.8 % superfluous; and one per cent rise in prices p^i without a change in p^w will, on the contrary, make things considerably more difficult. If account is taken of long-term reactions, more moderate changes in l will be needed; and usually parallel changes in p^w and p^i will occur, making the required changes in wages still less. If a rise of 5 % in p^i is accompanied by a rise of 3 % in p^w a wage rise of some 1 % will be justified. Formulae of this nature will be called *"directives"*: they imply a directive for a current adjustment in wage rates required by changes in the world market situation. Similar conclusions are implied as to X_0 (cf. § 3.33).

4.152 PROBLEM 142. MODEL 14.

Targets: "full" employment and balance of payments equilibrium
Instruments: government expenditure and the exchange rate
Comments: See problem 141. First we will compare the size of the changes required in wage rates with those required in exchange rates in order to attain the same targets. For case *C* (country whose imports are 50 % of its national income) in a normal cyclical position the following solutions can be found for short-term and long-term reactions, respectively:

Table 4.1521 *Some numerical solutions to problems 141 and 142 compared*

Wage policy (141)

Short-term reactions

$$X_0 = 1.59\,D - 0.06\,v - 0.393\,p^i + 0.492\,p^w$$
$$l = 11.8\,D - 4.17\,v - 6.88\,p^i + 8.82\,p^w$$

Long-term reactions

$$X_0 = 1.03\,D + 0.056\,v - 0.067\,p^i + 0.067\,p^w$$
$$l = 1.00\,D - 0.478\,v - 0.99\,p^i + 1.99\,p^w$$

Exchange-rate policy (142)

Short-term reactions

$$X_0 = D + 0.149\,v - 0.05\,p^i + 0.05\,p^w$$
$$k = 6.06\,D - 2.15\,v - 3.55\,p^i + 4.55\,p^w$$

Long-term reactions

$$X_0 = 1.03\,D + 0.056\,v - 0.067\,p^i + 0.067\,p^w$$
$$k = 1.00\,D - 0.478\,v - 0.99\,p^i + 1.99\,p^w$$

For our comparison it will also be useful to have the solutions to the analytical problem, i.e. the expression of the main variables in terms of the instruments and data. They are:

Table 4.1522 *Solutions to analytical problems 141 and 142*

Wage policy (141)

Short-term reactions

$$v = 1.99\,X_0 - 0.27\,l - 1.06\,p^i + 1.39\,p^w$$
$$D = 0.71\,X_0 - 0.01\,l + 0.21\,p^i - 0.26\,p^w$$
$$p^x = 0.20\,X_0 + 0.30\,l + 0.22\,p^i + 0.14\,p^w$$
$$Y = 1.57\,X_0 + 0.20\,l - 0.93\,p^i + 1.35\,p^w$$

Long-term reactions

$$v = 1.81\,X_0 - 1.88\,l - 1.74\,p^i + 3.62\,p^w$$
$$D = 0.87\,X_0 + 0.103\,l + 0.16\,p^i - 0.26\,p^w$$
$$p^x = 0.181\,X_0 + 0.482\,l + 0.156\,p^i + 0.362\,p^w$$
$$Y = 1.48\,X_0 - 0.568\,l - 1.4\,p^i + 2.96\,p^w$$

Exchange-rate policy (142)

Short-term reactions

$$v = 1.99\,X_0 - 0.33\,k - 1.06\,p^i + 1.39\,p^w$$
$$D = 0.71\,X_0 + 0.049\,k + 0.21\,p^i - 0.26\,p^w$$
$$p^x = 0.20\,X_0 - 0.36\,k + 0.22\,p^i + 0.14\,p^w$$
$$Y = 1.57\,X_0 - 0.43\,k - 0.93\,p^i + 1.35\,p^w$$

Long-term reactions

$$v = 1.81\,X_0 - 1.88\,k - 1.74\,p^i + 3.62\,p^w$$
$$D = 0.87\,X_0 + 0.103\,k + 0.16\,p^i - 0.26\,p^w$$
$$p^x = 0.181\,X_0 - 0.518\,k + 0.156\,p^i + 0.362\,p^w$$
$$Y = 1.48\,X_0 - 1.54\,k - 1.4\,p^i + 2.96\,p^w$$

4.153 From these equations we observe that, in *short-term reactions*, k exerts a slightly stronger influence on both D and v and that, as a result, less extreme changes in k are required to produce given changes in D or v: k might be called a more efficient instrument for regulating both the balance of payments and the level of production, comparing equal percentage changes in l and k as equally "difficult". Since, in fact, wage reductions are more difficult to obtain than exchange rate reductions of equal size, this conclusion stands firm for reductions. It is only natural, but very important for our comparison, that internal prices p^x are affected differently: a wage change affecting them positively and an exchange rate negatively. For all groups with fixed money incomes, i.e. especially those dependent on savings in bonds, this makes a big difference. Of course it also makes a big difference to wage earners; we are going to discuss its consequences in § 4.155.

Under boom conditions (case b) as defined in the description of model 14 (Appendix 3) the coefficient of v in the expression k in table 4.1521, upper half, is —2.76 instead of —2.15.

It needs hardly to be stressed that the numerical values of the coefficients shown will depend very much on the structure of the country considered. The reader may be able to derive similar equations for cases B and D.

4.154 Turning now to *long-term reactions* we observe that, at least with our interpretation of this phrase, the influence of equal percentage changes in l and k on D and on v is exactly equal. On closer investigation this appears to be the consequence of two assumptions involved, namely that: (i) incomes of independents move parallel to wages, and (ii) the coefficients ξ_1 and ξ_2 add up to unity, meaning that there is no money illusion. [1] On these conditions it can be proved that the changes in each physical variable (e, x, v, i) and in D brought about by equal percentage changes in l and k are equal.

4.155 So far we discussed wage rates and exchange rates as alternative instruments. Very often the choice to be made is different: if wages are not considered an instrument, they will have to be considered as a dependent variable in the system; and if there is a devaluation of money they will change also. Evidently the consequences depend on how wage rates react to a devaluation. Often they will tend to move proportionally to internal

[1] This may be proved in the following way: since $dX = \xi_1 dY + \xi_2 dp$ we have $dx = dX - dp = \xi_1 dY + (\xi_2 - 1)\, dp$; if $\xi_1 + \xi_2 = 1$ this may be written: $dx = \xi_1 (dY - dp) = \xi_1 dy$, meaning that real expenditure increases are only dependent on changes in real income and not, in addition, on price changes.

prices. We will make this assumption and recalculate the consequences of a change in k. Instead of putting $l = 0$ we add an equation

$$l = p^x \tag{4126}$$

The analytical problem now shows the following solutions (case *Csn*):

$$v = 1.91\ X_0 - 0.19\ \ k - 1.14\ p^i + 1.34\ p^w \tag{4127}$$

$$D = 0.71\ X_0 + 0.054\ k + 0.21\ p^i - 0.26\ p^w \tag{4128}$$

These equations have to be compared to formulae 9 and 10 of table 4.1522. It appears that the influence on v is now considerably less than in the case of "pure" exchange-rate policy (without a change in wage rates): the coefficient has gone down from 0.33 to 0.19. The efficiency of exchange rates with respect to the volume of production in now less even than that of wage rates, provided we compare equal percentage changes in both rates as equivalent. This clearly is not realistic, however, and certainly devaluation will be the easier way still.

4.156 PROBLEM 143. MODEL 14.

Targets: "full" employment, balance of payments equilibrium and monetary equilibrium

Instruments: government expenditure, the wage rate and the exchange rate

Comments: Since our definition of monetary equilibrium does not coincide with that of balance of payments equilibrium there is scope for introducing both, as two different targets, together with the target of full employment. Since three instruments are then required, both the wage rate and the rate of exchange have been introduced as such, in addition to public expenditure.

The solutions to the political and the analytical problem are given below, for short-term and for long-term reactions.

Table 4.156 Solutions to problem 143, cases Csn and Cln

I. Political problem; (*s*) short-term reactions:

$$\begin{aligned} X_0 &= 0.1\ v + 1.2\ D + 0.1\ p^x - 0.2\ p^i + 0.2\ p^w \\ l &= -1.6\ v + 4.0\ D + 2.0\ p^x - 3\ p^i + 3\ p^w \\ k &= -1.3\ v + 4.0\ D - 1.0\ p^x - 2\ p^i + 3\ p^w \end{aligned}$$

(*l*) long-term reactions:

$$\begin{aligned} X_0 &= 0.06\ v + 1.0\ D - 0.07\ p^i + 0.07\ p^w \\ l &= -0.26\ v + 0.33\ D + 1.0\ p^x - 0.66\ p^i + 0.66\ p^w \\ k &= -0.22\ v + 0.67\ D - 1.0\ p^x - 0.33\ p^i + 1.33\ p^w \end{aligned}$$

II. Analytical problem; (*s*) short-term reactions

$$\begin{aligned} D &= 0.71\,X_0 - 0.01\,l + 0.049\,k + 0.21\,p^i - 0.26\,p^w \\ v &= 1.99\,X_0 - 0.27\,l - 0.33\,k - 1.06\,p^i + 1.39\,p^w \\ p^x &= 0.20\,X_0 + 0.30\,l - 0.36\,k + 0.22\,p^i + 0.14\,p^w \end{aligned}$$

(*l*) long-term reactions

$$\begin{aligned} D &= 0.87\,X_0 + 0.10\,l + 0.10\,k + 0.16\,p^i - 0.26\,p^w \\ v &= 1.81\,X_0 - 1.88\,l - 1.88\,k - 1.74\,p^i + 3.62\,p^w \\ p^x &= 0.18\,X_0 + 0.48\,l - 0.52\,k + 0.16\,p^i + 0.36\,p^w \end{aligned}$$

The reader will be able to compare the solutions of the analytical problems with those given before and to explain the resemblance. The solutions to the political problem show the characteristics that could be expected: less violent changes in l and k will be sufficient in order to restore either a certain volume of production or a certain balance of payments surplus. An increase in production by say 5 % will require a wage reduction by 8 % and a devaluation by 6.5 %; an improvement in the balance of payments situation by 1 % of national income or 2 % of imports will require a reduction of both rates by 4 %. If it is desired, at the same time, to let internal prices fall by 1 % this requires an *extra* wage reduction by 2 % and 1 % *less* devaluation. Although these figures are indeed less considerable than the ones previously calculated, they are still high.

The long-run figures are much more acceptable from the practical point of view. Their application will not lead to the desired aim within the course of one or two years, but only after two or three years. The implication is that other instruments of economic policy will then have to be applied meanwhile, e.g. quantitative restrictions, or that the evils of unsatisfactory employment or balance of payments deficit or too high prices, when they occur, will have to be borne for some time.

4.161 PROBLEM 151. MODEL 15.

Targets: "full" employment and balance of payments equilibrium
Instruments: public expenditure and debt policy
Comments: In many countries wages are not considered an instrument of economic policy; and in accordance with the Bretton Woods agreement the exchange rate is not considered a current instrument either. On the other hand, the tendency to accept at least the two targets indicated requires more than one instrument. In this and the next problem two instruments from the sphere of credit policy are introduced as alternatives: government debt policy and discount policy. Their analysis requires a model which somewhat more explicitly deals with the monetary variables of the

economy; to this end model 15 has been constructed, of importance also in the purely statistical description of the economy. Unfortunately, the relations entering into this model have so far been neglected by statistical and econometric research; little is known about their true shape and hence our treatment can only be sketchy, and our conclusions tentative.

In this problem, $m_B{}^1$ may be considered to be the second instrument. The foreign interest rates $m_B{}^3$ and $m_M{}^1$ as well as the national short-term rate $m_M{}^1$ will be considered as data; and so will E. Also given in the mathematical sense are the values of the target variables, Y and D. Unknowns are the instrument values X_0 and $m_B{}^1$ and the irrelevant variables X, I, six variables ΔB^1, ΔB^2, ΔB^3, ΔB^{21}, ΔB^{31} and ΔB^{32} and the corresponding six ΔM-values. Their total number is 16 and they can, in principle, be determined with the aid of the 16 equations of model 15. Some remarks on the probable results will be given together with those on problem 152.

The choice made implies that credit rationing is left out of consideration. Some remarks on it will be made in section 4.177.

4.162 PROBLEM 152. MODEL 15.

Targets: "full" employment and balance of payments equilibrium
Instruments: public expenditure and the rate of discount
Comments: The difference, as to logical structure, from the previous problem is only slight. The short-term interest rate $m_M{}^1$ will now be an instrument variable, and hence unknown, and the longterm rate $m_B{}^1$ will be given. The number of equations therefore will again be sufficient to solve for the unknowns.

Discussing, now, the possible solutions to both problems (151 and 152) we may state that there would be no solution if D were defined as before, namely as the deficit on current account: $D = I - E$. The reason is very simple: full employment requires a certain value of Y; from this a certain value for I follows; and with given E, D results and as a rule will not be zero. The cases where it is positive are the ones asking for a solution. A superficial solution will be possible if balance of payments equilibrium is understood in a different way, namely by including non-current items which are then required to offset any lack of equilibrium in the current items. By its nature such an equilibrium will, however, be a temporary one. Both debt management and discount policy can indeed attract a certain amount of capital from abroad, corresponding with the interest offered. When demand for assets reaches its equilibrium at the new interest rate, no further inflow of foreign investment will, however, occur unless a further rise in rates is effectuated. These policies therefore can only be recommended for

temporary solutions. Little is known, as was already observed, about the extent to which a given interest differential with other countries attracts such a temporary flow of capital.

A lasting solution of the problem of balance of payments disequilibrium can only be obtained if E is adapted to the desired level of Y and I; which will require either price policy or policies of "sales promotion" on a national scale (cf. problems 131, 141, 142 and 143).

4.171 We may now summarize our findings in this §. The regulation of short-term equilibrium in an open economy is complicated by its international links. Economic development generally and economic policy in foreign countries both influence, and may disturb, the economy. Policy requirements depend very much on the degree of similarity between the targets set abroad and at home. They tend to become more difficult the larger the number of targets set. Even without any further targets it will be necessary, at least in the long run, to maintain balance of payments equilibrium. In modern societies the need will increasingly be felt to add the targets of "full" employment and of monetary equilibrium. One instrument will be sufficient in rare cases only: one or two other general instruments will usually be badly needed. Only if the country happens to be in favourable circumstances can it do without: if it commands ample reserves, or if its price level is highly competitive, there will be no balance of payments problem.

4.172 Again, the most effective instrument that may be used to regulate employment as well as balance of payments equilibrium or monetary equilibrium (but not simultaneously) is government expenditure (or more generally government surplus or deficit). The high efficiency of this instrument is due to the fact that it directly affects the volume of demand, whereas most other instruments do so only indirectly. The effectiveness of public expenditure is illustrated by its multiplier. This multiplier is lower in an open economy, however, than in a closed one, and is lower, the higher is the import quota of the country. It is also lower, in respect of the volume of production, in boom conditions than in a normal cyclical situation; and in the long run as compared with short-run reactions. For nominal income it is higher in a boom period and in the long run, but this is due to a higher rise in prices.

4.173 If two targets are set it becomes necessary to add another main instrument, preferably one taken from the price structure; for technical reasons exchange rates and wage rates seem to be the best ones. Both do influence the volume of production and hence employment, but their short-term influence is not strong. This means that in the case of disturbances of some importance, intensive changes may be necessary. Both have their draw-backs. The Bretton Woods agreement requires exchange rates to be as stable as possible. Unions will oppose big reductions in wage rates. This situation illustrates the importance of international coordination. Heavy disturbances are less likely to occur if all countries adhere to a similar policy.

4.174 Wage policy is not a generally accepted main instrument of economic policy; freedom of negotiation is very often felt to be of great importance. The preceding analysis shows how necessary a revision of this attitude is. The Netherlands have chosen in favour of a centralized wage policy, making wage changes dependent on government approval. Their experience in the ten-year period 1945–1955 has been favourable. Holland regained its strong position in international trade, vital to the country, by a policy of wage restraint during the years 1951–1954.

4.175 Comparing the exchange-rate and wage-rate adjustments required to meet a given disturbance we find that percentage changes in exchange rates can be smaller than percentage changes in wage rates. This, however, only applies to isolated changes in exchange rates, that is changes not accompanied by wage adjustments. If wages are adjusted so as to maintain real wages, the necessary exchange rate changes will exceed those in wage rates. Neither isolated wage changes nor wage-adjusted devaluations are very elegant: in the former case wage earners bear the full burden, or more, and in the latter case they do not share at all in the burden. Some sharing will usually be preferable.

4.176 In the long run the effects of exchange rate and wage rate changes are considerably larger and so the adjustments required to meet a given disturbance lie more within the limits of practical possibilities. This implies that such disturbances will have to be met

temporarily either by drawing upon reserves or by quantitative restrictions (cf. § 5.2).

4.177 Credit policies, as a rule, do not form a powerful instrument in the maintenance of short-term equilibrium. The influence of a change in interest rates on activity is only weak; a rise in discount rates will attract short-term foreign capital, but this, by its nature, means only a temporary flow. Restrictive credit policy will, however, influence activity more directly and more effectively.

Credit restriction may be used to impose an upper limit to national expenditure and hence to national income. Thus, by credit restriction, it may be possible, if need be, to restrict the expansion of national income so as to avoid a balance of payments deficit: the level of income determined in problem 112, equation (4104). In other words, it is possible to restrict the growth of monetary circulation to the cash balances corresponding to that level of national income.

4.178 If three targets are set, three instruments are needed. This especially applies to a program of "full" employment, balance of payments equilibrium and monetary equilibrium in the sense of stable prices. If it is desired to carry out such a program in an unstable world, it will be necessary to accept exchange rates as a regular instrument of policy. This can only be avoided if the leading countries pursue a policy of stable prices.

4.2. Multiple-Target Policies for Open Economies

4.211 The general type of quantitative policy problems arising in most countries will pursue a number of different targets at the same time; among them will be short-term targets and the relevant phases of certain longer-term policies. Since most countries are definitely open economies, such "multiple-target policies for open economies" play an important role in practical life. We have collected, in the preceding chapter and the preceding section, sufficient elements of the problems involved in order to be able to face the design of such policies as a whole.

4.212 In an open economy the element of interdependency takes forms which are different from those which it takes in closed econo-

mies. We already discussed (cf. § 4.111–4.113) the reduction in freedom with respect to the price level, at least if exchange rates are not considered an instrument of current economic policy. We introduced the phrase of "imported inflation" as an illustration of this reduced freedom. On the other hand, an open economy can be helped by others in order to overcome certain difficulties of inflation; we used the expression "exportation of inflation" in order to illustrate that point. Another example of the change in economic interdependency is supplied by the consequences of changes in productivity. A rise in productivity with constant employment in a closed economy will increase the volume of production and hence the volume of consumption. In an open economy it may happen that such an increase in production does not result in an increase in consumption because of a deterioration in the terms of trade. The advantages of the increase in productivity have then been handed over to other countries; sometimes the circumstances will not permit any other attitude. And the country concerned may obtain a greater advantage from the increase in productivity elsewhere than from its own increases in productivity. The case is similar to the well-known fact that building workers have seen their wages rise during the last century more because of rises in productivity in other industries than because of rises in their own industry.

4.213 All these interdependencies have to be expressed in the models used, and it is because of the complicated interdependencies (especially in open economies) that these models render valuable services here. Models have to be designed so much with a view to the special problems to be solved that it is hardly possible to give a complete treatment in a general way. Again a number of examples will be discussed and some of the more general conclusions will be set out at the end of this section (cf. 4.27). These examples are intended to illustrate the formal as well as the material aspects of the problem of multiple-target policies. The author believes that, as far as the material aspect is concerned problem 162, in particular, is of practical relevance to present-day policies.

4.214 The examples to be discussed are still extremely simple in comparison to the problems of actual practice. As in earlier examples,

they have been chosen to be simple for explanatory purposes. An additional reason for doing so is that the more complicated methods, including input-output analysis, are still in the experimental stage. Probably they will soon be available as supplementary methods, insofar as sufficient statistical data will have been collected meanwhile. For the time being it seems advisable to use a two-stage method. The main problems of economic policy for the economy as a whole may be provisionally solved with the aid of the methods to be described in this section. Sector problems may, as a second stage, be considered with the aid of these provisional solutions of the general problem, using the figures found concerning general activity, general price and wage level, etc., and applying methods similar to those of this section.

4.221 PROBLEM 161. MODEL 16 [EQUATIONS (1)—(17)].

Targets: "full" employment,
balance of payments equilibrium,
a given volume of investment,
a given distribution of income between workers and independents;
meaning that the target variables are a, D, j and λ;
it depends on the initial situation which numerical values these variables have to assume.
Instruments: government expenditure X_0, wage rate l, indirect tax rate τ and direct tax rate θ.
Comments: this problem is chosen as an example of modern policy, with two targets of a short-run character and the two others representing long-term targets: a given volume of investment being a prerequisite for a certain rate oí development and a given distribution being part of a policy of social equilibrium.

4.222 Evidently we have to solve the system of equations for the values of X_0, l, τ, and θ. Since this problem will be shown—for this model—to be insoluble, it is worth while to go into the process at some detail, using various methods of presentation.

As a first method we use an "arrow system" constructed in an intuitive way: starting with data and given values of target variables we try to find out which of the irrelevant variables and of the instrument variables (forming, together, our unknowns) can be determined. And it appears that the structure is such as to permit us to go a long way with this "method".

Starting with equation (9) we see that the given value of a enables us

to find v; equation (8) then yields i; equation (13) I; together with the given value for D, equation (15) then supplies E. According to (14) and (6)—here we have to combine two equations in order to find our way—then may be written:

$$E = (\bar{e} - \varepsilon_1)\, p \tag{4201}$$

from which we can find p, and with (6), e. Next, (7) now yields l, our first instrument variable. Also, we can now deduce Y, since equation (1) may be given a somewhat different form in this model, namely:

$$Y = v + \bar{v}p - I \tag{1'}$$

and all the right-hand side members are known.

Remembering now that j is also given, we find from equation (12) the value of J and from v, j and e, equation (16), the value of c. From (10) C^F can then be calculated. Taking up l again, and combining it with a, according to equation (2), we deduce L; Z can now be found with the help of equation (3).

4.223 Here our first important result emerges: now that we know both L and Z, *we cannot prescribe a ratio λ between them*, as equation (17) and our fourth target would require us to do: this social equilibrium target is not therefore compatible with the other targets so far used to find Z and L, i.e. only a and D. Of course this incompatibility only applies to the specific model now considered, including the choice of instruments. With one more instrument intervening in one of the relations so far used, it would be possible to reconcile the targets a, D and λ.

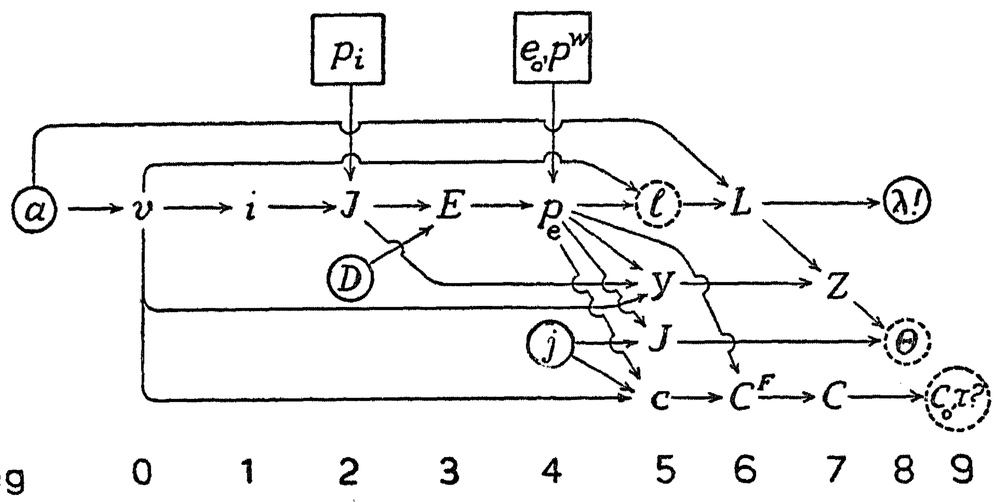
4.224 The second important result is the counterpart of the first one; it is that the two instruments not yet calculated, namely C_0 and τ, *cannot be calculated separately*. This is most easily seen if we eliminate C from our equations by substituting (11) into (4):

$$\bar{c}\,(p + \tau) + (1 + \bar{\tau})\, c = C_0 + \gamma\,(1 - \bar{\theta})\, Z - \gamma\, \bar{Z}\theta + L \tag{4'}$$

Having eliminated C we do not need equation (11) any more in our system and (4') is now the only equation left in which both the unknowns τ and C_0 appear. It follows that one of them can be chosen freely, and only then can the other be derived. The phenomena just discovered may also be formulated thus. If we had eliminated all the irrelevant variables and thus retained only four equations in the four unknown instruments, we would have found that in three of these four equations the values of the two instruments l and θ only would have occurred, whereas in the fourth equation only the

two others, τ and C_0, would have occurred. This has the two consequences just stated; on the one hand the first three equations cannot be satisfied at the same time, meaning that the targets cannot all be reached at the same time, whereas the fourth equation is not sufficient to yield us the two remaining instruments.

4.225 The logical structure just discussed can be symbolized in the arrow scheme of graph 4.225. Here the symbols are those used in the equations;



Graph 4.225. Logical structure of problem 161. Symbols in fully-drawn squares indicate data; those in fully-drawn circles are targets and those in dotted circles (unknown) instrument values. Simon ordering is indicated below.

target variables are indicated by a fully drawn circle; data have been indicated by a square (these data do not occur in model 16, but might have easily been added in the same way as in model 12).

4.226 As another presentation of the same state of affairs we use Herbert Simon's causal ordering, which primarily comes down to writing the equations in another order: (see page 119).

4.227 From this presentation it is easily seen that the matrix of the system of equations is almost triangular; the exception being that in equation 14 a term $-e$ appears; and the implication being that, with that exception, every unknown can be calculated in succession from the others. This is, however, not possible with the unknowns τ and C_0, since these only occur in the last equation; they cannot be calculated separately. In revenge, the last but one equation (17) only contains variables (L and Z) that have already been determined and that will then satisfy equation (17) only by pure coincidence. Simon's "ordering" can be read from this list. Variables v, i, I, E are of orders 0, 1, 2 and 3, respectively; variables p and e of order

Table 4.225 Equations for problem 161

Eq.↓	Var.: →	v	i	I	E	p	e	l	Y	J	c	L	C^F	Z	θ	τ	C_0
9	$a =$	αv															
8	$0 =$	ιv	$-i$														
13	$0 =$		i	$-I$													
15	$D =$			I	$-E$												
14	$0 =$				E	$-\bar{e}p$	$-e$										
6	$0 =$					$+\varepsilon_1 p$	$+e$										
7	$0 =$	$\pi_1 v$				$-p$		$+\pi_2 l$									
1′	$0 =$	v	$-I$			$+\bar{v}p$			$-Y$								
12	$j =$					$-\bar{j}p$				$+J$							
16	$j =$	v					$-e$				$-c$						
2	$\bar{L}a =$							$-\bar{L}l$				$+L$					
10	$0 =$					$\bar{c}p$					$+c$		$-C^F$				
3	$0 =$								$-Y$			$+L$		$+Z$			
5	$0 =$									$-J$			$+(1-\gamma)$	$(1-\bar{\theta})\ Z-(1-\gamma)\ \bar{Z}\theta$			
17	$0 =$											$-L$		$+\lambda Z$			
4	$0 =$					$-\bar{c}p$					$-(1+\bar{\tau})c$		$+$	$\gamma(1-\bar{\theta})Z-$	$\gamma\ \bar{Z}\theta$	$-\bar{c}\tau$	$+C_0$

4. Variables l, Y, J and c are of the order 5. In our arrow scheme this is brought out by their being placed in one (vertical) column. Similarly, L and C^F are of order 6, Z is of order 7, θ of order 8 and $-c\tau+C_0$ of order 9.

4.228 One last remark, one of *economic interpretation*, may be made. Upon closer consideration it will be clear that in this model and with the targets and instruments chosen, the instrument τ is irrelevant by itself; it only influences the internal price level for consumer goods; if it is raised, private consumption will fall but it may do so without changing anything else if only C_0, public consumption, is raised accordingly. It is only the two types of consumption together that matter for the balance of payments, for employment or for incomes.

4.231 PROBLEM 162. MODEL 16 [EQUATIONS (1)—(16) AND (17′)]

Targets: "full" employment,
balance of payments equilibrium,
a given volume of investment,
a given internal price level.
Instruments: public expenditure,
the wage rate,
the indirect tax rate,
the direct tax rate.
Comments: by a slight change in the problem we have now presented a soluble problem. In addition, this problem may be considered a good example of modern economic policy, the emphasis now being laid on a somewhat different aspect of social policy: the protection of fixed incomes and of savings. (We already stated that the aim of a certain distribution of income between workers and independents might also have been brought in, but would have required the introduction of another instrument.)

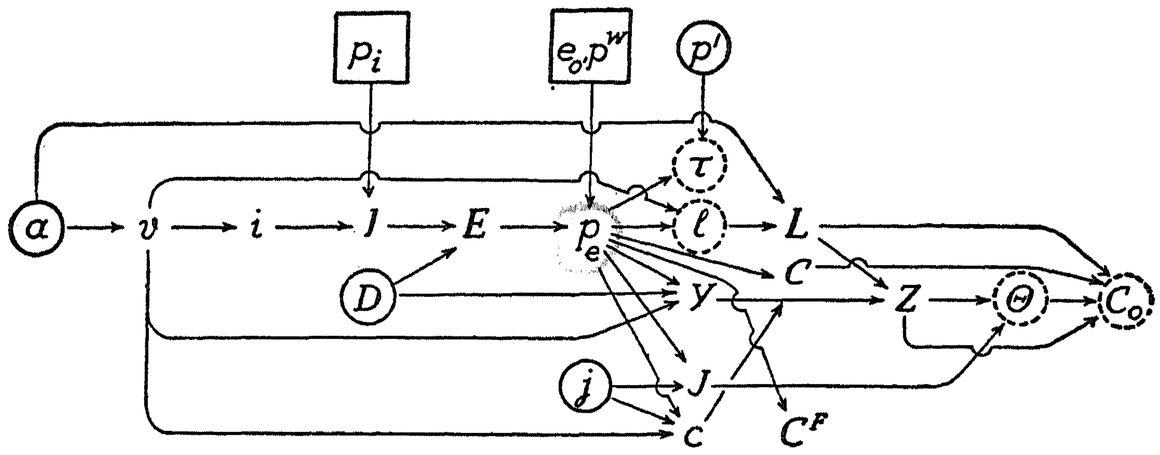
4.232 After what has been said about the solution of problem 161 we may be brief here and only reproduce both the arrow scheme and the Simon arrangement of the equations. (cf. graph 4.232 [1]) and page 121).

4.233 We will now proceed to the *numerical solution* in order to be able to discuss the orders of magnitude of the changes in instruments necessary to attain the targets. Using the values of the coefficients and constants indicated in model 16 we will obtain, in the order of the table below, the

[1] This graph was constructed independently of B. Hansen (cf. Finanspolitikens ekonomiska teori, p. 364).

Table 4.232 Equations for problem 162

Eq.↓	Var.: →	v	i	I	E	p	e	l	Y	J	c	L	C^F	Z	θ	τ	C_0
9	$a =$	αv															
8	$0 =$	ιv	$-i$														
13	$0 =$		i	$-I$													
15	$D =$			I	$-E$												
14	$0 =$				E	$-\bar{e}p$	$-e$										
6	$0 =$					$+\varepsilon_1 p$	$+e$										
7	$0 =$	$\pi_1 v$				$-p$		$+\pi_2 l$									
1′	$0 =$	v	$-I$			$+\bar{v}p$			$-Y$								
12	$j =$					$-\bar{j}p$				$+J$							
16	$j =$	v					$-e$				$-c$						
2	$\bar{L}a =$							$-\bar{L}l$				$+L$					
10	$0 =$					$\bar{c}p$					$+c$		$-C^F$				
3	$0 =$								$-Y$			$+L$	$+$	Z			
5	$0 =$									$-J$			$+(1-\gamma)$	$(1-\bar{\theta})\ Z-(1-\gamma)\ \bar{Z}\theta$			
17′	$p' =$					p										$+\tau$	
4′	$0 =$					$-\bar{c}p$				$-(1+\bar{\tau})c$			$+$	$\gamma(1-\bar{\theta})Z-$	$\gamma\ \bar{Z}\theta$	$-c\bar{\tau}$	$+C_0$



Ordering	0	1	2	3	4	5	6	7	8	9
Equation	9	8	13	15	14	17	2			
					6	7	11			
						1		3	5	4
						12				
						16	10′			

Graph 4.232. Logical structure of problem 162. For explanation cf. graph 4.225.

expressions of the instrument and the irrelevant variables in terms of the targets:

Solutions of problem 162:

$$v = 2.5\ a \tag{4202}$$
$$i = 0.84\ a \tag{4203}$$
$$I = 0.84\ a \tag{4204}$$
$$E = 0.84\ a - D \tag{4205}$$
$$p = -1.68\ a + 2\ D \tag{4206}$$
$$e = 1.68\ a - 2\ D \tag{4207}$$
$$*l = -5.8\ a + 6\ D \tag{4208}$$
$$Y = -0.86\ a + 3\ D \tag{4209}$$
$$J = -0.16\ a + 0.2\ D + j \tag{4210}$$
$$c = 0.82\ a + 2\ D - j \tag{4211}$$
$$L = -2.41\ a + 3\ D \tag{4212}$$
$$C^F = -0.70\ a + 3.8\ D - j \tag{4213}$$
$$C = -0.90\ a + 2.2\ D - 1.1\ j + 0.9\ p' \tag{4214}$$
$$Z = 1.55\ a \tag{4215}$$
$$*\theta = 3.27\ a - 1.33\ D - 6.7\ j \tag{4216}$$
$$*\tau = +1.68\ a - 2\ D + p' \tag{4217}$$
$$*C_0 = 3.71\ a - 1.27\ D - 3.4\ j + 0.9\ p' \tag{4218}$$

4.234 The solutions with an asterisk refer to *instruments* and hence are of particular interest. They enable us to compute, for whatever change in targets we desire, the necessary values of the instrument variables. In order to illustrate their use let us suppose that a country finds itself faced with a deficit in the balance of payments of 10 % of current items, i.e. $D = 0.05$; if it is desired to eliminate this deficit while maintaining employment, the rate of investment and the internal price level, our targets will be $D = -0.05$, $a = j = p' = 0$; and we easily deduce that: $l = -0.3$, $\theta = +0.07$, $\tau = 0.1$ and $C_0 = 0.06$, a very drastic programme indeed: the wage rate should be reduced by 30 %, direct taxes increased from 0.3 to 0.37, i.e. by some 23 %, indirect taxes from 0.1 to 0.2, i.e. doubled and public expenditure be increased from 0.25 to 0.31, i.e. by some 15 %.

4.235 This program would, in most countries, be *politically impossible*; in our terminology, *boundary conditions* would be transgressed and a less ambitious programme should be accepted. Our formulae enable us to investigate a large number of possibilities. There are some remarkable further conclusions to be drawn: if, in particular, the huge reduction in wage rate should, rightly, be deemed impossible, the only change in targets that can help to overcome this difficulty is either a change in the balance of payments target or a change in the employment target: the other target variables do not enter into (4208). For each procent less employment 6 % less wage reduction could be "bought". Surely this statement does not apply to real wage rates; they can be easily calculated to be

$$l^R = l - p' = -5.8a + 6D - p'$$

and evidently depend on the internal price target as well; still not, however, on the investment target.

4.236 Suppose now we choose the targets: $D = -0.03$, $a = -0.01$, $j = 0$ and $p' = -0.05$; we find $l = -0.12$, $\theta = 0.01$, $\tau = -0.007$ and $C_0 = -0.044$; implying that real wage rates will now have to be down 7 % "only". The striking feature is the very important place taken in these problems by the wage rate.

4.237 The reader should be aware of the simple structure of the solution now discussed; in particular it should be mentioned that for this same model the analytical method would be much more cumbersome: the matrix of the system of equations then becomes far from triangular and the causal ordering much less simple. This is not an incidental property of the example chosen; it is closely related to the role played by the two main targets,

full employment and balance of payments equilibrium. Had a and D be among the variables, the interrelations between the variables would have been much more complicated.

4.241 PROBLEM 171. MODEL 17 [OMITTING EQUATION (4)].

Targets: "full" employment and conservation of a certain "desired" gold stock, to be represented by Y^F and Au^D respectively.
Instruments: the rate of discount m and the ratio ϱ of required reserves to deposits.
Comments: this problem illustrates some of the aspects of *monetary policy*, especially (i) the indirect guidance that can be given by the Central Bank to the credit market as a whole, and (ii) the narrow limits set to the effects on the general economy. In this field, especially, a careful distinction should be made between members of the endless variety of problems that may be considered. This will be illustrated by the choices that can be made as to targets and instruments, by the role boundary conditions may play and by a discussion of the difference between systematic and "trial-and-error" policy.

4.242 The targets chosen are indicative of the modern point of view that monetary policy should not only be directed towards the conservation of a certain desired gold stock (a target not essentially different from "balance of payments equilibrium", the phrase so far used) but also to the maintenance of "full" employment. It remains to be seen whether it will prove possible to do so under all circumstances, even under more or less normal circumstances.

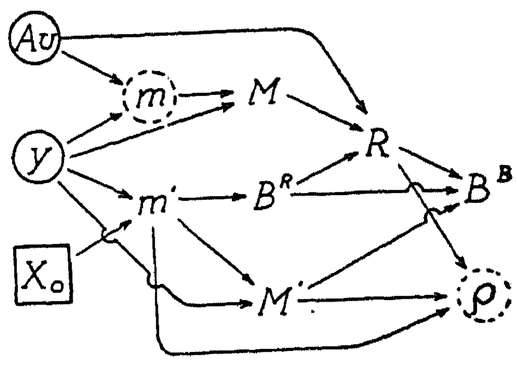
The instruments have to be two, if we wish to pursue two targets. In some important countries there are the two instruments introduced in one model, the discount rate m and the reserve ratio ϱ. In some other important countries ϱ is not a regular instrument; in most countries open market policy would be another. This instrument works largely in the same way as the reserve ratio does, in that it influences the public's or the banks' need for central bank liquidities. [1]

Since m is considered an instrument variable, and so determined deliber-

[1] Model 17 might be adapted to this instrument of policy by adding a new item to the Central Bank assets: B°, "open market holdings" by the Central Bank; this item also influences the public's demand for deposits and bank notes; hence equations (6) and (7) should have a third right-hand side item, $-\mu_3 B^0$ and $-\mu_3' B^0$, respectively.

ately in the light of its consequences, equation (4) has to be left out. It will be discussed when we consider "trial-and-error" policy.

4.243 The solution of our problem appears to be easy as far as the formal logic is concerned. Again the causal ordering is very differentiated. From (9) m will follow; from (8) m'; from (7) M', and from (6) M; from (3) B^R. Now R will follow from (1) and B^B from (2). Or in ordinary speech: the two interest rates will follow from the targets they have to fulfil; from them both the demand for bank notes and that for deposits will follow; and also the demand for rediscounts. This leaves only one item as the closing item in (our simplified version of) the Central Bank balance sheet, namely bankers balances (reserves); then, there remains one closing item in the private banks' balance sheet, namely their bills and advances. With deposits and reserves both determined, equation (5) will only lead the private banks to choose the correct private discount rate if the reserve ratio is chosen properly by the Central Bank. Graph 4.243 again illustrates, in the form of an arrow scheme, the logic of this solution.



Graph 4.243. Logical structure of problem 171. For explanation cf. graph 4.225

It might seem as if this easy solution depends on our somewhat arbitrary assumptions that m only appears in the balance of payments equation and m' only in the national income (multiplier) equation. In fact, it does not matter whether this or a slightly different model is chosen, e.g. one where both rates occur in both equations.

4.244 So much for the qualitative logic; nothing yet has been said about the *numerical values* of the unknowns. These evidently depend very much on the numerical values of the coefficients in the equations. Here the difficulties about monetary policy come in. It is probable that the coefficient η_2 is rather small, meaning that not very much influence on the level of national income can be exerted by monetary policy (unless this takes the form of credit rationing, cf. below and § 3.532). Suppose, as an extreme case, that $\eta_2 = 0$. This would mean that m' is a consequence of, rather than a factor in, economic life; according to equation (5) it will reflect changes in demand for credit, but not itself influence that demand. It also means that the *only way to influence Y is to influence autonomous national expenditure* X_0. This may be an exaggeration, but it nevertheless gives a good first approximation. It means that the level of national income can hardly be influenced by monetary policy; and that only slight deviations from equilibrium will

already require heavy changes in interest rates, with the possibility that certain boundary conditions will be violated. These we will discuss below.

4.245 There is not quite the same difficulty in relation to the *balance of payments*. The coefficient α' is not as low in an open economy: by a raising of its discount rate it may attract considerable short-term credits from abroad. Moderate discount variations will be able therefore, in the short run, to influence considerably the movements in the gold stock, as experience has shown. But this equilibrating influence is only a short-run one, as is illustrated by the occurrence, in equation (9), of the rate of change $m - m_{-1}$. If, for another time unit, another inflow of foreign capital is needed, the discount rate has to be raised again. And the influence is only superficial; it does not affect the fundamental economic variables E and Y in this equation very much. Even if it did, the difficulty, already discussed in § 4.121, would exist that the level of Y wanted for its own sake (Y^F) does not necessarily produce the balance of payments surplus we want; it produces $E - \iota Y^F$ on current account, which may be different from what we want in order to obtain Au^D.

In the light of these two difficulties it is not very important how the details of the other equations look; they determine the proportions within the monetary sphere but do not change the fundamental difficulties.

4.246 These equations will determine, however, whether certain *boundary conditions* will be reached and possibly violated. These we are now going to discuss. There are two which in more or less stringent form may play a role, both referring to a "reserve ratio": the Central Bank's and the private banks' reserve ratio. As soon as Au falls below a proportion α of notes in circulation (possibly corrected for some minor items) there will be concern about the gold stock (based or not on a legally prescribed ratio); and as soon as R would fall short of a certain proportion ϱ of deposits, there will be similar concern about the banks' reserves. The reaction to such an event will be, first, a raising of the discount rate concerned (official rate m in the former case and private rate m' in the latter). As far as the Central Bank is concerned, this reaction may be represented by a slight change in the setting of our problem. In stead of considering Au to be given we may assume that the ratio of Au to M is given: $Au = \alpha M$. For private banks the reaction just mentioned has to be represented as follows. Although in equation (5) of model 17 some reaction of this kind is already expressed, it will not be sufficiently strong to prevent M', under all circumstances, to rise above $\frac{R}{\varrho}$. If this is desired, the interest rate m' will have to be raised

to such an extent as to restrict demand to $\frac{R}{\varrho}$. This rise in m' will be found if a boundary condition for M' is assumed, namely

$$M' = \frac{R}{\varrho}$$

This equation will now replace the supply equation (5) and at the same time the problem will change its character. Equation (7) will now determine the level of national income attainable in these circumstances and equation (8) will determine the rate of discount m'.

4.247 Our present problem supplies a good example for discussing the *difference between systematic and trial-and-error policy*. The solution to our problem takes the form:

$$m = \mu_{11} Au^D + \mu_{12} Y^F + \mu_{10} \tag{4219}$$

$$\varrho = \mu_{21} Au^D + \mu_{22} Y^F + \mu_{20} \tag{4220}$$

where the coefficients $\mu_{11} \ldots \mu_{20}$ can be expressed in terms of the coefficients of model 17. If the model is exact, these values of m and ϱ are such that Au actually will assume the value Au^D and Y the value Y^F. This choice of m and ϱ we shall call *systematic policy*. For simplicity's sake we will forget about the target Y^F for a while and continue the discussion for the case of one target Au^D and one instrument m. Systematic policy will then be represented by a choice:

$$m = \mu_S Au^D$$

Trial-and-error policy has to be applied if the structure and the coefficients of the model are not exactly known. It will, in principle, consist of a succession of changes in the instrument values, as long as actual Au values do not coincide with desired values Au^D, and may take the form:

$$m - m_{-1} = \mu_S' \, (Au_{-1}{}^D - Au_{-1}) \tag{4221}$$

where suffixes —1 indicate a time lag; i.e. the discount rate will be raised as long as Au is below Au^D. Since a rise in the interest rate will attract foreign credits, it is possible that Au will rise, and if μ'_S is sufficiently large and the time units sufficiently small, the target value will be reached after some time. But there will be values of μ'_S and the time lag applied which may not necessarily always bring Au closer to its target value. In a general way it depends on the dynamics of "the system" whether there will be convergency towards a limiting value of the variables or not. "The system"

now means the system of equations of model 17, plus equation (4221). The methods of dynamic analysis, in this case of difference equations, have to be applied to find this out; and it is well known that, especially in the more complicated cases, rather unexpected movements may be the result of some seemingly "natural" reaction equation. With too high values of $\mu's$, e.g., fluctuations with ever increasing amplitudes may occur; with more than one difference equation, or more than one lag in the same equation, long swings may occur, not necessarily converging towards an equilibrium. This particularly applies to the cases where, again, more than one target and hence more than one instrument occur. An interesting illustration of the difficulties that may arise here is the question of the direction of the changes that should be brought about. Suppose we have again the two targets of problem 171, and suppose also that Au as well as Y are too low. In order to raise Y, a reduction in m has to be performed. What should the total reaction of the authorities be? Evidently here the knowledge of the formulae of systematic policy would be of great help. They tell us whether an increase in Au of a given extent, plus an increase in Y of another, given, extent requires a rise or a fall in m and a rise or fall in ϱ.

The essence of trial-and-error policy is that it introduces a dynamic feature into the system, leading to an adjusting movement of the system, which upon certain conditions (in our simplest example of one target, this condition is that $\mu's$ be below some limit) ends up with equilibrium values of the variables as desired for a systematic policy. The dynamic feature may take different forms. In stead of (4221) we might have chosen:

$$m = \mu\,(Au_{-1}{}^{D} - Au_{-1}) + \mu_0 \qquad (4221')$$

Here the conditions for convergence towards an equilibrium will be different.

4.248 So far we *did not specify* Au^D. In a number of situations it will be chosen so as to be at least the amount required by the reserve ratio to note circulation; i.e. αM. We may substitute this expression, adding perhaps an extra item for safety's sake or in order to build up an extra reserve, into equation (4219) and (4220). These would then indicate how m and ϱ should be regulated in order just to maintain the minimum gold reserve required. This same specification of Au^D would give (4221) the form

$$m - m_{-1} = \mu's\,(\alpha M - Au) \qquad (4222)$$

approaching equation (4) of model 17. It would completely cover equation (4) if we had given to the trial-and-error reaction the form (4221') and again specified Au^D to be αM.

This leads to:

$$m = \mu (\alpha M_{-1} - Au_{-1}) + \mu_0 \qquad (4223)$$

which, apart from timing, is identical to equation (4) of model (17), the equation we so far left out. Under conditions of convergency of the adjusting movement, this variant of trial-and-error policy therefore leads to the situation described by model (17), including equation (4).

Both (4221) and (4223) assume also that trial-and-error policy is in a way systematic, namely that there is a constant pattern of reaction of the monetary authorities, represented by the coefficients of these equations. Even this constancy need not be complete. There may be—and usually will be—a random component in such a reaction. Still the effect may also then be a gradual approach to Au^D.

4.249 The difference between systematic policy and trial-and-error policy should not be exaggerated. Systematic policy as here advocated will sometimes be able to reach the goal more quickly and with less waste of time and energy. But the conditions for an exact systematic policy are exact and complete knowledge of the functioning of the economy; and these conditions are not fulfilled. In addition, the continuous change of data causes the target values to move continuously also, requiring a succession of changes also with systematic policy. The difference between systematic and trial-and-error policy thus becomes less pronounced; still the chances are that even a policy that is only partly systematic will, on the average, make a better "hit" than a trial-and-error policy.

4.251 PROBLEM 181. MODEL 18.

Targets: "full" employment, balance of payments equilibrium
Instruments: increases in productivity in 2 industries
Comments: This problem has been chosen in order to illustrate as clearly as possible some of the drawbacks of international connections. Contrary to what is usually thought, isolated increases in productivity in a single country are as a rule not very appropriate for solving, in the short run, any employment or balance of payments problems. The model used is very simple in some respects but probably gives, if anything, a favourable bias, in that it assumes that cost reductions are passed on to the buyer by price reductions of the same magnitude.

4.252 The solution of the political problem appears, in this case, to run parallel with the solution of the analytical problem, and, since the latter

may help to clarify certain of the conclusions, we will take up both at the same time. The two target variables D and a depend on the v's and the α's:

$$D = (\varepsilon_1 - \bar{e}^1)\,\alpha_1 + (\varepsilon_1 - \bar{e}^2)\,\alpha_2 + \iota_1 v^1 + \iota_2 v^2$$
$$a = \bar{v}^1\,\alpha_1 + \bar{v}^2\,\alpha_2 + \bar{\alpha}_1 v^1 + \bar{\alpha}_2 v^2$$

but the v's cannot be determined without the X's:

$$v^1 = X^1 - \bar{x}^1 a_1 - \varepsilon_1 a_1$$

and similar for v^2; and so we have to use equations (1)—(3) leading to:

$$Y = \frac{A}{1 - \xi_1 (1 - \iota_1) - \xi_2 (1 - \iota_2)} \tag{4225}$$

$$X^1 = \frac{\xi_1 A}{1 - \xi_1 (1 - \iota_1) - \xi_2 (1 - \iota_2)} \tag{4226}$$

$$D = \frac{-1 + \xi_1 + \xi_2}{1 - \xi_1 (1 - \iota_1) - \xi_2 (1 - \iota_2)} A \tag{4227}$$

where

$$A = (\bar{e}^1 - \varepsilon_1 + \iota_1 \varepsilon_1 + \iota_1 \bar{x}^1)\,\alpha_1 + (\bar{e}^2 - \varepsilon_2 + \iota_2 \varepsilon_2 + \iota_2 \bar{x}^2)\,\alpha_2 \tag{4228}$$

From the preceding equations we then find:

$$v^1 = \xi_1 Y - (\bar{x}^1 + \varepsilon_1)\,\alpha_1 \tag{4229}$$

$$a^1 = \bar{\alpha}_1 v^1 + \bar{v}^1 \alpha_1 \tag{4230}$$

The discussion of the influence of α_1 and α_2 on the target variables may best be given in successive steps. The denominators of Y, X^h and D ($h = 1,2$) are evidently positive; and, almost always, ξ_1 and ξ_2 will also be positive; Y, X^1 and X^2 therefore have the same sign as A, and D has opposite sign. Since increases α_1 and α_2 must be negative in order to represent productivity increases, the sign of the contribution of each industry to A will be opposite to the sign of $\bar{e}^h - \varepsilon_h + \iota_h \varepsilon_h + \iota_h \bar{x}^h$ and this apparently depends to a large extent on ε_h. Writing η_h for the elasticity of export demand of industry h we have

$$\varepsilon_h = \bar{e}^h \eta_h \tag{4231}$$

and hence:

$$A = \Sigma^h \{\bar{e}_h (1 - \eta_h + \iota_h \eta_h) + \iota_h \bar{x}^h\}\,\alpha_h \tag{4232}$$

Since ι_h is always <1, the expression between $\{\}$ becomes negative and hence A positive for "sufficiently" large η_h's. But for $\eta_h = 1$ we have

$$A = \Sigma^h \iota_h (\bar{e}^h + \bar{x}^h)\, \alpha_h = \Sigma^h\, \iota_h\, \bar{v}^h\, \alpha_h < 0 \qquad (4233)$$

Since the various η_h need not be equal there is a range of uncertain signs in between. For $\eta_h = 2$, a realistic approximation in many cases, we have

$$A = \Sigma^h \{\bar{e}^h (-1 + 2\iota_h) + \iota_h\, \bar{x}^h\}\, \alpha_h \qquad (4233')$$

where it depends on ι_h and the ratio between $\bar{e}^h$ and $\bar{x}^h$, whether $\{\}$ is positive or negative. In the case of one single industry (our usual macro-economic approach) and a "small" country (cf. model 14, Appendix 3) we had $\bar{e} = 0.5$, $\bar{x} = 1$ and $\iota_h = 0.33$, leading to $A = \{0.5\ (-1 + 0.67) + + 0.33\}\, \alpha = 0.17\, \alpha < 0$. This is an indication for the probability that negative values of A and hence deterioration of the balance of payments may be very often a consequence of increased productivity and will only be avoided if elasticities are well above 1.

4.253 The second step in the analysis, to be based on (4229), shows us that v^h, apart from a component proportional to A, includes a component $-(\bar{x}^h + \varepsilon_h)\, \alpha_h$, which will always be positive and, furthermore, the more so the higher is ε_h. The influence of A will be the more pronounced the higher is ξ_h, for obvious reasons. In the above case of only one industry with $\xi_1 = 0.9$ and $\eta_1 = 2$, we have:

$$v^1 = \frac{0.9\, A}{1 - 0.9\ (1 - 0.33)} = -\ 1.6\, \alpha_1,$$

a clearly positive value.

4.254 The final step brings us to a with the aid of (4230) and shows that a negative component, the direct influence of the increase in labour productivity, is now added, which introduces the possibility for a to be negative. Combining the last two steps, we may express a in terms of Y:

$$a = \Sigma^h \bar{a}_h v^h + \Sigma^h \bar{v}^h \alpha_h = Y\, \Sigma^h \alpha_h \xi_h + \Sigma^h (\bar{v}^h - \bar{a}_h\, \bar{x}^h - \bar{a}_h \varepsilon_h)\, \alpha_h \qquad (4234)$$

Of this expression the second sum will have a negative sign for an important range of ε_h-values, since $\bar{v}^h = \bar{x}^h + \bar{e}^h$ and hence:

$$\bar{v}^h - \bar{a}_h \bar{x}^h - \bar{a}_h \varepsilon_h = \bar{x}^h\, (1 - \bar{a}_h) + \bar{e}^h\, (1 - a_h \eta_h).$$

Here the first term is positive, while, even for $\eta_h = 2$, the second term will usually also be positive. Remembering that even Y may, in many normal cases, be negative we deduce that over a wide range of values for the constants employment will have fallen. For the one-industry small-

country case with $\eta_h = 2$, already quoted a few times, we again find

$$a = 1.0\,\alpha$$

a clearly negative value.

4.255 This orientation may suffice to show that in many cases with realistic values of the coefficients the *effect of productivity increases on both the balance of payments and employment will be negative*. As already briefly indicated, this is largely due to the fact that the terms of trade will deteriorate; and this effect will be stronger the shorter the period considered: for longer periods the elasticity of demand for export products will be higher. In addition other adaptations will be possible.

4.256 Our formulae enable us to make more precise calculations, taking account of divergencies between the two industries as to all the characteristics considered. Evidently the contribution of each single industry will be influenced by its ε, ξ, ι, $\bar{x}$ and $\bar{e}$ and a large variety of possibilities exist. This opens up the possibility of a *"directed" increase in labour productivity*, i.e. directed towards the types of industries most suited to make positive contributions to either the balance of payments or employment. As far as the balance of payments is concerned we saw already [cf. equation (4227)] that the highest contributions will be made by the industries of which

$$\bar{e}^h \{\eta_h (1 - \iota_h) - 1\} - \iota_h \bar{x}^h$$

is as high as possible. Export volume $\bar{e}^h$ and elasticity η_h evidently are the favourable factors and import quota ι_h and home market sales volume $\bar{x}^h$ the unfavourable ones. The employment effect is more complicated. With the help of equations (4230), (4229), (4231) and equation (16) of model 18 we obtain:

$$a^h = \bar{\alpha}_h \xi_h Y - \{\bar{x}^h (\bar{\alpha}_h - 1) + \bar{e}^h (\bar{\alpha}_h \eta_h - 1)\} \alpha_h$$

where Y is due to the combined effect of the productivity increases in all industries, and the coefficient of Y as well as the whole second term on the right-hand side depend on the particular data of industry h. The reader is invited to discuss the influence exerted by the various coefficients $\bar{\alpha}_h$, ξ_h, $\bar{x}^h$, $\bar{e}^h$ and η_h on a^h.

2.261 **PROBLEM 191. MODEL 19.**

Targets: "full" employment in all H industries; balance of payments equilibrium
Instruments: the wage rate and indirect tax rates in H industries.

Comments: This problem is chosen as an illustration of a possible treatment of problems with a large number of industries. Comparison with the previous problem will show that again the political problem is much simpler than the analytical problem if employment and balance of payments equilibrium are among the targets.

4.262 The solution will not be considered with the degree of detail given with the solution of problems 161 and 162, but the reader will be able to go into the relevant questions himself. This time the sketch only of a solution will be given.
Using equations (7), (8), (10), (3) and (5) we transform equation (11) 4 into:

$$D = \sum_h \frac{\iota_h}{a_h} a^h - l \sum (\bar{e}^h - \varepsilon_h) \pi_h \tag{4235}$$

from which we can compute l and hence all p^h.

Next x^h $(h = 1 \ldots H)$ can be calculated from (12), (7) and (3):

$$x^h = \frac{a^h}{a_h} + \varepsilon_h \pi_h l \tag{4236}$$

With (8), (9) and (1) we then find Y:

$$Y = \sum_h \{x^h + \bar{x}^h p^h + (\bar{e}^h - \xi_h) p^h\} - \sum_h \frac{\iota_h}{a_h} a^h + X_0 \tag{4237}$$

Equations (2) can now be used to find the system of τ^h $(h = 1 \ldots H)$:

$$X^{Fh}(1 + \bar{\tau}^h) + \bar{X}^{Fh} \tau^h = \xi_h Y + \sum_k \xi_{hk} (p^k + \tau^k) \tag{4238}$$

Because of the presence of the "mixed" terms with ξ_{hk} the τ^h cannot now, as in problem 061 (§ 3.535) be found separately each of them, but only simultaneously.

4.271 We will now try to *summarize our findings* and to suggest some general conclusions. As stated earlier, we distinguish between the formal and the material aspects. We first discuss the *formal aspects*, i.e. the mathematical aspects that may present themselves whatever the material contents of the policy are. The relevant starting point to any problem of quantitative policy then is the set of target values, or the numerical combination of targets, e.g. 1% more employment, a surplus on current account of the balance of payments of say 1%

of national income, an investment activity of 12% of national income, etc. Such a set of targets can be attained, in principle, by the combination of instruments chosen if (i) the number is at least equal to that of the targets, and (ii) each instrument acts on the various target variables in different ratios, as we exemplified in § 3.56. The values of the instrument variables have to be found from the solution of a system of simultaneous equations, which in most cases can be approximated by linear equations. For a full discussion of the different situations that may here present themselves we refer the reader to the theory of linear equations. In this section we only want to inform the non-mathematical reader on the possibility of simplifications as well as complications and we will exemplify them by reference to the problems just discussed.

Very often verbal treatment in practice is—openly or tacitly—based on the assumption of simplifying circumstances which are not always guaranteed. It is a happy feature, however, that in a number of quite realistic models—at least for certain types of economies—simplifications are, in fact, possible and that it is due to the inversion of the analytical problem into a political problem that they come in. This is well exemplified by our problems 161/2 and 191, referring to policies with employment and the balance of payments deficit (or surplus) among the target variables and to models where employment as well as imports are linked up with the volume of production without the interference of other variables. In these cases the employment target determines the volume of production and this in turn the volume of imports; with the balance of payments target given this at once fixes the value of exports which, in the short run and as far as the economic policy of the country considered is concerned, depends only on the price level at which they are offered. In this situation the price level of export products is, therefore, uniquely determined and it only depends on the instruments chosen whether either the exchange rate or the wage rate can now be computed. If one of them is taken to be no instrument of government policy, it is only the other that has to do the job; and if none of the two is accepted the problem is just insoluble. With the volume of production and the price level determined, the national product at factor prices is also fixed, and the frame of the situation is obtained. Such situations may present themselves also

in other policy problems (our problem 171 on monetary policy being another example) and they may be a considerable help in discussing the broad lines of a situation. It should be kept in mind, however, that they are strictly limited to the precise conditions enumerated and that the chances are high that more complicated situations will arise as soon as these conditions cease to apply. If imports depend on specific internal price levels and on the composition of production, the model may become more complicated (except in the very special case of problem 191, where the individual employment figures in the various industries have been assumed to be fixed); and numerous other complications may arise. In order to avoid overlooking them the use of a mathematical model is preferred by the author, in any case.

4.272 The complications in the solution that may arise can be characterized by the phrase *"inconsistency of targets"* although mathematically this term covers a variety of forms. The *simplest form* is that they are contradictory, irrespective of the instruments proposed, which means that by themselves they already are contradictory to one or some of the structural relations. An example has been given already in section 1.4; another would be a policy aiming at a higher level of real home expenditure (x) and a higher level of exports (e) but not willing to change productivity, while there was no idle labour available; it would then be impossible to increase v, which would be necessary to attain the higher level of $x + e$, since one of the structural equations is $v = x + e$.

4.273 A *second form of inconsistency* may arise in the case where the targets relevant to one single equation could be linked up only if a certain instrument were used, and its value changed. The inconsistency may be that no change is proposed in that instrument variable. A certain level of income may be reconciled, as a target, with any value of expenditure as a second target, provided that taxes, for example, be adjusted; but this reconciliation will not be possible if no tax adjustment is proposed.

4.274 Numerous other examples may be given; nevertheless this is not the most probable form of inconsistency that is likely to arise. The more probable ones are, of course, those which are less clear

beforehand, and more hidden. Mathematically, such a situation arises if the targets are not contradictory to any one single equation of the model but to a combination, that is, to the result of the elimination of certain variables between a number of equations. Here our problem 161 yields an example. Our analysis has shown that in that problem, based on model 16, the target λ of a given ratio between the increase in labour and non-labour income will, as a rule, be contradictory to the targets of a given employment and a given balance of payments deficit (or surplus): the latter two already determine a certain ratio between labour and non-labour income and it could only be by mere coincidence that this ratio would be the desired one. The situation there appears to be that three of the four equations, from which the unknown values of the instruments have to be determined, contain only two of the unknown instruments and one contains the two remaining ones. The consequence is that the first three equations will as a rule be contradictory, whereas the fourth cannot yield us the values of both unknowns but only of a certain combination. In other words, the two latter instruments appear to be relevant to the targets in a fixed combination only, and in no other way. The two instruments meant here were indirect taxation and government spending. In the model discussed, and with the instruments proposed, indirect taxation would only affect total home expenditure, and so would government spending; and only the difference between government spending and indirect taxation revenue is therefore relevant. No matter at what level one of them were chosen, the other could always be chosen such as to let them, together, have the desired effect on the targets. On the other hand, the remaining two instruments, the wage rate and the direct tax rate, would have "to do three jobs", and this they cannot. One instrument can only "do one job" as a rule. Other examples can be given; they would, however, require a mathematical treatment which goes beyond the limits set to this book. The reader may be referred to some literature. [1]

4.275 Still another form of inconsistency manifests itself even if, mathematically speaking, the solution of the equations presents no

[1] J. Tinbergen, On the Theory of Economic Policy, Amsterdam 1952; id., Centralization and Decentralization in Economic Policy, Amsterdam 1954.

difficulties, namely if certain of the values found for the unknown instruments violate the *boundary conditions* that, for practical considerations, have to be set (cf. § 3.4). The problems just discussed contained some examples of this type of inconsistency, and other examples have already been given.

4.276 The use of more instruments of economic policy than strictly needed (i.e. dictated by the number of targets explicitly assumed) may be recommended. Not only will it be possible so to avoid some difficulties arising from boundary conditions, but also the "pressure" on the population may be more evenly distributed, that is, the temptation to evade taxes or otherwise to diverge from the behaviour required. Evidently these are other targets, implicitly assumed.

4.277 In practical discussions it is often asserted that there may be *inconsistency between short-term and long-term policies* or targets. A well-known example is the desirability, in a boom period, of raising taxes for short-run employment regulation, while it may be desirable, at the same time, to lower taxes with a view to stimulating long-term development. Similarly, for short-term considerations it may be desirable to maintain a certain industrial activity, whereas for long-term considerations it may be better to replace it by other activities. Such inconsistencies are not always real. It depends on the possibility of *sufficiently differentiating the set of instruments* chosen. If taxes are used as a general regulator of activity and, in addition, investment is treated in a special way by subsidies or tax exemptions, it may be possible to put a brake on general activity and yet, at the same time, to stimulate investment. This may be called a *reconciliation by instrument differentiation*. If, however, no such differentiation is possible, the only possibility is a "weighing of targets" or, in practical terms, a compromise. This impossibility of differentiating may be due to a lack of administrative possibilities or to a lack of imagination on the part of policy-makers. If they are not permitted, or not willing, in our first example, to introduce subsidies or tax exemptions for stimulating investment, and taxes remain the only instrument, then the advantages and disadvantages have to be valued and an optimum level has to be found, leaving both targets only partly realized. The impossibility of differentiating may, however, also be in the nature

of things. It may be, in principle, one and the same target variable which has to be subject to both long-term and short-term influences. A certain type of government expenditure may have to be falling in the long run since it covers a need which diminishes over time; but as part of an anti-cyclic policy it may have to rise during the development of a depression. In such a case it is necessary to add both components and this may yield a rise in some time periods, and a fall in others as the most desirable outcome.

4.278 A final point on the formal side of quantitative policy refers to the *relation between "systematic" and "trial-and-error" policy*, exemplified in some technical detail in problem 171. The aim of this book is to indicate methods for making policy more systematic, meaning that the values to be given to certain instrument variables are those required to reach the target at once, if possible. In the absence of the different types of knowledge needed for the execution of such a systematic policy we shall often have to follow trial and error methods. These will only lead immediately to the desired values of the target variables by coincidence. They may do so after several consecutive steps but will not always necessarily do so. If they consist of steps taken sufficiently close together and related in magnitude to the divergence still prevailing between the desired and the actual value of the target variable, then they may be successful. Even so, their success depends on the satisfaction of certain numerical conditions by the magnitudes of the steps. Clearly, therefore, systematic policy is at an advantage; this advantage is, however, somewhat reduced by the fact that the continuous changes in data necessitate, for both types of policy, a continuous revision, or that we have a bad model only.

4.281 Turning now to the *material side* of the problem, it should be made clear at once that it is impossible to make statements of general validity. The state of our knowledge about economic models is still too primitive to make this possible, and it may be that, even were our knowledge better, general statements of practical importance would be very difficult to arrive at. It can only be, therefore, in a provisional and tentative way that some of our findings are summarized here. Part of the problem has already been dealt with in §§ 3.5 and 4.1 and

we will only try to complete the findings presented there. The relevance of problem 162 to practical policy, already stressed, may be taken as an excuse for emphasising some of the conclusions derived from it. The *important role of the wage rate as a supplementary instrument in an open economy* is confirmed. An equally important instrument may be found in *indirect tax rates*, because of their immediate influence on consumer prices and hence on national expenditure. In many countries wage rates are not considered a feasible instrument of economic policy in that government intervention in wage negociations is not considered desirable; it may be questioned whether this attitude is wise in the long run. With an increasing desire to consider full employment and a constant price level as important targets of economic policy the need for these instruments will have to be recognized.

4.282 *Monetary policy*, on the contrary, looks less promising. There are important arguments to be given in favour of constant or almost constant *rates of exchange*. Once they are recognized as an instrument of current economic policy there will be a tendency to use them for everything. It seems better to have them in reserve for emergencies. *Discount policy* has a very restricted influence; its influence on general activity is very limited and its influence on the balance of payments of a small country, though more important, is only temporary. The only monetary influence of importance is *credit rationing*, which, from its nature, only works one way.

4.283 Finally, as an instrument of economic policy *productivity* has some considerable peculiarities. Although it represents, without any doubt, a vital factor in the long-term world-wide development of wellbeing, it can evidently work in a paradoxical way, in the short run, in isolated countries and accordingly should be handled with some care. From our example we showed the usefulness of "*directed productivity increases*".

4.3. Example of Sector Policy in an Open Economy: Agriculture

4.31 An example of sector policy in a closed economy was discussed in § 3.7, where the features specific to sector policy were mentioned. These will also be found in the present example. In addition it will

show some features characteristic of an open economy. Agriculture provides a good example of a sector in an open economy since most agricultural products have international markets. Foreign policies will, as a consequence, exert a considerable influence on national agriculture. An independent price policy for agricultural products will only be possible if trade impediments are accepted as one of the instruments. An important question for the design of a national agricultural policy is whether the aims of that policy coincide or do not coincide with those of international policies, if these exist, or with the combined outcome of foreign policies as far as they are relevant to the market concerned.

4.32 Our example, agriculture, is a very specific one, itself characterized by a number of features that are decisive for the policy being devised. They are:

(*a*) the existence of random fluctuations in production, that cannot be foreseen and usually create a deviation between intended and actual production;

(*b*) a low elasticity of supply: prices cannot exert a short-term influence on the volume of product available, especially of crop products;

(*c*) a low elasticity of demand: prices cannot, in the short run, exert much influence on the quantity demanded, particularly of primary food;

(*d*) a time-consuming production process: crop products often take more than half a year, some even much more, whereas meat and dairy products, as far as dependent on the numbers of livestock also require years, sometimes many years;

(*e*) the existence of seasonal fluctuations of different types;

(*f*) in many western countries agriculture is a well-organized industry, able to carry out a number of measures of regulation, either of prices or of production or trade;

(*g*) usually land is in short supply, at least in the densily populated areas; and in particular in the country taken as an example here, the Netherlands, there is the additional characteristic

(*h*) of high fertility of the soil.

4.33 As our example we not only take the situation prevailing in

Dutch agriculture but also the agricultural policies of the Netherlands government. Its aims may be said to be, loosely speaking [1]:

(1) agriculture should make a maximum contribution to national income, under the following conditions:
(2) agricultural income should at the same time be as stable as possible;
(3) it should be reasonable in comparison to the incomes earned in other industries;
(4) it should be regionally well distributed, and
(5) the seasonal pattern in labour demand should not show too wide fluctuations.

A more precise formulation will only be possible if certain of the rather loose terms have been given an exact meaning; evidently there is, in the minds of the policy-makers, a system of preference scales with regard to the degree of stability, the ratio of agricultural to other incomes, the regional distribution and the amplitude of seasonal fluctuations in labour demand, each of which have to be defined. These preferences should be given numerically if any precise and consistent policy is to be designed; in practice the relative weights are, of course, a question of feeling. They provide good examples of the target variables that may be chosen in a more elaborate economic policy.

4.34 The instruments needed in order to carry out a policy with so many aims must, of course, be numerous. Nevertheless there would seem to be quite a variety of possibilities. Historically there has been, during the period the policy was carried out, some shift in emphasis, in line with the general trend of preferences. Immediately after World War II a larger number of instruments was used than in later years and gradually a considerable extent of freedom was introduced. This was partly due to the fact that, in the beginning, a detailed intervention in consumption was also considered necessary. The instruments

[1] The terminology is loose in that the following expressions are of doubtful clarity: (*a*) the contribution to national income made by agriculture; (*b*) it should be a maximum and (*c*) agricultural income should be reasonable. Probably a better formulation of the aims would be that total real income for the country should be a maximum (account taken of the sacrifices made) and that the distribution of benefits and efforts over the various sectors should be reasonable; but, even then, much remains to be explained (cf. §§ 1.4 and 1.5).

that were used are the following: import duties or subsidies, export duties or subsidies, price subsidies to the consumer, quantitative restrictions in imports and exports, the regulation of production, periodic stock accumulation and liquidation, and rent and wage control. With liberalization of trade developing in Europe, several of these instruments have been given up, in particular, quantitative restrictions on trade and price subsidies to the consumer. Accordingly, some of the aims have had to be given up or to be interpreted more loosely. Regional distribution of agricultural income, to quote one example, may be influenced in a very precise way as long as the prices of all separate products are regulated; if only a few prices are regulated, however, only a loose influence on regional distribution can be exerted.

4.35 The use made of some of the instruments in order to attain the set aims may be illustrated by a few examples. It goes without saying that a complete and thorough discussion would require a rather more complicated mathematical treatment than it is intended to offer. The policy obviously has to be flexible, since world market conditions change rapidly; in principle the production pattern has to be adapted to the profitability of world market prices. A complete adaptation in this sense would, however, mean that absolute priority would be given to the first of the aims mentioned before; corrections will be needed in order to satisfy the other aims. The extent of these corrections must depend on the relative weight given to the other aims as well as on the influence the corrections exert on the target variables. In view of aim (5), rather less of products with very wide fluctuations in labour demand and rather more of products with small fluctuations will have to be chosen. World market prices may be considered to be abnormal because of exceptional crop conditions; either too low or too high. Accordingly it may be thought better [cf. aim (2)] not to let national prices follow world prices for this would yield either too low or too high incomes to farmers, and place consumers in either a too favourable or a too unfavourable condition; and it would perhaps induce farmers to production patterns which, in the following year, when the products become available, would no longer be considered attractive. In order to regulate internal prices, then, duties or subsidies will be needed. For products of which the country has a deficit and

so is importing, these duties or subsidies will have to be applied on the import side, while for products of which there is a surplus in the country, export duties or subsidies may be necessary.

Stabilization of farm income may also require direct regulation of production; this applies particularly to time-consuming processes, such as pork production. Here the well-known endogenous cycle, which does not serve any useful purpose, may be eliminated by such regulation.

To the extent that agricultural incomes are high in comparison to other industries with due account taken of differences in the quality of labour required [cf. aim (3)]—a fact that may be due, for example, to the high fertility of the soil—prices to consumers may be fixed at a lower level than world market prices. These again will have to be accompanied by certain regulations at the frontier. In addition there may be need for rent control, the more so if the supply of land is very restricted. On the other hand aim (3) or (4) may sometimes require price regulations in favour of farmers as well. This may be possible if incomes in certain regions depend largely on one product and there are no other possibilities of assisting the regions concerned in the short run. In the long run shifts in production will be the better solution.

4.4. Quantitative Economic Policy Where Policy-Makers are Many: (1) International Quantitative Policy

4.41 So far we have assumed that the responsibility for the design of economic policy is the concern of one single unit or at least of a group of agencies and persons acting as one unit: in brief, that there is only one "policy-maker". We will now consider cases where there are a larger number of policy-makers, that is, of centres of action in the field of economic policy. Evidently, the assumption of the existence of only one policy-maker applies approximately if one single country is considered. [1] It certainly does not apply to the international community, and even in one nation there may be, in reality, more than one centre of action. In this §, some attention will be given to international economic policy. In accordance with the subject matter of this chapter we restrict ourselves to quantitative policy.

[1] Cf., however, §§ 8.3 and 8.4.

4.42 Each of the policy-makers will handle a certain number of instruments. If there is no doubt as to the policy-maker's sovereignty in handling the instruments, the problem remains relatively simple. It becomes more complicated if certain instruments can only be handled after agreement has been reached with other policy-makers. Here the negotiating process should be considered part of the problem. We will not go into this complication.

Again, as in the case of the single policy-maker, the instruments will be handled in order to attain certain targets. An important complication, due to the larger number of policy-makers, is the uncertainty on the part of any one of them as to what the others will do with the instruments under their command. These instruments will, as a rule, also influence the target variables of the other policy-makers. Any one of them who has to decide on the numerical value to be given to his instruments has to make an assumption about the level of the other policy-makers' instrument variables. The simplest assumption he can make is that the other instruments will not be changed. In certain cases this may be erroneous, however; it is well possible that an act on the part of one policy-maker will evoke a reaction from some of the others. This is especially true for instruments in the nature of trade impediments, and in the field of currency policy.

The problems emerging from this state of affairs are more complicated, therefore, than in the case of a single policy-maker; they are comparable to the problems of duopoly or polipoly in the theory of imperfect competition. They will be illustrated by a problem of employment policy in a group of ten countries.

4.43 PROBLEM 211. MODEL 21.

Targets: for each of the ten countries, balance of payments equilibrium and full employment.
Instruments: public expenditure (represented by $x_0{}^h$) and national component in price level $p_0{}^h$.
Comments: The problem is the international analogue of problems 131 and 141, or 142, since $p_0{}^h$ may either be changed by a change in wage rates or by a change in rates of exchange, or both. It has been simplified in order to make it easily manageable: there is complete "symmetry" between the countries in that they all have the same value of the coefficients ξ, μ and ε. It would not be impossible to introduce diverging values for these

coefficients, but it would be a cumbersome process of algebra, whereas some of the fundamental features of the problem are to be found even in this simplified version.

For the solution of our problem the reader will be referred to a previous publication [1] where it is shown that:

$$dx^h = 3.7\, dx_0{}^h + 4.7\, dx_0{}^{h''} - 7.5\, (dp_0{}^h - dp_0{}^{h''}) \tag{4431}$$

$$dD^h = 0.7\, (dx_0{}^h - dx_0{}^{h''}) + 2.5\, (dp_0{}^h - dp_0{}^{h''}) \tag{4432}$$

where $x_0{}^{h''}$ and $p_0{}^{h''}$ are averages for all values of $h' \neq h$.

These formulae illustrate the fact that the target variables x^h and D^h of country h depend not only on the instruments $x_0{}^h$ and $p_0{}^h$ of the same country but also on the instruments $x_0{}^{h'}$ and $p_0{}^{h'}$ of the other countries. Evidently the values to be given to $x_0{}^h$ and $p_0{}^h$ have to depend on the values assumed to be given, by the policy-makers h', to their instruments.

We may apply the formulae to a situation of general depression in the ten countries. The targets to be set will then be an increase of x^h, say $dx^h = 1$, while maintaining balance of payments equilibrium, which we assume to exist already; hence $dD^h = 0$. If country h policy-maker assumes that the other countries will not follow the same policy, but rather be inactive, i.e. $dx_0{}^{h''} = dp_0{}^{h''} = 0$, equations (4431) and (4432) will become:

$$1 = 3.7\, dx_0{}^h - 7.5\, dp_0{}^h \tag{4433}$$

$$0 = 0.7\, dx_0{}^h + 2.5\, dp_0{}^h \tag{4434}$$

leading to $dx_0{}^h = 0.17$, $dp_0{}^h = -0.048$, i.e. an increase in national expenditure of some 2 % (since $\bar{x}^h = 8.3$) and a reduction in income scales of some 5 % (since $p_0{}^h = 1$).

If, however, country h's policy-maker assumes that the other countries will act the same way as he will, i.e. if $dx_0{}^{h''} = dx_0$ and $dp_0{}^{h''} = dp_0$, the solution becomes:

$$1 = 8.4\, dx_0{}^h \text{ or } dx_0{}^h = 0.12;\ dp_0{}^h \text{ arbitrary}$$

making it possible to attain the same targets without any change in income scales and by an increase in national expenditure of only 1.4 %.

4.44 The problem just discussed illustrates the fact that the policy-maker's decisions will vary with different assumptions about the

[1] J. Tinbergen, Centralization and Decentralization in Economic Policy, Amsterdam 1954, pp. 30–34.

attitudes of his colleagues. This uncertainty is inherent in the situation. It can be removed only by some kind of co-operation or co-ordination between the policy-makers. A more important argument for such co-operation can also be seen in our example. The solution obtained in the second version of the problem, where it is assumed that the ten countries would behave in the same way, is essentially more attractive to all concerned. The same objective of full employment and balance of payments equilibrium is obtained without reduction in income scales and with the help of less additional expenditure. This situation may again be compared with the situation in problems of polipoly. It is well known that the situation where all competitors act as if they were members of one monopolistic coalition yields higher profits than any other situation. This raises the question whether not a change in organization would be in place. This represents a problem of qualitative policy which will be considered more systematically in Chapter 5 (§ 5.6).

4.5. Quantitative Economic Policy Where Policy-Makers are Many: (2) Pressure Groups

4.51 As was observed in § 4.41, the assumption of one policy-maker only is an approximation, even for one nation. Usually, upon closer consideration, there are other centres of action which are relevant for the shaping of economic policy. On the one hand, government does not represent one single unit. In most countries there is a certain autonomy in the various ministries and examples of a certain amount of competition between them are only too well known. Even if the government acted as a unit, there are more or less important fields sometimes left to other agencies. In various countries the Central Bank has a certain autonomy, if only in the short run. On the other hand, important parameters of economic life are sometimes fixed by non-governmental organizations. Wage rates are determined, in most countries, by negotiations between employers' and workers' unions. Prices of certain monopolized products may be fixed by private groups. Sometimes such groups have their channels for influencing certain government agencies. This brings the matter back to our first example. In a general way non-governmental centres of action relevant to the

design of economic policy may be called pressure groups. The picture of the mechanism of economic policy derived from recognition of the existence of pressure groups is again one of imperfect competition, or, more generally and in more modern terms, one of a game between various persons. As in the theory of games, the number of possible situations, each of them to be described by the rules of the game, is very large; and many more data would have to be available for a practical application of any such theory. In this study we can only illustrate, and by no means try to treat systematically, the type of problems which emerge. We will do so in a very simple example.

4.52 The example has been treated in full elsewhere.[1] Let it be assumed that both workers and employers are organized, each in a monopolistic union. The workers' union dictates wage rates, with a view to maximizing the real wage bill of all workers taken together. The employers' union dictates prices, with a view to maximizing total real profits. Together they include all citizens of the economy, which is supposed to be an open economy of the type described in models 12–14 (cf. Appendix 3). Both unions are aware of the fact that higher prices mean a smaller volume of exports; in addition, the workers' union is also aware of the influence wage rates exert on prices.

With these assumptions it is possible to compute the wage and price level as well as the resulting levels of production, employment and both types of incomes that will result from the two pressure groups' policies. It appears that wage rates would be pushed up by 44% of the level they had in the situation actually observed in 1949 in the Netherlands (for which the data were estimated); prices would be raised by 29%; leading to a volume of production of 73% and to real profits of 70% and total real wages of 90%.

If, on the other hand[2] the two unions had co-operated and acted as a single monopolist, the level of prices would have been 90 %, and total real income 102% of the figures of 1949. It would have depended on the nature of the agreement how this income was distributed.

4.53 The example exaggerates, of course, the influence of pressure

[1] J. Tinbergen, Centralization and Decentralization in Economic Policy, Amsterdam 1954, pp. 25–28 and 41.

[2] Loc. cit. p. 65.

groups because of the oversimplification it implies. It seems to illustrate tendencies, however, and it should not be overlooked that it is based on coefficients that are not contradicted by observation. The example suggests that these "states within the state", as one might call pressure groups, may behave in a way which is distinctly counter to the general interest. As in the case of international policy, the conclusion should be that forms of co-operation and co-ordination are needed in order to avoid these adverse tendencies, as well as to eliminate the uncertainties in economic policy arising from the existence of more than one centre of action. The conclusions to be reached in § 5.6 may also apply to the problems created by the existence of pressure groups.