CHAPTER 3

QUANTITATIVE POLICY: REGULATING THE POSITION WITHIN A GIVEN STRUCTURE; I—CLOSED ECONOMY

3.1. Nature of Problem; Practical Approach so far Mostly Used

3.11 According to our terminology quantitative policy leaves the structure and the foundations (i.e. the organization of the economy) unchanged. It consists mainly in the current adaptation of the economy to the continuous changes in data that threaten to upset its equilibrium. Changes in the world market, caused by crop changes or changes in policies of other countries, changes in techniques applied or in the age structure of the stock of capital goods, and numerous incidental deviations in human decisions, are continuously interfering with the economy and make it dance up and down; sometimes, in the past, with long swings. Irrespective of whether the structure and the foundations are considered satisfactory or not, the economy has to be kept at a certain level of activity and certain other aspects have to be taken care of. Prices are to be kept from moving too violently, and perhaps certain internal ratios (say between farm income and total income) are to be kept from changing suddenly. All this requires adjustment: can it be carried out by adequate changes in some of the instruments of economic policy?

3.12 This type of policy therefore lays less emphasis on certain of the long-term aims which are taken care of by infrequent or slow changes in the more qualitative means of policy. The most important practical aspects of short-term quantitative policy will first be considered, each in isolation. The present chapter, for example, deals with problems of closed economies, whereas chapter 4 deals with the problems of open countries. To begin with, the adjustments in employment and monetary equilibrium will be considered. For open

economies the adjustment of the balance of payments will then be added. There are also, however, elements in quantitative policy that are more of a long-term character; these will be dealt with in section 3.6. There are, in addition, problems of particular sectors of the economy that deserve separate attention and require separate instruments of a less general character. These will be exemplified in §§ 3.7 and 4.3. Real policy will have to be a synthesis and, finally, something about this synthesis will be said in chapter 4.

3.13 Quantitative economic policy, and short-term policy especially, often takes the form of a *trial and error* adjustment. If disturbances of equilibrium occur, more or less arbitrary changes in some of the instruments are made and, if after some time they appear to have been insufficient, something more is done. Or, if the first change overshoots the mark, a change is made back in the opposite direction. The justification for this method is generally considered to be our lack of knowledge about the reactions of the economy. Though our knowledge is certainly defective it has gradually improved and a more systematic policy is now possible.

There is, in addition, a tendency to an *incoherent* treatment. Measures regarding various instruments are taken separately, often at different moments and without much co-ordination. This tendency is to some extent based on the belief that there is a one-to-one correspondence between targets and instruments, that is, that each instrument has to serve one special target. Taxes and government expenditure are thought to be relevant to financial equilibrium, wage rates to employment, exchange rates to the balance of payments and so on. The interdependence is neglected or underestimated.

The choice between alternative instruments is also sometimes made on *qualitative* rather than quantitative arguments, which, again, was understandable at a time when little was known about the quantitative reactions of the economy.

3.14 It would seem that a better approach has now become possible. It is no longer necessary to neglect the interrelations, and a simultaneous consideration of all targets and instruments, as well as their quantitative relations, should be considered.

For heuristic reasons it is to be recommended, however, that a start

be made with relatively simple situations and that complications be introduced gradually. For this reason we shall start our examples (§ 3.5 and following) with single-target problems and introduce more targets and instruments only gradually. The logic of the treatment will first be given, however, in its general form, in §§ 3.2 to 3.4 inclusive. This may be said to represent the formal aspect, the material aspect being discussed in the examples.

3.2. The Logic of Quantitative Economic Policy

3.21 The logical structure of problems of quantitative economic policy differs, first of all, as between problems with fixed targets and those with flexible targets. For problems with a given number of targets, the problem varies according to the number of instruments. Finally, the logical structure will be changed if boundary conditions are imposed (cf. § 1.5). Logically the simplest situation prevails if targets are fixed and instruments are available in a number equal to the number of targets, while no boundary conditions are interposed. The policy-maker cannot, however, choose all the aspects himself.

3.22 The basis for every design has to be the *initial situation* of the economy considered, either as it is known from the most recent statistics or, if that would mean too remote a picture, as taken from a forecast. Since the execution of measures of economic policy will itself also require some time, it is to be preferred to start with a forecast, i.e. an estimate of what the situation will be in, say, the following year, under the assumption of an unchanged economic policy. A forecast will itself have to be based on the most recent statistics and will then have to answer two questions:

(*a*) what changes will probably occur in the "other data", the data that are not instruments;

(*b*) what will the most probable influence of these changes in data on the economic variables be? [1]

The answer to the first question will usually be based on expert estimates about these changes; examples of the type of data involved

[1] For a numerical treatment of these questions in a practical case (the economy of the Netherlands) cf. Central Economic Plan 1955, published by the Netherlands Central Planning Bureau, The Hague 1955.

are prices at the world market, changes in population, in productivity, in crops, etc. Some of these estimates might be, in principle, based on studies of foreign economies.

The answer to the second question has to be given by the substitution of the changes in data in the equations of the economic model for the economy concerned. In fact, these contain the data as given quantities and the economic variables as unknowns that can be solved. The solutions are of course only approximations [1]. Sometimes there may be a priori reasons to amend these solutions in the light of qualitative information.

3.23 The criteria for economic policy are now to be derived from a possible *divergency between the "actual" situation* as revealed by either the statistics or the prognosis *and* what is considered *the most desirable situation*. The deviations between these two—dependent on the nature and number of targets the policy-maker chooses to set himself—represent the given changes that have to be brought about in the target variables. The simplest situation is presented when the policy-maker has certain fixed targets in his mind. Let these be a degree of unemployment equal to 97% of the working force and balance of payments equilibrium, and let the forecast yield an employment of 95% and a balance of payments deficit of $0.5 milliards. Then the aim of the policy being sought is to increase employment by 2% and to reduce the balance of payments deficit by $0.5 milliards. The situation is less simple if the targets are, for example, balance of payments equilibrium and the highest possible volume of employment: here we have a flexible target. The situation is also more complicated if, apart from the targets set, certain boundary conditions are imposed on certain of the instruments to be used.

3.24 Setting the targets of the policy is only one side; in addition the *instruments* have to be indicated. As we discussed already (cf. § 1.5) there are a good deal of pre-conceived ideas about what instruments should be used; and in the short run the choice will often be determined by general political forces. If so, the problem is clearly defined. The

[1] For an appraisal of the forecasts made by the Netherlands Central Planning Bureau cf. Een vergelijking van de ramingen van het Centraal Planbureau met de feitelijke economische ontwikkeling 1949–1953, The Hague 1955.

more satisfactory attitude is, however, that the choice be itself also made part of the problem. And this choice should then be made on the basis of what was called the *efficiency* of the instruments (cf. also § 1.5). This requires a study of a number of alternative solutions to be discussed in § 3.3, and examples will be given in the § 3.5 and ff. The most complete investigation of efficiency should also reckon with the influence of the instruments on the social welfare function. In practice, however, it will often be on incomplete information, only, that decisions have to be taken. Examples of the type of considerations that may be decisive here will also be given in § 3.5.

3.25 The solution of the problems thus defined will depend on the model of the economy used in the analysis. It goes without saying that the more realistic the model is, the more accurate will be the results. The difficulty facing the adviser on economic policy is, however, that the model, apart from being realistic, should also be "manageable". First of all, it must be possible, with its aid, to make the calculations needed to find the values to be given to the instrument variables. Limitations here are rapidly diminishing with the development of calculation machines. There are, however, also other aspects of manageability. The data and variables appearing in the model should be available in quantitative form. This is not always the case if such concepts as "expectations" are coming in. Also here, to be sure, observation is rapidly increasing in volume and quality. Another important practical aspect of the manageability of models concerns their appeal to the policy-maker or -makers: they must be understandable. Here the most serious limitations are sometimes to be found. Again the situation is not fixed once and for all. The knowledge of policy-makers about economic matters is, on the whole, increasing. Furthermore, their confidence in economists may increase, permitting them to accept certain results of more refined technical analysis.

3.26 The problems described are of a stochastic nature, that is, the data, and hence the unknowns, of the problems are not exact figures, but figures subject to errors. As a consequence, a complete treatment requires the cooperation of mathematical statisticians. They can, in specified cases, indicate the probability distribution of the answers found or at least make certain statements about such distribution.

In particular they are able to find out, whether, in specific cases, the answers obtained by neglecting the stochastic element are or are not biased [1]. Since this book is meant to emphasize the economic aspect of the problems considered, the stochastic element has been left out. The reader should be warned, however, that this is not always admissable.

3.3. Provisional solution; efficiency of instruments

3.31 The optimum values of the instrument values, the unknowns in the problem of quantitative policy, have to be estimated with the help of the model used [2].

(*a*) *Fixed targets, number of instruments equal to number of targets; no boundary conditions violated.* The simplest case indicated in the previous section, one where targets are fixed and the number of instruments equals the number of targets, and where no boundary conditions are violated, presents a problem with as many unknowns as there are equations. The logical situation may be described more precisely with the aid of some symbols, indicating by:

x^i economic variables that are not targets (irrelevant variables);
y^j target variables;
z^k instrument variables, i.e. data controlled by the policy-maker; and
u^l data, not controlled by the policy-maker.

The number of each of these four categories, of which the first two represent the economic variables and the other two the data of economic analysis, will be indicated by the capital letter corresponding to the index used for each; so there are I irrelevant variables, J targets, K instruments and L data. In addition there will be a number of N equations describing the "structural relations" in the model:

[1] Professor H. Theil, "Econometric Models and Welfare Maximisation," Weltwirtschaftliches Archiv 72 (1954) p. 60 has proved that no bias occurs "if the covariance matrix of the deviations (of target variables) is independent of the instruments and if the welfare function of the policy-maker is quadratic in the indirect (target) variables, the coefficients of the quadratic terms being independent of the instruments".

[2] Instrument variables which are identical with target variables will not, of course, be unknowns.

$$\varphi_n (x^i, y^j, z^k, u^l) = 0 \quad n = 1,2 \ldots\ldots N$$

If the model is a consistent one, the number of equations will be equal to the number of economic variables, i.e. $I + J = N$; otherwise the model would not be able to "explain" the economic variables with the aid of the data. The problem of economic policy in this simplest case consists of finding the values of the instrument variables z^k; in addition the x^i are unknown, but the y^j are now given. The unknowns are now $I + K$ in number; since the number of instruments is assumed to be equal to the number of targets, $K = J$ and hence the number of unknowns equals that of the equations. The problem is soluble except in special cases. If the equations are linear, there will, as a rule, also be only one solution: it is unique. However, if by some coincidence the equations became dependent, the number of solutions would be infinite, or, if the equations became incompatible, the solution would be non-existent [1]. The interesting thing is that this may also occur if the original set of equations, with the economic variables as unknowns, is not dependent or incompatible in these variables; it only depends on the numerical values given to the targets and on the coefficients with which the new unknowns, i.e. the instruments, appear [2].

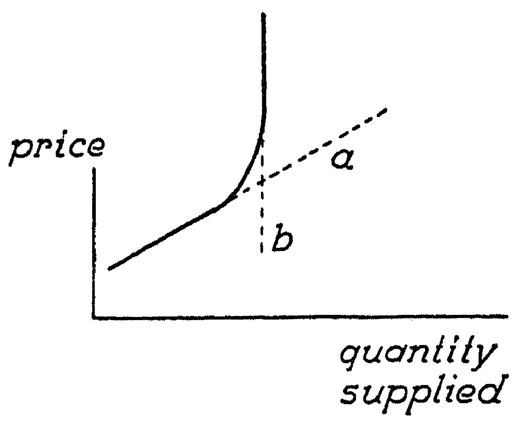
Linear equations are, of course, only an approximation to reality and do not represent the most general case. With non-linear equations a large number of different logical situations may present themselves. There may be more than one solution; there may be no solution. A general treatment is hardly possible.

With sufficiently complicated non-linear equations all phenomena of saturation, bottlenecks, etc., will be accounted for by the equations already and no boundary conditions will have to be added. Boundary conditions are needed only as corrections on too simple linear equations. The simplest well-known example is that of a supply curve of the shape indicated by fig. 3.31. This may be replaced by two straight lines

[1] An interesting case will be found in P. C. Mahalanobis: "Planning in India", Sankhya 1956, where four instruments λ_1, λ_2, λ_3 and λ_4 are considered, which have to satisfy the equation $\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 = 1$ in which no other variables occur. Evidently three only out of these four instruments can be chosen freely; three targets only can therefore be set.

[2] For an example the reader may be referred to J. Tinbergen, On the Theory of Economic Policy, Amsterdam 1952, p. 46.

(dotted) a and b. Using such linear function instead of the curve will simplify the mathematics of the solution of some economic problem in which the supply curve plays a role. If, however, a solution is found outside the range of a which coincides with part of the supply curve, this solution is of no value. A new attempt will then have to be made with b instead of a. Here then the boundary condition b comes in, as a consequence of the use of the linear approximation a. It will be clear that one might also have started with b as the approximation and then have added a as a boundary condition.



Graph 3.31. A curvilinear function (in this example a supply function) may be approximated by a linear function (a) and a boundary condition (b).

The use of linear equations, apart from being simple and being sometimes the only possible way of arriving at a solution, has an economic justification for most problems where small variations, only, are studied. For small variations, as is well known, curvilinear functions may often be replaced by their tangents. This makes linear equations suitable for cases in which only small variations are considered.

3.32 (*b*) *Fixed targets; number of instruments unequal to number of targets*. In these cases the necessary condition for a unique solution is not fulfilled. If the number of instruments is smaller than the number of targets, the number of unknowns in the political problem will be smaller than the number of equations they have to satisfy, and this will, as a rule, be impossible. A solution will only be possible by pure coincidence, i.e. for certain "happy" combinations of targets. In this case we will therefore say that the targets are *inconsistent* with the set of instruments chosen. Examples will be given in § 3.5.

If, on the other hand, the number of instruments surpasses the number of targets, there will be more unknowns than equations and, as a rule, an infinite number of solutions will be possible. This means that one or more of the instruments may be chosen arbitrarily, and the others will then follow. The number of instruments that can be chosen arbitrarily equals the difference between the number of instru-

ments and that of targets: it will also be called the number of the degrees of freedom.

3.33 (*c*) *Flexible targets*. In this case the nature of the problem changes completely: it becomes a "maximum problem with side conditions", i.e. a certain function, the social welfare function, has to be made a maximum. This function depends on the variables y^j and possibly also on the instrument values z^k; thus: $\omega(y^j, z^k)$max.

Between the y^j and the z^k there are now a certain number of relations, namely, the relations that remain after the elimination of the irrelevant variables x^i from the structural equations. There will be $N - I$ such relations, which we will call the "*simplified relations*"; they may be symbolized by:

$$\varphi'_m\,(y^j, z^k, u^l) = 0 \quad \text{(side conditions)}$$

As a rule a maximum problem with side conditions will have a unique solution, irrespective of the number of side conditions.

Often the instrument variables cannot assume all values that are mathematically conceivable. Yet it may happen that the maximum value for welfare ω will correspond to such an impossible value of one of the instruments. We will then have to be satisfied with a lower value of ω, namely the highest within the possible region. This 'next best' will be determined by the boundary condition, or, if there are more than one, by one of these conditions. Often methods of trial and error will be the only ones available to find the solution. We will not here go into these complications and only quote a very simple example to illustrate the role of a boundary condition.

Suppose a wage level lower than the existing one can be shown to make welfare a maximum, but that trade unions do not accept any reduction in wages. This represents a boundary condition, putting a limit to the wage level. The maximum attainable under these conditions will evidently be reached at that limit.

In each of the cases dealt with, the solution, or solutions, if any, will also depend on the data. That is, the values the data u^l assume will also influence the optimum values of the instrument variables. If one is particularly interested in the influence exerted on these optimum values by a change in data, the solutions may be expressed "in terms of" these data, i.e. in the form of equations expressing the

optimum values of the instrument values as functions of the data values. Such eqùations, since they contain directives as how the policy-maker should react on changes in data will be called "*directives*". Examples will be found in §§ 4.151–4.156.

3.34 We will now discuss the concept of *efficiency* in economic policy. The approach will be made in two stages. We will call the efficiency coefficient of a certain instrument with respect to a certain target variable the ratio between the change obtained in the target variable and the change needed in the instrument variable. In a general way, the change in target variable may be indicated by Δy and that in instrument variable Δz; the efficiency coefficient will then be $\frac{\Delta y}{\Delta z}$. Its value evidently depends on the units in which the target and instrument variable are expressed. If an increase in employment is measured in million man-years and government expenditure in milliards of dollars and, if one million man-years can be obtained by an extra expenditure of 3 milliards of dollars, then the efficiency will be $\frac{1}{3}$.

The value of the coefficient also depends on the policy-problem considered, in particular on the hypotheses made as to the other target and instrument variables. It may be assumed, for example, that all other target variables are left unchanged, but it may also be supposed that all other instruments are unchanged. In the latter case the coefficient may be represented mathematically by $\frac{\partial y}{\partial z}$; for this symbol assumes (i) that the y's are functions of the z's (i.e. the "analytical problem" is set) and (ii) that all the other z's are kept constant. In the case where all other target variables are assumed constant, the simplest representation is $\frac{1}{\frac{\partial z}{\partial y}}$; this symbol assumes (i) that the z's are functions of the y's (the political problem) and (ii) that all the other y's are constant. In order, nevertheless, to obtain an expression with Δy in the numerator and Δz in the nominator, we have then to invert the partial differential coefficient $\frac{\partial z}{\partial y}$.

The two measures for the efficiency coefficient thus obtained—and others would be possible, leaving some of the other instruments and

some of the other target variables unchanged—need not be equal and usually will not be equal either. For example, it will take more dollars to increase employment by one million if the balance of payments is not kept in equilibrium and part of the expenditure therefore "leaks away" than if that balance is kept in equilibrium by simultaneous wage reduction.

Efficiency coefficients as defined are not comparable between different instrument variables. The knowledge, for example, that an increase of one million man-years can either be obtained by spending 3 milliard dollars or by devaluing the currency by 5% does not enable us to make a comparison. The two alternative changes in instrument variables have to be brought on the same denominator, i.e. they have to be valued. It goes without saying that the most natural valuation is the one to be taken from the policy-maker's welfare function. If 5% devaluation is believed to be twice as burdensome as the spending of $3 milliard, then evidently the efficiency of devaluation is half that of public spending.

The comparison between the efficiencies of two instruments therefore requires (i) the solution of two alternative problems of economic policy and (ii) the valuation of the changes in instrument variables needed.

3.35 The comparison may be brought still one stage further: results obtained for different target variables may also be compared. This is, again, only possible if the relative valuation of the changes obtained is made; as before, it can best be made on the basis of the welfare function. Suppose 1 million man-year employment is valued as high as 10 milliard additional national income; then, if with the same sacrifice in instrument variables either 1 million man-years employment or 2 milliard additional national income (with constant employment) can be obtained, the first policy is 5 times as efficient as the second. This latter comparison has no other significance than the measurement of the increase in "gross welfare" to be obtained with the same sacrifice in „cost", and the most appropriate definition might be derived from a comparison of the "net increases" in welfare obtained by two different policies.

3.4 Appraisal and Amendment of the Solution

3.41 The solution found as a result of the first stage described in the preceding section will not always turn out to be acceptable. The changes required in some or all of the instruments may appear to be too large, for some reason. There are in fact, as has already been observed, certain limits (or *boundary conditions*) to be set to some of the instruments. This may be so for physical reasons: if government building activity were an instrument, this activity cannot surpass the production capacity present in the relevant industries. It may also be so for psychological, and hence political, reasons: tax increases will be subject to certain maxima of this nature. These maxima are, to be sure, less clearly defined and one policy-maker or commentator may assume lower limits than the other. But there are limits, vague though they may be, of this kind. Wage decreases are another example. In this case it may even be maintained that the boundary is the figure zero, no wage decreases at all being, in present conditions, acceptable. This statement seems to be too general; it depends on the circumstances in which the economy finds itself, and on the changes in other instruments considered, whether the trade unions will be willing to accept reductions. It will depend, for example, on the composition of the government, on the influence given to unions in the general design of economic policy, and on the sacrifices required from other groups of the population, whether they are able to accept.

3.42 However this may be, the existence of boundary conditions makes it impossible to accept the solution sometimes found by the procedures described so far. In fact, this means that there is no solution to the political problem as set originally, including the boundary conditions. The same conclusion will have to be drawn if the value of the unknowns are found to be infinite or even, in certain cases, negative; in fact, these results are special cases of the same inacceptability.

If there is no solution, then evidently the problem itself will have to be changed. Some of the targets will have to be dropped, or changed numerically. These should be selected from the "less urgent" targets which we may bring together in a class to be called *conditional* targets, in contradistinction to the other *unconditional* targets to which we

want to stick. This is evidently a question of practical judgment and only partly accessible to economic analysis. By dropping one or more conditional targets we obtain a new problem which we may then try to solve; it may again appear that some boundary conditions are violated. The search for another setting of the problem will then have to continue.

3.43 The procedure indicated may be illustrated by referring to an example treated elsewhere. [1] The example is a problem in which two unconditional, and two conditional, targets are set, the former being a certain requirement concerning the balance of payments and the volume of goods available for use in the country, the latter being full employment and a certain level of real wage rate. Since four targets are set, also four instruments have to be chosen; they are the nominal wage rate, labour productivity, the profit margin and the indirect tax rate. The choice of the targets as well as the instruments was based on the situation the Netherlands had to face in 1950 and the instruments then available: wages were, as well as a number of prices (and hence profit margins) under government control and there was a drive for the improvement of labour productivity, symbolized even by the presence in the Cabinet of a minister for productivity furtherance. In the situation of that year and as far as the model used was a true representation of the Dutch economy, the calculations showed that the targets set would require a wage decrease of 5%, a decrease in profit margins of some 13%, an increase in labour productivity of 4% and an increase in indirect taxes equal to 2% of prices. Both the wage decrease and the profit reduction seemed to be beyond the boundary conditions. A long list of alternative choices of targets was then studied. Accepting a boundary condition of no reduction in the nominal wage rate meant the necessity of still heavier reductions in profit margins and a heavier increase in indirect taxes; accepting a boundary condition of no profit margin reduction implied impossible requirements as to labour: either a reduction in real wages of 13% or a reduction of employment by the same percentage, both accompanied by increases in labour productivity. The only alternatives likely to be acceptable

[1] Cf. J. Tinbergen, On the Theory of Economic Policy, Amsterdam 1952, p. 45 ff.

were those in which no prior boundary conditions on either wage rates or profit margins were introduced, but a certain fixed relation was introduced between the sacrifices to be made by either group.

3.44 The situation will be simpler in all those cases where certain degrees of freedom are available; i.e. where the number of instruments surpasses that of the targets. To be sure, no number of instruments can ever help to violate fundamental conditions, such as the rule that a country cannot consume more than the total of its own production, its stocks and the foreign aid available. But with less ambitious programs there are sometimes degrees of freedom. An increase in indirect taxation necessary to reduce consumption to an accepted degree may still be obtained by increasing either one or another, or several other, individual tax rates. Here the choice may finally be made by a closer analysis of the influence of these alternative instruments on social welfare. The consequences for the volume of production of various separate industries may be taken into consideration; or the influence on public health, leading perhaps to increases in taxation on stimulants; or certain simplifications in the administration of taxes; or, finally, certain international agreements may be involved, as is the case of the Benelux countries, which have pledged the unification of indirect taxes.

3.5. Methods to Regulate Employment and Monetary Equilibrium

3.51 We are now going to apply the general methods set out in sections 3.1 to 3.4 to a number of practical situations and problems. As our first series of applications we choose the short-term adaptations needed to meet the continuous changes in the more variable of the data. These changes threaten to throw the economy out of equilibrium —either to create a certain amount of unemployment or to create inflationary situations—and it is the current task of any government so see to it that such deviations do not become too large. As we already stated (cf. § 2.2) the selfadjusting forces in this respect are none too reliable.

The two important targets of short-term quantitative policy involved will first have to be defined somewhat more precisely. The target of

employment policy is often described as *full employment*, and also as *high and stable employment*. In the practice of economic policy the latter is often taken to be equivalent to an employment level that never falls below 97% of employable persons; but there are deviations to either side. Full employment is taken by some to be identical with high and stable employment; but others think of lower percentages of unemployment than 3. Among difficulties of unemployment rates below about 0.5% has been found to be [1] an increased turnover in the labour force, depressing efficiency. In countries, or regions, or occupations, with a high seasonal employment amplitude, an annual average of 3% will sometimes be more difficult to attain than in countries with less seasonal employment; in countries with a one-sided industrial structure it will be also more difficult to keep employment within small limits than in countries with a manysided structure. In this text we will consider the 3% level of unemployment as the "danger point", i.e. the point at which action will have to be taken if it tends to be exceeded. This is, admittedly, a rather arbitrary choice.

The concept of *monetary equilibrium* has also been defined in different ways. [2] The more sophisticated definitions are based on a comparison between an economy with and one without money; it is assumed that the latter will not show certain disturbances that are observed in the former; and monetary equilibrium is taken to mean that these disturbances are avoided. More specifically, it means that prices "only reflect changes on the commodity side of the market, and not changes in money supply", or, in other words, that the active circulation of money does not change. Our choice will be different. The thing to be avoided because it does harm to the economy is, we think, a violent movement in prices. Such violent movements lead to undesirable effects such as "unstable speculation" [3] and other disturbances. Slow movements in prices do not have these effects; from this point of view a slow upward as well as a slow downward movement are just

[1] Cf. B. Ohlin, The Problem of Employment Stabilization, New York 1949, p. 14.

[2] Professor F. de Roos, "Condities voor monetair evenwicht", De Economist, 102 (1954), p. 321 even advocates a definition consisting of two conditions.

[3] For a discussion of different types of speculation, cf. H. Rijken van Olst, Prijsstabiliteit en Speculatie, Rotterdam 1948.

as acceptable as no movement at all. On the other hand, abrupt movements, even if due to "the commodity side of the market" are undesirable. The dividing line therefore should not necessarily be between the "commodity side" and the "money side", but between what is, from the standpoint of general aims of economic policy undesirable and desirable. Among the general aims there should be, apart from the aspect, already mentioned, of avoiding certain disturbances, the protection of savings, which may require constant prices; and the technical verification of the aim should be simple. Finally, there should be similarity of definition for closed and open economies. [1] For all these reasons we define monetary equilibrium as the *realization of the most desirable price level* and for a closed economy we interpret this as a *constant price level.* Accordingly we shall speak of "*inflation*" if prices rise more than is considered desirable and of "*deflation*" if they fall more or rise less than is thought preferable.

As already announced, we will study the policy problems involved by considering a succession of well-defined, simplified problems which the reader will find listed again in Appendix 2. The models used will be indicated with their numbers and are to be found in Appendix 3.

A summary of our findings, also meant for those among the readers who do not like algebra, will be given at the and of this section.

3.521: PROBLEM 011. MODEL 01.

Target: high and stable ("full") employment
Instrument: public expenditure
Comment: it is assumed that there is a stable relation between national income Y and employment and that, therefore, the target can be expressed in terms of Y; i.e. that a certain value Y, namely Y^F, is the target. We have to do with a fixed-target quantitative-policy problem with one target and one instrument. In the equations (1) and (2) of the model we now substitute this desired value Y^F for Y; and we eliminate the variable X which, according to our terminology, since it is not a target, represents an irrelevant variable. We retain

$$Y^F = X_0 + \xi_1 Y^F \tag{3501}$$

[1] This aspect was rightly emphasized by professor H. J. Witteveen. Cf. H. C. Bos, A Discussion on Methods of Monetary Analysis and Norms for Monetary Policy, Rotterdam 1956.

in which only the target variable and the instrument variable X_0 appear. Solving for the unknown value X_0 we find:

$$X_0 = (1 - \xi_1)\ Y^F \tag{3502}$$

It follows that, in order *to attain a certain value* Y^F *a much smaller value of* X_0 *is sufficient:* as a rule, $1 - \xi_1$ is only a small fraction.

The formula obtained is of course the inverse of Keynes' well-known *"multiplier" formula:*

$$Y^F = \frac{1}{1 - \xi_1} X_0 \tag{3503}$$

meant to be used for similar purposes.

A well-known difficulty arises with the interpretation of these formulae for the case where the marginal propensity to spend ξ_1 is equal to 1. The equations of model 01 then become either contradictory or dependent: they are contradictory if $X_0 \neq 0$, for then they run:

$$Y = X \text{ and } X = X_0 + Y$$

and they become dependent if $X_0 = 0$. When trying to interpret the equations one should, then, not forget that they are meant to determine the situation of lasting equilibrium; i.e. a situation of unchanged values of X and Y that can persist. The conclusion has to be reached that such an equilibrium does not, under these circumstances, exist. It should not be that the movements of the economy themselves are indeterminate. These movements have to be represented by a set of dynamic equations, dependent on the dynamic features of the economy. One very simple possibility is that expenditure depends on income one time unit before, or in symbols:

$$X_t = X_{0t} + \xi_1\ Y_{t-1} \tag{2'}$$

and now it is easily found that, for $\xi_1 = 1$,

$$Y_t = X_t = X_{0t} + Y_{t-1}$$

that, therefore Y_t is rising every time unit by an amount equal to X_{0t} for that time unit. The movements of Y_t are thus perfectly determinate. They might have been different if another dynamic behaviour would have been assumed, however.

3.522 PROBLEM 021. MODEL 02.

Target: high and stable employment
Instrument: public expenditure
Comment: Since we are now making a distinction between money flows

and the product flow and since the latter is more relevant to employment, we will now express our target in terms of x and indicate it by x^F. Again we have a fixed-target quantitative-policy problem with one target and one instrument. We again eliminate all the irrelevant variables (now being, Y, X and p). From model equation (2) we get, with (4) and (1):

$$x^F p = x_0 p + \xi_1 x^F p \tag{3504}$$

We should now consider $x_0 p = X_0$ as the instrument; the other terms with p are expressed with model equation (3) in terms of x (and hence x^F):

$$x^F (1 - \xi_1) (p_0 + \pi x^F) = X_0 \tag{3505}$$

This formula at once expresses X_0, the value of the instrument, in terms of x^F, the target. It appears that no longer the simple relationship found in (3502) is valid, but that with increasing x^F it becomes more difficult to attain the target. One may also express the situation in this way: part of the X_0 is needed to pay for the higher price level that will occur as a necessary corrolary of higher production. In Keynes' language: *the multiplier becomes less large* if prices are, as is usual in a closed economy, also dependent on the volume of production.[1]

3.523: PROBLEMS 031/2. MODEL 03.

Target: high and stable employment
Instrument: public expenditure (problem 031) or wage rate (problem 032)
Comment: As an alternative to the two previous problems—to be considered once more for this somewhat more complicated model in problem 031—we are now also considering the possibility of influencing employment with the help of wage rates. As is well known this was the usual pre-Keynesian method recommended for the cure of unemployment. Again we have fixed-target quantitative-policy problems with one target and one instrument.

Our target will now be a certain value of a, to be called a^F. The instrument is X_0 (problem 031) or l (problem 032). The other variables are irrelevant, i.e. Y, X, L, p and x. The first problem means that we are repeating the treatment of problems 011 and 021 with this, more complicated, model. Y and L are first eliminated:

$$X = \xi_1 X + \xi_2 l\, a^F + X_0 \tag{3506}$$

[1] Evidently the situation will be different when, in stead of money expenditure X_o, the corresponding volume x_0 of government spending is assumed to be the instrument. The reader may be invited to deal with this problem.

Elimination of X brings in x and p, which in turn can be eliminated with the help of model equations (4) and (5):

$$x = \frac{a^F - a_0}{\alpha} \qquad p = p_0 + \pi_1 l + \pi_2 \frac{a^F - a_0}{\alpha}$$

Hence:

$$(1 - \xi_1) \frac{a^F - a_0}{\alpha} \left(p_0 + \pi_1 l + \pi_2 \frac{a^F - a_0}{\alpha} \right) = \xi_2 \, l \, a^F + X_0 \quad (3507)$$

Rearranged, this equation may express l or X_0 as a function of a^F:

$$- X_0 + l \{\pi_1 (1 - \xi_1) \frac{a^F - a_0}{\alpha} - \xi_2 \, a^F\} = - p_0 (1 - \xi_1) \frac{a^F - a_0}{\alpha} + \\ - \pi_2 (1 - \xi_1) \left(\frac{a^F - a_0}{\alpha} \right)^2 \quad (3508)$$

PROBLEM 031.

For $l = 0$ we have the solution to this problem which appears to be similar to the solution of problem 021: in fact we easily transform formula (3505) into (3508) if instead of x^F we read $\frac{a^F - a_0}{\alpha}$ and instead of π read π_2.

PROBLEM 032.

Formula (3508) also shows us, however, how a certain value of a^F may be obtained by a change in l, since for $X_0 = \text{const.}$, it connects l with a^F. In order to see how a change in l would affect a^F it is useful first to assume that $\xi_2 = 0$, i.e. that workers spend their income in the same way as non-workers. Formula (3508) without the X_0-term than reduces to:

$$\pi_1 \, l = - p_0 - \pi_2 \frac{a^F - a_0}{\alpha} + \frac{\alpha \, X_0}{(1 - \xi_1) \, (a^F - a_0)} \quad (3509)$$

From this formula we deduce that a small change da^F requires a change in l:

$$dl = - da^F \left(\frac{\pi_2}{\pi_1 \, \alpha} + \frac{\alpha \, X_0}{\pi_1 (1 - \xi_1) \, (a^F - a_0)^2} \right) \quad (3510)$$

i.e. a reduction of wages; in order to estimate the order of magnitude of the change needed, we take the realistic values of the coefficients as indicated

in model 03: $\pi_2 = 0.1$ to 0.2; $\pi_1 = 0.4$ and $\alpha = 0.4$; the resulting formula becomes

$$\frac{dl}{da^F} = \frac{-1.1}{0.16} \text{ to } \frac{-1.2}{0.16} \text{ or } -7 \text{ to } -8 \qquad (3511)$$

Since the equilibrium value of l was taken equal to 1 and that of a^F equal to 0.5, this means that a change in employment of say 10 % would require a wage reduction of —0.35 to — 0.4, or 35 to 40 % reduction. This already shows that the wage rate is not a very influential instrument.

If, however, the spending behaviour of workers should differ systematically from that of non-workers, the result would be very different. The formula would then read:

$$l = \frac{-p_0 - \pi_2 \dfrac{a^F - a_0}{\alpha} + \dfrac{\alpha X_0}{(1-\xi_1)(a^F - a_0)}}{\pi_1 - \dfrac{\xi_2}{1-\xi_1}\dfrac{\alpha a^F}{a^F - a_0}} \qquad (3512)$$

and it might happen that the denominator of this fraction would become near to zero; this may easily happen because both $1 - \xi_1$ and ξ_2 may be assuming small and rather uncertain values and these could be such as to make

$$\pi_1 = \frac{\xi_2}{1-\xi_1}\frac{\alpha a^F}{a^F - a_0}$$

For certain combinations of values the sign of $\dfrac{dl}{da^F}$ may now even become positive. Choosing again the values of π_1, α, a_o and a^F already quoted in model 03, and the value for p_o as well as the initial value for X_o which follow from this choice, we obtain:

$$\left(-0.4 + 0.5\frac{\xi_2}{1-\xi_1}\right) d\,l = \left(\frac{\xi_2}{1-\xi_1} + 2.5 + 2.5\,\pi_2\right) da^F \qquad (3513)$$

It appears that for $\dfrac{\xi_2}{1-\xi_1} > 0.8$, $\dfrac{dl}{da^F} > 0$; such a situation could present itself when workers simply spend their income completely and non-workers do not; for then $\xi_2 + \xi_1 = 1$ or $\xi_2 = 1 - \xi_1$. The explanation is that in these circumstances a shift of income from non-workers to workers means an increase in demand; and this may overcompensate the negative effect of higher prices on demand.

The conclusion then must be that the *wage rate is an unreliable instrument*

to regulate employment in a closed economy. Under certain circumstances it may work, under other circumstances it may not work.

3.524 PROBLEM 033. MODEL 03.

Targets: "Full" employment and monetary equilibrium
Instruments: Public expenditure and wage rate
Comment: Whereas "full" employment is now generally accepted as a desirable target, the danger of a continuous rise in prices which it might evoke is more and more being recognized and it may therefore be said that the targets set should be full employment and, at the same time, stable prices or, more generally, monetary equilibrium. For a two-target policy the use of two instruments will be necessary and for reasons set out at some more length in section 3.56, the wage rate has been chosen as the second one.

Solution: Evidently the values of a and p are now given; say

$$a = a^F \text{ and } p = p^D \text{ (desired price level)}$$

The unknowns are l and X_0. It is easily found, that, after substitution of equations (1), (2) and (6) of model 3 in the other equations, (5) will supply the value of x, which again may be substituted in (3) and (4). The solutions for l and X_0 will be found to be:

$$l = \frac{p^D - p_0 - \pi_2 \dfrac{a^F - a_0}{\alpha}}{\pi_1}$$

$$X_0 = (1 - \xi_1)\, p^D \frac{a^F - a_0}{\alpha} - \xi_2\, a^F \frac{p^D - p_0 - \pi_2 \dfrac{a^F - a_0}{\alpha}}{\pi_1}$$

The structure of these equations is much simpler than (3512) e.g., and accordingly there is much greater stability of the numerical values that will be found for varying values of the coefficients. Since π_2 is relatively small, it may be said, as an approximation, that the wage level is determined by the desired price level, whereas government expenditure primarily has the task to stabilize employment.

3.525 PROBLEMS 041/2. MODEL 04.

Target: high and stable employment
Instruments: public expenditure (problem 041) or taxes (problem 042)
Comment: Since there has, in principle, to be made a choice between in-

fluencing economic activity by an increase of government expenditure and a decrease in taxes, some closer investigation of the consequences in either case seems useful. The choice is, in principle, between an increase in government expenditure or an increase in private expenditure (or, as the case may be, a decrease in either of the types of expenditure). A first aspect to be considered is the utility, in any given situation, of each of these types. Since there are wide differences in incomes between various classes of the population, it is not possible to speak of "the" marginal utility of private expenditure. Still less is it possible, with our present knowledge, to indicate objective criteria of the relative usefulness of public expenditure on the one hand, and private expenditure, for any group of the population, on the other hand. Subjective judgment will have to play an important role anyhow, therefore, but it may be obtained in a more precise way than is usual, nowadays, by systematic study of (*a*) the type of expenditure involved on either side and (*b*) public opinion—both with policy-makers and with the general public—on their usefulness.

Apart from these considerations, there are, however, other aspects to the choice to be made. They are to be found in the *multiplier effects* of both instruments. It is the purpose of problems 041 and 042 to determine those effects.

The following cases will be considered separately:

(1) The marginal propensity to spend $\xi < 1$, autonomous changes in public expenditure and taxes;
(2) $\xi < 1$, and the changes in taxes are equal to those in expenditure ("balanced budget change");
(3) $\xi = 1$ and autonomous changes in expenditure and taxes;
(4) $\xi = 1$ with a balanced budget change.

In cases (2) and (4) it will first be assumed that the marginal rate τ of taxation is not changed and secondly that it is also permitted to change (cases 2A and 4A).

(1) Since in model 04 we again use the simplification of model 01 to disregard divergencies between money flows, product flows and factor flows, we consider as our target a value Y^F of the variable Y.

Again we have to eliminate the irrelevant variables, which are now X^P and T and we easily obtain:

$$Y^F = X_0{}^P + \xi\,(Y^F - \tau\,Y^F - T_0) + X^G \qquad (3514)$$

from which the analytical equation is deduced:

$$Y^F = \frac{-\xi T_0 + X^G + X_0{}^P}{1 - \xi + \xi\tau} \qquad (3515)$$

which shows the influence that can be exerted on Y^F by T_0 and X^G. Considering the marginal tax rate τ as given, it may be said that there is a multiplier $\frac{1}{1-\xi+\xi\tau}$ to be applied to X^G if X^G is changed; and another multiplier $\frac{-\xi}{1-\xi+\xi\tau}$ to be applied to T_0, i.e. to the autonomous component of tax revenue. The *multiplier for government expenditure is thus larger than that for taxation*, as long as $\xi<1$. The reason for this difference is, as is easily understood, that a tax reduction is, according to our behaviour formula (2) of model 04, only spent to the proportion ξ; the rest, $1-\xi$, being hoarded.

(2) Some special attention has, for this reason, been given [1] to increases in government expenditure and in taxes which are such as to maintain equilibrium in the government budget. It follows from the preceding paragraph that an equal increase in government expenditures $X_0{}^G$ and autonomous taxes T_0 does not leave the national income unchanged, as long as $\xi \neq 1$; if we call this increase $\Delta' X^G$, where the $'$ indicates that there is the side condition of a balanced budget, we find from formula (3515) an increase ΔY in income

$$\Delta Y = \frac{1-\xi}{1-\xi+\xi\tau}\Delta' X^G \tag{3516}$$

i.e. an income effect with a multiplier $\frac{1-\xi}{1-\xi+\xi\tau}$; this multiplier is smaller than 1. If tax revenue is independent from income (no induced tax revenue changes) it becomes just 1, the case dealt with by Haavelmo. The way in which changes in the marginal rate τ of taxation would act on income is a little bit more complicated, since income Y is not linearly dependent on this parameter. It can be found from equation (3515) as well.

(2A) A combined change in T_0 and τ to the extent that the change in tax revenue equals the change X^G would require that $\Delta' X^G = \Delta T_0 + Y\Delta\tau + + \tau\Delta Y + \Delta\tau\Delta Y$ and would lead to a much more complicated problem, which, however, is easily solved in principle by our formulae.

[1] Cf. Haavelmo, "Multiplier Effects of a Balanced Budget", Econometrica 13 (1945) and subsequent discussion with Haberler, Goodwin and Hagen in Econometrica 14 (1946). After this was written I came across Baumol and Peston's article, "More on the Multiplier Effects of a Balanced Budget," The American Economic Review 45 (1955), p. 140.

(3) The conclusions so far reached are valid for values of $\xi \neq 1$ and are meaningful for values of $\xi < 1$. It is worth its while to investigate what happens when $\xi = 1$, i.e. when private expenditure changes by the same amounts as private national income after tax. It follows from equations (3514) and (3515) that in that case

$$Y^F = \frac{-T_0 + X^G + X_0{}^P}{\tau} \tag{3517}$$

i.e. that now the multiplier equals $\frac{1}{\tau}$ for both an increase in government expenditure and a decrease in taxes.

(4) If also in this case the additional condition is set that the changes in X^G and T_0 should be equal—i.e. the hypothesis of a balanced budget is introduced and the marginal rate of taxation unchanged—the resulting income change appears to be zero. Here, for obvious reasons, the statement about a multiplier with a balanced budget does not therefore apply.

(4A) If, finally, the marginal rate of taxation τ is again also permitted to change, the analysis runs as follows. Both before and after the change in T_0, τ and X^G we have:

$$Y = Y - \tau Y - T_0 + X^G$$

and

$$X^G = T_0 + \tau Y$$

which, however, leads to a tautological equation for Y, namely:

$$Y = Y$$

Seemingly, then, Y would be indeterminate both before and after the change. Here we are again concerned with a situation similar to that dealt with at the end of problem 011. Again, therefore, we have to have recourse to a dynamic analysis. If we assume the same dynamic behaviour as in problem 011, we have:

$$Y_t = Y_{t-1} - \tau_{t-1} Y_{t-1} - T_{0,\,t-1} + X_t{}^G \tag{3518}$$

If, in addition:

$$X_t{}^G = T_{0t} + \tau_t Y_t \tag{3519}$$

we obtain:

$$(1 - \tau_t)\, Y_t = (1 - \tau_{t-1})\, Y_{t-1} + \Delta T_0$$

which determines Y's movements. We could have assumed other dynamic

features, however, in both (3518) and (3519) and might then have found different results.

Our findings may be summarized by saying that the multiplier for an increase in public expenditure is different from that for a decrease in autonomous tax revenue as soon as the marginal propensity to spend of the private economy is different from one; if public expenditure and autonomous tax revenue are varied by equal amounts, the multiplier for expenditure is smaller than one. If the marginal propensity to spend equals one, expenditure and autonomous taxes have numerically equal multipliers, equal to the inverse of the marginal tax rate. No change in income then results, therefore, for an increase in expenditure equal to that in autonomous taxes. The cases in which the marginal rate of taxation also changes are much more complicated.

So far, in problems 041/042, we have kept to the analytical method. The policy problems will have to be solved by the inversion of the equations after a choice of the instrument to be used has been made. Thus, equation (3515) would yield the value of T_0 if that instrument be chosen:

$$\Delta T_0 = -\frac{1-\xi+\xi\tau}{\xi}\Delta Y^F = \left(1-\tau-\frac{1}{\xi}\right)\Delta Y^F \qquad (3520)$$

Similar equations for other cases could be easily derived.

Here the procedure discussed in section 3.4 may be necessary. It may appear from (3520) that, for psychological reasons, the tax increase found is too high, as could be the case in a situation of threatening over-full employment. It may then be necessary to use not only the instrument of taxes but, in addition, that of expenditures; in the situation now referred to, this would mean that a decrease in expenditure would be necessary. Illustrations may be taken from the situation in both the United Kingdom and the Netherlands in 1955. The psychological situation was even such as to demand for a tax reduction after years of high post-war taxation. The instantaneous situation was one of over-employment. Reduction in public expenditure was the alternative to be considered. Another illustration may be taken from the situation prevailing in the Netherlands in 1951, again one of overemployment (and of balance of payments deficits). A combination of tax increase and decrease in expenditure was chosen; because of the balance of payments problem involved we will deal with this example in more detail in chapter 4.

A final example may be taken from the situation in the United States in 1954, one of recession. Tax reductions were applied that had been previously promised; and it was made clear by the government that, if these tax reductions should prove to be insufficient, an increase in expenditure would be considered.

3.531 PROBLEMS 051/053. MODEL 05.

Targets: high and stable employment; no potential inflation, that is, a fixed amount of money in circulation.
Instruments: public expenditure, debt policy
Comment: we are now going to consider the complication arising from possible future consequences of full-employment policies. To the extent that such a policy makes use of money creation, the danger of potential inflation may come up, i.e. the danger that money balances in the hands of the public will be spent at too high a rate during later time periods. One way to forego this danger is not to create money, but to finance deficit budgets with the aid of long-term or medium-term loans.

This feature in our problem provides an example of the complications that arise if not only short-term, but, at the same time, long-term targets have to be taken care of. As B. Hansen rightly observes [1] more instruments will then be needed.

It is useful to make a distinction between three situations regarding the provision of the economy with money. First, the "normal" situation may be considered where the circulation of money M is sufficient to finance desired transactions Y^F, or only slightly above it. In the second place, a situation may be considered where the supply of money is kept relatively low, to be called the situation of insufficient cash balances. This is the state of affairs if credit is made scarce or even rationed. In the third place, a situation of excess cash reserves will be given some attention, i.e. the situation prevailing after a period of sustained inflation, e.g. after a war.

It depends on the targets set with respect to M, whether we will be in a situation of sufficient, insufficient or excess cash balances.

We do not introduce the rate of interest as a separate variable. This more subtle instrument of regulating the provision of the economy with means of payments does not, it seems (cf. § 2.2) exert a very large influence [2]. Mostly it works to an appreciable extent only in co-operation with either psychological factors—if it is used as a warning signal, but then the inter-

[1] B. Hansen, Finanspolitikens ekonomiska teori, ch. XVI.

[2] J. Tinbergen, Business Cycles in the U.S., 1919–1932, League of Nations, Geneva 1939; Business Cycles in the U.K., 1870–1914, Amsterdam 1951.

pretation is what really matters—or with straightforward rationing. This is the second of our three cases to be considered. (For open countries, cf. § 4.1). Attempts to use interest rates in economic models were made by the present author in previous work.[1]

PROBLEM 051. SITUATION OF SUFFICIENT CASH BALANCES

We will for this problem specify the function $X_0{}^P(M, B)$ as a general linear one:

$$X_0{}^P(M, B) = X_{00}{}^P + \xi_2 M + \xi_3 B \tag{3521}$$

Since the increase in M and B rather than their absolute values are relevant to the problem, it is more appropriate to write this function as:

$$X_0{}^P(M, B) = X_{00}{}^{P'} + \xi_2 \Delta M + \xi_3 \Delta B, \tag{3522}$$

where

$$X_{00}{}^{P'} = X_{00}{}^P + \xi_2 M_{-1} + \xi_3 B_{-1};$$

M_{-1} and B_{-1} indicate the values of M and B, respectively, one time unit before, i.e. at the end of the previous time unit. (This can be applied only to somewhat long units, such as years.)

Our equations may now be written in the following form (cf. model 05):

$$Y^F - X^G = \xi_1 Y^F + X_{00}{}^{P'} + \xi_2 \Delta M + \xi_3 \Delta B \tag{3523}$$

$$\Delta M = X^G - T_0 - \tau Y^F - \Delta B \tag{3524}$$

In these equations $X_{00}{}^{P'}$ and T_0 are data; Y^F and ΔM are targets (where ΔM will depend on future values of Y^F) and hence also given; ΔB and X^G are unknown. If $\xi_3 = 0$, X^G may first be derived from (3523); and with X^G determined, and ΔM given, ΔB may then be found from (3524). The situation is so simple here, that algebra would seem superfluous: ΔB represents the deficit of the government which, if no financing through money creation is desired, has to be raised from the capital market, and which is determined by $X_{00}{}^{P'}$ (the autonomous private expenditures) and the standard Y^F set for full-employment income. In times of depression, there will have to be a government deficit; in times of boom, a surplus. Accordingly bonds will have to be issued or to be paid back.[2]

The problem becomes a bit more complicated and algebra then becomes

[1] This does not imply that the rate of interest does not vary. It varies, but it does not influence the other variables to any appreciable extent.

[2] These amortizations may, however, better be spread over time, and the surplus may partly be hoarded.

useful, if $\xi_3 \neq 0$, i.e. if the bond holdings of the public do also influence their spending. In this case there is interdependence and after solution of the equations we find:

$$\Delta B = \frac{(1-\xi_1-\tau)\ Y^F - X_{00}{}^{P'} - T_0}{1+\xi_3} - \frac{1+\xi_2}{1+\xi_3}\Delta M \tag{3525}$$

The higher, with other data equal, the influence of bond holdings on spending, the lower the amount of loans to be floated now. On the other hand, however, a higher value of ξ_3 means an increase in the danger of potential inflation; for then the future propensity to spend will also be larger.

The question has to be raised whether not even the setting of the problem reflects too great a concern about the danger of potential inflation. At the moment that potential inflation would become actual inflation, i.e. when the excess of cash reserves would be spent, it is always possible to exert a counterforce by deflationary policies of the type discussed previously. This argument, taken together with the possibility that "consolidation" of cash reserves need not reduce the spending out of assets to zero, diminishes the importance of the problem now being considered. Nevertheless a better knowledge of the coefficients ξ_2 and ξ_3 seems desirable.

3.534 PROBLEM 052. SITUATION OF INSUFFICIENT CASH RESERVES.

The form so far given to the function $X_0{}^P$ can only be an approximation and in particular applies to the situation of sufficient cash reserves. This function assumes a different form if we reach the region where liquid assets are less than sufficient for a minimum transaction cash balance. Such a minimum balance depends on the organization of payments facilities and on habits. It is well-known that in developed countries cash-balances of between one quarter and one half of annual income are customary. If M falls below such a minimum, it will influence X^P to a much stronger degree, almost or exactly with a coefficient $\xi_2 = 1/\mu$, where μ is the ratio between minimum cash balances and annual income.

We have then to replace the spending equation by

$$X^P = \frac{1}{\mu} M \tag{3526}$$

i.e. $X^{P'}{}_{00} = \xi_1 = \xi_3 = 0$. Ths relation may be said to represent a boundary condition to our variable X^P, transforming our equation (3523) and (3524) into:

$$Y^F - X^G = \frac{1}{\mu}(M_{-1} + \Delta M) \tag{3527}$$

$$\Delta M = X^G - T_0 - \tau Y^F - \Delta B \tag{3528}$$

and brings us back to the simpler logic where X^G can be derived from (3527) and consequently ΔB from (3528). The solution reads:

$$X^G = Y^F - \frac{M_{-1}}{\mu} \tag{3529}$$

$$\Delta B = Y^F(1-\tau) - \frac{M_{-1}}{\mu} - T_0 \tag{3530}$$

3.533 PROBLEM 053. SITUATION OF EXCESS CASH RESERVES.

In this situation we will again have to use formula (3521), but now the target to be set for M may be different. It may now be desirable to let M fall to a more normal level. Such a fall presupposes surplus spending during the period of the fall, however, the phenomenon well-known from the post-war period. That is to say, ΔM cannot fall by more than the public is willing to spend above its income, unless another type of measure should be introduced, such as a forced "monetary purge". The autonomous willingness to spend is expressed in our formulae by the level of $X_{00}{}^P$; it may be high in a post-war period, for reasons of back-log demand. If $X_{00}{}^P$ happens to be high, ΔM may therefore be strongly diminished; otherwise it cannot. The limitation, or boundary condition, now involved, can be expressed in our formulae by an unwillingness, of the public, under such circumstances, to take bonds; i.e. by the boundary condition $\Delta B = 0$. Such a boundary condition changes the logical structure of our problem, in the way indicated in section 3.4. We cannot now impose a target with regard to ΔM unless we either give up our target with respect to Y and let Y go up into the inflationary region; or introduce further instruments, e.g. a forced purge. This latter solution comes down to imposing a certain value ΔB on the public, if a "blocked account", as it is usually created in the case of a monetary purge, is considered a type of bond.

3.534 PROBLEM 054.

Target: "full" employment
Instrument: money circulation
Comment: We may use formula (3523) or (3527) for other problems of economic policy also, namely problems where M is used as an instrument. In practical terms this represents credit policy, i.e. the regulation of the

quantity of means of payments in the hands of the public by regulating the extent of credits given to business. Here again the asymetric behaviour of the public with regard to cash balances comes into play. If the target of policy, is to reach a certain level of activity Y^F and for some reason X^G, cannot be changed sufficiently (there may be an upper as well as a lower boundary condition for X^G), it may be attempted to influence X^P (and so, according to equation (1) the level of Y) by the intermediary of M (according to equation (2) of model 05). The influence of M on X^P has been represented by the coefficient ξ_2 in equation (3521), and been specified to be $\frac{1}{\mu}$ under conditions of insufficient cash reserves (equation 3526)). As far as our knowledge goes, ξ_2 is only about 0.1 [1], whereas $\frac{1}{\mu}$ is 2 to 3. This "kinked curve" represents the well-known fact that the instrument of credit restriction by rationing (downward from the point of "sufficient cash balances") is very efficient, but that it is much less easy to increase expenditure by making ample credits available, if for other reasons there is no desire to spend. Credits can hardly be forced on people. One of the ways in which one could express this is that the stimulating effect of a (short-term) interest rate reduction is only limited. We believe it to be so limited that we think one might even disregard the short-term rate of interest as an instrument of economic policy. Its influence is no larger than the margin of error in most of our knowledge about the economic mechanism. This does not apply to all types of long-term interest rates, and still less to such types of "interest rates" as the yield on shares or the profit rate. They have a larger and fairly considerable influence.[2] (For an open country, cf. § 4.1.).

3.535 PROBLEM 061. MODEL 06.

Targets: high and stable employment in each industry.
Instruments: public expenditure, indirect tax rates for each industry.
Comment: This problem is given to illustrate certain short-term aspects of the problem of full employment: the inelasticity of supply in different industries. Even if it is admitted that in the longer run supply should be adapted to demand, it will be necessary to have available short-term instruments in order to regulate employment by industry. Here indirect taxes or

[1] Cf. L. R. Klein and A. S. Goldberger, An Econometric Model of the United States, 1929–1952, Amsterdam 1955, p. 65.

[2] Cf. references given in problem 051. The remark may be added that also, in the long run, a persistent change in short-term rates will influence long-term rates.

subsidies seem to be the most appropriate instruments. Since, in addition, we will maintain the instrument of public expenditure, the number of instruments surpasses that of targets by one, and there will be one degree of freedom. This may be used to satisfy some further condition, either a boundary condition or another target.

In accordance with this state of affairs we find, upon counting equations and variables, the following situation:

Number of equations: $3H + 3$

Number of economic variables: $3H + 3$, distributed over targets (number: H, namely the production volumes $x^h = x_0{}^h$) and irrelevant variables ($2H + 3$, namely X^h, p^h, X, X^P, Y).

Among the data there are the $H + 1$ instruments τ^h and X^G.

Elimination of the irrelevant variables may be undertaken as follows. From equations (5) of model 06 we deduce

$$x^h = \xi_1{}^h \frac{Y}{p^h} + \xi_2{}^h \tag{3531}$$

or

$$x^h - \xi_2{}^h = \xi_1{}^h \frac{Y}{p^h} \tag{3532}$$

Since $x^h = x_0{}^h$ is given (target), we may express p^h in terms of Y:

$$p^h = \pi^h Y \tag{3533}$$

where

$$\pi^h = \frac{\xi_1{}^h}{x_0{}^h - \xi_2{}^h} \tag{3534}$$

We may further express Y in terms of X^G, since:

$$Y = X = X^G + X^P = X^G + \Sigma X^h = X^G + Y\Sigma\xi_1{}^h + Y\Sigma\xi_2{}^h\pi^h$$

or:

$$Y(1 - \Sigma\xi_1{}^h - \Sigma\xi_2{}^h\pi^h) = X^G \tag{3535}$$

Putting

$$\frac{1}{1 - \Sigma\xi_1{}^h - \Sigma\xi_2{}^h\pi^h} = \eta \tag{3536}$$

we have

$$Y = \eta X^G$$

and can now write our H equations between the $H + 1$ unknown instrument variables in the form:

$$p_0{}^h + \tau^h = \pi^h\eta X^G \qquad h = 1 \ldots H \tag{3537}$$

or, expressed in the original coefficients:

$$p_0{}^h + \tau^h = \frac{\xi_1{}^h}{x_0{}^h - \xi_2{}^h} \quad \frac{X^G}{1 - \Sigma\xi_1{}^h - \Sigma\xi_2{}^h\pi^h} \tag{3538}$$

It is now easily seen that we may freely choose e.g. X^G and having done so will then find τ^h. It appears that the higher X^G, the higher also all the τ^h have to be taken, for the obvious reason that if X^G already stimulates demand in a general way, the indirect taxes need not do so, and vice versa. On the other hand, the τ^h vary inversely with the targets $x_0{}^h$, also for obvious reasons. The only thing that could not have been found easily without our algebra is the exact form of the relationships (3538); as already observed, these are still simplified and would become more complicated as soon as the spending equations (5) would also depend on the prices of the other goods.

The degree of freedom present in (3538) may be used, as already observed, to fulfil certain boundary conditions. If X^G is subject to such a condition, this may be used to restrict the intervals to the admissable solutions. On the other hand, also the τ^h may be subject to certain boundary conditions. It may e.g. be thought that subsidies are not an appropriate instrument of economic policy. In such a case, each of the τ^h has to be > 0. The situations that can present themselves here are manyfold; as will be clear, it is easily conceivable that not all these conditions can be fulfilled at the same time; but just as well it may happen that all can be satisfied and that even a certain interval of freedom remains to some or all of the variables. The reader may be invited to construct numerical examples himself.

3.541 The isolated problems considered in §§ 3.521 to 3.535 inclusive may now serve as a few stepping stones to a reasoned discussion of the various alternative methods of regulating employment and monetary equilibrium. We start with policies where *only the employment target* is set. The alternative methods available may first be subdivided into money-flow methods and factor-price methods, indicating that the instruments are money flows in the former case and prices of productive factors in the latter, i.e. wage or interest rates.

The first point to be made is that in closed, or nearly closed, economies the *factor price instruments are unreliable* (cf. problem 032). Both wage rates and interest rates have only a restricted influence on the total activity of a closed economy. The influence of wage rates is uncertain even as to its direction: a fall in wage rates may lead, under conditions of depression, to a fall in total activity. The chief explanation

is that its influence consists partly of positive and partly of negative elements, and that the size of these influences varies, but is about equal. The general reason why interest rates, at least short-term interest rates, are inactive has been discussed in § 2.2.

3.542 *Money-flow instruments* are mainly the money flows regulated by the government: *public expenditure and taxes*. Their influence on total activity is considerable, as has been characterized by Kahn's and Keynes' famous expression "multiplier" (problems 011, 021, 031). As far as a choice has to be made between both, the choice is between certain private expenditures, made possible by a tax reduction, or eliminated by a tax rise, and certain public expenditures made possible by their rise or eliminated by their reduction. A first criterion should be their utility, but this device has only a restricted value because of the fact that many very different individuals will mostly be involved, the marginal utility of money to whom differs widely. Not much more can be recommended than careful "public opinion polls", among the policy-makers and the citizens.

A clear-cut situation prevails, however, when huge expenditures simply have to be made, as in the case of war or other emergencies (floods, post-war reconstruction). There is no choice then and taxes have to be increased. They may even have to be increased to such an extent that the boundary condition for taxes is reached, meaning the limit where, because of evasion or lack of inducement to produce, a further increase in taxes has its own drawbacks. In this situation the extra expenditures, technically speaking, will have to be financed either out of loans or by credit creation. The choice here should be loans and not credit creation, since the latter would lead to over-employment.

In more normal circumstances the choice between increases in expenditure and decreases in taxation is, however, less unambiguous.

3.543 A second criterion for the choice between different money flows as instruments for regulating employment exists in the delay to be expected in their handling. This delay will be considerable if parliamentary approval is needed for the change to be brought about, as will be the case for changes in tax rates or increases in expenditure. The delay may also be considerable if complicated tax chemes that are

usually applied to, say, annual assessments, should have to be changed. There are, however, numerous ways of avoiding delays. The government may, for example, accelerate or slow down the collection of taxes, or the execution of a certain spending program, without parliamentary consent, and, in urgent cases, it is certainly possible to obtain the quick co-operation of parliament.

A third factor that may then be of some importance is that the multiplier for an increase in expenditure may be somewhat larger than the one for a reduction in taxation (cf., problems 041 and 042). This is only true when the marginal propensity to spend is below one; and in those circumstances even an increase in public expenditure with an equal increase in taxes will increase total demand.

3.544 A further choice has to be made, or can be made, namely between *direct and indirect taxes*. The exact effects exerted by each of these instruments depend on many particular details: a reduction may be a general one, say proportional to the existing rates, or a specific one, say the reduction of rates on some specific income groups or goods. It will be clear that specific changes may have very different results according to their shape. Usually there are good reasons for maintaining a certain balance between the rates for different income groups or different goods (see, however, the end of this §). A proportional reduction of existing rates will mean, in the case of direct taxes, a reduction which primarily affects high incomes, whereas a proportional reduction in indirect taxes will affect lower incomes more. Accordingly, their influences on total demand will be different, and particularly so if they are applied during a depression. In such a period the marginal propensity to spend will be below one for the higher income brackets; and the probable effect on total outlay is less in the case of direct taxes than in the case of indirect ones. Under more normal conditions there need not be any differences in the total effect on outlay; but there will be a difference as to the composition of the increase in demand. The demand for investment goods as well as for luxury goods will be more affected by a change in direct taxes, whereas the demand for consumer goods generally will be more affected by a change in indirect taxes.

3.545 Money-flow instruments are mainly the government-controlled

money flows; there is, however, the possibility of the banking system, and hence especially of the central bank, of influencing money flows spent by the private (and even the government) sector by credit policy. This policy is only efficient when it takes the form of credit restriction by rationing (cf. problem 052); it is to be compared with a cable, which can only be used to pull, but not to push. In an inflationary situation it may be very important. In a deflationary situation the initiative to spend is the decisive one and this cannot be imposed on the private sector; either the factors making for demand have to be changed (as e.g. taxes) or the spending has to be undertaken by the public sector.

3.546 A final remark to be made on the problem of regulating employment in the short run refers to the question, whether a government deficit should be financed by *credit creation* or by *loans*. For the instantaneous effect this is a matter of indifference, as long as total demand is unaffected. For this to be so the loans should attract only money flows that would not otherwise have been spent. If loans reduce the money flows for spending, financing by credit creation deserves preference. We are coming back to this subject after a while (§ 3.57).

3.55 We continue our discussion by asking what policy is required if *monetary equilibrium is the only target*, irrespective of the level of employment. From our problem 021 we deduce that as a rule the price level, also, is affected by changes in money flows; and that hence autonomous changes in price level, such as crop variations, technical changes or wage changes can be counteracted by changes in money flows. Such changes will, however, affect the employment situation at the same time, and it will, as a rule, not be possible to attain both monetary equilibrium and a certain employment target by the use of only one instrument. In the absence of any violent autonomous changes in prices, a well-known device will have to be employed, namely, to let total expenditure be just sufficient to buy the national product at the prices of the previous time unit.

Another instrument that may be used for the maintenance of monetary equilibrium is the *wage rate* (cf. model 03). If the only autonomous changes in price-determining factors are changes in productivity, the way to maintain a constant price level is to let wage

rates rise in proportion to labour productivity, no less and no more. Wages may also be raised, of course, if the incomes of other than wage-earners are lowered, but this will affect employment at the same time.

3.56 Most modern policy-makers, however, prefer to pursue a *two-target policy* at least, i.e. to maintain both *high employment and monetary equilibrium*. Such a policy requires the use of at least also two intruments. One of them should be one of the government-controlled money flows, since the reliability of factor prices for the regulation of employment was found to be low. The most natural choice for the second instrument is the *wage rate:* as a regulator of the price level this is a quite efficient instrument. All the alternatives, with the possible exception of one, turn out to have serious drawbacks. The *interest rate* only exerts a very small influence on the price level. Direct regulation of prices themselves requires a complicated administration and considerable friction will be one of the accompanying phenomena. For certain bulk commodities, such as raw materials, it could be done, however (cf. § 6.5).

A third possibility might, in theory, be the use of two money flows (government expenditure and tax revenue) or two types of taxes. This would only work if the relative effects of each of these instruments on the two target variables were different. Suppose both instruments should affect employment and prices in the same proportion. Then any combination of these instruments would do the same, so that it would not be possible to affect employment and prices in any other proportion. It would also be, if not impossible, scarcely possible to affect the target variables, employment and price level, in a different proportion if the instruments should affect both in almost the same ratio. Suppose government expenditure would, if applied to a certain amount A, increase employment by 1% and prices by 0.9%, while taxes, when increased by A, would decrease employment by 1% and prices by 1.1%. Then it would theoretically be possible to attain any combination of changes in employment and price level. If an increase in employment of 2% and a decrease in price level of 2% were desired, a very large increase both in expenditure and in taxes should be applied, namely an increase of $21A$ in expenditure and an increase of $19A$ in taxes.

This would in all probability mean a bad policy since very debatable expenditures would have to be involved.

A less unfavourable alternative would seem to be the use of *indirect taxes* in order to influence prices. This would be possible as long as the indirect tax level were sufficient to allow a reduction of the size needed to counteract an excessive rise, say, in wage rates. Other purposes aimed at by the policy-makers in handling indirect taxes (cf. also end of this §) would then, however, have to be foregone. This alternative, therefore, also has some drawbacks, although to a smaller extent.

For these reasons, wage rates have to be a deliberate instrument of economic policy if employment targets and monetary equilibrium are to be pursued at the same time. There is an important and well-known argument against making wage rates an instrument of economic policy. It is felt by many that wages should be a subject for "free negotiation" between workers' and employers' organizations. Making wages subject to government approval or even decree would be, following this train of thought, a tendency towards totalitarianism. In the author's opinion the desire for "freedom" in wage negotiations is very close to an inconsistency. The real freedom of course is very small, since the choice of a wage rate deviating from the one required by "full" employment and monetary equilibrium will endanger one, or both, of these targets. And the assertion regarding totalitarianism seems to be exaggerated respecting countries in which trade unions have an important influence on the decisions taken by the government.

3.57 The problem again becomes a little bit more complicated if, not only short-term targets, but also some *longer-term targets* are aimed at. Monetary equilibrium, especially, should not only be maintained in the short run, but in the long run as well. Here the problem of choosing between credit creation and loan policy comes up again. If in a period of low private expenditure employment is to be maintained by increased government expenditure, and a resulting deficit is financed by credit creation, this may introduce the danger of potential inflation, i.e. the possibility of future inflation. The larger cash balances left in the hands of the public may later be spent by them in addition to their incomes. This makes it preferable to finance the budget deficit with the aid of loans (cf. problems 051–053). To the extent that the public

is willing to take the bonds presented at not too high interest rates and without too great a reduction in their expenditures, this policy will work. The adaptation of the types of loans presented to the preferences of the public will be an important technical problem to be solved. The better the financial authorities succeed in attracting the exact unspent margin between income and private expenditure, the more successful this policy will be. As has been already observed, however, when discussing problem 051, there is no need to restrict extra government expenditure during a depression to the amounts that can be borrowed in the capital market. This safeguard against potential inflation is only a second line of defence; actual inflation at some later time can always be matched by appropriate measures at that time, namely reduction of government expenditure or an increase in taxes.

3.58 The last problem we will consider in this section is the problem of maintaining employment, not only as a whole, but in *a number of different industries*. It is necessary here to make a distinction between the long-run and the short-run problem. It would be erroneous to try to maintain employment in each separate industry over a long period since this would mean a lack of adaptation to changes in taste, or in techniques, with a consequent loss to national income. In the short run, however, the problem is different. Adaptations, such as the ones just mentioned, take a certain length of time: retraining of labour, the replacement of capital goods in one industry by those of another, and the replacement of obsolete capital goods by more modern, are all time-consuming processes. During such a process of adaptation it is no use letting labour remain unemployed, and so the problem arises of how to ensure high employment in a number of "compartments" of the labour markets. Evidently the general instruments of public expenditure and general taxes will not perform this. The simplest way to solve this problem is to differentiate between the taxes applied to the various compartments; this can only be done as far as indirect taxes are concerned. If one indirect tax rate is available for each compartment, it would be possible to regulate employment in each. If in addition a general instrument is also used (cf. problem 061), there is one instrument more than strictly needed, introducing one "degree of freedom". One instrument may be chosen arbitrarily, say the level

of government expenditures; and the other (i.e. the indirect tax rates) then adapted to the targets of high employment in each industry. The higher the level of public expenditure, the higher also the tax rates have to be. The degree of freedom may be particularly useful if it is desired also to sustain employment in an industry for which demand is relatively weak, and not to do so by subsidizing that industry, i.e. not to do so by applying negative tax rates.

3.6. Main Problems of Development Policies

3.61 As a second set of examples we will consider some of the quantitative problems of long-term economic development and the policies needed to further it. Development policy, to be sure, is such a complex phenomenon, embracing not only the whole of economic life, but also important extra-economic phenomena, that it cannot, in its totality, be considered an example of quantitative policy. But some of the main interrelations are of a quantitative nature and they will be dealt with in this section. Other aspects will be considered elsewhere (cf. § 4.122, 5.7 and 6.4).

Development will be taken to mean the increase, over a prolonged period, of production per head of a given economy. It represents the most natural and the most reliable basis for a long-term increase in material well-being, a target that will be considered important by all peoples living at a low level and becoming aware of it. In recent times there has been an increasing awareness of the deficiencies in the standard of life of many Oriental, African and Latin American peoples, due partly to the ever increasing well-being of some Western countries, to the increasing contacts with the Western world, and to the growing interest in material well-being spread by socialists and communists.

There are various ways of raising production per head; the most important may be said to be an increase in capital per head, or in capital goods available per head, and improvements in the skill of a population and in the methods of production used. As a rise in capital per head is equivalent to investment and the improvements in skill and methods also require investments, to a certain extent, it may be said that investment is the key to increased production. For reasons to be discussed later, investment can only be made partly out of

foreign savings and has, as a rule, to be obtained out of home savings therefore. The fundamental choice to be made here is between more consumption now and less development, or less consumption now and more development; the choice, in fact, as to what degree of development is wanted. It is difficult to indicate any definite criteria on which to base this choice; there are, however, certain limits which narrow down the range of figures that are practically feasible.

As a basis for discussing this problem we will, as before, consider a clear-cut example and continue the general discussion afterwards.

3.62 PROBLEM 091. MODEL 09.

Target: development of production at a rate of α per time unit.
Instrument: volume of investment
Comment: it is the intention of this example to show the interrelation between some fundamental variables in economic development, the fuller discussion of which will be given after this example. More particularly it introduces a scheme slightly different from the well-known Harrod-Domar model, which will, nevertheless, be taken up as the guide to the fuller discussion. The difference consists of a technically more specific representation of the process of production. As has been assumed in model 09, production is seen as technically related to the stock of equipment rather than to capital; i.e. to the number of machines available—whatever their age and hence their value, if only not worn out. It is recognized, of course, that the life time is not as precisely constant as has here been assumed; but on the other hand it is believed useful to introduce the distinction between stock of equipment, or capacity, and capital.

The solution of the system of dynamic equations of model 09 is possible along the following lines:
Writing δ for $1/T$ we have, from (4), (9), (2), (3) and (7):

$$j = v - c = \varphi\dot{e} - (1 - \sigma)(\varphi - \delta)e = (\delta + \sigma\varphi - \sigma\delta)e \qquad (3601)$$

Since $\frac{de}{dt} = j - j_{-T}$ it follows that

$$\frac{dj}{dt} = (\delta + \sigma\varphi - \sigma\delta)(j - j_{-T}) \qquad (3602)$$

This is a differential-difference equation, which is also valid for e and all variables proportional to e. It can be found that under certain conditions the solution of this equation can be:

$$j = j_o e^{\alpha t} \qquad (3603)$$

The condition is that:

$$\alpha = (\delta + \sigma\varphi - \sigma\delta)\,(1 - e^{-aT}) \tag{3604}$$

since this is the result of substituting (3603) into (3602) and happens to be a relation independent from t. If the initial situation of the economy considered satisfies certain further conditions this possible solution will at the same time be the only solution. The economic significance of these latter conditions may be vaguely indicated as conditions of equilibrium, as contrasted to cyclical disequilibrium. [1] It may therefore be stated that the rate of development likely to occur is the one defined by (3604).

A numerical example may clarify the formula. We choose $\sigma = 0.12$, $T = 20$ and hence $\delta = 0.05$, and $\varphi = 0.196$; this latter choice being based on the hypothesis that the "capital coefficient", i.e. the ratio of k/y should be 4. The resulting value of α is 0.03, i.e. the same value as would be found in the simpler approach used by Harrod and Domar.

With these constants the composition of production at the moment where $y = 1$ would be:

$$v = 1.34;\ j = 0.46;\ d = 0.34;\ r = 0.26;\ s = 0.12;\ c = 0.88$$

The two stock figures would, in addition be:

$$k = 4 \qquad\qquad e = 6.58$$

Formula (3604) may now be used to calculate the necessary rate of savings for other values of α as well. The following results will be found:

α	σ
0.02	0.07
0.03	0.12
0.04	0.16
0.05	0.21

The results do not diverge much from the results that would have been found with the help of the Harrod-Domar formula

$$\alpha = \frac{\sigma}{\varkappa} \tag{3605}$$

where $\varkappa$ represents the capital coefficient, which in our initial case was taken

[1] The general solution of (3602) is more complicated than (3603) and also contains fluctuating components. These will be absent only if their amplitude in the initial movement (the given values from j_{t-T} to j_t) is zero.

to be 4. The Harrod-Domar theory considers $\varkappa$ to be a constant, whereas our theory takes φ to be constant, leading to a dependency of the capital coefficient on the rate of development.

In the following analysis this will, however, be disregarded and a constant capital coefficient will be assumed to exist.

3.63 We will now introduce the important element of *population growth* in order to continue our general discussion of the fundamental choice of the degree of development. Let it be given that population grows at a rate of π (say 1% per annum); let the capital coefficient be $\varkappa$ (say 4) and the rate of development, i.e. the rate of increase in production per head needed be α' (say 2% per annum). What rate of savings will be needed? Since the total rate α of increase in production will now have to be $\pi + \alpha'$ ($1 + 2 = 3\%$) annually it will be necessary, according to the definition of the capital coefficient, for the rate of investment and (in the absence of foreign help) for savings to be $\varkappa\,(\pi + \alpha')$ or, in our example, $4 \times 3 = 12\%$. Other figures could be easily calculated.

The rate of savings just found is already quite high in comparison to what is actually saved in most underdeveloped countries. A savings rate of 5 to 8% is the most frequent figure; and it is only in more developed countries that figures above 10% are found as a rule. Savings rates of 15% are exceptional, at least in free economies. It is in centrally regulated economies only that much higher rates have been obtained. And it will be clear that savings rates of this level imply an important sacrifice of a population with a low standard of life. The freedom of choice is therefore more restricted than it might seem at first sight.

3.64 In the present circumstances there are good reasons for advocating *foreign assistance* in order to step up the rate of development of under-developed countries. First of all, there are a number of developed countries able to supply such assistance. And secondly, it seems undesirable to let the divergence in living standards become larger and larger, as it actually has become during the last century. Such a divergence would, in the end, seriously threaten political stability. By a well-organized international effort important results

might be obtained.[1] Nevertheless there are also here limitations to what can be done. Investment projects of any kind always contain important elements of local effort. A machine can be imported, but it also has to be installed. Roads, railways, irrigation dams, have to be constructed, to a very large extent, with the aid of local labour, partly skilled which is not usually abundant. It follows that there is a limit to the degree to which total investment can be stepped up. Suppose the ratio of foreign to home costs in the average investment project to be 1 : 1 (a rather favourable supposition), then, if the maximum savings rate for the country concerned is 8, the maximum investment rate (in terms of national income) will be 16; with a capital coefficient of 4, the maximum rate of increase in production will be 4 and, with a rate of population increase of 1, the maximum rate of development will be 3% per annum.

3.65 Apart from foreign assistance, the main short-term instruments for furthering investment activity will be *direct taxes* and *government investment*. Direct taxes will, of course, influence investment in a negative way; they can only, therefore, be used as an instrument if they, for some reason, have been high for some time and are then lowered. A reduction may be made possible by taking measures to decrease tax evasion. Such a reduction will be most effective if it is linked to actual increases in investment. In countries where private initiative is still weak, or where no important private capital formation takes place, government investment activity will have to play an important role. This is particularly true for countries where the type of investment needed is of the public utility or "social overhead" type, or where transportation is an important bottleneck. Some problems connected with public investments will be considered in section 5.73. There are, in addition, numerous other instruments that may be used incidentally, according to circumstances. It would lead us too far to discuss these other instruments.

As was already observed, capital is not the only bottleneck in underdeveloped countries; *skill* in its most diversified forms is another one.

[1] Cf. the calculations presented by H. Theil, Enige kwantitatieve aspecten van het probleem der hulpverlening aan onderontwikkelde landen, Haarlem 1953.

And there should be a certain proportion between the increase in both. The general feeling of those in touch with the problem is that the need for medium-level technicians and for all levels of managers is the most urgent need at the moment; and all efforts should be made to meet that need.

There is, finally, one main factor intervening that also has to be mentioned explicitly: population growth. As will be clear from our calculations, a *reduction in population growth* will also be of considerable help in stepping up production per capita for the simple reason that there will be more available per head if there are less "heads". In a country with a savings rate of 8%, with a capital coefficient of 4 and a rate of increase in population of 1%, half of the savings are needed only to maintain the standard of life of the growing population. The situation will be worse if the rate of increase in population is say 3%, as is the case in many Latin-American countries. It may even be stated that the problem of a rapid decrease in the divergence of standards of life is insoluble unless a check on the growth of population is one of the means used.

3.7. Example of Sector Policy in a Closed Economy: Transportation

3.71 Economic policy, by its nature, applies to the economy as a whole and it should not have any particular bearing on certain sectors: all sectors are, in principle, needed and no discrimination should exist. There may, however, be certain characteristics asking for acts of policy which are more pronounced in their effects on one sector than on the other. Since the execution of a policy requires familiarity with business life and this familiarity usually bears on a certain sector, it is understandable why economic policy is so often subdivided into sector policies. Sector policy will always be determined, to a large extent, by the particularities of the sector concerned. In addition it will have an element which is absent in general policy: it has to pay attention to the position of the sector with regard to other sectors. For these reasons we are going to discuss one or two examples of sector policy; the first being an example applying in a closed economy, i.e. where international aspects are not important. We have chosen transportation as the sector in this example.

3.72 We will discuss, in succession: (i) the characteristics of the transportation sector; (ii) the aims of transportation policy; (iii) the instruments that can be used and (iv) why and how these instruments gave to be used.

(i) The *characteristics* of transportation are, of course, many and not all of them are equally relevant to policy problems. The activity may be described as a relatively simple (and hence often highly mechanized) operation needed in many production processes and also for human beings, every time where physical distances have to be bridged. Simple though the operation in principle may be, each single unit is characterized by a large number of special features: route, time of leaving, velocity, degree of care in handling needed, frequency of connection, quantities transported. The typical performance of transportation industries is the way in which they group units with similar characteristics in order to apply the economies of scale which are very considerable. With a more or less given structure of demand for transportation a complicated structure of transportation services emerges, showing various types alongside each other: water, rail, road and air traffic along a number of fixed and a number of free routes, in large and in small units (ships, trains, trucks etc.) in frequent or infrequent services.

3.73 The economic and technical characteristics which matter most for transportation policy seem to be the following:

(*a*) The elasticity of demand for transportation is generally low since transportation costs are only a minor part of total production costs.

(*b*) Some of the investments needed for an efficient transportation system are of the "bulky" type, i.e. the minimum size of certain parts of the equipment is large. This is particularly true for railways, ships and aircrafts.

(*c*) On the other side, there are some types of investment which permit the use of very small units, thereby attracting small business men; this applies to river and canal shipping, and road traffic.

(*d*) Finally there is a large number of market compartments that are mutually non-competing or almost so: traffic is always traffic along some specified route at some specified time etc.

3.74 (ii) The *aims of transportation policy* have to be seen as part of the aims of general economic policy; the general aims discussed earlier therefore apply, but they should be modified in view of the limited area of interest. Instead of aiming at a maximum real national income transportation policy can only aim at a maximum contribution by the industry to national income as a whole. This implies the most efficient use of the factors at the industry's command and no command over factors that could better be applied in other sectors; it also implies a remuneration which is "reasonable", a term to be discussed, in another context, later on (cf. § 6.4), but provisionally to be interpreted as "according to the value of its contribution". Of the general aims discussed earlier that of continuity and stability is also of particular concern. It will be taken to mean here that transportation facilities have to be available to the rest of the economy continuously and at stable rates; the exact implications will be discussed under (iv).

3.75 (iii) The *instruments available* for transportation policy are in principle the same as those used for the economy as a whole, with some of them perhaps more needed or more easily applicable because of the special structure of the industry. It goes without saying that instruments that can only be applied in an indiscriminatory way to the economy as a whole are not particularly interesting, since they can hardly influence the position of the industry with respect to others. The more interesting instruments are those which by their nature do influence that position. First, price fixing may be mentioned, relatively easy to apply in some of the simpler types of traffic. A second instrument is that of quantitative restrictions, especially of investments; this usually takes the form of concessions on the one hand and the obligation to carry freight as a corrollary. As a third example the formation as well as the control of monopolies has to be quoted.

3.76 (iv) The *use made of the instruments* is manifold and diversified. No policy can be a mechanical one and this is particularly true of transportation policy: it has continuously to be adapted to changing circumstances, because of the necessity for traffic to follow an inelastic demand. Because of the technical differences between the various types of transportation, policy has also to be different for these types. It cannot be the purpose of this section to give a complete and precise

picture of this many-sided policy, but rather to indicate the general principles. These may be formulated so as to approach, as closely as possible, the ideal situation with respect to prices and supply of transportation services in all the compartments of the industry. This situation is the one described by the theory of free competition, where prices are equal to average unit cost. Because of the technical characteristics of the industry there is a permanently recurring tendency towards deviations between actual and ideal prices and supply. The bulky investments needed for railways and ships imply a tendency to over- or undercapacity; the small investments needed for road and inland waterway transportation imply a tendency to over-investment. If prices were left free, they would, as a consequence of the inelasticity of demand, tend to show heavy divergencies either upward or downward from equilibrium prices. In the branches with bulky investment the tendency to unreasonably low supply prices, only covering a little more than short-term marginal cost, will prevail in periods or in market compartments with over-capacity. This will, in turn, produce a tendency towards monopoly, leading to unreasonably high prices. The instruments of economic policy enumerated under (iii) have to be used in order to let prices and supply approach their ideal level as much as possible. Price setting may have the function of protecting the industry against cut-throat competition and protecting the customers against monopoly exploitation. Concessions will have to restrict investments to what can be reasonably expected to be needed; in cases of over-capacity the formation of an artificial monopoly may protect the industry. In cases of unreasonably restrictive practices the control of a monopoly may be necessary.

3.77 The policy pursued may be a looser one or a more rigorous one. A looser policy will only act in case of large deviations between the actual and the ideal situation; a more rigorous policy will begin to act with smaller deviations. The more rigorous the policy, the more need there will be for exact figures about what constitutes a reasonable price; and here the biggest practical difficulties arise. Cost calculations are difficult because, on the one hand, of certain theoretical problems involved and, on the other hand, of the lack of precise data. Cost calculations made by private enterprises are sometimes "falsified" by

the existence of irrational taxes or by the absence of rational charges. Theoretical difficulties are, for example, those connected with the true costs of a road constructed in a low-price period, and those connected with the splitting up of joint costs between various types of freight. Precise data are not always available because of bad administration (small enterprises), secret administration (big enterprises) or because of theoretical difficulties about what types of data are relevant.