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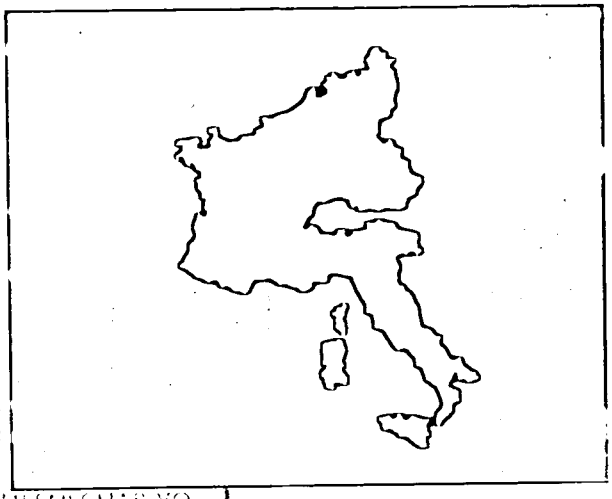

Methods of fore

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1960 - No. 6

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DELLE COMUNITA' EUROPEE**

**BUREAU VOOR DE STATISTIEK
DER EUROPESE GEMEENSCHAPPEN**

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METHODS OF FORECASTING LONG-TERM ECONOMIC GROWTH

Report by a group of experts

FOREWORD

This issue completes the eighth year of "Statistical Information".

Some readers may find the report which follows rather technical and, therefore, complicated; but the subject considered by the experts — a critical analysis of methods of forecasting long-term economic growth — is of such importance and their findings are set out so competently that the Statistical Office felt that their report should be circulated as widely as possible.

The experts are, of course, solely responsible for the study carried out.

We would ask readers of "Statistical Information" to excuse the slight delay in publishing this issue, caused by technical factors.

Luxembourg/Brussels, 1st March 1961.

Rolf WAGENFÜHR
Director - General of the
Statistical Office of
The European Communities

Monsieur Pierre Malvestiti

President of the High Authority
of the European Coal and
Steel Community, Luxembourg

Sir,

In May 1958, the High Authority instructed the undersigned Group of Experts to prepare a report on long-term forecasting methods.

The scope of this report was defined as follows in a letter, dated 29th July 1958, from the chairman of the Group :

"The aim of your studies will be to lay down a method :

a) which can be used in all countries of the Community without undue preliminary work;

b) which will enable forecasts to be made on the basis of certain hypotheses formulated by the experts....."

We believe that we have complied with these terms of reference by seeking to assemble the essential elements of a method suitable for use in each of the six members of the Community. We have not tried, therefore, to formulate a method of forecasting for the Community as a whole, but to establish an uniform methodological basis for national forecasts, to be combined subsequently in a forecast for the whole Community.

In the course of our studies we found differences not only between the methods used in the six countries but also in the aims of long-term forecasting, the legal status of forecasting departments and the form of forecasts. We, therefore, decided to summarise work on the subject to date in the countries of the Community and, at the same time, to review the present state of knowledge and scientific methods for long-term forecasting.

While recognising that forecasts may have different purposes in the various countries, we have felt able to recommend some standardisation of long-term forecasting methods.

Such standardisation is essential to enable national forecasts to be compared and later to be checked for mutual consistency; it is made easier by the fact that the procedures used in the various countries have many points in common. At the same time, it must be flexible enough to suit the economic policies and institutions of each country.

On this basis, we now have the honour, Sir, to transmit the report we were asked to prepare.

In so doing, we should like to draw special attention to a number of points.

First, our report does not claim to be exhaustive, because scientific research into long-term forecasting, although very active for some years, has not yet definitely formulated completely acceptable rules regarding methods.

However, a number of points concerning methods and possible solutions, which will be of interest to specialists only, are discussed in the various chapters and appendices. The whole report is briefly reviewed in the first chapter to facilitate application of the methods which we recommend. This summary sets out our main findings.

Finally, we wish to make it clear that the members of the Group are personally responsible for the drafting of the report. The views and proposals put forward do not therefore, commit the organisations and services from which some members of the Group are drawn.

Representatives from the following organisations also took part in our studies:

— Organisation for European Economic Co-operation (O.E.E.C.);

— Commission of the European Economic Community;

— Commission of the European Atomic Energy Community.

Mr. Abraham, a member of the Power Economy Directorate of the High Authority, acted as secretary to the Group and drafted the report in final form. We wish to thank him most warmly for the highly efficient manner in which he has carried out his duties.

Yours faithfully,

Rudolf Regul, Luxembourg, *Group Chairman*,

Wilhelm Bauer, Essen

Jean Benard, Poitiers

Vera Cao-Pinna, Rome

Claude Gruson, Paris

Etienne S. Kirschen, Brussels.

Pieter J. Verdoorn, The Hague.

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CHAPTER ONE

INTERPRETATION OF TERMS OF REFERENCE, METHOD OF APPROACH SUMMARY OF STUDIES

A — INTERPRETATION OF TERMS OF REFERENCE

1. By its terms of reference to the group of experts, the High Authority stated its intention that all forecasts made by the various European institutions in collaboration with the competent authorities in member countries should be based on jointly-formulated methods, allowing comparison between countries.

We believe that we have complied with these terms of reference by seeking to assemble the elements of a method suitable for use in each of the six countries of the Community.

We have not tried, therefore, to define a method of forecasting directly applicable to the Community as a whole or a specific method for each country, but to work out a *uniform methodological basis* for national forecasts, to be combined subsequently into a forecast for the whole Community.

Any method of forecasting must be related to the particular target. Economic forecasting is not a self-contained activity but is always designed to provide more or less accurate information as a basis for a decision, or a number of decisions, to be taken by undertakings, governments or international organisations. The form and method of forecasting depend not only on the basic data used but also on the kind of decision to be taken.

These two fundamental points — the kind of decision to be taken and the type of basic data available — must, therefore, be stated clearly, first of all with reference to the work of the High Authority itself. The latter has to make forecasts, partly to keep in touch with the general economic trend of the countries of the Community, but principally to assess the prospects in terms of which separate coal and steel production targets have to be set and more general proposals formulated for energy policy. The problem is similar for the European Atomic Energy Community for matters within its province. Beyond the special requirements of these two communities, the European Economic Community wishes to compare the long-term forecasts of its six member countries, in order to discover any inconsistencies. The basic data for forecasts must be provided by the member countries.

In view of the foregoing, the High Authority's long-term forecasts must be:

— sufficiently detailed to show clearly the elements on which coal and steel production targets mainly depend;

— produced by combining national forecasts, which must be compiled on a co-ordinated basis to make forecasting possible.

2. This led us to consider the manner in which member countries produce their forecasts, and the possibility of co-ordinating the latter. Forecasts differ quite substantially from country to country; their aims are not the same, the agencies responsible differ as regards administrative status and methods used, and the actual forecasts are produced in different forms.

i) *Aims of long-term forecasts*

The aim of forecasts in their general form is to deduce the main lines of economic progress as determined by the main growth mechanisms, namely, the increase of the labour force, and particularly of the industrial labour force, the growth of fixed capital and technical progress.

In most cases, forecasting aims are now also considered to include identification of the structural changes which accompany economic growth.

In some countries, forecasts also have to form the basis for government planning and, particularly, for financial measures to promote what are considered to be necessary changes in the structure of industry, agriculture and commerce. In addition, they have to provide basic data for production sectors using long-term capital and therefore needing te take account of the government's economic development plans.

ii) *Status of forecasting agencies*

In some countries, forecasts are produced by public bodies with varying and still indeterminate powers of co-ordination over all State economic services. They may even be required to work in conjunction with private firms or their representative associations.

In other countries, the responsible agencies are government services associated with the departments responsible for the implementation of economic policy and with undertakings, but playing no active part in formulating government decisions and investment programmes.

In yet other cases, long-term forecasts are produced by private research institutes working independently.

iii) *Types of forecast*

A very general distinction can be made between, first, an overall forecast estimating the future level of a few major aggregates, such as gross domestic product, private and government consumption, capital resources and capital formation for a whole economy and, secondly, a more *detailed* forecast analysing the future course of the various components of final and intermediate demand in order to arrive at conclusions regarding *output trends* in the various sectors and branches of the economy, the labour and capital requirements of those sectors and branches, and the growth of imports of the various classes of commodities.

3. In some countries, the *overall* estimate is the *main* stage of the procedure. In its most developed form, the aim is to compute the rate of growth and future level of the various aggregates by means of a series of functional relationships expressing the interaction of the most representative variables of general economic progress. The purpose of the detailed forecast is then to provide a transposed image of the overall growth hypothesis, which can be used direct by individual economic sectors for their own forecasts.

In other countries, the overall forecast is regarded only as a *preliminary* stage, and is merely a first exploration providing a .basis for formulating one or more growth hypotheses. The purpose of the detailed forecast is then to study the possibility of implementing these hypotheses, by assembling complete data regarding the growth conditions of final demand and output and comparing them by the application of a number of consistency tests, so that the overall forecast finally becomes a synthesis of all data assembled concerning conditions of growth for each element in demand and each branch of production. Government plans are, of course, included in these data :

— plans which, although not linked with a growth target, form part of the premises of economic growth :

— specific measures to achieve a growth target and forming part of a co-ordinated programme.

B — BASIS AND STRUCTURE OF THE REPORT

4. The Group's task was, therefore, to find a common basis and points of comparison between studies differing substantially as regards aims, form and body responsible.

We thought this to be possible because, regardless of the approach adopted, the various forecasts raise a number of common problems and use techniques which overlap to a certain extent.

The common problems relate mainly to the actual purpose of a long-term forecast, the fundamental hypotheses on which it is based, the kind of techniques likely to be used and the general manner in which those techniques can be applied. These general aspects of long-term forecasting are dealt with in Chapter II.

As regards the techniques used in forecasting, a basis for comparison can be found by studying the methods adopted for detailed forecasts.

Under the practice currently followed in the Community, detailed forecasts are not obtained by solving a system of simultaneous equations expressing the interaction of the various categories of demand and supply; they are, rather, the culmination of a series of successive approximations and of an iterative process leading, by stages only, to a final estimate of the future level of the different variables. A detailed forecast therefore, implies an overall pattern based on the overall forecast.

We, therefore, concluded that we should, in any case, define a *method of producing an overall forecast,* because this first stage is necessary for all countries, either to fulfil the main purpose of forecasting by identifying the main lines of future growth, or as an exploratory procedure to determine the basic hypothesis for a detailed forecast.

The methods to be used for the overall forecast are discussed in Chapters III and IV. Under the title "Overall estimate of supply" we have tried in Chapter III, to construct a model to be used essentially for computing the future *output of non-agricultural* undertakings.

For this aggregate, averaging 80 % of gross domestic product in the Community, we were able to recommend a number of methods and formulae, the theoretical basis of which has been discussed in detail in economic literature. They have also been checked statistically for a number of countries.

An overall forecast of *gross domestic product* is then arrived at by adding an estimate for the sectors which we regard as exogenous, namely agriculture, public services, and housing.

In Chapter IV we show how a semi-overall estimate of *demand* can be fitted to this overall forecast of output, by adding to the first estimates for capital formation, analysing public demand, formulating a hypothesis for the foreign trade balance and computing the probable growth of private consumption by main classes of needs. This part of the report concentrates on the procedure to be followed and the flexible codification of the criteria to be applied when estimating the main components of final demand. This section concludes with a suggested method for a preliminary comparison of the supply and demand forecasts.

We then considered at length whether our attempt to find a common basis for forecasts should extend to the detailed forecasts, and should, therefore, cover special growth conditions for the individual elements in final and intermediate demand and, correspondingly, for the various branches of production.

We found that national procedures vary most widely on this point. At this stage differences between "pure" forecasts and those forming the basis of government planning become more marked and it becomes very difficult to lay down uniform methods because of the diversity of the basic data available and the techniques which can be applied.

We are, however, aware of the need to define a framework and a method for the transition from overall to detailed forecasts.

This second stage must clarify and develop the overall forecast, indicate structural changes as a guide to government action and provide undertakings with fuller details of the prospects with which they will be faced. In the case of the High Authority, this stage must provide the necessary information on iron and steel, coal and energy in general and must allow the incorporation of special studies of these sectors into a general economic pattern.

Furthermore, it is only at the stage of growth forecasts that national growth hypotheses can validly be compared by a detailed analysis of foreign trade prospects.

The present report is only a first contribution to the solution of these problems.

First, the procedure suggested in Chapter IV for the semi-overall estimate of demand assists the transition to detailed forecasts by suggesting an estimate by main *classes of use*, particularly for private consumption. In this way, detailed forecasts can be started by breaking down these estimates into separate products.

Secondly, Chapter V quotes, as an example, the procedure used for detailed forecasts in France. Without expressing any final opinion regarding the application of these methods in the other member countries, the Group consider that this contribution offers a useful guide to the techniques which can be used and the conclusions which can be drawn from detailed forecasts.

The general tenor of the report can now be defined in the light of the foregoing remarks. It recommends a procedure for the solution of a detailed growth model by a series of successive approximations. It divides the forecasting process into a number of stages which vary in complexity, starting with an overall forecast of supply and concluding with a detailed forecast by elements of demand and sectors of production. Each stage has a separate model but the models for all stages are linked with each other. At the overall stage, the main emphasis is on econometric systematization, but more use is made of direct estimates for the detailed forecasts.

C — SUMMARY OF STUDIES

5. In conclusion, we thought it useful to summarise our studies and the results obtained.

We began by reviewing the present *state* of long-term forecasting in the countries of the Community, noting differences and possible points of similarity.

As indicated in the previous sub-section, we consider that a common basis can be found primarily at the *overall* forecast level, but that the transition to detailed forecasts raises problems.

In order to comply with our terms of reference, we next had to undertake a *series of statistical studies* to provide a basis for the formulation of proposals regarding methods.

These studies comprised an empirical check of the various types of overall production function and an attempt to classify data from the input-output tables available in the countries of the Community according to a simplified nomenclature providing a basis for comparison between the various countries. The basic material and results of these studies are set out in the appendices.

For our work on *production functions* we had to collect or construct sufficiently long time series for output, employment and capital resources for a number of member countries.

Here we found the existing data to be inadequate, particularly in the matter of figures for the capital resources. Chapter III therefore contains an urgent recommendation that the governments of the six member countries should take steps, in conjunction with the Statistical Office of the European Committee, to *estimate their country's capital resources.*

From our calculations using the available basic material we concluded we concluded that it is preferable to analyse economic growth by means of functions allowing substitution between the labour and capital factors, but that studies only give statistically valid results when restrictions are imposed on the numerical values of certain parameters.

As regards *input-output tables*, our studies show that the difficulty of standardising the tables for the various Community countries is not primarily a matter of differences in nomenclature but rather of differences in the principles followed in the evaluation of transactions and the treatment of imports. Our attempt at harmonisation was confined to the nomenclature for the time being.

These statistical studies have some intrinsic value, insofar as they help to clarify certain aspects of the present economic structure and of earlier economic growth.

Within our terms of reference, however, they could not be regarded as the basis of *methodological studies relating to long-term forecasting*. The results of our studies and discussions on this particular point can be summarised as a series of proposals concerning:

i) The general aspects of long-term forecasting;

ii) The overall forecast of supply;

iii) The demand forecast and comparison of the supply and demand forecasts;

iv) The transition to detailed forecasts.

i) *General aspects of long-term forecasting*

a) Long-term forecasts exclude cyclical and chance fluctuations and are concerned with the normal growth which can be expected with full employment of the factors of production.

b) The premise of full employment assumes that unemployment is reduced to what can be regarded as a reasonable minimum for each country. It does not imply an identical level of unemployment in all countries.

c) Of the various forecasting techniques — extrapolation of trends, use of information obtained by inquiry, application of models — the last-named should be preferred as a general basis for long-term forecasting. The forecast then takes the form of a series of functional relationships expressing the interaction of the different variables.

d) With the *detailed* forecasts there is the difficulty that a complete econometric model cannot usually be constructed direct from the basic data. We therefore, recommend a series of successive approximations, using an *iterative process* with a specific model at each stage. These specific models will be linked and solved in a fixed order, with the possibility of returning to a previous stage.

e) Any serious analysis of prospects must consider the consistency of the estimates produced. Consistency tests will check the *probability* of the results obtained and also the *compatibility* of estimates for the same variable at different stages of the forecast, if the method of successive approximations is used.

ii) *Overall forecast of supply*

a) The first stage in the process of successive approximations will be a *forecast of total output*. At this stage the model must be kept simple, and will differentiate only between the non-agricultural sector and the three sectors treated as exogenous i.e. agriculture, public services and housing.

b) We recommend that the estimate for *non-agricultural undertakings* should be based on a production function explaining the growth of output in terms of the growth of labour and capital and of a time trend which is considered to represent the influence of all other factors, and of technical progress in particular.

In its general form, this function is written as :

$$v = \beta a^{\lambda} k^{\mu} e^{\nu t}$$

where :

v = volume of output,
a = quantity of labour,
t = time, which is considered to represent all other factors, and technical progress in particular,
k = capital resources,
λ = labour elasticity of output,
μ = capital elasticity of output,
ν = annual rate of increase of the residual trend.

For forecasting purposes, we recommend that only the number of persons employed should be included in variable "a", and that a variable "h" representing hours of work, should be added to the formula. Forming the differential of the function so modified we have :

$$\frac{\dot{v}}{v} = \lambda \frac{\dot{a}}{a} + \mu \frac{\dot{k}}{k} + \tau \frac{\dot{h}}{h} + \nu$$

where :

$\frac{\dot{v}}{v}$ = annual rate of output increase,

$\frac{\dot{a}}{a}$ = annual rate of increase in the number of workers,

$\frac{\dot{k}}{k}$ = annual rate of capital increase,

$\frac{\dot{h}}{h}$ = annual rate of variation in hours of work;

λ, μ, τ = elasticity of output in relation to the various factors of production,

ν = rate of increase of the residual trend.

c) The estimate of the rate of increase of the output of non-agricultural undertakings then involves :

— *The determination of numerical values for the parameters* λ, μ, τ *and* ν.

On the basis of empirical studies, we propose that the value of λ and μ should be 2/3 and 1/3 respectively.

The value of τ need not be the same for all countries. It is noted, for guidance, that a value of 0,7 was recorded for one member country.

Previous experience gives values ranging from 0,1 % to 1.6 % for ν. In our opinion the new impetus given by the establishment of the common market justifies raising these figures to 0,5 % and 2 % respectively. If forecasters in certain countries wish to use values outside these limits they should explain clearly the nature of their choice and give their reasons. If such values are adopted for *exploratory purposes* the forecasts for other countries should include variants based on these hypotheses.

— *An estimate of the growth of the independent variables* a, k and h.

Changes in variable "a", the number of workers, will be estimated exogenously on the basis of direct demographic and economic data, allowing for the anticipated agricultural and public labour force.

The growth of variable "k", capital resources, should preferably be estimated by means of an investment function linking output and capital formation over the whole economy or directly in the non-agricultural sector.

Variable "h" average hours of work, must be estimated direct.

d) At this stage, the estimates for the *exogenous sectors* — agriculture, public services and housing — will be provisional hypotheses arrived at in various ways. These hypotheses will have to be reviewed at subsequent stages of the forecast.

e) An estimate of *gross domestic product* is finally obtained by aggregating the estimates for the non-agricultural sector and the three exogenous sectors.

iii) *Forecast of demand and comparison of the supply-and-demand forecasts*

a) At this stage, a forecasting hypothesis has to be formulated for the main components of final demand i.e. private public consumption, gross fixed capital formation, increase in stocks and foreign trade balance.

These estimates will form part of a functional analysis preparing for the transition to detailed forecasts.

Some calculations, such as those for public consumption and the foreign trade balance, will be more clearly exogenous than others.

b) The main elements for the estimate of *fixed capital formation* will already have been obtained in connection with the forecast of total supply, because the capital resources, will have been estimated by means of an investment function linking output and capital formation. Public capital formation will be estimated as part of the functional analysis of public expenditure (see d) below) and housing capital formation as part of the estimate of housing expenditure (see f) below).

c) *Increase in stocks* will be covered by a straightforward hypothesis based on the increment of domestic product during the terminal year of the period covered by the forecast.

d) Estimates of *government consumption and capital formation* can be arrived at by a study confined to *final* demand and therefore covering current consumption of goods and services, expenditure on staff and purchases of capital goods. However, when these estimates have to prepare for the transition to detailed forecasts and must be suitable for full consistency tests, it may be preferable to include the analysis of final demand in a wider study covering *all* public expenditure (including transfers), sub-divided into the main administrative functions i.e. general administration, education, economic policy, welfare, national defence etc.

Expenditure on the different functions will be estimated, as appropriate, according the aims pursued or the general characteristics of economic growth, or on the basis of discussions with experts *from certain sectors.*

c) In the case of *foreign trade*, it may be sufficient at this stage to estimate only the *balance* of such trade on the basis of certain economic and political requirements or targets, In some cases, it will be preferable to estimate separately :

— either imports, in relation to domestic product, relative price levels and a time trend,

— or exports, in relation to the domestic product of customer countries, relative price levels and a time trend.

f) The volume of *total private consumption* may either be calculated as a *residual figure*, representing the difference between domestic product and the sum of all other elements in final demand, or may be computed *independently*. In the latter case, the fraction of the total product absorbed by private consumption may be treated either as a premise of economic policy or as a structural constant.

In all cases, consumption must be analysed by *main classes of commodity* (food, clothing, etc.).

The necessary material is provided by retrospective series, family budget inquiries and international comparisons.

According to circumstances and the data available, one or more of the following factors will be used as a variable explaining the growth of a particular class of expenditure :

— population,

— available income per head, represented for practical reasons by total consumption per head or per consumption unit,

— the distribution of incomes,

— relative prices,

— the effects of economic and social policy,

— spontaneous variations in consumption habits,

— the total stock of durable consumer goods.

The significance of each individual factor and the extent to which its influence can be incorporated as a quantitative term in the forecasting analysis, differ not only as between commodities but also as between countries. No uniform rules can, therefore, be proposed. For guidance, the report summarises the results of studies carried out in France.

g) When estimates have been made for output and the various elements in final demand, a preliminary comparison will be made of the results so far obtained.

The main points to be considered are :

— the consistency of the results obtained by aggregating the various estimates of consumption by classes of commodity;

— the compatibility of the output forecasts for the exogenous sectors (agriculture, housing and public services) with the corresponding items in final demand;

— the compatibility of the estimates for the foreign trade balance, imports and exports when they have been arrived at separately;

— the equilibrium of total resources and uses.

The *probability* of the levels forecast for the different variables will be checked and corrections made to equalise supply and demand, while at the same time ensuring at least roughly consistent relationships between the various components.

iv) *Transition to detailed forecasts by sector of production*

a) We recommend that the detailed forecasts should be produced in each country by methods enabling all data to be re-grouped in a simplified table of relationships between resources and uses, sub-divided into seventeen sectors of economic activity. The model proposed in table 1 is based on study of inter-industry relationships,

TABLE 1

Overall interrelation between resources and uses

RESOURCES \ USES	INDUSTRIES																	Capital formation		Public sector	Households	Rest of world		Total uses	
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	Total intermediate uses	Change in stocks	Gross fixed capital formation	Consumption	Consumption	Exports to EEC countries	Exports to rest of world	Final goods and services	Intermediate and final goods and services
SECTORS																										
01 Agriculture, forestry	-																									
02 Agricultural and food industries		-																								
03 Coal, coke and industrial gas			-																							
04 Electric power				-																						
05 Petroleum and fuels, natural gas					-																					
06 Building materials and glass						-																				
07 Iron ore, iron and steel (E.C.S.C. products)							-																			
08 Non-ferrous ores and metals								-																		
09 Engineering and electrical industries									-																	
10 Chemicals										-																
11 Textiles, clothing, leather											-															
12 Timber, paper and miscellaneous industries												-														
13 Building													-													
14 Transport														-												
15 Housing services															-											
16 Other services																-										
17 Commercial activities																	-									
Total intermediate resources																										
Value added (*a*)																										
Total output																										
Rest of world — Imports from E.E.C. countries																										
Rest of world — Imports from rest of world																										
Public sec. — Indirect taxation, less subsidies																										
Total resources																										

(a) Includes : Households, wages, profits, other incomes; capital formation; depreciation.

which have developed rapidly in most of our countries since the basic work of Leontief. We recommend the use of this table, particularly for the international comparison.

b) In the present state of theoretical and empirical studies we were unable to formulate a common methodological basis for the forecasts by branches of production.

One of the major gaps in the existing material is the shortage of information on production functions by sectors and on the causes and effects of variations in relative prices. We urgently recommend a thorough study of both these subjects.

c) In Chapter V the method at present used by the French Government services is described as an example of a forecasting procedure whereby estimates of output by branches are arrived at by successive approximations and the detailed information so obtained is then used to revise the overall forecast.

While unable to advise the application of this pattern in all the Community countries, we nevertheless recommend that all concerned should study it in detail. In this description they will find useful guidance on means of overcoming difficulties in the construction of a complete econometric model by a procedure comprising the following stages :

— breakdown of final demand by categories of *products*,

— study of intermediate demand with the help of a table of inter-industry relationships,

— estimate of output, productive investment and labour requirements by sectors, with the help of an input-output and by consultation of experts,

— return to the overall forecast on the basis of information obtained during the detailed forecast; revision of hypotheses formulated in the overall forecast, study of alternative solutions and consistency tests.

6. These are our main recommendations, which should be regarded as a first contribution only. We hope, however, that our suggestions, as summarised above and developed in subsequent chapters, will be of assistance in long-term forecasting.

Before closing this introductory section, we wish to add to these recommendations, forming the practical result of our studies, two *general conclusions*, which emerge from our discussions as a whole.

The preference expressed in this report for the application of models and the importance attached to consistency tests in the case of forecasts by successive approximations, reflect our desire that long-term forecasts should follow a logical pattern respecting inter-relationships between the different variables and ensuring the consistency of all estimates.

To this end, we have used econometric relationships wherever this has seemed possible and opportune.

On the other hand, we have abandoned such formulae whenever, at a given stage of the forecast, they have seemed to be too general or based on assumptions which cannot certainly be regarded as permanent in future, even though they have proved so in the past.

In such cases, we have recommended direct estimates, where, in addition to quantitative data, the element of *judgment*, based on knowledge which cannot be measured statistically and on the powers of deduction, and even the "flair", of the forecaster, play an important part. The value of a procedure using successive approximations lies precisely in the fact that it allows comparison of various approximations, some based on functional relationships adequately proved to be reliable and of general application and others resulting from direct estimates, in which the element of judgment and knowledge of exogenous and intentional factors play a significant part.

Our second conclusion relates to the distinction between what might be called a *pure forecast*, concerned essentially with estimating "spontaneous" economic growth, and a forecast more concerned with *"decisions"* which includes certain target-variables and is designed to give guidance to the government in achieving those targets. These, of course, are the two extremes, between which many intermediate positions are possible, and indeed are adopted in practice in the industrialised countries of the West.

The report shows that the techniques to be used for these two types of forecast overlap to a considerable extent, but we feel that we should draw attention to a major difference of emphasis.

A "pure" forecast is not required to specify ways and means of implementing a growth policy. It merely stipulates the conditions of growth and, on the basis of what is known of the behaviour of all centres of decision on which growth depends, weighs the chances of those conditions being fulfilled.

Simply by virtue of its existence and its statement of the conditions of growth, such a forecast may induce the various centres of decision on which economic growth depends to move in the direction of consistent growth. Nevertheless, a pure forecast must consider the possibility that decentralised decisions, however enlightened, may be incompatible with each other or, for some reason, may not ensure regular growth. The forecast must assess these risks and their effect on rates of growth.

During the past years known to us, the decisions on which growth depends have not always been consistent. The rate of growth actually achieved, therefore includes the weight of such inconsistencies so that the systematic interpretation of historical experience is a valuable instrument for the establishment of pure forecasts.

In forecasts taking account of decisions, such systematic interpretation of the past is regarded only as a starting point. Forecasts of this kind do not, of course, ignore the firmest and most permanent structural relationships deduced from the past, but treat them as "limiting factors". However, the essential feature of this type is that it defines a consistent complex of targets and means of eliminating the inconsistencies which have hitherto held back economic growth. A badly-constructed forecast is merely a programme of action whose effects are uncertain. If, on the other hand, the means are in general clearly shown to be adequate and fully applicable, the targets laid down can be accepted as forecasts.

A "pure" forecast will generally tend to lay more emphasis on functional relationships using parameters with numerical values deduced from observed facts; a forecast taking account of decisions will rely more on direct estimates which allow the inclusion of exogenous and intentional elements.

In this report, which is concerned with methods, no preference had to be stated for either type of forecast. The fact that its completion has proved possible tends to show that the two types should not be impossible to reconcile provided their essential characteristics are clearly stated.

We wish to bring this point to the particular attention of the High Authority whose duties involve both forecasting and the definition of "general targets", that is, the systematic interpretation of the past and the taking into account of certain objectives.

CHAPTER II

GENERAL ASPECTS OF LONG-TERM FORECASTING

Section I — Purpose of long-term forecasting and methods used

7. To put our recommendations into proper perspective, we shall first examine some of the main features of long-term forecasting and then set out the advantages and disadvantages of the various methods suggested. Our remarks will be confined at this point to the main considerations by which we were guided in framing our recommendations, with particular emphasis on the possibility of using models as the medium for a long-term forecast.

A — THE CONCEPT OF A NORMAL TREND

8. The first point to be noted is the fundamental difference between short and long-term forecasts.

Throughout the remainder of this report the latter term is used to mean estimates covering a period of not less than ten years, i.e. extending beyond fluctuations attributable to cyclical or chance factors.

Forecasts covering so long a period are needed as a guide in taking certain decisions regarding investment and long-term policy. To the extent that they throw light on the economic conditions likely to prevail after the transitional stage of the European Economic Community, such forecasts are of undoubted value and, from this standpoint, are regarded as most important by the three European Communities.

When seeking to establish the difference between this type of forecast and short-term estimates, two elements must be distinguished in the trend of the aggregates to be forecast. The first component is the normal trend to be expected if full use of production factors is maintained (1). The second, which may be regarded as superimposed on the first, reflects the influence of changes in the general level of economic activity and also represents the influence of change factors such as wars and political tension.

In short-term forecasting an exact estimate of cyclical trends and of the influence of chance factors is the essential requirement, but as the period covered by the forecast lengthens these elements become less important and are replaced by the most accurate forecast possible of the normal trend.

9. This change of emphasis first of all affects *the premises* on which the forecast is based. We take the view that neither the period nor the extent of cyclical fluctuations remains constant, so that an estimate of the general level of economic activity over a period of ten years is impossible. This difficulty is usually overcome by assuming that forecasts relate to a year of normal activity.

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(1) Under structural unemployment conditions; if full use of existing equipment is maintained.

In the great majority of cases, this assumption appears to meet the purpose of the forecast. The aim is not to determine what the national product will be at the end of the period covered by the forecast, assuming 15 % unemployment; the required aggregate is the national product with normal use of production factors. The same applies *mutatis mutandis* to chance factors.

This assumption of a normal level of activity is usually referred to as the *hypothesis of full employment.* In our view this definition is acceptable provided it is not regarded as necessarily implying that the level of unemployment and the proportion of capacity used are identical in all countries.

Experience shows that through the influence of structural factors the percentage of unemployment to be regarded as normal varies from sector to sector and country to country. Here the position can be affected by institutional elements in addition to economic factors.

We consider, however, that a uniform approach can be made to this problem by simply interpreting the standard hypothesis of full employment to mean that the level of unemployment is such that it can be considered a *reasonable minimum* for the country concerned, having regard to existing structure, anticipated changes in structure and the economic policy followed. We would stress that this interpretation is fully compatible with the maintenance of stable prices and external equilibrium.

10. The special character of long-term forecasting affects not only the premises adopted but also the choice of *systematic relationships and estimation of the coefficients* involved in those relationships. The relationships and coefficients used must not reflect the trend and interdependence of the different variables during the trade cycle, but must relate exclusively to the normal trend component.

This means, first of all, that a special type of relationship will have to be used in analysing annual statistics. Secondly, measurement of the coefficients expressing the long-term trend raises problems regarding the statistical material itself. The original time series are influenced by cyclical and chance fluctuations and, as a result, cannot be used directly for long-term forecasting. We shall return to these two points in our examination of the various methods of forecasting.

Finally, the concept of a normal trend does not prevent the aims of economic policy from being taken into account in long-term forecasting. Both in the assessment of intentions and in straightforward forecasting, the aim is to estimate growth, *excluding all cyclical and chance elements.*

B — SURVEY OF THREE METHODS OF LONG TERM FORECASTING

11. All long-term forecasting methods can be classified under three headings:

i) straightforward extrapolation;

ii) the use of information obtained by means of inquiries;

iii) the application of models.

As will be shown later, these three methods are not mutually exclusive and under certain conditions can be used simultaneously. Their use will, however, depend on the particular characteristics of each. The main features of the three methods and their advantages and disadvantages are, therefore, briefly reviewed below.

a) Straightforward extrapolation

This method is based on the assumption that the average annual rate of increase as measured over several decades will vary only slightly. Experience shows that, over very long periods, relatively constant rates of increase can be assumed for certain variables. This applies for example, to *per capita* real national product, industrial productivity, etc. Since the purpose of long-term forecasting is precisely to estimate the normal trend, a fixed rate of increase of this type could be used as a representative figure in extrapolation.

As the term to be measured is not actual growth but normal growth over a period, *mathematical trends* are normally used in long-term extrapolation.

The reference period used for calculating the trend must therefore be relatively long in order to ensure that the calculated rate of growth is not too greatly affected by cyclical and chance factors.

Another possibility is to compare two economically-favourable but fairly widely-separated years such as 1890 and 1910 or 1929 and 1957, and deduce from them an average rate of growth for the period under review. The rate so calculated is then taken to represent normal growth over the period covered by the forecast. This variant can also be used when there is no continuous series of annual figures but ten-yearly censuses are available.

Advantages :

i) As compared with intuitive forecasting, extrapolation from empirically-deduced figures representing "normal growth", has the advantage of being based on a method which allows objective *measurement.*

ii) As forecasting by extrapolation is based on past growth it can be guaranteed not to go beyond the limits of what experience has shown to be *possible.*

Disadvantages

i) The first objection relates to the purely *mechanical* character of a method whereby the trend of a specific variable is defined as a fixed function of time. This presents two disadvantages. First, analysis is difficult; for example, the *causes* of an increase in *per capita* income cannot be more closely analysed. With extrapolation, any correction to the calculated value of the trend must of necessity be arbitrary.

The second difficulty, which is linked with the first, is that the *interdependence* of economic aggregates is not satisfactorily expressed. This rules out all possibility of considering different hypotheses regarding such factors as population trends or capital formation. When mechanical extrapolation is used, there can be only a single value for the historical trend.

ii) Certain variables can undoubtedly be regarded as showing a regular trend over very long periods.

We consider, however, that *the rate of growth can differ so much* during successive periods that the method loses its practical value.

iii) Such differences in the underlying rate of growth during successive periods (as, for example, between the average rates over the periods 1880-1899, 1900-1929 and 1929-1957) also throw doubt on the advantage of being able to use *measured* values.

When rates of increase differ, the value of the trend used to extrapolate depends very greatly on the reference period selected. Consequently, the results obtained may only be of a contingent nature.

Moreover, truly representative trend values are difficult to calculate not only because the necessary statistics are not available but also because of the gaps caused by the wars.

Nevertheless, extrapolation of the trend often provides useful information which can be compared with the results obtained by other methods of forecasting and thus provides a check on the reliability of the various estimates.

12. How should the immediate post-war years be treated ?

The use of trend coefficients may lead to serious difficulties if the reference period selected is unusually short or affected by specific influences.

We would particularly stress the disadvantages of this method if the last few years are used as a reference period for calculating trend coefficients.

This would involve the assumption that over the next ten to twenty years all factors present during this reference period (rising or falling level of activity) will have an unchanged influence on the level attained.

A number of circumstances, arising from the stagnation of the thirties and the years of the second world war, can be advanced to explain why, for example, real *per capita* income rose substantially more between 1949 and 1957 than might be considered normal for a long period.

i) As a result of the disorganisation of the private sector after the war, physical output per man started from a very low figure. It clearly took a fairly long time to regain a normal level.

In one member country, a special factor was the cessation of piece rates immediately after the war; while the gradual reintroduction of piece-rate systems subsequently acted as a considerable stimulus to productivity.

ii) The marginal productivity of investments was particularly high over the relevant period.

During the thirties and the war years, the rate of capital replacement was very low. Indeed, some of the means of production replaced during the years after 1944 had been in use for almost thirty years, whereas, under normal conditions replacement would have been necessary after about fifteen years.

Replacement, therefore, had the advantage of following an exceptionally long period of technical progress, extending to twice the normal number of years in the example quoted. During each of the immediate post-war years, part of the apparatus of production was therefore raised to a new and much higher technical level, without, as it were, passing through any intermediate stage.

iii) In the economies of the members of the Community, the post-war years were also marked by an increase in the share of the national product made available for new investment in the private sector. Any permanent increase in this rate of investment is a powerful stimulus to the growth of *per capita* income. However, this stimulus is no tconstant but gradually weakens over the years. This particular aspect of the recovery period is discussed in greater detail in Chapter III (Section 28).

Graph N° 1 suggests that the above circumstances and other similar elements, closely connected with the second world war, in fact exerted a major influence. The rate of change of industrial productivity, calculated as far as possible on a man-hour basis, is shown for four members of the Community and three non-member countries (1).

Despite statistical difficulties, two points seem to be clear :

i) Productivity rose more in the countries which had been most directly engaged in hostilities proper (since the scale of the graph is logarithmic identical slopes correspond to identical rates of increase).

ii) The lower the starting level — 1950 for Germany, 1947 for the other countries — the greater the increase. The graph further suggests that the process of catching up extended well beyond the years immediately following the war.

If we take the observations for the United Kingdom and the United States as representing normal growth, the graph shows that France, Italy and Germany did not reach this "normal" level until 1956-1957 and that, subject to certain statistical objections, the Netherlands were still below it in 1957.

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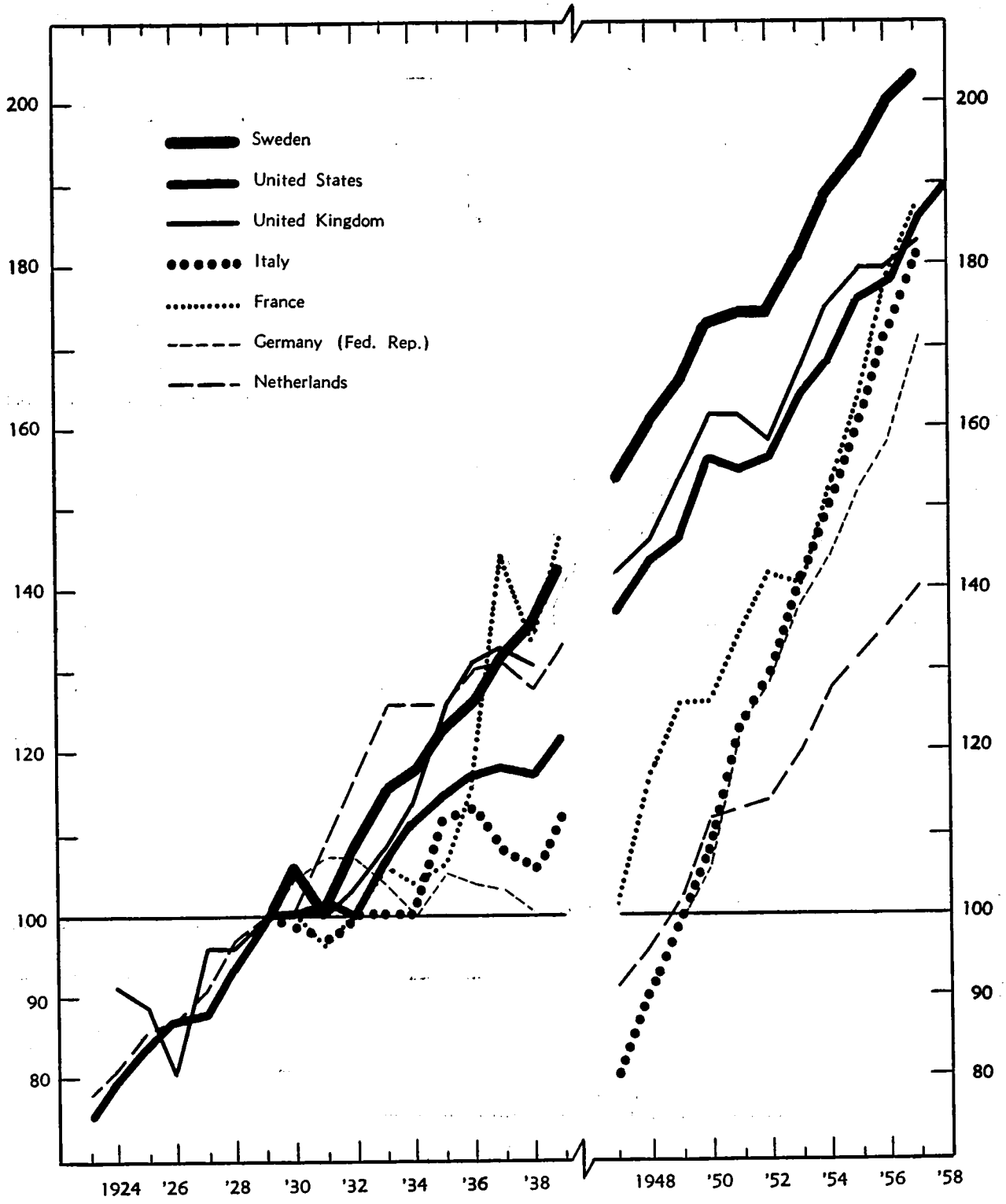
(1) The data are taken from the publications of several international organisations and are supplemented where necessary by figures from national sources (see Appendix 1). We recognize that comparison of industrial production indices for the years 1929 onwards with those for the post-war period is very difficult; international comparability could be improved by adopting an uniform weighting system for indices.

FIGURE I

HOURLY INDUSTRIAL PRODUCTIVITY

(1929 = 100)



Graph N° 2 confirms the relationship between average rate of increase in productivity and starting level, both for the ten years 1947 to 1957 and for the period 1950-1957. Clearly the process of "catching up" had not been completed by 1950.

All these considerations suggest the inadvisability of using the last ten years as the *sole* reference period for extrapolation. Obviously, rates of growth may be relatively high over the next few years. New stimuli are provided by such events as the formation of the European Economic Community and planned expansion may also help to maintain a high rate of growth. However, if we take such factors into account in our calculations, we immediately go beyond straightforward extrapolation of the recent trend.

b) Use of information obtained by means of inquiries

13. Although this method is widely used for short-term forecasting, it has not yet been generally adopted for long-term forecasts and the methodological significance of this means of investigation is still largely unexplored.

We shall, therefore, try to consider more closely :

— the scope of the inquiry method;

— its methodological value firstly, for a general forecast and, secondly, for a more detailed forecast.

We first wish to make it clear that we do not regard this method as being solely confined to sampling based on questionnaires by means or interviews, we look upon it rather as a *systematic inventory of all technical and economic information available* in a given field.

It therefore includes not only discussions with government departments, trade associations, consultative committees and individual experts, but also the use of economic and technical works of reference.

In this way, it may be hoped to obtain material on :

a) Certain *government spending plans*

For example, on education in the case of consumption expenditure and on road programmes in the case of capital expenditure.

b) Investment programmes and production capacities of large undertakings

This is particularly necessary in the case of certain nationalised undertakings, and undertakings in which public authorities have very large holdings

c) Trade associations' production forecasts for certain sectors

d) Anticipated technical progress in certain sectors

Difficulties arise fairly quickly, however. The first are quantitative in nature, since even in the case of large undertakings many producers and consumers have no detailed or concrete plans for more than one or two years ahead. Again, the *communication* of certain figures very often gives rise to considerable difficulties. As a result, it is frequently impossible to obtain a complete picture of the anticipated growth of a *whole sector*. Data are fragmentary, particularly if the co-operation of trade associations is not obtained.

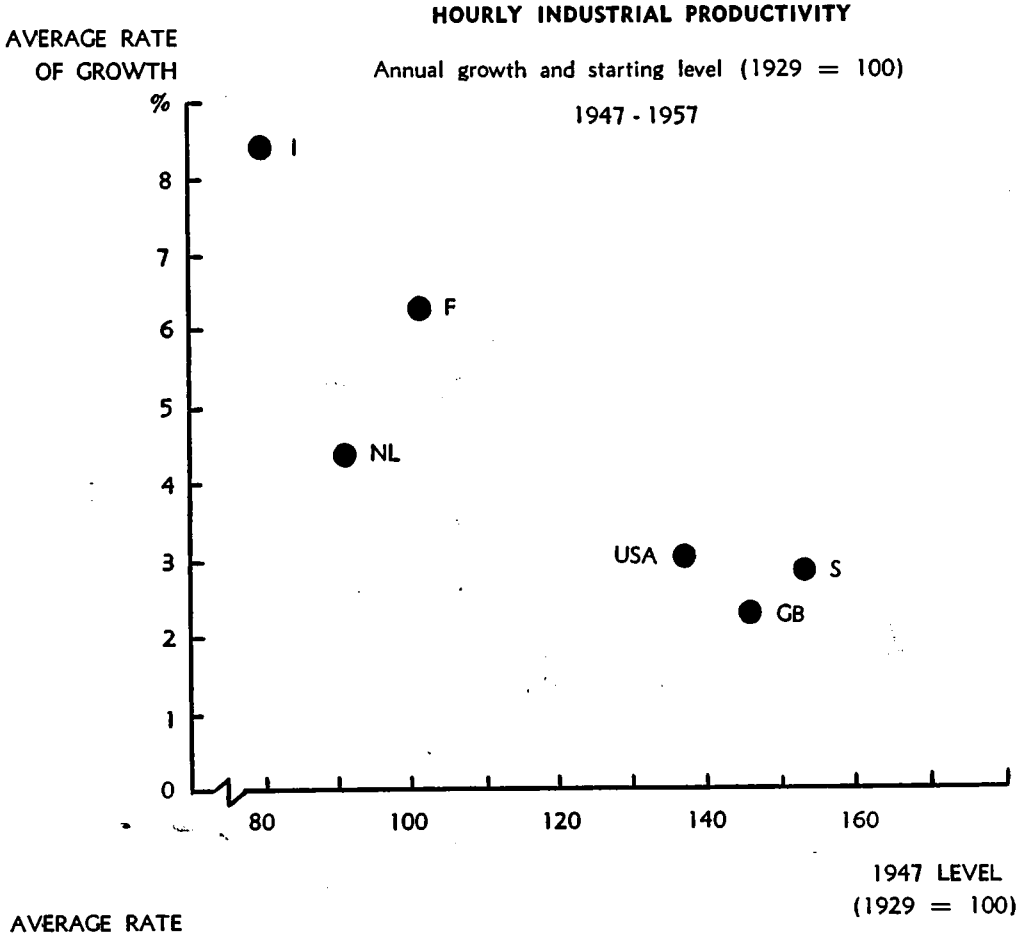
In addition there are difficulties of a qualitative nature. The plans collected are frequently based on *widely-differing assumptions regarding future growth* and are incompatible with each other. Moreover, they often project the existing situation in a particular branch and are liable to modification as the short-term situation changes. In other words, they are not very suitable for forecasting a normal long-term trend.

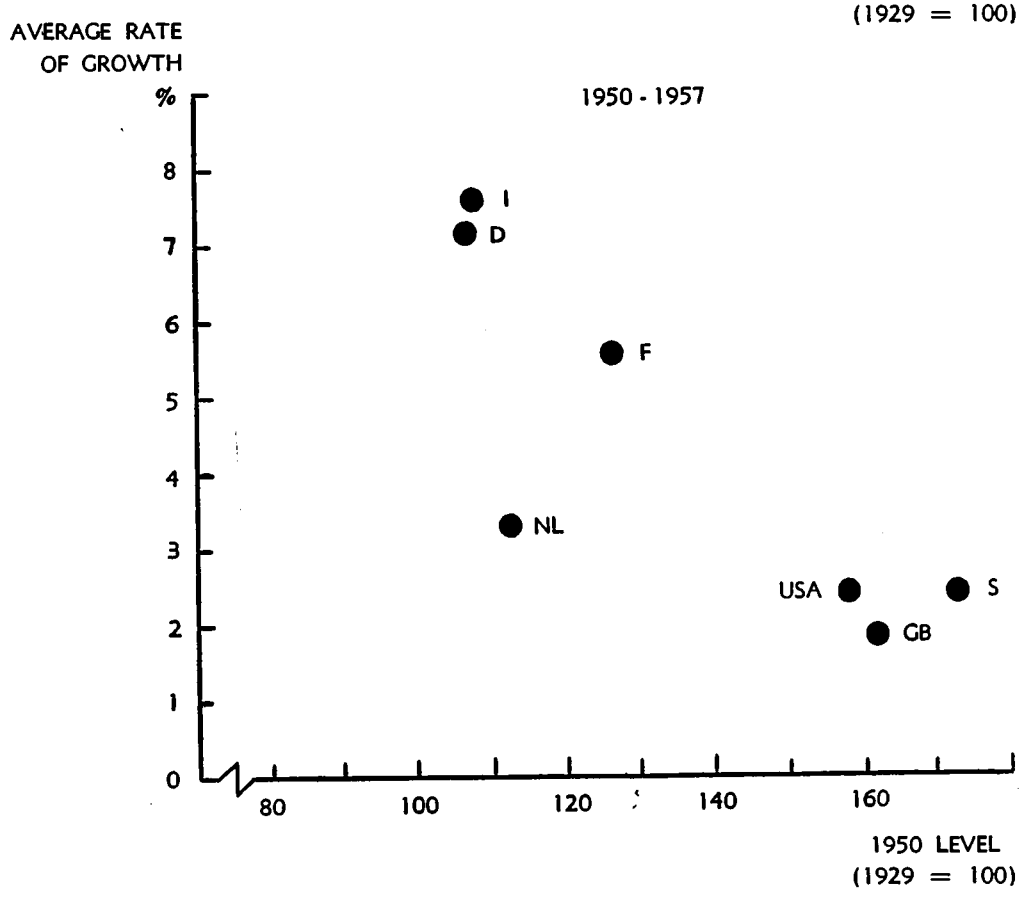
A number of conclusions can now be reached regarding the significance of this method.

FIGURE 2

HOURLY INDUSTRIAL PRODUCTIVITY

Annual growth and starting level (1929 = 100)





It is of little importance for the overall forecast planned as a first stage, when its value is severely restricted by the impossibility of aggregating fragmentary and scarcely compatible data. At this point it can, however, be used to estimate certain exogenous variables, such as agricultural productivity.

There is much greater scope for this method at the stage of more-detailed forecasting. Firstly, a general hypothesis regarding future growth can be laid before the persons consulted, who can be asked to work out the implications for their particular sectors. This method at least guarantees that the general hypotheses adopted for the different sectors will be compatible. Secondly, the investigator himself can try to produce sector forecasts on the basis of the general hypothesis. The "inquiry" then consists of comparing this forecast with the views of experts from the sector concerned.

At this stage, the inquiry becomes a means of adding considerably to the information obtained from the preliminary forecast.

Chapter V gives an example of the use of this method for detailed forecasts.

c) Application of models

14. By contrast with the mechanical extrapolation of a trend, forecasting on the basis of a model can be defined as "analytical forecasting". Dependence on time is replaced by a series of *functional relationships* expressing the interaction of the different variables.

Long-term forecasting involves two main categories of variables. The first are *endogenous*, interacting variables, exemplified by the relationship between national income, savings and investment. The numerical value of these variables cannot be estimated independently of the level forecast for the other variables but is determined by the functional relationships used and by hypotheses based directly on the *exogenous* variables.

On the other hand, the numerical value of *exogenous* variables can be estimated independently of the level forecast for endogenous variables.

Here we are concerned first of all with non-economic variables such as total population increase, which determines labour supply and, thus, productive capacity, but is independent of the national product.

Certain economic variables, such as agricultural production, government expenditure and exports can be treated in the same way, if it is assumed that their trend is not directly determined by that of the endogenous variables.

For forecasting purposes, each functional relationship is represented by a mathematical equation. The equations used are based on theoretical premises established empirically. The system of equations so obtained constitutes "the model", in which the multiplying parameters express the interaction of the variables. These multipliers are regarded as remaining constant for the period covered by the forecast.

Whereas forecasting with trends is based on trend coefficients which remain constant in relation to time, constant multipliers form the basis of the models method.

The capital coefficient, representing the relationship between capital resources and production resulting therefrom, can be taken as an example of a relationship which remains fairly constant over a long period.

15. Finally, the application of a model does not *a priori* exclude the use of trends. In many cases it may prove useful to introduce time as an additional variable.

This means that, in addition to capital and labour, a term with an autonomous trend can be introduced into a production function, representing the relationship between the product of a given sector and the quantity of production factors used. This term indicates that the product increases annually at a given rate, independently of the amounts of capital and labour used. In this way it is possible to express the influence of all other factors, and particularly of technical progress, on the volume of output.

Information collected by means of inquiries can also be used in conjunction with a model. When making an *overall* estimate, this method can, as already noted, be used to forecast agricultural productivity. In the case of detailed forecasts, inquiries provide essential data for sector forecasts.

The methods discussed above are not mutually exclusive, and the use of two or three of them together in fact allows considerable flexibility in forecasting.

16. We consider, however, that models should be used as the basis for building long-term forecasts. The type of model selected and the kind of statistical data available will then determine what supplementary use is to be made of trends and/or inquiries.

A few advantages of models are briefly reviewed below:

i) This method allows analysis and is not purely mechanical. Consequently, the forecast arrived at does not merely indicate that the national product will most probably increase by, say, 3 %. Estimates of increases in population and capital resources and possibly forecasts of structural changes, explaining the increase in national product, are also incorporated. In the case of a forecast covering several countries at once, it then becomes possible to identify the causes of differences between the results obtained. The more detailed the model the better the opportunities for such a comparison.

ii) The multipliers used in the equations of a model generally remain constant longer than trend coefficients. Anticipated variations in exogenous variables can be better allowed for with a model than with a necessarily rigid trend.

iii) By using a number of different hypotheses for the exogenous variables (population increase, export demand, technical progress) it is possible to arrive at alternative forecasts, while still taking account of the economic interdependence of the endogenous variables.

iv) Anticipated changes in the structure of the economy, such as a permanent increase in the rate of saving or government action affecting economic development, can be expressed coherently.

17. We are, however, fully aware of the difficulties inherent in the construction of models for such forecasts. There are two major problems. The first concerns the *type of model* to be used and, therefore, the selection of the relationships to be included. As the problem is not the same for the preliminary overall forecast as it is for the detailed forecast, it is not discussed in this section, which deals only with general aspects common to all long-term forecasting.

The second problem is how to determine the *numerical values of the parameters* used in the relationships covered by the model. Basically, the difficulty is the same as that already mentioned with reference to the calculation of trend coefficient : in a *long-term* forecast, the parameters in question must represent *long-term*, and not cyclical, interaction between the variables. It will be seen that this is in fact the greatest problem in the construction of a long-term model. In most countries, all figures for the inter-war years are dominated by the depression of the thirties, while the post-war period is still too much influenced by the process of "catching up". In order to obtain suitable statistical material, it might be necessary to use reference periods going back beyond 1929; but parameters based on such old situations are likely to be of doubtful value for our industrialised society, in which technical advances, changes in taste and the transformation of economic organisation are proceeding at an ever-increasing tempo. In the case of one member country parameters based on the pre-war years would relate to a different territory and thus to a different economic structure.

This leads on to the second difficulty, which concerns the *stability of the coefficients* as determined empirically. A model can only be applied if these coefficients are stable or, at least, follow a regular trend. When substantial changes are likely to occur during the period covered by the forecast, they must be allowed for by altering the numerical value of the coefficients deduced from earlier years. We have already mentioned that the rate of saving may change. When the detailed forecast is made, there may also be variations in factor coefficients and in elasticities and other parameters relating to consumer behaviour.

Information must then be obtained direct by the inquiry method.

These modifications raise problems of appreciation and interpretation, the importance of which must not be underestimated. Numerous examples are given in Chapters III to V.

Section II — The use of models for detailed forecasts

A — INTRODUCTION

18. As will be seen from Chapters III and IV, an *overall* forecast can be made with a fairly simple model. Using a production function, the rate of growth and the future level of gross domestic product are estimated by reference to anticipated changes in the quantity of labour, the volume of capital and a technical progress factor represented by a trend term. Final demand is estimated by more empirical methods and set against the forecast of supply.

However, useful an overall forecast of gross domestic product and the main components of final demand may be, it is not sufficient for a study of prospects and conditions for the long-term development of already industrialised economies. For the latter it is also necessary to determine rates of growth for the principal sectors of the economy — particularly for energy sectors which directly concern the ECSC — linked to the prospective development of inputs and techniques and the anticipated growth of demand for goods and services.

A detailed forecast by categories of products and sectors of activity is even more necessary in order to compare the national estimates of all members of the Community, so that any contradictions can be discovered in time and, if possible, eliminated. For this purpose a relatively detailed forecast of the course of foreign trade becomes essential in order to obtain a consistent series of national estimates. Such a forecast must, however, be confined to a minimum number of products and incomes.

The question is then whether such a "detailed" forecast can be made *by means of a complete econometric model*, enabling the different endogenous variables to be calculated by a system of simultaneous equations, without having to arrange provisional numerical values for some of them in a given order.

With our existing theoretical knowledge and statistical information, there appear to be reasonable grounds for adopting *an iterative* method, which is less ambitious but nevertheless allows more elements of technical information to be included.

This method, on which the present report is largely based, retains the systematic character of a complete model, and is, to some extent, a means of resolving the latter by successive approximations.

The problem of *consistency tests* is most important here, particularly when the forecast makes substantial allowance for the aims of government long-term economic policy and thus becomes a forecast of "intentions".

B — PROBLEMS OF CONSTRUCTING AND USING A COMPLETE MODEL OF SIMULTANEOUS EQUATIONS

19. The aim is to produce a consistent set of detailed forecasts giving separate estimates for:

— *final demand*, broken down both into main categories of uses and into categories of products;

— intermediate demand, broken down into sectors and categories of products;

— labour demand and the distribution of the labour force between sectors;

— the demand for fixed capital and its breakdown by sectors.

The most satisfactory solution is, clearly, to construct a complete econometric model, which can be applied by computer with varying degrees of technical difficulty. Such a model would express mathematically all known mechanisms of economic growth, relating to production, employment and investment by sectors, to private and government consumption and to foreign trade, and would take due account of the relationships linking those mechanisms.

To the extent that such mechanisms, and particularly those of growth in each sector, can be studied in isolation and in sufficient detail to be represented correctly in a set of mathematical relationships, the inclusion of all such mathematical patterns in a complete econometric model clearly provides the most reliable and most convenient instrument for forecasting. This is the most reliable method because all available information and all conditions of consistency can, without exception, be taken into account. It is also the most convenient because, once the model has been constructed and the calculating procedure has been set up, a whole series of development possibilities can be systematically studied, in conjunction with the various sets of hypotheses for the exogenous data of economic growth, including, for example, alternative assumptions regarding government action or foreign trade. It will be shown later that a method allowing the study of a whole series of growth hypotheses adds considerably to economic information and provides a more solid basis for decisions than any other method which is limited to fewer hypotheses.

However, although a few remarkable attempts, providing a great deal of information, have already been made in this direction, the complex technical and behaviour relationships which account for the growth of production in the various branches have to be considerably simplified for purposes of orderly presentation. L. Johansen's (1) work, in particular, indicates a new line which unquestionably deserves serious study but we feel that for the moment the gain in consistency so obtained does not generally outweigh the value of discussions with experts from each sector and the progressive addition to knowledge which only such conversations can provide. This will undoubtedly continue to be so until we are more fully acquainted with the structure and numerical value of the parameters of technical production functions and entrepreneurs' behaviour functions.

A complete econometric model can only be constructed in countries where extensive basic data are already available. In practice, information on sectoral growth mechnisms is in most cases incomplete and unsatisfactory : it is in any event insufficient to be expressed by means of a complete econometric model without reducing the latter to a highly-simplified pattern. Sectoral growth mechanisms are, in fact, not confined to their technological elements, because however detailed an econometric model, the separate sectors described are always relatively few in number and, therefore heterogeneous :

— Each sector produces a large number of goods and services for various uses, including in the most complex cases, household demand, intermediate consumption' investment, public consumption and exports. Economic expansion is always liable to change the relative importance of the needs satisfied by a particular sector and, thus, to alter the basic pattern of the category of goods and services provided. As a result, the structure of intermediate consumption and value added varies in accordance with economic mechanisms superimposed on the mechanisms of technological progress.

— Even if we ignore this difficulty and consider a sector which concentrates on a single product, or a minimum number of technically linked products, the undertakings engaged in production of these items are not usually at the same technical level but have reached different stages in a past or present state of technical progress. The structure of intermediate consumption and value added depends on this difference of technical achievement between undertakings within a given branch and on its changing pattern over a period of time, under the influence of mechanisms which, again, are not purely technological.

As a result, the growth mechanisms of each sector cannot easily be analysed *a priori* by a series of studies, each confined to a particular sector and in isolation from general economic growth. The data to be collected concerning possible trends in a given sector as a basis for constructing an overall model, may in fact vary considerably for different hypotheses, not only as regards the sector's rate of growth but also as regards general prospects for the distribution of labour, the structure of foreign trade and the form and intensity of international competition. For these reasons, the *immediate* construction of complete econometric models is only possible when the statistical bases and economic information available offer particularly favourable conditions. In other cases, an iterative method seems more reasonable.

(1) Particularly in the recent book "A multisectoral study of economic growth" (Contributions to Economic Analysis XXL, Amsterdam, North Holland Publishing Company, 1960).

C — AN ITERATIVE METHOD

20. With the iterative method, forecasting is broken down into a number of successive stages, during which specific models can be used. Together with direct estimates of the exogenous variables, this series of models, articulated with each other and resolved in a fixed order, with provision for a return to an earlier stage if necessary, forms a complex to which the method of successive approximations can be applied.

The procedure suggested is, briefly, as follows.

An overall model is first used to explore the probable growth of the principal national aggregates. Individual models, particularly for input-output and consumption, can then be used, in conjunction with direct estimates of the relevant exogenous variables, to study in detail the prospective growth of intermediate and final supply and demand, and if necessary to correct the original overall forecast.

Cases of *over-determination* may arise when a single variable (investment or employment, for example) is calculated by different methods at different stages of forecasting. The consistency test will then consist of reconciling the various estimates and may involve a fresh cycle of repetitions.

The advantage of the iterative method is that once a first general forecast of economic progress has been made on the basis of incomplete information, it defines the limits within which each sector will have to develop sufficiently accurately for experts from the sector concerned to be asked to study all the technical and economic data determining such growth, without having to consider an over-complex series of alternative hypotheses.

When this has been done a complete econometric model can of course be constructed. The disadvantage as compared with the first method is that such a model applies only within the limits allowed to the experts of the sector, that is around the growth hypothesis, or the necessarily small number of growth hypotheses, postulated at the outset. In a co-ordinated forecast by an international organisation, a synthesis of this kind, using the same patterns and nomenclatures, would allow systematic comparison of the hypotheses adopted in each country regarding the conditions of economic growth in each sector and prospects for foreign trade.

There is always a danger, however, that the detailed forecast by sectors may be based, as regards conditions of growth in each sector, on assumptions which are too far from reality and may conceal genuine obstacles to technical progress and thus, to increased output per head of working population, because they can be reduced to patterns applying to vast, heterogeneous complexes. The problem is not insoluble, however. Here the advantage of the iterative method is that, by studying growth conditions for each sector within clearly-defined general forecasts, it enables the elementary hypotheses on which it is based to be defined in more concrete terms provided the method is carefully applied by systematic consultation of experts covering the whole of production and distribution; this applies to the technological hypothesis for each individual activity and to the economic assumptions concerning not only the destination of each category of product and the basic composition of each sector but also the technical dispersion of the establishments manufacturing a given category of products. If the general hypothesis for a sector can be linked to more detailed hypotheses, with concrete economic and technical significance, the worst errors regarding growth prospects can be eliminated.

In future an attempt can be made to avoid these defects by the international co-ordination of forecasting, which should make it possible to harmonise assumptions concerning prospects for international trade and to discover the most obvious discrepancies between forecasts of growth in individual sectors. The fullest possible harmonisation is essential in this respect, because of the vital future role of foreign trade in maintaining international equilibrium and providing opportunities for growth.

D — NEED FOR "CONSISTENCY TESTS". TYPE OF TEST ACCORDING TO METHOD AND AIM OF LONG-TERM FORECASTING

21. Serious economic forecasting cannot be confined simply to estimating, even with the help of tested econometric relationships, the level of the main economic aggregates resulting from those relationships and from the assumptions adopted regarding the trend of variables treated as exogenous. The consistency of the results so obtained must also be checked.

Such consistency has *two aspects*, one of which is solely due to the substitution of an iteration for a complete model, for the reasons already given. The second aspect is, however, constant and applies whatever method is used, becoming increasingly important as explicit goals of long-term economic policy are included in the forecast.

The first type of consistency relates to the *compatibility of estimates of the endogenous variables*, the numerical values of which are determined by the relationships used and by hypotheses postulated, directly regarding the other values. A single model of simultaneous equations automatically guarantees such formal consistency. The same is not true of the iterative method which fixes an order for calculating the endogenous variables. It, therefore, becomes necessary to check whether estimates of the same variable at different stages of the forecast are identical and, if not, to go back and perform the necessary iterations both for the variable in question and for all the others linked with it to a major extent.

Convergence can usually be quickly achieved by superimposing the models and direct estimates which constitute the proposed iteration.

The second type of consistency relates to the *probability of results* obtained either by a forecast of "spontaneous" normal growth or by a forecast allowing for intentions.

In the first case, the model will be kept as "closed" as possible by increasing the number of econometric relationships drawn from observation of past structural links.

The "probability" test is more particularly necessary when, as in the second case, the forecast includes the aims of government economic policy and seeks to assess its effects.

Without neglecting the most solid and permanent of the structural relationships, regarded from this point onwards as "limiting factors", a distinction is made in this case between *target-variables*, which are treated as exogenous because they embody the aims of long-term economic policy, and *instrumental variables*, which are endogenous because their numerical value is determined by resolving the model (1).

Whatever method of calculation is used (model or iteration), it will, therefore, be necessary as soon as calculations have been completed to specify the economic, financial and, even, social measures which must be taken so that the instrumental variables will *in fact* reach the numerical values so obtained. If the relevant measures are impracticable or contrary to the institutional hypotheses on which the model or pattern is implicitly or explicitly based, the targets will have to be revised.

It may appear surprising to suggest that certain variables may not reach the numerical values arrived at by the resolution of a model or several associated models, because the latter are supposed to represent the most basic economic relationships involved in the process of developing our societies. The possibility exists, however, for two sets of reasons.

The first relates to the forecasting of intentions.

The method of fixing targets is, of course, backed by data; but it is also mathematically exogenous, so that the model only guarantees the compatibility of targets and instruments, even, and most of all, when it represents the facts accurately. On the other hand, it tells us nothing about the accuracy of the values which the said instruments must reach. We must consider this point and may have to revise our aims in consequence.

The second reason is more general, and applies even to a straightforward projection. It is connected with the reason advanced for preferring the method of successive approximations by stages to a single complete and detailed model. While models are useful as a means of reducing the subjectivity of forecasts and guaranteeing their internal consistency, our knowledge of the mechanisms of long-term growth and their quantitative

(1) The classification proposed by J. Tinbergen in "Economic Policy; Principals and Design" Amsterdam, 1956, Chapter I. has been adopted for the long term.

relationships is not so accurate or detailed that we can reasonably entertain the ambition of constructing an exhaustive model, incorporating all the main factors involved and guaranteeing that our forecasts will be accurate to a given degree of probability.

E — THE ITERATIVE METHOD USED IN THIS REPORT

22. While favouring the use of models, we have been led, by considerations of the kind discussed above, to incorporate our recommendations in a more flexible, but wider, pattern, based on the method of successive approximations.

Within this iterative method, the overall phase is considered with reference to the forecasting of gross domestic product in Chapter III and with reference to final demand in Chapter IV. The forecast of production for non-agricultural undertakings is based mainly on a long-term model.

Estimates of the principal elements of final demand, subdivided into major categories of uses, are then set against this production forecast, in preparation for transition to the detailed forecasts.

Chapter V gives an example of a detailed forecast taken from French experience and reproduced for guidance only.

The series of models obtained with this procedure are specific but at the same time linked to each other.

For an international study, this has the advantage that when the forecast for a given country cannot be carried to the stage of detailed forecasting by products and sectors of production, the work done at the overall stage still fits into a common pattern.

CHAPTER III

OVERALL FORECAST OF SUPPLY

Section I — Theoretical considerations

A — CHOICE OF A MODEL

23. Our view is that at the first stage of the successive approximations, the forecast should be global, and should not go into details of interaction between the different sectors of the economy. This justifies the use of a fairly simple model, which, it may be hoped, can be applied fairly uniformly from country to country without undue hindrance from gaps in statistical material.

The most important relationship in such a model is the *production function*, and here we may note a major difference between long-term models and those describing short-term fluctuations.

In the latter, the volume of production is determined mainly by total demand and a production function is normally represented by a labour demand function only.

Long-term models, on the other hand, start from the assumption of a normal use of production factors. The crucial point is, therefore, the production function which must indicate what the level of production will be with a given combination of production factors, particularly capital and labour.

The construction of a production function can be based on one of two hypotheses [1] :

i) *Possibility of complete substitutability of production factors*;

ii) *Strict complementarity of production factors.* Taking only capital and labour into account, this hypothesis implies that there is only one combination of capital and labour at a given level of production.

Obviously, neither of these two assumptions claims to represent the true facts. Both should be regarded rather as extreme theoretical possibilities.

In the following paragraphs we set out our reasons for preferring the substitution hypothesis for long-term forecasting.

We acknowledge, however, that the complementarity hypothesis has a number of advantages. It may lead to a less-complicated model and the numerical values of coefficients can be calculated simply but satisfactorily for statistical purposes.

We shall, therefore, discuss the scope of the complementarity hypothesis before recommending that models allowing substitution be used as a means of uniform forecasting.

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[1] We can leave aside the problem of variations in the relative prices of production factors because our assumption of full employment means that supply of these factors is inelastic in relation to prices.

B — FORECASTING ON THE BASIS OF COMPLEMENTARITY

Structure of forecasting equations

24. The model is distinguished by the relative simplicity of the forecasting equations, with a demand equation and a supply equation for each factor of production. For the labour factor:

$$\text{supply} : a = \beta_1 e^{\pi t} \qquad (1)$$

$$\text{demand} : a = \beta_2 v^{\rho} \qquad (2)$$

Where :

a = quantity of labour (number of workers, hours worked, etc.),
v = volume of production,
π = annual rate of growth of quantity of labour,
e = base of natural logarithms,
ρ = long-term elasticity of labour demand in relation to production,
β_1 and β_2 = dimensional coefficients.

Taking account of labour supply only, this would give an annual production increase of:

$$\frac{\dot{v}}{v} = \frac{\pi}{\rho} \qquad (3)$$

Where :

$\dot{v}$ = the annual increase of v (volume of production) in absolute terms.

$\frac{\dot{v}}{v}$ = the annual rate of increase of v.

Similarly, for capital we have:

$$\text{supply} : \dot{k} = \alpha v \qquad (4)$$

$$\text{demand} : k = \kappa v \qquad (5)$$

Where :

$\dot{k}$ = new investment,
k = capital resources,
α = "rate of new investment", meaning the part of production assigned to new investment (as distinct from replacement investment),
κ = average capital coefficient.

It will be observed that α is not necessarily equal to the net rate of saving. This is only so when depreciation is equal to replacement investment, a condition which is not always fulfilled in an expanding economy.

In accordance with the argument known as the "Harrod-Domar theorem" the increase in production guaranteeing full employment of capital (or maintenance of the existing level of use) can be expressed as:

$$\frac{\dot{v}}{v} = \frac{\alpha}{\kappa} \qquad (6)$$

Assuming that full employment applies to all production factors, the number of forecasting equations is the same as the number of factors of production in this type of model.

When distinction is made between capital and labour only, the production increases given by equations (3) and (6) must be identical for the forecast to be internally consistent (1). That is:

$$\frac{\pi}{\rho} = \frac{\alpha}{\kappa} \qquad (7)$$

(1) The long-term forecast (1950-1970) for the Netherlands is based on a variant of this model. For the actual forecasts see: Centraal Planbureau "Een Verkenning der economische Toekomstmogelijkheden van Nederland 1950-1970" The Hague, 1955. For the model used see: P.J. Verdoorn "Complementarity and Long-Range Projections" Econometrica, No. 4, 1956.

If this condition is not fulfilled, the forecast points to an unbalance which will have to be corrected according to technical, financial and political possibilities. Adjustments can be made, principally to α and, in lesser degree, to π .

Relationship between productivity of labour and volume of output

25. The use of a constant value for the capital coefficient κ is the keystone of most of the long-term forecasts so far made. We need not go into details here.

The same does not apply to the exponent ρ of the labour demand equation. Two arguments can be advanced to justify acceptance of a constant value for this exponent and, thus, of the hypothesis of complementarity in relation to labour :

i) From the theoretical point of view, complementarity can be considered a special case of "substitutability". Under given circumstances, quasi-complementarity is found in relation to capital and labour even with a production function allowing substitution (see sub-section 29 below).

Furthermore, dimensional effects cause labour productivity to rise more rapidly in industrial branches where production is expanding at a higher rate than in those where there is practically no expansion. In the latter case, it is virtually impossible to take advantage of the further division of labour, which in turn ensures the profitability of increased mechanisation. The "learning curve" operates in the same direction. (1)

ii) In many cases, a fairly stable relationship between productivity and volume of output can be observed empirically, a 10 % change in the "normal" level of production being accompanied by an increase of productivity generally varying between only 4 % and 6 %. The corresponding limits for ρ are thus 0.6 and 0.4 (2).

The relationship between labour and output can, therefore be expressed as :

$$\frac{v}{a} = \beta v^{\eta} \qquad (8)$$

Where :

$\frac{v}{a}$ = productivity of labour,
v = volume of output,
η = elasticity of labour productivity in relation to production $1 - \rho$,
β = dimensional coefficient.

This relationship is not, of course, confirmed over a short period when the cyclical component of the $\frac{v}{a}$ and v series is dominant; it does apply, however, for the normal evolution of these series and will thus appear in the analysis of trend values.

Table 2 shows a few cases in which our studies have confirmed this relationship and the parameters were found to have values approximately within the limits quoted.

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(1) F.J. Andress : "The learning curve as a producton tool" Harvard Business Review XXXII (January-February 1954), pp. 37-38.
W.Z. Hirsch : "Manufacturing Progress Functions", Review of Economics and Statistics XXXIV (May 1952), pp. 143 and seq.

(2) Defining η as the elasticity of labour productivity (v/a) in relation to output (v) we get :

$$\eta = \frac{d \log v/a}{d \log v} = \frac{d \log v - d \log a}{d \log v} = 1 - \frac{d \log a}{d \log v} = 1 - \rho$$

TABLE 2

Elasticity of labour productivity in relation to volume of output

(Total industrial output)

Country	Period	Percentage annual increase		Elasticity (η)
		v/a	v	
Germany (Fed. Rep.)	1882-1907	2.1	4.4	0.49
	(1929-1957) (*a*)	(2.0)	(3.2)	(0.62)
United Kingdom	1841-1907	1.0	2.4	0.41
	1007-1930	0.6	1.3	0.47
United States	1869-1899	2.3	5.6	0.42
	1899-1950	1.8	3.8	0.47
Sweden	1913-1930	1.0	2.4	0.43
	(1929-1957) (*a*)	2.5	4.1	0.61
Italy (*b*)	1922-1939	1.0	2.7	0.34
	1950-1958	3.0	6.2	0.48
	1922-1958	1.7	4.0	0.39

(*a*) Rate of increase and elasticity calculated by comparing 1957 with 1929.
(*b*) Private industry and services.
Sources : see Appendices 1 and 3.

Table 2 appears tosuggest that the numerical values obtained for η lie fairly uniformly between 0.4 and 0.6.

26. However, a number of facts indicate that forecasting with complementary relationships cannot easily be applied in a uniform manner.

The first point is that the numerical values obtained for certain countries and/or periods do not fall within the limits named above.

Table 2 itself shows that in several countries the value of η was consistently lower before 1929 than during the subsequent period. Colin Clark (1) reached the same conclusion for the United States on the basis of cross-sections between industrial branches. Growth in the United States and Sweden since 1949 suggests that, under certain circumstances, values of 0,8 and 0,9 may also be found for industry as a whole. These results are not conclusive, however, because they are based on a relatively small number of observations, which are considerably affected by cyclical fluctuations.

Our calculations for longer periods have, nevertheless, given high elasticities, sometimes exceeding unity, for France and Belgium.

These calculations were based on the statistical material summarised in tables 3 and 4.

(1) "Conditions of Economic Progress" 3rd edition, 1957, p. 363 and seq.

TABLE 3

FRANCE

Industrial productivity and volume of output

(1901 = 100)

Year	Output (*a*)	Employment (*b*)	Hours of work	Annual productivity	Hourly productivity
1906	112.4	103.1	97.1	109	112.3
1911	142.3	105.9	97.2	134.4	138.3
1921	103.5	106.1	76.8	97.5	127.0
1926	173.8	120.3	78.5	144.4	184.1
1931	187.2	121.5	74.0	154.1	208.1
1936	162.3	99.7	74.0	162.8	219.9
1948	173.1	115.1	89.1	150.4	168.0
1954	250.1	118.7	89.2	210.5	236.2

(*a*) Five-yearly average taking the dates in the first column as median years.
(*b*) Data from five-yearly population censuses.
Sources : series compiled by J. Bénard on the basis of :
Production and employment : INSEE : Statistical Yearbook 1957.
Hours of work : 1901-1936 : A. Vincent "Le progrès technique en France depuis 100 ans" (Institut de conjoncture, Etude no. 3, 1944).
1931-1936-1948-1954 linked by means of Ministry of Labour indices applied to industry as a whole.

TABLE 4

BELGIUM

Industrial productivity and volume of output

(1910 = 100)

Year	Output	Employment	Annual productivity
1930	138	109	126
1948	146	104	140
1956	209	107	196

Source : 1910-1948. C. Carbonnelle : " Recherches sur l'évolution de la production en Belgique de 1900 à 1957 ", Cahiers économiques de Bruxelles, No. 3, p. 353-378.

Values for η were calculated from these data. Because of the limited number of observations, a reasonably significant regression calculation was possible in one case only. In the others, the level for the base year was compared with that for the terminal year, and the numerical values obtained by the latter method are shown in brackets in table 5 on page 566.

This second drawback to the use of complementary relationships arises from the fact that forecasting equation (3) allows no increase in output if the quantity of labour remains constant or falls. This does not appear to be in accordance with the facts, as presented by the figures quoted for French and Belgian industry.

These two defects do not occur separately (in both Belgium and France a high η value coincides with a low value for π, representing the growth of labour). Consequently, there is a risk that forecasting equation (3) will become indeterminate, because when $\pi \to 0$ and, $\rho = 1 - \eta \to 0$ we have :

$$\frac{\dot{v}}{v} = \frac{\pi}{\rho} = \frac{0}{0}$$

TABLE 5

FRANCE - BELGIUM

Elasticity of productivity in relation to output

Country and period	Elasticity annual productivity	Elasticity hourly productivity
France :		
1901-1954	0,805 (0.812)	0,932 (0.938)
1901-1931	(0.690)	(1.117)
1931-1954	(1.077)	(0.437)
Belgium :		
1910-1956	(0.913)	
1910-1930	(0.718)	
1930-1956	(1.079)	

This difficulty can, of course, be avoided by assuming that the demand for labour undergoes a trend "shift", representing as it were the residual influence of technical progress.
Equation (2) would then appear as

$$a = v^{\rho} e^{\psi t} \qquad (9)$$

and the forecasting equation would become :

$$\frac{\dot{v}}{v} = \frac{\pi - \psi}{\rho} \qquad (10).$$

thus avoiding the risk of an infinite or indeterminate increase.

There remains the difficulty of estimating the value of ψ, when π approaches 0. Recent trends in Sweden show that the coefficient ψ can have a relatively high value.

Furthermore, immediately $\pi \to 0$, any estimate of the rate of output increase would be based *wholly* on a trend extrapolation. Extrapolation from model relationships then has no advantage over mechanical extrapolation of the trend. For this reason, we felt that such a model did not offer a particularly suitable basis for uniform long-term forecasts.

C — FORECASTING WITH MODELS ALLOWING SUBSTITUTION

Structure of forecasting equations

27. The problem of the production function and of the measurement of its coefficients has been under consideration since the early thirties (1).

Douglas attempted the first empirical checks, using a formula

$$v = \beta a^{\lambda} k^{\mu} \qquad (11)$$

Where :

- v = volume of output
- a = quantity of labour
- k = capital resources
- β = dimensional coefficient.

(1) See bibliography in Appendix 4. The following articles by Tinbergen, Phelps Brown and Barna may be mentioned among major contributions to methodological criticism : Tinbergen, J., "Professor Douglas Production Function", Review of the International Statistical Institute, 1942, 1.
Brown, Phelps, "The meaning of the fitted Cobb Douglas Function", Quarterly Journal of Economics, LXXI, 1957, pp. 546-557.
Barna, T., "Du capital envisagé comme une variable économique", Cahiers du séminaire d'économétrie, No. 5 : "Production investissements et productivité", published by the Centre national de la recherche scientifique, Paris, 1959.

The exponents λ and μ represent the elasticities of output in relation to labour and capital respectively.

These are partial elasticities; μ, for example, represents the percentage increase in v when k increases by 1 % (1).

When, for example, a and k increase at exactly the same rate, v increases at $(\lambda + \mu)$ times that rate.

In Douglas' earliest work the sum of these exponents was restricted to :

$$\lambda + \mu = 1$$

With an equal increase of a and k, v increases in proportion to the growth of the factors of production.

This description of growth is purely static; the productivity of labour can only be raised by increasing the amount of capital per worker, that is by increasing k more than a.

Dynamic elements can be introduced in two ways :

i) By allowing for a *systematic relation* between the efficiency of the production process and the level of output itself ("returns to scale", "manufacturing progress curve", "induced inventions"). When, for example, "returns to scale" play an important part, the sum of λ and μ may be expected to exceed unity. Systematic relations of this type will, therefore, be allowed for by abandoning the restrictive value $\lambda + \mu = 1$.

ii) In the form of *autonomous* increases in efficiency resulting from the creative reactions of entrepreneurs, improved education and apprenticeship schemes, etc. Here we are concerned not with adaptive reactions, connected with the growth and expansion of production, but with technical progress occurring independently from "returns to scale" and the "learning curve". As there is a time element in these improvements, this independent technical progress can be expressed by a trend term $e^{\nu t}$, with the coefficient ν in the exponent representing the annual rate at which v increases as a result of such progress. It may be noted at once that, *for practical forecasting purposes*, we found it impossible to separate "autonomous" increases from the effects of the actual growth of output. In sub-section 33 below, the limiting value $\lambda + \mu = 1$ is retained, and the two types of reaction are combined in the trend term $e^{\nu t}$. We felt, however, that we should at least refer to the distinction in the theoretical part of this chapter. By combining these different dynamic elements we obtain the following modified Cobb-Douglas function :

$$v = \beta a^{\lambda} k^{\mu} e^{\nu t} \qquad (12)$$

Where :

- v = volume of output
- a = quantity of labour
- k = capital resources
- t = time
- β = dimensional coefficient
- λ = elasticity of output in relation to labour
- μ = elasticity of output in relation to capital
- e = base of natural logarithms
- ν = annual rate of increase of residual trend.

As already noted in sub-section 23, a function of this kind does not claim to give a complete description of the interrelationships between output and the factors of production. In the same way as functions based on complementary relationships, it is only a theoretical method of approximation and its practical value must be closely examined in each individual case.

---

(1) This exponent μ is not to be confused with the capital coefficient which means "capital-output ratio" (k) and expresses the relationship between capital resources and output $\left(k = \frac{k}{v} \right)$.

The following forecasting equation can be deduced by differentiation from the general formula (12):

$$\frac{\dot{v}}{v} = \lambda \frac{\dot{a}}{a} + \mu \frac{\dot{k}}{k} + \nu \qquad (13)$$

where $\frac{\dot{v}}{v}, \frac{\dot{a}}{a}, \frac{\dot{k}}{k}$ and ν represent the annual rates of increase of output, quantity of labour, capital and the residual trend respectively.

In other words, when estimates of increases in the quantity of labour and the stock of capital goods are available, a forecast can very simply be produced with the help of a Cobb-Douglas function.

28. Equation (13) does not, however, guarantee the ultimate consistency of such an estimate because the increase in the stock of capital in turn depends on the growth of the national product.

The production function must, therefore, be supplemented by, for example, the labour and capital supply functions, as discussed in sub-section 24 :

$$a_t = a_o e^{\pi t} \qquad (1bis)$$

$$k_t = \varkappa v_t \qquad (4bis)$$

Where :

a_o = labour supply in the base year
a_t = labour supply in the last year covered by the forecast
π = annual rate of increase of labour supply

$\dot{k}$ = new investment
α = "rate of new investment"
v_t = output in the last year covered by the forecast.

It will be observed that the labour factor is here treated as an exogenous variable.

A forecasting equation, which should guarantee an internally consistent estimate, can be deduced from this very simple series of three equations, as follows :

$$\gamma_t = (\pi\lambda + \nu) \frac{\kappa_o(\pi\lambda + \nu) + \alpha e^{(\pi\lambda + \nu)t} - \alpha(1 - \mu)}{\kappa_o(\pi\lambda + \nu) + \alpha(1 - \mu) e^{(\pi\lambda + \nu)t} - \alpha(1 - \mu)} \qquad (14)$$

Where :

γ = annual rate of increase of $v = \frac{\dot{v}}{v}$ as derived from the model

κ_o = capital coefficient for the base year : $\frac{k_o}{v_o}$

This formula is absolutely exact (1); an approximation formula is discussed in section III.

29. However, there seem to be good grounds for presenting equation (14) in its original form, because it leads to certain important conclusions.

To give a clearer idea of the scope of this formula, its application is first illustrated by a numerical example in which the various parameters are given values based on previously recorded values. Table 6 shows the annual

(1) Cf. "Colloque sur le capital fixe des entreprises" Brussels, 1959, contribution by P.J. Verdoorn : "The role of capital in longterm projection models", Cahiers économiques de Bruxelles, October 1959, pp. 49-70.

rate of output increase(γ)obtained with different values of the time variable (t), assuming the following values :

$$\pi = 0.01$$
$$\lambda = 0.667$$
$$\mu = 0.333$$
$$\nu = 0.0133$$
$$\alpha = 0.08$$
$$\kappa_0 = 2$$

It will be observed that the values of the parameters, and particularly the annual rate of increase of the supply of labour π and the investment proportion α are here kept constant over the whole period covered by the forecast.

TABLE 6

Changes in estimated rate of growth with time

t	γ_t (as a percentage)
0	3.33
1	3.32
2	3.31
5	3.29
10	3.25
20	3.20
50	3.10
∞	2.99

Three important conclusions can, thus, be drawn from equation (14) on page (568), the significance of which is demonstrated by the above example :

i) It is quite clear that if α and π remain constant over a long period, γ also becomes constant. In such conditions of growth in equilibrium, the increase of v becomes :

$$\lim_{t \to \infty} \gamma = \frac{\pi\lambda + \nu}{1 - \mu} \qquad (15)$$

In other words, when, after a long period, growth of the stock of capital goods has become adapted to a given rate of new investment (α), the actual level of α no longer affects the economy's rate of expansion. If, however, the level of α changes during the period, a new process of adaptation will obviously be started and will be reflected in the rate of expansion (see iii below).

ii) If we accept that a modified "Cobb-Douglas" production function is of practical significance, the limiting value of γ also shows why the elasticity of productivity is often stable in relation to the volume of output, as already noted in sub-section 25. This elasticity can, in fact, be expressed as :

$$\eta = \frac{\mathrm{d} \log v/a}{\mathrm{d} \log v} = 1 \frac{\mathrm{d} \log a}{\mathrm{d} \log v} = 1 - \frac{\pi}{\gamma} \qquad (16)$$

Since, according to equation (15), the rate of output increase tends towards a constant value, we then have

$$\eta = 1 - \frac{\pi (1 - \mu)}{\pi\lambda + \nu} \qquad (17)$$

In the same way, it can be deduced that in the long run the capital coefficient κ, must approach a limiting value, when π and α remain constant :

$$\lim_{t \to \infty} \kappa = \lim \frac{\alpha}{\gamma} = \frac{\alpha(1 - \mu)}{\pi\lambda + \nu} \qquad (18)$$

This offers a very simple explanation for the well-known fact that the capital coefficient of any given country varies only slightly over very long periods.

Consequently, there is no fundamental antithesis between complementary approximation and substitution as methods of assessing the development of long-term equilibrium.

However, η must necessarily tend towards unity when π becomes small in relation to v. This would explain the very high coefficients recorded for France and Belgium in sub-section 26.

iii) The influence of a once-for-all change in the rate of new investment on the rate of growth can be expressed by transforming (14). Such a transformation is very useful for analysing the present stage of development in the countries of the Community.

Defining the initial rate of investment as α_0 and the new rate as α_1, formula (18) shows that the rate of growth will continue to be affected for some time by the change from α_0 to α_1.

$$\gamma_t = \frac{\pi\lambda + \nu}{1-\mu}\left\{1 + \mu\frac{\alpha_1 - \alpha_0}{\alpha_1\left\{e^{(\pi\lambda+\nu)t} - 1\right\} + \alpha_0}\right\} \qquad (19)$$

This process can again be illustrated by a numerical example. The following values are again assumed: $\pi = 0.01$, $\nu = 0.0133$, $\lambda = 0.667$ and $\mu = 0.333$. Equation (15) gives the equilibrium rate of output growth as 0,03 or 3 %; if we assume that the normal level α is now raised from say, 0.08 to 0.16, the additional increase *per unit of* v during the first year (when $t = 0$) will then be:

$$\mu\frac{\alpha_1 - \alpha_0}{\alpha_0} = 0.33$$

The increase in v is thus raised from 3 % to 4 % and the growth of productivity is even more affected, rising from (3-1) % to (4-1) %, an increase of 50 %.

It is significant, however, that this rise in the rate of growth is not permanent. As t rises, the additional increase in productivity falls and finally tends towards equilibrium level. This process of adjustment is illustrated by table 7 which shows the additional increase, for the example given, with different values of t. In this example equilibrium level is reached only after a very long time.

TABLE 7

Temporary increase in labour productivity

when $\alpha_1 = 2\alpha_0$, $\lambda = \frac{2}{3}$, $\mu = \frac{1}{3}$, $\pi = 0.01$, $\nu = 0.0133$

t	Relative increase	t	Relative increase
0	0.50	40	0.14
5	0.42	50	0.11
10	0.35	60	0.09
20	0.25	80	0.06
30	0.19	100	0.04

As noted in sub-section 12 of Chapter II, a mechanism of this kind would appear to have acted in the countries most immediately affected by hostilities. It should not be over-looked, however, that the period of low investment rates lasted little more than fifteen years, covering both the depression of the thirties, and the war period. Adjustment to final equilibrium may, therefore, take place much more quickly than in the example illustrated in table 7.

Section II — A concrete model for the Community

A — SCOPE OF THE PRODUCTION FUNCTION

30. Any attempt to produce a concrete model of production from the type of function described above, raises the question of defining the aggregates to which the function is to be applied. Should we take all or part of the national product ? Should there be a separate production function for each sector ?

The final choice clearly depends on the material available and cannot, therefore, be made at this stage of the analysis. However, a number of principles already emerge and will serve as a guide for the rest of our study.

In sub-section 23 we indicated our preference for a fairly general preliminary forecast. Certain problems, such as the distribution of labour supply by sectors and deliveries between sectors, can be avoided by keeping the number of sectors as low as possible. This argues in favour of applying the modified Cobb-Douglas function directly to the whole national product.

On the other hand, it has already been established that this function does not apply — at least not in the same way — to sectors, whose growth is essentially exogenous from the economic standpoint. We, therefore, thought it advisable to suggest separate estimates for :

i) *Agriculture :* Although it is theoretically possible to work out a production function for this sector, its structure will not necessarily be the same as that of the "Cobb-Douglas" function. Furthermore, the growth of this sector is affected by highly specific factors, which also suggest the advisability of a separate estimate.

ii) *Housing services :* This sector uses a very considerable fraction of the stock of capital goods but practically no labour. In addition, government intervention is often substantial, in the form of rent control, building subsidies and low interest rates.

iii) *Government :* There are no market transactions in services in this sector, for which the definition of production is purely conventional.

Details of the estimating methods used for these sectors are given in sub-sections 53 to 55.

Having excluded these three exogenous sectors, we propose to apply the production function to all other sectors, that is to non-agricultural undertakings (excluding housing services).

Table 8 shows that this aggregate includes by far the greater part of the national product of member countries, with an overall figure of 80 % for the whole Community.

TABLE 8

Composition of gross domestic product at factor cost in 1957

(%)

Country	Non-agricultural undertakings (except housing)	Agriculture Forestry Fisheries	Housing services	Government and defence	Total
Germany (Fed. Rep.) (*a*)	82.8	7.3	2.4	7.5	100.0
Belgium	76.9	7.1	7.5	8.5	100.0
France (*b*)	77.8	10.4	2.4	9.4	100.0
Italy	66.6	20.4	2.1	10.9	100.0
Luxembourg	77.6	8.4	3.6	10.4	100.0
Netherlands (*c*)	79.0	11.0	2.6	7.4	100.0

(*a*) Basic data at market prices.
(*b*) Data relating to national product, at 1954 market prices.
(*c*) Provisional estimate.
Sources : Belgium : Cahiers économiques de Bruxelles, No. 5 October 1959. France : "Rapport sur la situation économique dans les pays de la Communauté" p. 268, table 7. Netherlands : Central Planning Office. Other countries : General statistics, O.E.E.C., March 1959.

B — NUMERICAL VALUE OF THE EXPONENTS OF THE PRODUCTION FUNCTION

Difficulties with the use of existing material

31. A function of the type described in sub-sections 27 to 29 can only be used for forecasting on condition that numerical values can be reliably determined for the exponents λ, μ and ν.

Since Douglas' original attempt, much work has been done on the empirical measurement of these exponents. It must be acknowledged, however, that the results obtained — those which have been published at least — are only of very limited use for forecasting. This may be attributed to three reasons:

i) A large proportion of empirical analyses relate to cross-sections of various industrial branches and not to time series for the same group of undertakings. As Tinbergen and Bronfenbrenner have shown, the exponents of a and k so obtained do not describe the production function but rather the mechanism of price formation as it can be deduced from a comparison of various categories of undertakings (1).

ii) Where the basic data are in fact drawn from time series, there is often the difficulty that the variation of the cyclical component dominates that of normal growth. The disadvantage is similar to that mentioned in the case of trend coefficients; material in which cyclical variations have not been corrected, are in principle not suitable for calculating relations which are supposed to represent the normal long-term trend.

Assuming a depression, during which variations in the stock of capital goods are very small, the exponent λ worked out for labour merely indicates the way in which the entrepreneur has adapted employment to variations in economic activity, with a *given quantity of capital.* The coefficient λ is, in fact, only the reciprocal of the short-term elasticity of the demand for labour.

This consideration renders suspect all numerical values of λ and μ based exclusively on statistics for the inter-war period.

Most of us are of the opinion that this situation cannot be greatly modified by applying utilisation coefficients to correct capital stock figures to allow for fluctuations in the degree of utilisation. One member of our group does not agree and prefers this procedure to the use of moving averages, as described in sub-section 32 below.

iii) On the other hand, in the case of research based either on longer series or on material corrected for cyclical variations, the determination of numerical values for λ, μ and ν is often found to be particularly difficult for reasons of statistical technique. With the modified Cobb-Douglas function, there is in fact a risk of *intercorrelation* between the various explanatory variables, thus reducing the significance of the numerical values obtained and even calling in question their algebraic sign.

A solution for this difficulty may be sought either by excluding the residual trend term or by imposing certain restrictions on λ and μ, such as the limiting value $\lambda + \mu = 1$.

Exclusion of the trend term means that no separate allowance is made for the contribution of "autonomous" technical progress, which is generally regarded as the most important addition to the original version of the Cobb-Douglas function.

Action confined to imposing restrictions on λ and μ leaves another source of errors, the importance of which was brought out by Mendershausen. (2) Immediately v, a and k are closely correlated to time. λ and μ are determined exclusively by a combination of the trend values of these variables and give no information regarding the form of the actual production function.

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(1) Tinbergen, J., "Professor Douglas' Production Function" Review of the International Statistical Institute, 1942-1. Bronfenbrenner, M., "Production functions: C. Douglas, "interfirm, intrafirm", Econometrica, 1944.

(2) "On the significance of Prof. Douglas' production function" Econometrica, VI, 1938.

In addition to these problems of method, there are a number of purely statistical difficulties:

i) Existing studies frequently relate to very different aggregates;

ii) In studies of this type, sufficient statistics are often not available for one or more variables.

In most cases, corresponding series for labour and output can be compiled, either for industrial and service sectors, or for the whole national product, but major difficulties arise when movements in the stock of capital goods have to be estimated.

In order to provide a suitable basis for estimating the production function, the estimate of capital must satisfy specific requirements, which are generally very strict as regards quality (1).

Research by the Group

32. These statistical gaps are one of the reasons why very few attempts have hitherto been made to estimate the production function in the countries of the Community.

So far as we know, the only available sources are material concerning the Federal Republic of Germany (2) and a study covering a short period for Belgium (3).

Even accepting fairly lax standards, the absence of a continuous series of figures for capital, covering a long enough period, has so far prevented any empirical approximation of the production function for France, Luxembourg and the Netherlands, as well as for Belgium over a long period.

We were able to make tentative estimates for Italy, covering non-agricultural undertakings (including housing), over the period 1922 to 1939. Our calculations were based on non-corrected series for cyclical fluctuations. We also tried to include the years 1950 to 1958, but decided that the two sub-periods 1922 to 1939 and 1950-1958 could not be combined in a single series because of the special factors which dominated the post-war years. Results are given for the first sub-period only.

In the absence of adequate data for the other countries of the Community, we also made a number of calculations for non-member countries to provide points of comparison. The countries selected were Canada, Norway, the United Kingdom and the United States (4).

As the series on which we based our studies generally covered a longer period than that considered for Italy, we were able to use nine-year moving averages to correct for cyclical influences. No correction was however possible in the case of Canada, because only ten-yearly estimates were available.

33. Detailed results are given in Appendix 2, and we shall only comment on our work at this point.

In the case of both Italy and the non-member countries, we came up against the problem of *intercorrelation* which is inherent in the statistical analysis of such figures. We, therefore, concluded that a satisfactory estimate both of ν (autonomous trend coefficient) and of λ and μ could only be obtained by imposing certain restrictions on λ and μ.

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(1) This point has recently been further emphasized by T. Barna "Du capital envisagé comme variable économique" Cahiers du séminaire d'économétrie, No. 5; "Production, investissements et productivité" published by the Centre national de la recherche scientifique. Paris, 1959.

(2) The IFO-Institut für Wirtschaftsforschung, Munich has made studies, in which imports are treated as a production factor.

(3) J. Waelbroeck, "Le rythme d'expansion de l'économie belge de 1948 à 1957", Cahiers économiques de Bruxelles, 1958, No. 2 pp. 321-344.

(4) The basic data were drawn from the numerous sources listed in Appendix 3. The numerical values obtained for the various parameters were calculated by the Group. These studies are quite separate from those made by other workers, in some cases with the same basic data.

For our final estimates, we, therefore, accepted Douglas' original limiting value : $\lambda + \mu = 1$.

The autonomous character of the trend term $e^{\nu t}$ partly disappears as a result, since under these conditions, the effect of the limitation is that the trend term also has to represent increases linked systematically with v (1).

In other words, the imposition of a homogeneous linear form on the production function introduces a certain systematic error, to the extent that ν may be overestimated at the expense of λ and μ .

On the other hand, the application of this restriction has the advantage of showing what rates of growth can be reached without technical progress and increasing returns.

Another consequence of statistical difficulties is that, even with the limiting value $\lambda + \mu = 1$, either λ or μ is negative in three of the five cases and μ appears to have relatively low positive values in the other cases. As a result we had to start by assuming a fixed ratio between λ and μ, for the non-member countries at least. As their sum is already fixed a priori, only the coefficient ν of the trend term can be determined as a residual value by free adjustment.

In our view, however, the *a priori* fixing of this term should not be regarded in advance as purely arbitrary. From the theoretical point of view the ratio λ/μ corresponds to the relationship between remuneration of labour and of capital within the national product.

If the estimated remuneration of self-employed persons is included in the remuneration of the labour factor, it is acceptable, from the purely theoretical standpoint, to fix values for λ and μ falling between the limits within which the national income is normally distributed. The general limits so calculated for the ratio λ/μ are approximately 3 : 1 and 2 : 1.

Table 9 on page 575 sets out the results obtained by applying the limitations discussed above.

The limiting value $\lambda + \mu = 1$ was, therefore, applied in all five cases. With the four non-member countries, the limiting values $\lambda/\mu = 3$ and $\lambda/\mu = 2$ were also applied in turn.

The second restriction was not applied in the case of Italy because free adjustment gave a ratio of practically 2 : 1 between the numerical values of λ and μ.

The successive application of the limiting values $\lambda/\mu = 3$ and $\lambda/\mu = 2$ produces only slight differences in the results for the other four countries. The correlation coefficient R is virtually unchanged, and there is no significant variation in the residual trend coefficient. This result is confirmed by variant 1*c* (see table 9) for Italy, which gives figures for an assumed ratio of $\lambda/\mu = 3$.

Assuming $\lambda/\mu = 2$, the lowest numerical values obtained for the trend term ν are 0.1 % — 0.3 % (Canada and Italy), while the highest value deducible from these historical analyses is about 1.5 % per annum (see Norway and United States).

Differences in the value of the trend may of course be at least partly attributed to differences in the method of estimating the variables, particularly the stock of capital and output (2) : but they no doubt also reflect differences in the technical and institutional factors. We did not go into this question in greater detail.

C — PROPOSED NUMERICAL VALUES

34. On the basis of these studies, we propose that the growth of the output of non-agricultural undertakings be expressed by the following equation :

$$v = \beta a^{\lambda} k^{\mu} e^{\nu t} \qquad (12)$$

(1) The overall figures for the United States appear, however, to suggest fairly considerable "returns to scale".
(2) All statistical material used is discussed in Appendix 3.

TABLE 9

Numerical values of the exponents of the production function and o the correlation coefficient

No.	Country	Period	Sectors	Restrictions	λ	μ	$\lambda + \mu$	ν	R
1*a*	*Italy*	1922-1939	non agricultural undertakings	$\lambda + \mu = 1$ without trend	0.675	0.325	1.000	—	0.962
1*b*	»	»	»	$\lambda + \mu = 1$ with trend	0.724	0.276	1.000	0.1	0.970
1*c*	»	»	»	$\lambda + \mu = 1$ $\lambda/\mu = 3$	0.75	0.25	1.000	0.2	0.971
2*a*	*Canada*	1870-1938	Industry	$\lambda + \mu = 1$ $\lambda/\mu = 2$	0.667	0.333	1.000	0.3	0.992
2*b*	§	»	»	$\lambda + \mu = 1$ $\lambda/\mu = 3$	0.75	0.25	1.000	0.5	0.994
3*a*	*Norway*	1900-1955	Whole economy	$\lambda + \mu = 1$ $\lambda/\mu = 2$	0.667	0.333	1.000	1.5	0.997
3*b*	»	»	»	$\lambda + \mu = 1$ $\lambda/\mu = 3$	0.75	0.25	1.000	1.7	0.998
4*a*	*United Kingdom*	1870-1919 and 1924-1938	Whole economy	$\lambda + \mu = 1$ $\lambda/\mu = 2$	0.667	0.333	1.000	0.6	0.982
4*b*	»	»	»	$\lambda + \mu = 1$ $\lambda/\mu = 3$	0.75	0.25	1.000	0.7	0.981
5*a*	*United States*	1909-1949	Non-agricultural undertakings	$\lambda + \mu = 1$ $\lambda/\mu = 2$	0.667	0.333	1.000	1.5	0.969
5*b*	»	»	»	$\lambda + \mu = 1$ $\lambda/\mu = 3$	0.75	0.25	1.000	1.6	0.980

in which :

i) Limitations would be applied both to the sum of $\lambda + \mu$ and to the ratio of their numerical values.

ii) The numerical values of v adopted for the various countries would have to fall within fixed limits.

The forecasting equation would then become :

$$\frac{\dot{v}}{v} = \lambda \frac{\dot{a}}{a} + \mu \frac{\dot{k}}{k} + \nu \qquad (13)$$

Three points in this proposal require further clarification :

i) The results in table 9 relate to aggregates which are not exactly the same for all countries. Are they valid for the *non-agricultural sector* as defined in sub-section 30 ?

ii) If the limiting value $\lambda + \mu = 1$ is applied to the *sum* of the coefficients, what ratio should be used for λ/μ in the forecasting equation ?

iii) Can a *uniform value* be recommended *for the coefficient* v, or at least *limits* within which the values for all countries must fall ?

Application to the non-agricultural sector

35. To try and answer the first question we decided to examine how far the results obtained by applying equation (13) to the whole of production would differ from those for industry taken separately. We, therefore,

applied equation (13) to a series of observations relating to industrial production (11 observations) and the whole of production (22 observations) respectively.

As the basic data consisted of average annual rates of increase in a number of countries over selected periods, we combined elements relating to different countries and periods in a cross-section type of analysis.

The countries and periods chosen are given in Appendix 3. Our results are summarised in table 10 and given in full in the same Appendix.

TABLE 10

Results of cross-section Analysis

Restrictions applied	Aggregate	Trend term (*a*)	R	Standard deviation of "ex-post" forecasts
$\lambda + \mu = 1$ and $\lambda/\mu = 2$	Industry	0.93 % (0.21)	0.702	0.70 %
	Total output	0.75 % (0.17)	0.646	0.79 %

(*a*) Standard deviations of the trend coefficients are given in brackets after each coefficient.

The correlation coefficients in table 10 are relatively low, with values of 0.702 for industrial output and 0.646 for total output respectively. These figures nevertheless imply that, by applying the modified Cobb-Douglas function the scatter of differences between "estimated" and "real" values has been reduced in the first case to 49 %, and in the second to 42 %, as compared with the estimate based on a uniform rate of increase, that is, the average increase of all observations included in the sample. The inclusion of available quantities of labour and capital in the forecast therefore gives a much more finely-graduated result (1).

The trend coefficient is 0.93 % for industry and 0.75 % for total output. The difference of 0.18 % is not big enough to be considered statistically significant (2). Our calculations, therefore, give no grounds for assuming any difference in residual trend between total output and industrial output.

This leads on logically to the conclusion that the numerical values calculated can be used for the *non-agricultural sector* aggregate which is larger than industrial output but less than total output.

Ratio of λ *to* μ .

36. Because of difficulties in the matter of statistical techniques, empirical analysis can give no exact guide to which λ/μ, ratio should be used.

The conventional values, worked out by Douglas and his associates, are 0.75 for λ and 0.25 for μ, giving a ratio of 3 : 1.

(1) The "coefficient of inequality" test devised by Prof. H. Theil to assess the accuracy of forecasts gives values of 0.087 and 0.1483 for industry and total output respectively. This formula is described in Theil. H. : "Economic forecasts and policy". Amsterdam. 1958. Contributions to Economic Analysis Vol. XV. If the forecast is borne out completely by events Theil's coefficient is 0; if actual progress is exactly the reverse of what was forecast its value is 1. Even in the case of "ex post" forecasts, the values obtained undoubtedly give a more favourable impression than those obtained by analysis of the economic situation, for example.

(2) To be statistically significant, the difference would in all cases have to be greater than the square root of the sum of the variants of the two coefficients. In our example, it would therefore have to be greater than $\sqrt{0.21^2 + 0.17^2} = 0.27$

Our reason for selecting a ratio of 2 : 1 is not that experimental analysis has decisively demontrated a permanent change in the relationship between the productivities of labour and capital since the period covered by the studies of the Douglas school; it is simply that a choice had to be made and that recent studies, such as that for Italy, suggest that the relative contribution of capital can be increased

Value of the trend coefficient

37. Finally, the numerical value of the *trend coefficient* v has to be settled. For the examples studied, table 10 gives figures of 0.93 % for industrial output and 0.75 % for all output.

From the historical cases examined, a trend coefficient of about 0.85 % per annum may, therefore, be deduced for the *non-agricultural sector*, which includes most services in addition to industrial output.

It may be assumed that the growth of agricultural output, which is generally below that of industrial output, tends to lower the trend value for total output.

Allowance must be made, however, for the errors liable to arise in this type of forecast. Table 10, on page 576, shows a standard deviation of 0.7 — 0.8 % between "ex-post" forecasts and sample observations.

This is represented in graphs A and B in figure 3 on page 578. Observed results for the countries examined during the relevant periods are plotted horizontally and "estimated" values vertically.

If the "ex-post" forecast corresponded exactly to the recorded value, all observations in these graphs would lie on the 45° line passing through the origin. Forecasting errors are therefore represented by the vertical distance of the plotted points from the 45° line.

The standard error of the forecast, that is the standard deviation, σ, is represented by the distance between 45° line and the first of the two straight lines drawn either side of the 45° line. In accordance with theoretical probability, about two-thirds of all observations fall within the space between these two straight lines.

The probability of a point outside the limits of 2 σ, that is beyond the two outer straight lines on either side of the 45° line, is about 1 in 20.

Such a widely diverging forecast does not appear more than once in either of the two samples.

Leaving aside errors in the basic statistics, observed deviations in the forecasts can be attributed to differences in the economic structure of the various countries and to the influence of chance factors.

On the basis of the cases studied, historical experience already suggests a certain margin in assessing a country's potential growth.

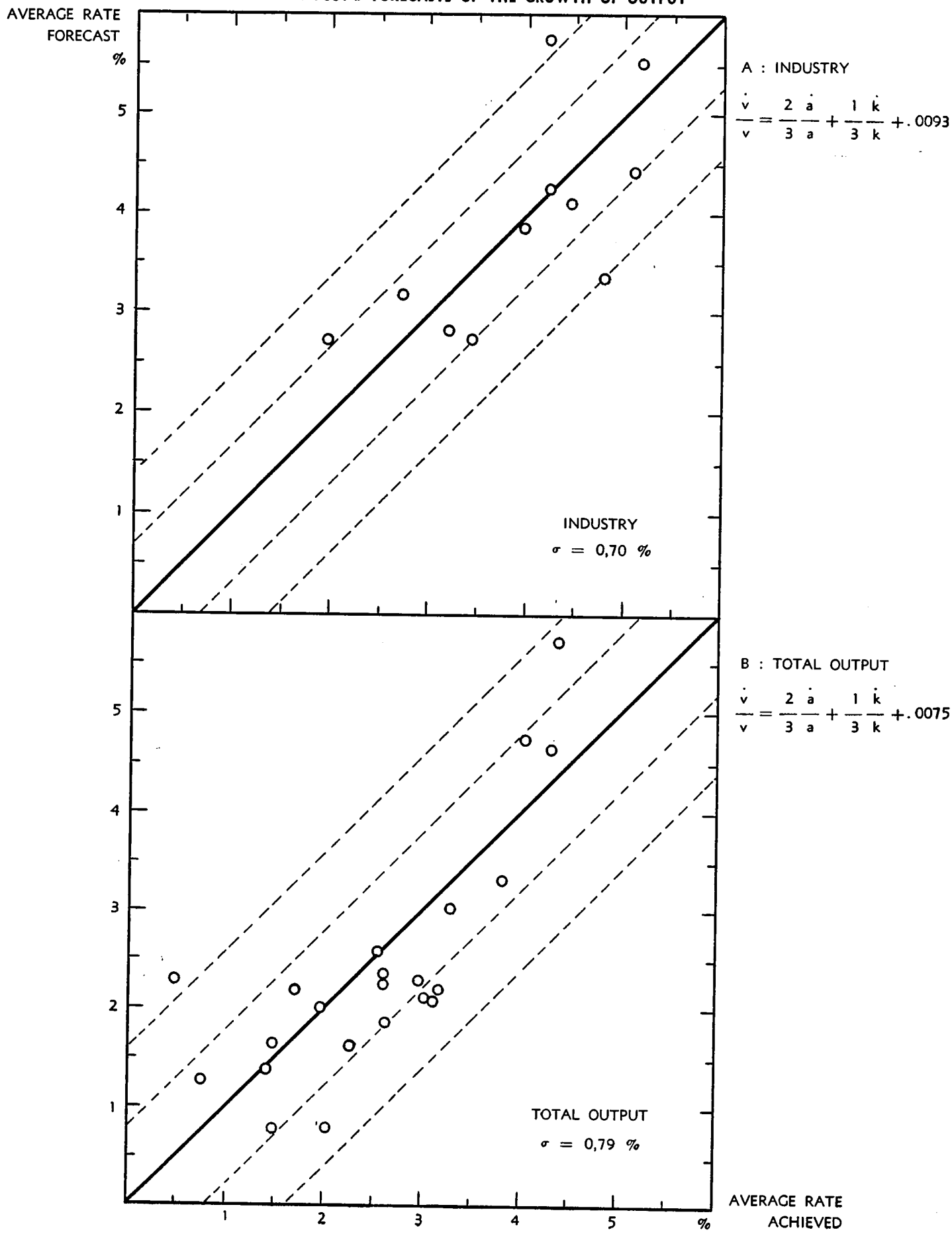
The standard deviation of the "ex-post" estimates, as determined for the sample, could be used as the variation range of the residual trend; the figure would thus be 0.7 — 0.8 % or approximately 0.75 % (1). In other words, if 0,85 is taken as reference point, the values for the different countries could vary between a minimum of $\boxed{0.85 - 0.75} = 0.10$ % and a maximum of $\boxed{0.85 + 0.75} = 1.6$ %.

38. Our experimental analysis appears to justify the conclusions set out above. Our results indicate what was feasible in the past and the range of differences between countries.

(1) As λ and μ in equation (2) are not stochastic values but have been determined *a priori*, the standard deviation of the forecast is independent of the extent of the proposed range and is, therefore, a constant.

FIGURE 3

« EX POST » FORECASTS OF THE GROWTH OF OUTPUT



We have already noted in Chapter II that the calculated numerical values must remain for some time if results of this kind are to be used for *forecasting*. If major changes are probable during the period covered by the forecast, coefficients based on past experience must be modified accordingly.

This raised the question of how to make allowance, at this stage of the forecast, for the possible influence on the residual trend term of a series of factors liable to alter the rate of productivity increase during the period covered by the forecast. The main influencing factors are :

i) The progressive establishment of the common market in accordance with the Rome treaties;

ii) Major technical advances;

iii) Structural changes brought about by economic and social policy.

We regard the *common market* as a new fact likely to change the course of the historical trend and suggesting the likelihood of a supplementary increase in the trend term. Although the post-war years have been dominated by recovery elements, the measures taken by several member countries to liberalise world or European trade have already acted as a powerful stimulus to productivity.

Subject to a number of conditions regarding the maintenance of stable economic conditions, increased trade within the common market is likely to strengthen and extend the tendency towards more rapid technical progress in all member countries.

Clearly it is difficult to assess the extent of the "autonomous" increase in productivity to be expected as a result, but there seems to be good grounds for including this "common market effect" by slightly raising the limits suggested above for the rate of increase of the residual trend.

More difficult problems arise when other factors liable to modify the historical trend are taken into consideration. It is no longer a matter of assessing the incidence of a clearly-defined new fact, coming into being on terms and conditions which are already known; it is rather a question of estimating the effects of more far-reaching changes, which are seen only in the broadest outline and often depend on action by institutions such as the government.

There are two major arguments in favour of taking these factors into consideration. The first relates to the concept of forecasting and the second to the assessment of an actual situation :

i) Economic forecasting is not an end in itself, but is designed to help in arriving at decisions (1). It is therefore, concerned with the *possibility* of achieving different rates of economic growth. This being so one cannot exclude *a priori* the hypothesis that, under the influence of various factors, productivity may increase much more rapidly in future than it has in the past. On the contrary, the possibility of its being fulfilled must be analysed in greater detail and this alone will indicate whether the hypothesis should be accepted or rejected.

ii) Apart from the immediate phenomenon of "recovery", the post-war years have been characterized, in most member countries, by realisation of the fact of economic progress. This applies to both public authorities and institutions in the private sector. In most cases, the effect of this awareness on productivity is far from exhausted and for the next few years, would appear to justify higher rates of increase for the residual trend than those recorded in the past.

While acknowledging the strength of these arguments, we are well aware that incorporation of the above factors, with *a different emphasis for each country*, may produce incompatibilities between member countries' forecasts. What influence does the government in fact have on long-term economic growth ? Are not the margins of variation suggested by experimental analysis sufficient to allow for special conditions in certain

(1) See sub-section 1 in Chapter 1 on this point.

countries ? The reply to questions of this kind probably will not be — and often cannot be — the same in all countries of the Community.

39. The proposals which follow do not claim to eliminate all difficulties. To a certain extent, they try to link forecasting with the results of empirical analysis of earlier periods. Beyond this point, they are designed, first, to facilitate assessment of the premises adopted and, secondly, to provide a basis for a co-ordinated study of the possibility of achieving rates of growth above the limits indicated by historical analysis.

i) For reference purposes, we consider 0.10 % and 1.6 % per annum to be the lower and upper limits of the residual trend coefficient v *in the past.*

The range of variation between these two values corresponds satisfactorily with the maximum difference between the trend values obtained in table 9 by conventional analysis of time series, with the restrictions adopted in this report. The maximum was in fact 1.5 % (Norway) and the minimum about 0.1 % — 0.3 % (Italy and Canada).

The highest figure of 1.5 % in table 9 is much the same as that obtained by other workers with λ fixed at 2/3—3/4 and μ at 1/4—1/3. For example, Aukrust found a trend value of 1.7 % for Norway while Solow, who tried to isolate the technological trend in the United States by completely different methods, also arrived at an average trend value of 1.5 % per annum (1).

ii) We thought it reasonable to raise these values to 0.5 % and 2 % respectively to allow for the fresh impetus which may be given by the establishment of the *common market* (2).

iii) If forecasters in any country wish to give v numerical values outside the above limits they should state clearly their reasons for so doing and the elements on which their choice is based. In the case of numerical values exceeding the upper limit of 2 % it will be necessary to indicate, for example :

— the extent of estimated "returns to scale",

— anticipated technical innovations,

— expected changes in economic, social or political structure.

iv) When numerical values below 0.5 % or above 2 % are adopted for certain countries on *an exploratory basis* — to study whether they are possible in practice — the forecasts for the other countries should include variants based on the same assumption. Studies of the possibility of achieving a given figure are, in fact, concerned particularly with foreign trade and an analysis of this kind has no significance unless the premises adopted for the various countries are co-ordinated.

The framework sketched above clearly allows a very wide margin for selecting the numerical value of v. We believe, however, that we have succeeded in :

— fixing certain points of reference;

— facilitating analysis of any differences between the rates adopted for the various countries;

— guaranteeing the possibility of a co-ordinated study of the conditions under which certain growth hypotheses can be fulfilled.

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(1) Aukrust : "Investissement et expansion économique". Revue de la Productivité, February 1959, pp. 39-58; Solow : "Technical change and the aggregate production function", Review of Economics and Statistics, XXXIX, August 1957.

(2) It may be noted that the upper limit of 2 % corresponds to that adopted in a forecast for the United States, produced for Congress, while this report was in preparation. See "86th Congress, 2nd Session. Joint Committee Print" Study Paper No. 20; "The Potential Economic Growth in the United States" by J.W. Knowles, with the assistance of C.B. Warden Jr. (Washington, 1960). This forecast uses a trend term of 2.07 % per annum, observed over the period 1909-1958.

Section III — Practical application of the model

A — ACCOUNTING PLAN

40. We have tried to keep to a minimum the number of aggregates and sectors used in the overall forecast of supply. The accounting plan for a forecast of this kind can be extremely simple, and has only to meet the following two requirements:

— it should isolate, in the economy as a whole, those sectors which must be regarded as exogenous and cannot be treated by the general method described in the earlier part of this chapter;

— it must be suitable for a type of forecast limited to an estimate of the factors of production and of output itself in the sectors considered.

The figures for each country can therefore, be consolidated on the following pattern:

TABLE 11

Accounting plan

Sectors	Quantity of labour	Stock of capital	Fixed capital formation		Replacement	Output
			New Investment	Depreciation		
1	2	3	4	5	6	7
A. Endogenous sector						
1. Non-agricultural undertakings	a	k	$\dot{k}$	d	r	v
B. Exogenous sectors	$\bar{a}$		$\bar{\dot{k}}$	$\bar{d}$	$\bar{r}$	$\bar{v}$
1. Agriculture						
2. Housing services						
3. Government						
Whole economy	A					V

41. *Definitions*

A. *Sectors*

— *Non-agricultural undertakings:* The whole economy, except the exogenous sectors, which are agriculture, housing services and government.

— *Agriculture:* Agriculture, forestry and hunting.

— items 01, 02 and 03 of the Standard International Industrial Classification

— items 1 a) and 1 b) in Table 1 in the OEEC Standardised System of National Accounts, 1958 edition.

— *Housing services:* All use of dwellings by tenants and owners,

— item 9 (real property) in Table 1 in the OEEC Standardised System of National Accounts.

— *Government:* Departments of national and foreign governments, and international organisations, established in the territory, except those selling their services on the market. The distinction between the public and private sectors is to be made in accordance with the rules applied in each country.

B. *Quantity of labour*

This is defined as the product of numbers employed and the average of hours worked per year.

We recommend, however, the use of employment only, that is, the average annual number of persons employed (wage-earners, employers and self-employed persons), expressed in millions of workers.

For the endogenous sector, we shall later consider the influence of the number of hours worked.

C. *Capital*

Stock of reproducible tangible fixed capital, computed at depreciated replacement value, in thousand million units of national currency, at specified constant prices.

This definition excludes land, intangible assets, stocks of raw materials and working capital.

The stock of capital of the *endogenous sector* (k) should include as far as possible, railways, airfields and telecommunications installations, even if they are state-owned. These items are essential to calculate the output of certain sectors (transport and services) in the endogenous sector.

D. *Fixed capital formation*

— *New investment* ($\dot{k}$ and $\dot{\overline{k}}$) : Fixed capital assets purchased or produced for own use for addition to the stock of capital goods.

— *Depreciation* (d and $\overline{d}$) : Sums allocated from current earnings to cover expenditure or losses arising from the depreciation of fixed capital.

— *Replacement investment* (r and $\overline{r}$) : Sums actually spent on replacing capital assets.

These three aggregates are expressed in thousand million units of national currency, at specified constant prices.

E. *Output* ($V = v + \overline{v}$)

Gross value added at market prices, calculated by the normal method for the territory and expressed in thousand million units of national currency, at specified constant prices.

The product of the "housing" sector is the sum of real rents and rental values, while the product of the "government" sector is the sum of wages and salaries paid to government officials and public employees, together with the estimated income of departments.

The aggregate "domestic product" (V) is arrived at by adding together the various sectoral outputs.

The domestic product of the Community will be aggregated by converting national currencies into an international unit of account *at purchasing power parities.* As Gilbert and his associates have already gone into this subject for 1955, the latter might usefully be taken as the base year for prices (1).

B — ESTIMATE OF QUANTITY OF LABOUR

42. In accordance with the terminology used in this chapter, we have to estimate the labour supply function :

$$A_t = A_o e^{\pi_t} \qquad (20)$$

In our model, the quantity of labour is treated as an exogenous variable, and the problem is to try and establish the future trend of this variable from *direct* demographic and economic data. As this is a direct estimate, the coefficient π must not be regarded as a *constant* annual rate of increase.

(1) "Comparative national products and price levels" Paris, 1958.

The estimate involves four major problems :

— estimating the total labour force, that is, the overall supply of labour;

— the distribution of the total supply of labour between the various sectors considered;

— the hypotheses to be adopted regarding the level of employment;

— the influence of variations in the average number of hours worked.

Total labour force

43. The composition and trend of the labour force depend primarily on demographic factors such as growth of the total population, age-group structure, etc.

On these grounds, the labour force could validly be treated as an exogenous factor in the production model described earlier in this chapter.

In reality, however, the trend of this variable is also influenced by economic and political factors, some of which are not completely independent of *per capita* income. For instance, income levels affect the number of children at school, the age of retirement and the number of women at work, which in turn affect the available labour force.

An estimate on a time basis does not expressly allow for these interrelations. While accepting this simplification, we at least consider it essential that the hypotheses adopted for the factors which directly determine the size of the labour force should be clearly stated.

The most important of these factors can be grouped as follows :

i) *Demographic*

a) Distribution of total population by age groups;

b) Breakdown of age-groups by sex and marital status;

c) Female fertility by age groups;

d) Mortality by age groups.

ii) *Economic and political*

a) Immigration or emigration

— national policy

— international co-operation with the countries of the European Economic Community; with other countries.

b) Factors influencing participation in the labour force, by age and sex;

— number of years at school;

— period of military service;

— retirement age;

— factors influencing the rate of participation of women in the labour force (marriage, fertility, standard of living, expansion of services sector, etc.).

We recommend that the following points be examined for these factors :

— the situation during the base period;

— the hypotheses adopted for national forecasts;

— the compatibility of the hypotheses adopted by the various countries. This is of particular importance as regards migration within the European Economic Community.

These proposals aim at an overall analysis of labour supply incorporating a series of elements which are often treated separately, without any evaluation of their general economic incidence. In particular, they will provide the basis for a more accurate assessment of the effect of political decisions on such subjects as duration of education, military service, age of retirement and migratory movements.

Distribution of the labour force between the sectors considered.

44. In accordance with the general method described in this chapter, the labour force employed in the non-agricultural sector has to be calculated by subtracting the estimated number of people employed in the exogenous sectors from the total labour force. The housing services sector, which employs very few people, can be ignored.

i) *Agricultural labour force*

As graph 4 shows, there is a general decline in the *proportion* of the total labour force engaged in agriculture (see appendix 5 for basic data and sources).

Extrapolation of this trend would appear to be justified. As the *total* labour force will already have been estimated, an absolute figure for the number of persons engaged in agriculture at the end of the period covered by the forecast can also be calculated by an operation of this kind.

In estimating the relative and absolute reduction in the agricultural labour force, allowance will be made for the fact that only certain age groups of the agricultural population move away from the land. Roughly speaking, the twenty to thirty five age groups are those affected.

The age pyramid of the agricultural labour force at the beginning and end of the period covered by the forecast, consequently affects the extent of drift from the land and, thus, the total labour force of this sector.

We, therefore, consider that the analysis of the structure of the population by age groups should include a separate study for the agricultural sector, possibly limited to a few typically agricultural regions where emigration is a major factor.

The hypothesis adopted at this stage for the agricultural labour force will, of course, have to be reviewed in connection with the detailed forecast, which will specify labour requirements for the different sectors of activity.

ii) *Labour force of the government sector*

A direct estimate will be made, covering :

— the growth of requirements for such branches as education and health services;
— government planning.

We, therefore, recommend that the labour forces of the following five sub-sectors should be *estimated* separately :

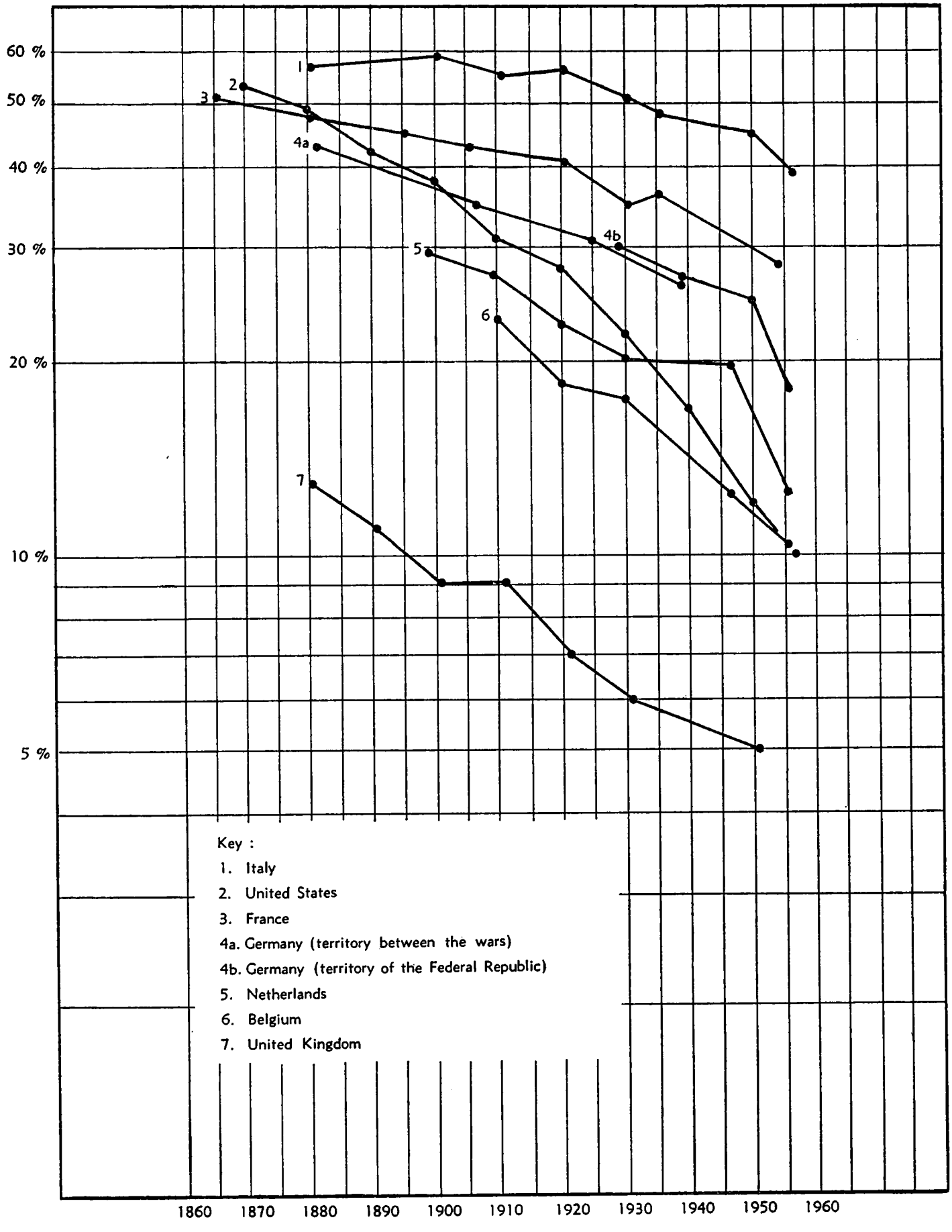
— general administration;
— defence;
— education;
— health services;
— public works.

When the detailed forecasts are made, this classification can be used as a basis for estimating government consumption, so that estimates of the government labour force and government expenditure will be more closely compatible.

It is not absolutely essential that the results for each country should be *submitted* in accordance with this classification. The overall figure required for schedule 11 might be sufficient for the labour force, provided its components are based on the above sub-division.

FIGURE 4

CHANGES IN THE PROPORTION OF THE TOTAL LABOUR FORCE ENGAGED IN AGRICULTURE



Level of employment

45. In sub-section 9 of Chapter II we explained our theoretical grounds for assuming full employment, interpreted as meaning that unemployment is at a level "which can be regarded as a reasonable minimum for each country, having regard to its existing economic structure".

The adoption of "a reasonable minimum" as a standard clearly implies no suggestion of a uniform rate for all countries of the Community. The rate must be estimated for *each country individually*, taking due account of its structural and institutional characteristics.

As a long-term forecast is to be made, this rate must refer to *normal activity* and must in no circumstances relate to a period of slump.

The average rate recorded over the last ten years might be taken as a preliminary guide, but differences between the unemployment rates of the members of the Community during that period cannot be ignored. In some countries the rate exceeded the standard 2 % - 3 % which, rightly or wrongly, is considered to indicate a situation of full employment; but in other member countries there was some pressure on the labour market.

In making the final choice, account will be taken of the following points:

i) In some countries, historical rates are liable to be modified by changes in structure and economic policy. This applies particularly to countries like Italy which are still not fully industrialised. In such cases, it will be a matter of determining the level of employment considered feasible, with the aim of reducing structural unemployment without trying to eliminate it straightaway.

ii) Converse adjustments will have to be made for countries where the average rate of unemployment over the last ten years has been appreciably affected by boom pressures on the labour market.

Variations in average hours of work

46. In the theoretical section of this chapter, the variable "a" was defined as the quantity of labour used in production.

This labour input is best represented by the total number of hours worked per year, which is the product of the two terms:

— employment (average number of persons employed during the year);

— average time worked (number of hours per person employed per year).

Frequently, however, time series for employment are used alone to represent variations in the quantity of labour.

In long-term studies, this simplication can be justified for sectors such as agriculture, where variations in average hours worked show no regular trend.

In the case of the *non-agricultural sector*, this method ignores the way in which volumes of output have been affected by the marked drop in hours worked in all the main industrial countries, which will no doubt continue throughout the Community during the coming years.

We feel, therefore, that this variable must be considered separately in the production model we have constructed for the non-agricultural sector. This would appear to be less essential for sectors covered by estimates made without a Cobb-Douglas function.

The neatest way of including hours worked in the production function for non-agricultural undertakings would seem to be the addition of a supplementary variable h, with an exponent τ expressing the interaction of hours worked and output, to the variable a which represents only the number of persons employed.

The forecasting equation would then be :

$$\frac{\dot{v}}{v} = \frac{2}{3}\frac{\dot{a}}{a} + \frac{1}{3}\frac{\dot{k}}{k} + \tau\frac{\dot{h}}{h} + \nu \qquad (21)$$

The exponent τ would thus represent the extent to which output is affected by variations in hours worked. Studies on this subject (1), show that a reduction in hours worked generally leads to a less than proportionate fall in output. In one member country values around 0,7 have been recorded for this exponent.

At present, however, we do not feel able to recommend the adoption of a single numerical value for all countries.

The numerical value of τ depends on hours worked at the beginning of the period covered by the forecast and institutional factors which may vary from country to country. It should be closer to 1 in countries where less hours were worked at the beginning of the period and there is normally less chance that the reduction in hours worked will be partly counterbalanced by an increase in productivity per hour worked. Forecasters will have to estimate the most suitable value of τ for their countries.

C. — ESTIMATE OF CAPITAL AND OUTPUT

a) *Stock of capital in the base year*

47. The model outlined for the non-agricultural sector can only be used if sufficient data are available concerning the stock of capital in the countries of the Community during the reference year.

We have already mentioned the qualities required in such data (see sub-section 31 above). Unfortunately, data are fragmentary in some cases and non-existent in others. As they are essential for any analysis of economic growth, we urgently recommend that each of the six governments of the Community should take steps to *estimate* its country's *stock of capital.* Such an estimate, which might be made in connection with a general census of industry, should observe the following rules :

— it should cover the *stock of reproducible tangible fixed capital,* excluding land, intangible assets, stocks of raw materials and working capital; the items included are the fixed capital of undertakings and government departments, together with dwellings owned by families;

— both *new replacement value* and *depreciated replacement value* should be estimated;

— the estimate should be subdivided into *the main sectors of the economy* or should at least distinguish between the resources represented respectively by non-agricultural undertakings, agricultural capital, government capital and dwellings;

— *the same rules* should be followed *in all countries.*

We have no authority to choose between the various methods of evaluation but, in order to provide results which can be used at Community level, all countries' estimates must be based on the same principles. We, therefore, recommend that the Statistical Office of the European Communities shouls take an active part in this work.

Must these official estimates be available before the capital factor can be considered explicitly in our long-term forecasts ?

Only privately-compiled data are available at present; they are fragmentary in some cases and are not based on uniform standards. Some most probably contain fairly substantial errors.

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(1) See for example : P.J. Verdoorn, „ Arbeidsduur en Welvaartspeil ", Capita selecta der Economie, Leyden, 1947.

TABLE 12

Estimate of the stock of fixed capital in the countries of the Community

Country	Sector covered	Date	Prices	Stock of capital		Sources
				Value gross of depreciation	Net value	
Germany (Fed. Rep.)	*Whole economy*	31/12/1955	1950	DM 544 thousand million	DM 306 thousand million	Deutsches Institut für Wirtschaftsforschung F. Grünig
	of which :					
	— non-agricultural undertakings	»	»	DM 257.8 thousand million	DM 144.7 thousand million	Versuch eines Volksvermögens Rechnung der Deutschen Bundesrepublik, Berlin 1958
	— agriculture	»	»	DM 33.2 thousand million	DM 18.8 thousand million	
	— housing	»	»	DM 168.0 thousand million	DM 100.0 thousand million	
	— government	»	»	DM 85.0 thousand million	DM 42.5 thousand million	
Belgium	*Whole economy*	31/12/1957	1957	B.Fr. 2,520 thousand million		Preliminary estimates by C. Duprez and B. Kahn Departement of Applied Economics, Free University of Brussels
	of which :					
	— non-agricultural undertakings	»	»	B.Fr. 930 thousand million		
	— agricultural	»	»	B.Fr. 70 thousand million		
	— housing	»	»	B.Fr. 1,220 thousand million		
	— government	»	»	B.Fr. 300 thousand million		
Italy	*Whole economy*	1938	1938		Lire 473.4 thousand million	B. Barberi (*a*)
	Non-agricultural undertakings	31/12/1955	1955		Lire 19 billion	V. Cao-Pinna (*b*)
France	*Whole economy*	1954	1954		Frs. 42.6 billion	J. Bénard (*c*)
	of which :					
	— non-agricultural undertakings	»	»		Frs. 20.2 billion	
	— agriculture	»	»		Frs. 1.5 billion	
	— housing	»	»		Frs. 8.9 billion	
	— government	»	»		Frs. 12 billion	
	of which :					
	transport infrastructure	»	»		Frs. 9.3 billion	
Netherlands	*Whole private sector*	31/12/1950	1950		Fl. 80.9 thousand million	Central Planbureau
	of which :					
	— non-agricultural undertakings	»	»		Fl. 40.9 thousand million	
	— agriculture and fisheries	»	»		Fl. 17.8 thousand million	
	— housing	»	»		Fl. 22.2 thousand million	

(*a*) B. Barberi : "Aspetti statistici nelle teorie dello sviluppo economico", L'industria, No. 3, 1960.

(*b*) This figure does not include housing, public works and private transport but does include railway and post installations and public transport.

(*c*) Rough estimate based on the figures of Divisia, Dupia and R. Roy. "Fortune de la France", 1958. These authors' figures for the processing industries and commerce have been raised on the basic of information taken from insurance company files.

Although aware of the objections to using these imperfect data, we believe that this would be less unsatisfactory than a complete refusal to include capital as a separate factor. We, therefore, recommend that these fragmentary data be used as a provisional basis. A number of figures are given in Table 12.

b) *Estimate of the capital stock and output of the endogenous sector at the end of the period covered by the forecast*

48. The systematic relationships adopted in earlier sections now have to be supplemented and combined to produce a model which can be used to estimate output at the end of the period convered by the forecast.

So far we have a production function for the endogenous sector and a total labour supply function, from which the quantity of labour in the endogenous sector can be estimated.

The following operations have still to be performed:

i) An investment function has to be worked out and applied;

ii) The output of all exogenous sectors has to be estimated;

iii) The output of non-agricultural undertakings at the end of the forecast period has to be computed, either by a direct approximation or by a year-to-year calculation.

Point ii) — which relates to the forecasting technique for the exogenous sectors, is discussed later in sub-sections 53 to 55. We provisionally assume the output ($\overline{v}$ in table 11) and fixed capital formation ($\dot{\overline{k}}$, $\overline{d}$ and $\overline{r}$) of these sectors combined to be known quantities. The symbols appearing in the accounting plan (table 11) are used in the paragraphs which follow.

Investment function

49. Theoretically, there are at least four possible ways of linking capital formation with output or income:

i) The classical hypothesis that *net investment* is a function of the level of output or income:

$$\dot{k} + \dot{\overline{k}} + r + \overline{r} - d - \overline{d} = \alpha V \qquad (22)$$

ii) A variant of this hypothesis, considering the relationship between *gross investment* and output:

$$\dot{k} + \dot{\overline{k}} + r + \overline{r} = \alpha V \qquad (23)$$

iii) Domar's first method of approximation, in which new investment constitues a fixed percentage of output and income. Equation (14) in sub section 28 is based on this approximation. With two sectors, this gives:

$$\dot{k} + \dot{\overline{k}} = \alpha V \qquad (24)$$

iv) The phenomenon, observed after the second World War, that gross investment in industry represents a fairly stable proportion (20 %) of value added in the various countries of the Community (1). Applying this relationship to all industry and services, we get:

$$\dot{k} + \dot{r} = \alpha V \qquad (25)$$

A priori, there is little to be said for or against any particular investment function. We must, therefore, consider which relationship seems most appropriate in a specific case.

(1) See O.E.E.C. General Statistics, March 1959.

The parameter α is of primary importance in all the suggested functions. For forecasting purposes, the simplest approximation is clearly to consider this parameter as a structural constant and to use, for the forecasting period, the value given by the selected function for *a previous period.*

In many cases, however, this method cannot be used because α is an instrument of economic policy, and becomes a strategic parameter in a development programme. In such circumstances, an average value, differing from that recorded in the past, can be adopted for the *whole* period covered by the forecast.

When there is a substantial difference as compared with the past, equation (27) below can also be used and the difference can be expressed in the value of the variable q (investment surplus or deficit of the exogenous sector).

50. For purposes of mathematical approximation, it does not matter greatly which formula is selected. As an example, we give the equation for the most complicated case, in which the relationship between net investment and the volume of output and income is considered.

Expressing this relationship as an explicit function of $\dot{k}$ and replacing V by $v + \overline{v}$ equation (22) becomes:

$$\dot{k} = \alpha v + \overline{\alpha v} - \overline{\dot{k}} - r - \overline{r} + d + \overline{d} \qquad (26)$$

Here, $\overline{v}$, $\overline{r}$ and $\overline{d}$ are exogenous and given, while r is known so long as the forecasting period does not go beyond the average life of the capital goods. Postulating

$$\overline{\alpha v} - \overline{\dot{k}} - r - \overline{r} + \overline{d} = q \qquad (27)$$

q represents, as it were, "the investment surplus or deficit" of the exogenous sector. Obviously q can also be defined to include imports and exports of capital. As the sign of this term may change over a period of time — as happened after the war when external aid declined — a linear function should be used to approximate q:

$$q = q_0 + \iota t \qquad (28)$$

Representing depreciation by:

$$d = \delta k \qquad (29)$$

we finally express the investment relationship as:

$$k = \alpha v + \delta k + q_0 + \iota t \qquad (30)$$

Output of the endogenous sector

51. This volume can be estimated either by *a year-to-year calculation* or by a *direct estimate* of output in the terminal year.

In the first case, the volume of output in year 1 is calculated from data for year 0 with the help of the following equations:

— the production function for the non-agricultural sector;

— the investment function for the same sector;

— the relationship between the capital *stock* of this sector and investment.

The operation is then repeated until year t. An example of such a calculation is given in Appendix 6.

In the second case, equation (14), given in sub-section 28, can be used or, alternatively, can be replaced by a practical approximation formula. Appendix 6 gives an example of a procedure based on the condition:

$$k_0 + \frac{t}{2}\dot{k}_0 = k_t - \frac{t}{2}\dot{k}_t \qquad (31)$$

where t is the number of years covered by the forecast, $\dot{k}_o$ is the growth of k at the beginning of the forecast period and $\dot{k}_t$ its growth at the end of that period.

This equation is, therefore, based on the assumption that the growth of capital during the period covered by the forecast $(k_t - k_o)$ is equal to average capital formation at the beginning and end of that period, multiplied by the number of years in the period:

$$t\left(\frac{\dot{k}_o + \dot{k}_t}{2}\right)$$

Estimates for exogenous sectors

52. In the preceding paragraphs, the output and capital formation of all exogenous sectors have been provisionally regarded as known. A few comments are now necessary on methods of establishing a provisional forecasting hypothesis for the sectors concerned, namely agriculture, housing services and government.

1. *Stock of capital and capital formation*

i) In the recommended model, movements of the *stock* of capital in the exogenous sectors need not be estimated. The most that it is required is an estimate of changes in the *physical* number of dwellings. Housing requirements are in fact better appreciated by a study of the number of dwellings than by a direct assessment of annual building requirements. A study of this kind will also help in estimating value added by this sector.

Estimates of the future number of dwellings should take into account the number of families, the number of rooms per family, the average age of existing dwellings and the relevant government programmes (for fuller details, see sub-section 92 in Chapter IV).

ii) Capital formation in the exogenous sectors must be estimated if the investment function chosen for the *endogenous sector* is based on a relationship between investment and income *over the whole economy*. This is the case with equations (22), (23) and (24) given in sub-section 49 above. The most synthetic method of including such exogenous capital formation is to estimate the movement of the quantity q which we have defined as the investment surplus or deficit of all exogenous sectors.

In sub-section 50, we showed that, with an investment function linking net investment to national income, q is defined as:

$$q = \bar{\alpha}\bar{v} - \bar{\dot{k}} - r - \bar{r} + \bar{d} \qquad (27)$$

For forecasting purposes, we recommend a linear approximation for q:

$$q_t = q_o + \iota t \qquad (28)$$

Estimates should take into account the special requirements and characteristics of each exogenous sector.

In the case of *agriculture*, we can start from the idea that the current trends towards a declining agricultural labour force and increasing production are due to the progressive introduction of techniques involving the use of:

— tractors and agricultural machinery;

— special farm equipment;

— buildings (particuarly modern cattle-sheds).

Once we know the number and composition of existing farms, and the foreseeable movement of these elements, a hypothesis can be postulated regarding future requirements of capital equipment. The extent to which these optimum requirements can be met and the time needed to do so, must then be estimated, having regard to current trends; after which, the annual implications of this hypothesis in the form of new equipment or the extension and replacement of existing equipment, will have to be worked out.

In the case of *housing*, it is preferable to start by attempting an approximation of stock at the end of the period before estimating annual investment requirements for the sector.

Finally, a preliminary hypothesis will be postulated *for government services* on the basis of planned programmes. This hypothesis can be reviewed later, in connection with the functional analysis of government expenditure described in Chapter IV.

2. *Volume of output*

Agriculture

53. i) The trend of agricultural output will be examined as a first approximation, taking vegetable and animal products separately. This analysis will show whether sufficient regularity has been observed in the past to justify a time estimate in the form of a straightforward extrapolation of the historic trend.

ii) In some countries, like France and Italy, the extrapolation method could be refined, for vegetable products at least, by using a production function linking output with certain inputs such as fertilisers, the use of tractors and, possibly, the area under cultivation (1).

iii) Additional information obtained by inquiry can be used to check the results arrived at by the above methods.

iv) This preliminary forecast for agriculture will of necessity be extremely tentative, and will, therefore, have to be re-examined at a later stage.

Before the preliminary forecasts are concluded, a check should be made to establish whether the share represented by agricultural output in the overall domestic product at the end of the forecasting period — as indicated by the preliminary forecasts as a whole — reflects the trend of the relative importance of this sector in the economies of the Community.

The estimated increase in productivity computed from the forecasts of agricultural output and labour force will also be checked against the previous trend of agricultural productivity, taking into consideration at the same time the previous and anticipated trend of productivity in the other sectors.

If the forecast shows a broken trend, the factors responsible for the break will have to be investigated.

v) *Demand* factors cannot be ignored in explaining the growth of agriculture. When the detailed forecasts are made, the preliminary output forecast will have to be further revised to bring it into line with the *detailed* forecasts for consumption and imports of food products.

Housing services

54. i) It can be assumed, as a first approximation, that value added by this sector varies with the number of dwellings; in countries with a substantial backlog, a slight positive trend should be added to allow for the lower average age of dwellings and the better service provided.

ii) Such an approximation does not allow for possible changes in the rent control policy of several member countries. A further adjustment will therefore be necessary if such changes are considered probable.

iii) At a later stage, this preliminary forecast will have to be revised during the analysis of final demand (see sub-section 92, Chapter IV).

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(1) A function of the type $\frac{\overline{v}}{s} = \beta \left(\frac{i}{s}\right)^n$, where $\overline{v}$ is output of vegetable products, s the area under cultivation, i expenditure at constant prices on fertilisers, insecticides and fuel and ß a dimensional factor, gave satisfactory results for growth in Italy from 1949 to 1958.

Government

55. The difficulties experienced by national accountants in defining a valid concept of value added by government departments are well known.

The most usual convention is to regard wages and salaries paid as representing value added; in calculations *at constant prices*, the effect of this convention is to consider value added per person employed in this sector as constant, apart from the effect of a shift of staff towards higher (and better-paid) grades.

In the case of long-term forecasts, this method is admissible at the overall stage, when the aim is to produce a figure for gross domestic product comparable with the results for other countries. It is not acceptable when a later stage of the forecasting process includes a preliminary study of the distribution of incomes and the correlative formation of demand, before analysis of anticipated price variations is started. At this later stage, which is discussed in Chapter V, it must be assumed, however approximately :

— that incomes, particularly wages, are linked to general productivity changes;

— consequently, that incomes paid by government departments, which follow wage movements, increase in the same proportion.

However, with the recommended model, no estimate of the anticipated future course of value added per worker in the other sectors will be available *at this stage* (1). Forecasters will, therefore, only be able to make a straightforward extrapolation of the trend.

As an expedient, we suggest that :

i) As a first approximation, when calculating the output of the government sector, allowance be made only for expected movements in the number of persons employed and possibly for a shift towards higher grades (2).

ii) At later stages, and, in any case, for the detailed forecast at variable relative prices, the estimated government product should be adjusted to reflect an increase in value added per person employed, substantially the same as that adopted for the non-agricultural sector.

(1) Except if the investment function used is strictly confined to the non-agricultural sector. See equation (25) in sub-section 49.

(2) The effect of this shift can be calculated, for example, by reference to changes in value added per person employed in government over the last ten years.

CHAPTER IV

FORECAST OF DEMAND AND COMPARISON OF SUPPLY-AND-DEMAND FORECASTS

Section I — General considerations

56. The methods described in the previous chapter can be used to formulate one or more hypotheses for the growth of supply, covering the following items:

— the supply of labour and its distribution between agriculture, government and non-agricultural undertakings;

— capital resources and formation, for non-agricultural undertakings at least;

— gross domestic product and its distribution between agriculture, housing services, government and the output of non-agricultural undertakings.

This chapter is concerned with methods of formulating a hypothesis for the associated movement of final demand and preparing for the transition to a detailed forecast by categories of goods and services and sectors of production.

Before going into details of the methods used, we should point out that it is extremely difficult to suggest uniform criteria for all countries in this matter. Since the influence of most of the determining factors is exogenous, final demand cannot be computed exclusively by means of econometric relationships.

The functional relationships suggested in the paragraphs which follow are not offered as norms and the probability of the results obtained will have to be checked much more thoroughly than the overall supply estimates.

57. The formulation of final demand hypotheses after an overall supply hypothesis has been worked out raises a number of general problems which must be considered first.

We shall start with the relationships which represent the accounting balance between supply and demand. In order to express private consumption and private investment in terms of income, we introduce the factors: direct taxation (T_d), net indirect taxation (T_i) and transfer payments (R).

The transition from the concept of output V, used in Chapter III, to that of product at factor cost Y is effected by means of the defining equation:

$$V = Y + T_i \qquad (32)$$

The balance of supply and demand is then expressed by the following equations:

$$Y + T_i = C + A + I + \Delta S + (X - M) \qquad (33)$$

$$A + R = T_i + T_d + Z \qquad (34)$$

$$\phi(Y + R - T_d) = I + \Delta S + (X - M) + Z \qquad (35)$$

Where:

Y = gross domestic product at factor cost
C = private consumption

A = final government expenditure including staff wages and salaries : Ti + Td — R
I = gross fixed capital formation of undertakings and gross investment in housing
Δs = increase of stocks
X — M = balance of current external transactions : exports (X) less imports (M) of goods and services
R = transfer payments
Ti = net indirect taxation (less subsidies)
Td = direct taxation, including social security contributions
Z = budget imbalance. Limits may be set to the value of this variable; for example $Z = 0$ or $Z \leqslant \overline{Z}$ where $\overline{Z}$ is the maximum permissible deficit
ϕ = gross rate of saving by undertakings and households

In this series of relationships, equations (33) and (34) are accounting equations balancing resources and uses, the former in respect of goods and services and the latter in respect of government departments. Equation (35) is a performance equation, representing the financing of expenditure, other than on consumption, out of income (including undistributed company profits) after payment of direct taxation.

Referring to the various elements in final demand covered by equation (33) we must now formulate separate expressions to represent private consumption, government demand, investment, imports and exports.

i) The following equation for private consumption is deduced from relationships (33) and (35) :

$$C = (1 - \phi)\ (Y + R - T_d) \qquad (36)$$

The share of net direct taxation in domestic product can be expressed as :

$$\frac{T_d - R}{Y} = \theta \qquad (37)$$

Equation (36) then becomes :

$$C = (1 - \phi)\ (1 - \theta)\ Y \qquad (38)$$

Private consumption so defined must be analysed by categories of needs. Expenditure C_i for need i represents the following fraction of total expenditure :

$$C_i = \gamma_i C \qquad (39)$$

The coefficient γ_i is linked (by relations which can very widely both from one category of needs to another and from one country to another) to per capita consumption $\frac{(1 - \phi)\ (1 - \theta)\ Y}{N}$, to price structures $\frac{p_i}{p}$ to the distribution of incomes which can be symbolised by Pareto's coefficient α_p and finally a term representing the trend $e^{\xi t}$

$$\gamma_i = f\left\{ \frac{(1 - \phi)\ (1 - \theta)\ Y}{N},\ \frac{p_i}{p},\ \alpha_p \cdot e^{\xi t} \right\} \qquad (40)$$

The function f can be associated with various assumptions as follows : constant income elasticity; decreasing elasticity; predominance of the time trend; predominance of the formation and progressive utilisation of a stock of durable consumer goods.

ii) *Government demand* can be regarded, first, as a function of certain socio-economic variables, such as population and domestic product per head of population and, secondly, as a function of economic policy goals.

iii) Adding the relationships $\frac{T_d - R}{Y} = \theta$ equation (35) becomes :

$$\phi(1 - \theta)\ Y = I + \Delta S + (X - M) + Z \qquad (41)$$

As we saw in Chapter III, *gross fixed capital formation* is a function of domestic product, which in turn depends on capital formation in preceding years.

iv) From a long-term point of view, annual stock increases are a function of the annual increase in domestic product.

$$\Delta S_t = f(\Delta Y_t) \qquad (42)$$

v) Imports M are a function of domestic product, a term representing relative price levels and a term representing the time trend.

$$M = f\left(Y, \frac{p}{p_{ext}}, e^{\zeta t}\right) \qquad (43)$$

vi) Exports X are a function of the domestic product of consumer countries, a term representing relative price levels and a term representing the time trend.

$$X = f\left(Y_{ext}, \frac{p}{p_{ext}}, e^{\zeta t}\right) \qquad (44)$$

58. The components of final demand, other than exports, are thus a function of gross domestic product. We have seen, however, that most of these components are also a function of other factors which may cause them to develop independently of Y. Thus, it is not established that the various functions representing the components of final demand can be added together to produce the initial value of Y on completion of the calculation.

Consequently, there will generally be no book balance between anticipated supply and anticipated demand unless a correcting term u is added; this gives:

$$Y + T_i = C + A + I + \Delta S + (X - M) + \mu \qquad (33\text{bis})$$

for equation (33) :

To keep the correction to a minimum, we can begin by regarding one or other demand component as residual. In some countries, investment is so regarded and, in others, private consumption.

Some of us hold the view that the domestic product $V = Y + T_i$ calculated in the previous chapter, is also open to question at this point.

Thus a correction has to be made in any case. The problem must be solved by a process of successive approximations which will be dealt with in greater detail in the last part of this chapter. Generally speaking, the overall picture of domestic demand so obtained must not differ too widely from previously recorded facts, except in special circumstances.

59. These general remarks show that the problems raised by the semi-global estimate of demand can be devided into two categories. First, we have *to forecast the major components of final demand* in relation to the main factors influencing the trend of the various classes of demand. These problems are dealt with in Section II of this chapter.

There we shall consider:

i) How demand can initially be broken down into its major components.

ii) How an initial functional analysis of each final demand component can be made. Capital formation is divided between non-agricultural undertakings, agricultural undertakings, housing and government investment. The latter is sub-divided between the major spending departments and private consumption into various categories of *needs*.

We must then compare the hypotheses for gross domestic product and its distribution with those relating to domestic demand and its distribution, by making an *initial comparison* of the results obtained for supply by the methods described in Chapter III and those obtained for demand by the methods proposed in the present chapter. Section III discusses how a preliminary critical assessment can be made, suggesting what adjustments are required.

Since the available basic data and the factors influencing the movement of demand components vary from country, to country, the following paragraphs are not primarily concerned with the technical details of a uniform method of forecasting. They merely indicate *the general line* to be followed, list the main factors to be taken into account and give a number of examples to illustrate the practical formulation of demand forecasts.

60. Under the general procedure adopted in this report the prospective level of the elements of final demand is calculated, more or less directly according to circumstances, from the estimate of output and income. However, the considerations raised in the preceding paragraphs led us to examine the influence of explanatory variables, other than income, and to consider whether they could be taken into practical account in forecasts. The effect of *changes in the relative prices of goods and services* is a particularly difficult problem, which concerns the whole process of forecasting. Its significance is, therefore, briefly discussed in this section.

The effect of changes in relative prices depends directly on the level of aggregation of the forecast. It is small in an overall forecast, but becomes greater immediately any attempt is made to subdivide the latter

— into major production sectors, on the supply side,

— into classes of demand corresponding to the main types of needs on the demand side, as described in this chapter.

The effect of such changes is of crucial importance when the forecast covers the growth of demand by categories of *products* and the growth of supply by sectors of industry.

In the context of this chapter, the problem of relative prices has two important aspects. The first relates to the forecasting of variations in these prices; How far can or should the original hypothesis of constant prices be abandoned ? The second concerns the *effect* of such variations on the structure of demand, and particularly on the structure of private consumption; what hypotheses should be adopted regarding price elasticity for the various categories of expenditure ?

The extent of these problems becomes more apparent when we consider the factors which determine the long-term movements of relative prices. They are principally the following :

i) Unequal increases in the *productivity* of the factors of production in the different sectors of industry;

ii) Unequal increases in production factor *prices*;

iii) Changes in the composition of products;

iv) Economic policy, particularly as regards foreign trade.

These elements are themselves determined by such factors as the growth of available labour and capital in the various sectors and the unequal opportunities between sectors for substituting labour and capital.

Consequently, even a summary analysis of relative price movements, presupposes a study of relations between industrial sectors and of income distribution mechanisms, details of which are not yet available at this stage of the forecast.

From the practical point of view, there are two possible courses of action at this point :

i) The initial hypothesis of constant prices can be maintained in full. The analysis of demand by main classes of needs as outlined in this chapter would then be regarded as a transitional step to a more detailed forecast incorporating the effects of anticipated movements of relative prices.

ii) The forecast at constant prices can be roughly adjusted on the basis of known price trends. For example, the effects of price changes to be expected as a result of the increase in incomes linked with the growth of the domestic product can be incorporated in the forecast. These effects are obvious in the relative increase

in the price of services. It may also be useful to allow for the effects of price changes expected as a result of political measures concerning rents, for example.

The great danger with such adjustments is, however, that in trying to eliminate certain distortions from the forecasts, one merely introduces others, because of the partial character of the adjustments made. Chapter V gives an example of a valid method of dealing with the problem of variations in relative prices.

We freely recognise, however, that the problem is far from being solved. By bringing it to notice, we hope to stimulate more detailed study of the subject.

Section II — Formulation of forecasting hypotheses for the components of final demand

A — INTRODUCTION

61. Equation (33) distinguishes between the following components of final demand:

— private consumption (C),

— final government expenditure (A),

— gross fixed capital formation of undertakings and housing investment (I),

— stock variations (ΔS),

— the balance of current external transactions (X-M).

This breakdown calls for the following comments:

i) Chapter III described methods of computing *fixed capital formation* both for the whole economy and for the non-agricultural sector (sub-sections 49 and 50). We shall not discuss this element of domestic expenditure in greater detail and will merely note that the results obtained by one or other of these methods will have to be adapted or supplemented in certain respects to bring them into line with the aims of this chapter.

— Some of the methods considered in Chapter III only evaluate the capital formation of non-agricultural undertakings. The figure so obtained must, therefore, be supplemented by estimates for agricultural undertakings, government and housing, based on the principles suggested in sub-section 52. Reference should also be made to the functional analysis of government expenditure in sub-section 64, and to the study of housing expenditure in sub-section 92.

— The application of certain relationships proposed in Chapter III gives a figure for *net* capital formation or *new* capital formation. In order to obtain figures for *gross* capital formation, a hypothesis must be formulated for depreciation or replacement investment. The latter can be regarded as a function of the value of the capital resources at the end of the forecasting period or, more approximately, as a percentage of the gross domestic product.

ii) No detailed comments are necessary concerning the estimate of *stock variations*. Only a very approximate hypothesis is possible, preferably based on a relationship between the annual increase in stocks and the annual increase in domestic product at the end of the period covered by the forecast.

iii) The methods used to estimate *private consumption, government expenditure* and the *foreign trade balance* need to be studied in more detail. We shall deal first with the last two elements which are more markedly exogenous.

B — GOVERNMENT EXPENDITURE

62. *General procedure*

For the purposes of this chapter, the estimate of government expenditure should try to evaluate the current consumption of goods and services (including expenditure on staff) and the gross fixed capital formation of government departments. The sum of these two items constitutes term A in equation (33).

One method is to supplement the estimates made for government departments in the overall supply forecasts. In sub-sections 52 to 54, for example, we suggested a number of rules for estimating capital formation and value added, the latter being by definition the amount of wages and salaries paid by government departments.

An estimate of consumption expenditure, other than expenditure on staff, is then added to produce a hypothesis for *total* final government expenditure. This can be based on:

— the proportion of total public consumption accounted for by such expenditure during previous years;

— an analysis of government programmes.

Calculations of this kind may be too short for a fairly detailed forecast. It is, in fact, difficult to estimate separately consumption of goods and services in connection with the day-to-day work of government departments, purchases of equipment for the latter, staff strengths and salaries, and transfer payments; although these various forms of administrative activity are not all equally important for the study of economic growth, and although transfer payments, in particular, are only of interest when the distribution of incomes is studied, they are too closely interwoven for there to be any easy way of estimating their likely trends separately.

An analytical forecasting diagram covering *all* government expenditure is, therefore, worked out in the paragraphs which follow; the items included are current consumption of goods and services, wages and salaries, purchases of capital goods and transfer payments.

The *functional* dimension of public expenditure must be distinguished from the *economic* dimension for the purpose of our analysis. The first dimension is based on the purpose of the expenditure (for example, education and national defence), the second on its economic nature (current consumption of goods and services, wages, capital formation, etc.). If the working instruments needed to make the transition from one dimension to the other are available, the results of an analytical forecast based on the functional dimension can be expressed in terms of consumption, investment etc., and can be incorporated in the patterns normally used for analysing final demand. In this way the consumption and investment items to be estimated at this stage of the forecast can be separately identified.

63. *Basic material for a forecast of all government expenditure*

Data for a forecast covering government operations are obtained from the public accounts which provide a cross-breakdown of government expenditure on both a functional and an economic basis. The classifications used for this purpose are not exactly the same in all countries and the variations observed partly differences in administrative structure.

In the Benelux countries, the main classifications have been standardised and table 13 shows that, as regards functional breakdown, the Benelux nomenclature cross-checks with those used in the French, German and Italian accounts (1).

(1) The functional breakdown used in the OEEC Standardised System of National Accounts covers current expenditure only and is, therefore, less suitable for the purpose of this study (see Table V B, 1958 edition).

TABLE 13

Functional breakdown of government expenditure

BENELUX		FRANCE		GERMANY (F.R.)		ITALY	
No. in national nomenclature	Functions	No. in national nomenclature	Functions	No. in national nomenclature	Functions	No. in national nomenclature	Functions
1*a*)	General services	1	Public authorities and general administration	1	Government and general administration	1	General administration
1*b*)	National defence	4	National defence	2	Defence	2	National defence
1*c*)	Overseas territories				—		—
1*d*)	Foreign relations	3	International relations		(Included under 1)	4	International relations
1*e*)	Police and juctice	2	Justice and internal security	3 4	Public security and order Justice	3	Justice and internal security
2*a*)	Education and culture	5	Education and culture	5	Schools, science, art, education, churches	5	Education and culture
2*b*)	Welfare services and public health	6	Welfare services	6	Welfare and health services	6	Welfare services
2*c*)	Housing	8	Housing and accomodation	ex 7	Building and housing		(Included under 6)
2*d*)	War damage		(Included in economic breakdown)	9	Special war damage payments	7	Economic action
3*a*) *b*) *c*)	Agriculture, horticulture Commerce, industry Transport, communications and waterways	7	Economic action	ex 7	Economy and transport		
4	Unclassified expenditure (national debt and relations with subordinate authorities)			8	Provision of employment etc.	8	Unclassified expenditure
		9	Non-functional expenditure (e.g. national debt service)			9	Non-functional expenditure
		10	Unclassified expenditure	10	Debt service	10	Reserve fund

All these nomenclatures list the essential administrative functions on which the forecast has to concentrate, namely, the various general collective activities, education, economic action, welfare services and housing.

The economic breakdown generally shows net current consumption of goods and services, wages and salaries paid to government officials and all transfer payments appearing in departmental accounts. The capital account shows gross fixed capital formation and, in some cases, stock variations and financial operations.

A cross-breakdown can then be constructed on the basis of the two types of breakdown described above. The cross-breakdown used for the French public accounts is given as an example in Appendix 7.

Economic interpretation of a cross-breakdown, independently of the actual administrative structure, is only possible if the national accounts provide a consolidated picture of all administrative operations. They must combine, within a single framework, not only all operations of the State, government establishments and local authorities but also the operations of foreign or international authorities and of private administrative bodies. In particular, the educational and cultural function is not validly represented unless expenditure by private educational bodies (excluding boarding schools, which are treated as commercial undertakings) is added to expenditure by central and local authorities on national education. Normally, the statistics are not immediately available in this form and some preparatory work is necessary.

64. *Methods of forecasting*

The basis so constituted is not suitable for the application of simple forecasting procedures, and three different methods have to be used, according to circumstances:

i) In the case of certain administrative functions, once the *objectives* of administrative action have been specified, clearly-defined items of expenditure can be set against these objectives by a relatively simple interpretation of recorded observations.

This applies first of all to *educational action.* Making due allowance for targets regarding the average size of classes, all that is necessary to produce an estimate of future expenditure on staff and equipment, by public and private educational authorities, is to formulate a hypothesis of the trend in numbers of pupils attending primary, secondary and advanced establishments, taking into account population forecasts and expectations regarding the average period of schooling. This calculation can be made from previous records without too much difficulty, provided the item „Educational and cultural function" is itself broken down into the various levels of education. The same applies to *economic action.* A number of objectives, linked with the prospective growth of transport, can be defined for roads, urban and rural infrastructures, ports, airfields and inland waterways. The corresponding administrative expenditure can then be estimated by reference to recorded data for each functional sub-item.

In all cases, effective use can be made of data collected for the functional analysis of administrative operations, because an objective can be assigned to each function considered, and hypotheses regarding the future course of expenditure can then be linked with that objective.

ii) The relatively systematic method briefly described above cannot be used with certain other functions. The future course of administrative operations can only be linked with *general characteristics of economic growth.*

For example, *the process of government and general administration,* the administration of justice, the maintenance of internal security and the management of international relations are to some extent the overheads of collective activity. A growth hypothesis linked with the general hypothesis can be postulated for these functions, starting from an empirical extrapolation of recorded data.

Social action (welfare) covers operations of the social security system and assistance organisations, consisting mainly of transfer payments, the growth of which is linked with that of certain items of medical consumption expenditure (social insurance benefits), with population trends and with average per capita wages (pensions,

family allowances). These are the most important links, but the true position is obviously much more complex. While, for example, part of transfer expenditure is connected with the growth of medical consumption, it is conversely true that the latter is linked with the rate of benefit; population trends are themselves partly determined by the amount of medical consumption.

iii) Finally, recorded data are not an acceptable basis for forecasting in the case of *national defence.* In view of the speed of technological progress in this field and the changing political premises of national defence, the forecast must be made by specialists, whether it expresses government targets or whether experts are called in (if the forecast is not made by government officials). In many cases, it will only be possible to formulate a simple hypothesis, the more or less arbitrary nature of which should be duly noted.

These studies should provide details not only of government consumption of goods and services and gross fixed capital formation but also of government expenditure on wages and salaries and public transfers.

Within the framework described, it is thus possible :

i) To identify government expenditures constituting elements in final domestic demand :

— government consumption of goods and services,

— gross fixed capital formation by government departments;

ii) To revise the hypothesis for government output on the basis of a more detailed study;

iii) To extract data which might be used at a later stage for an analysis of future income trends.

C — FOREIGN TRADE BALANCE

65. At the stage now reached, namely the composition of final demand, it may be considered sufficient to predict the foreign trade balance, X-M, by reference to certain economic or political requirements.

Most of us hold the view that the estimated foreign trade balance should result in balanced payments, allowing for the expected trend of long-term capital movements both for foreign debt repayment and for investment abroad. Trade with under-industrialised economies (and particularly with those which have political links or agreements with the countries whose economies form the subject of forecasts) should show a surplus of exports, as a means of furthering or speeding up the development of the economies concerned.

One member of the group considers, however, that *unbalanced* payments may quite legitimately be assumed in a forecast, provided the estimated imbalance is compatible with the terms of international monetary agreements and the requirements of currency stability.

66. One may, however, seek to go beyond an estimate of the foreign trade *balance* and try to forecast imports or exports, or possibly both. The need to do so is greater, the more the country concerned depends on its foreign trade and the more the components of that trade have previously shown trends differing quite substantially from those followed by the elements of internal demand.

Exports must then be treated as a function of the domestic product of customer countries, of a term representing relative price levels and of a term representing the time trend :

$$X = f\left(Y_{ext.} \frac{p}{p_{ext}}, e^{\zeta t} \right) \qquad (44)$$

For forecasting purposes, it will be necessary to select a function and try to establish the probable trend of the three terms in the second part of equation (44).

According to certain economic ideas, the relative level of prices can be regarded as an objective of economic policy.

The coefficient, ζ, of the trend term will allow for the present move towards freer trade, both at world level and in Europe. In this connection it will be recalled that, in the previous chapter, we postulated a 0.5 % per annum increase in the rate of growth of the domestic products of member countries as a result of European economic integration; the main effect of the increased competition quoted as the reason for this rise will be an expansion of trade.

The rule for *imports* seems to differ slightly from that governing exports. In this case, the first explanatory variable is the domestic product of the country concerned.

$$M = f\left(Y, \frac{p}{p_{ext}}, e^{\zeta t}\right) \qquad (43)$$

Imports are, therefore, more endogenous than exports and should be estimated, as a first approximation, from the value obtained for Y from the overall estimate of supply. For the terms $\frac{p}{p_{ext}}$ and $e^{\zeta t}$ the reasoning used with reference to exports again applies.

When the foreign trade balance, X-M, and its two components are estimated separately, there is a problem of comparison which will be discussed at the end of this chapter.

It is also highly desirable that national forecasts of trade between the members of the Community should be compared. For this purpose we consider it essential that each country's forecast of foreign trade should give separate figures for trade within the Community and trade with the rest of the world.

D — PRIVATE CONSUMPTION

Introductory remarks

67. As indicated in sub-section 58 above, this item can be calculated either as a residual term or independently.

In the former case, the procedure described in this report gives private consumption as a remainder; when gross domestic product has been calculated, including the gross internal output of undertakings and value added by government departments, private consumption is arrived at by subtracting from the total so obtained the amounts absorbed in gross fixed capital formation, government consumption and the surplus (positive or negative) of exports over imports.

When a separate estimate is preferable, the parameters of function (38) — $C = (1-\phi)(1-\theta)Y$ — can be treated either as instruments of economic policy or as structural constants.

Whichever method is used to estimate C, an analysis by classes of needs is essential. This item, in fact, averages 60 %-70 % of the national product, and includes expenditure on classes of needs which follow substantially differents trends. The following analysis is, therefore, made by categories of needs.

Because the available basic data and the factors determining demand vary from country, we decided not to suggest projection methods which could be applied uniformly, by the same procedure, to all member countries.

A recapitulation of some elements in the definition of private consumption is followed by a general analysis of the factors determining demand by categories of needs and of the material available as a basis for forecasting. The appendix to this chapter sets out the main conclusions of forecasts of private consumption in France.

Definition of private consumption

68. A recapitulation of some elements in the definition of private consumption will help to clarify the scope of our investigation.

In addition to transactions forming the subject of market dealings, private consumption includes auto-consumption, particularly by the agricultural population, and the rental value of premises occupied by their owners. Both items are also included in the domestic product.

As regards classification by economic agents, private consumption as an element in final demand comprises:

— consumption by families

— consumption by persons living communally (population of institutions), not included in government consumption,

— consumption by persons only staying on the territory for a short time (non-residents).

For the sake of consistency, it is necessary to try and estimate consumption prospects for each of these classes of consumers.

We shall not go into details of the methods used to estimate the last two of these elements in total consumption, It will be sufficient to note that:

— consumption by the population of institutions can be estimated from the numbers involved, allowing for an improvement in living standards parallel to that of the population as a whole;

— consumption by non-residents raises a number of methodological problems. This element consists chiefly of purchases of goods and services by foreign tourists. In this case, therefore, there is no precise link between income out of gross domestic product and consumption expenditure.

This item is more a function of the increase in the national product of the countries from which the tourists come.

These problems undoubtedly complicate the estimating of private consumption in certain cases. At this stage, however, it would appear that the index of total consumption (calculated as described in the previous sub-section) can reasonably be used to represent the expected trend of consumption by households proper. We shall start our analysis by classes of needs on that basis.

Factors determining consumption expenditure by classes of needs

69. Consumption expenditure on the various classes of needs is determined by numerous factors, some of which are not economic. For forecasting purposes, it is recommended that only a few factors, recognised as dominant, should be selected; the actual choice will be determined by considering, on the basis of past experience, whether the factors concerned explain with sufficient statistical accuracy, the real growth of the various classes of expenditure.

The main explanatory factors to be considered are:

i) Population (N),

ii) Available par capita income: $\left(\frac{(1-\varphi)(1-\theta)}{N} Y \right)$,

iii) Income distribution,

iv) Relative prices,

v) Effects of economic and social policy,

vi) Other specific factors which create new trends in the pattern of consumption.

i) *Population*

70. Consumption expenditure varies not only with changes in the total population but also with its distribution between social and occupational groups, changes in the number of households, the anticipated composition of households and the associated increase in the number of consumption units.

As regards the social and occupational structure, special allowance must be made for the different consumption habits of the farming and non-farming populations. Major changes in this structure, particularly as a result of the drift from the land, can have a considerable effect on total consumption in countries where the farming population still constitutes a large fraction of total population.

The population forecasts used for estimating the size and distribution of the labour force (see Chapter III) will have to be supplemented to take account of these factors. The number of consumption units (a figure which will be particularly useful when making the detailed forecasts of expenditure on food and clothing) will be estimated by means of a scale relating the number of persons in each household to its volume of consumption at the same income level. In the conventional scale, the consumption of the head of family is weighted at 1, that of other adult members of the household at 0.7, and that of children under 14 at 0.5.

ii) *Income*

71. This factor can be regarded as the most important of the explanatory variables for many categories of expenditure. The link between the income factor and consumption expenditures (or quantities consumed) is generally expressed by a coefficient of elasticity. However, there is neither theoretical nor experimental justification for assuming *a priori* that any coefficient selected will necessarily remain constant throughout the period covered by the forecast.

A link between income and consumption, with a saturation level for the particular category of consumption, is, therefore, to be preferred as theoretical starting point. Atchinson and Brown [1] proposed, as a general expression, a sigmoid relationship in which consumption of a particular item is a function of a saturation level: $c_i = f_i s$ where c_i is consumption of the item or category i and s is the saturation level. The coefficient of saturation f_i is itself a function of per capita income.

The general shape of the sigmoid curve shows that income elasticity always decreases; but the rate of decrease depends on the point on the curve. Different types of practical approximation are, therefore, possible; for general forecasts, bi-logarithmic and semi-logarithmic relationships are of chief interest:

$$\text{bi-logarithmic form}: \log c_i = \log \beta + \epsilon \log \left[\frac{(1-\varphi)(1-\theta)Y}{N} \right] \qquad (45)$$

$$\text{semi-logarithmic form}: \quad c_i = \beta + \epsilon \log_e \left[\frac{(1-\varphi)(1-\theta)Y}{N} \right] \qquad (46)$$

Where :

c_i = expenditure per head or per consumption unit of the item (or category of goods) i

$\frac{(1-\varphi)(1-\theta)Y}{N}$ = overall consumption per head or per consumption unit, which can be regarded, for practical purposes, as a sufficient approximation to available income; many statistics used in connection with studies of consumption, and in particular studies of family budgets, show total private consumption and not available income,

β = dimensional factor.

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[1] "A synthesis of Engel Curve Theory" The review of Economic Studies. Vol. XXII (1), 1954-1955, p. 35-46. See also the more general study by the same authors : "The lognormal distribution, with special reference to its uses in economics" Cambridge University Press, 1957. For application to expenditure on food see Goreux, M.L.M. : "Elasticité de la dépense alimentaire par rapport au revenu. Analyses d'enquêtes de consommation "(E.E.C. - F.A.O. 1959).

Equation (45) gives a constant coefficient of elasticity ϵ.

Equation (46) gives decreasing elasticity as consumption increases : $\frac{\epsilon}{c_1}$.

A double rule can, therefore, be formulated for approximating the relationship between income and consumption for a given need :

i) The bi-logarithmic function will be used when the decrease in elasticity is small and can be ignored in practice;

ii) A semi-logarithmic function will be used when there is a substantial decrease. Such a function may, however, exaggerate the rate of decrease by assuming a hyperbolic relationship with income.

In practice, the choice between these two methods of approximation will be determined by the characteristic standard deviation of the statistical correction.

iii) *Distribution of incomes*

72. As the mechanisms of income distribution have not yet been considered at this stage, modifications cannot be included as an explanatory variable in the *structure* of the income pyramid, which, as a first approximation, will therefore, have to be regarded as *constant.*

iv) *Relative prices*

73. The reader should refer to sub-section 60 on this point.

v) *Effects of economic and social policy*

74. Expenditure on certain categories of needs can be appreciably influenced by a wide variety of government measures. In several countries of the Community, the government intervenes to a considerable extent on the *housing* market, by such measures as rent controls, the financing of building schemes, town-planning programmes involving the redesigning of towns and the demolition of old houses. In such cases, the rent hypothesis must take account of the aims of economic and social policy, which tends towards the gradual elimination of the housing shortage and thus, the removal of rent controls.

Government policy also affects expenditure on *medical attention*, which depend partly on the social security system and the standard of hospital services.

Finally, reference should be made to the effect of agricultural policy on expenditure on food and of fiscal policy on such items as tobacco and petrol.

vi) *Other factors*

75. For several categories of needs, allowance must be made for a more or less independent variation of *consumption habits*, which can be represented by a trend term.

One of the most characteristic trends is the movement towards higher *quality* products, which is linked production techniques as well as consumption habits. Some of the ways in which expenditure on food and clothing is affected are discussed in the appendix to this chapter.

Durable consumer goods (vehicles, household equipment) have special features, and additional factors have to be introduced to estimate the growth of expenditure on this category. In particular, account must be taken of the fact that such expenditure is now spreading to all households after first appearing in very limited sections of the population, and that it is the corollary of other expenditure.

Purchases of such goods should be dealt with either by referring to the *quantity already in service* or by treating such expenditure as *complementary* (for example, by establishing a connection between expenditure on furniture and the number of new dwellings).

Running expenses (fuel, heating and lighting) are obviously linked with the growth of the above-mentioned quantity and the extent to which they are used.

Sources for forecasts

Three main sources can be used for estimating the future growth of consumption :

i) Retrospective series,

ii) Family budget inquiries,

iii) International comparisons.

i) *Retrospective series*

76. The following are generally available :

— estimates of consumption by categories of goods and products, at constant prices, given in the national accounts;

— consumption series for individual products, usually in the form of series for physical qualities supplied to the market.

These data can be used to study the most recent trends, while changes in the structure of private consumption can be observed from the national accounts series.

Straightforward long-term extrapolation of the trends observed is not advisable, however.

In many cases the series are fairly short. In most countries, national accounting data relate only to the post-war period or, at most, go back as far as 1938. They are too much influenced by the factors responsible for the rapid changes in the structure of private consumption immediately after the war (house building and modernisation, replacement of household equipment, increase in the number of motor cars, appearance of many new articles, growth of tourism). This applies in particular to countries where living standards were drastically reduced by hostilities, or growth was substantially influenced by inflation or price policy.

These retrospective series also have disadvantages arising from more technical factors, including :

a) *The method of compiling* retrospective consumption series. Many are based solely on production and foreign trade statistics and therefore, only give figures for quantities available or delivered, without any check against tables for trade between industries, which provide information on industrial uses of certain goods and services (textiles, wood, paper and rubber goods, chemicals, glass, credit and insurance services). Consequently, the relevant series sometimes fail to reflect growth correctly and this is a source of error.

b) *The criteria used for deflating* values expressed in terms of current prices in the national accounts series. First, any attempt to *dissociate* the price and quantity factors in certain items of expenditure runs up against both theoretical and practical difficulties. This is particularly so in the case of services. Secondly, deflation is normally based on variations in *market prices*, but a major part of consumption does not in fact appear in market dealings. The cost price of foodstuffs is sometimes used as a deflating instrument to try and allow for food consumed by the farming population, but the unmarketed fraction of many foodstuffs and industrial products is much larger, because it also covers the requirements of the vast number of traders and middlemen. The annual increases for each category of expenditure must therefore be compared with those given by the series recording the physical quantities, available or supplied to the market, of the products under each heading.

c) The goods and services in the classes of needs used in the standardised system of national accounts are *heterogeneous*, so that it is difficult to deduce behaviour laws applying to all goods and services under each heading. A typically heterogeneous grouping is housing and household expenditure, which includes goods varying widely in value and length of service; demand for these items is influenced by factors which differ quite considerably.

Finally, therefore, the trends revealed by these series cannot be relied on absolutely. They provide elements for assessing the future trend of requirements but the trends identified must in all cases be compared with those obtained by analysing family budgets (see sub-section 77). Furthermore, as we have already suggested, the level already reached by certain categories of expenditure and the targets of economic policy must also be taken into account.

ii) *Family budget inquiries*

77. Inquiries of this kind give a valid picture of the relationships existing, at a particular time, between the consumption by classes of needs and by products, on the one hand, and the total consumption, on the other hand, of the households questioned, classified by social and economic groupings, type of locality, geographical area, size of household, etc.

These relationships can be transposed to give an idea of the way in which a progressive increase in income available for consumption affects a group of families with a given average total expenditure. This is a completely empirical and static method, because it is based on the following hypotheses:

a) That the cross-section covered by the sample of households investigated is sufficiently typical of the *social structure* of the nation as a whole, which is not always demonstrable if the inquiry is carried out some time after a population census;

b) That the trends recorded for groups of families observed at a particular time reflect the behaviour of *all* households classified in each social category;

c) That on moving from a given average level of total expenditure to a higher level, any social group immediately adapts its behaviour to that of families in higher categories;

d) That the income distribution curve (and the propensity to consume) does not change within each category, which becomes an even more crucial assumption if the relationships between consumption by categories of needs (or by products) and total consumption are analysed for the families observed as a whole and not separately for the various groupings used in the sample (geographical, social and occupational, etc.).

e) That, during the period covered by the forecast, there are no major changes in the structure of relative prices, which might alter the urgency and degree of preference for the various categories of needs;

f) That, during the same period, technical progress does not modify consumption tastes in favour of completely new goods.

78. When the results of such inquiries are used in conjunction with retrospective series for forecasting purposes, substantial discrepancies are often observed as regards:

i) the total (in absolute terms) of each category of expenditure and; ii) the trends indicated by the two sources of information for per capita expenditure or quantities (in physical terms) of goods consumed.

Total of each category of expenditure. — Even when the varying size of families is allowed for by calculating average expenditure per head and by weighting according to the number of households, or, better still, the number of persons in each class of household, it is often found that neither average total consumption per head nor the values for each category of expenditure agree with the estimates for the whole economy provided by the national accounts for the inquiry reference period. The extent to which the various sources of information can be relied on must be assessed for each case separately, and the basis used for forecasting will be the *structure*

of total consumption considered most probable in the light of consistency tests performed to qualify (and, if necessary, correct) the macro-economic estimates of the national accounts. This conclusion coincides with our remarks on retrospective series in sub-section 76 above; an analysis in terms of the whole economy can give only an approximate picture of the real facts. The task of the investigator in this field is precisely to obtain likely consistent values representing the current extent and probable growth of the items examined.

Trends identified. The trends obtained for per capita expenditure (or quantities of goods measurable in physical terms) by a cross-sectional analysis of family budgets may also differ from those indicated by the time series. It has been found, for example, that average elasticities calculated by static analysis of consumption are generally lower than elasticities calculated by dynamic analysis, in the case of goods regarded as prime necessities, and higher for other goods.

No standard rules can be recommended for reconciling these discrepancies, which must be examined and dealt with *case by case.* We shall merely note that the purpose of static analysis is to *isolate* the influence of the level of total consumption per head on the structure of consumption expenditure. On the other hand, the results obtained are necessarily independent of the effect of relative price movements.

Consequently, if the forecast is based on the hypothesis of constant prices, importance must be attached to the trends indicated by the static analysis, particularly if it covers separate regions and social and occupational groups (agricultural and non-agricultural, operatives and self-employed persons, etc.), so that the forecast for each social category can subsequently be weighted in proportion to anticipated variations in the size of each such category in the economy as a whole.

It also follows that, in some cases, comparison of the elasticities obtained by static analysis with those calculated from time series gives a rough idea of the significance, for a given expenditure category, of all factors, *other than income,* which influence the amount of expenditure on that category.

In the case of demand for food, the difference between static and dynamic elasticity is largely due to the fact that the former represents a phenomenon in which price variations play no part and quality variations only a limited part, whereas the latter reflects a phenomenon in which combined price and quality variations play a somewhat obscure, but unquestionably important role.

In the case of expenditure on durable consumer goods, the difference mainly reflects the fact that such expenditure is closely linked with levels of existing stocks and that dynamic elasticity expresses the rate at which new products spread to the whole population.

Finally, we may note that the results of general inquiries into family budgets are much easier to interpret in countries where more limited annual inquiries, covering a small sample of one or more types of family, are conducted each year, without repeating the full-scale investigation. While this procedure cannot be regarded as observation proper, it does provide specific information on time changes in the consumption of the particular types of household.

iii) *International comparisons*

79. Statistical studies of consumption in other countries can furnish valuable bases of comparison (1).

They can be used, first, to check the quantitative expression of the consumption laws formulated on the basis of national observations only; they also give a preliminary idea of developing forms of consumption in countries with similar traditions and social structure but a higher standard of living.

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(1) For the United States, the works of Dewhurst and Roos should be consulted; projections for the periods 1961-1965, 1966-1970 and 1971-1975 are also available.

For the United Kingdom : Stone, J.R.N. : "The measurement of consumers' expenditure and behaviour in the United Kingdom 1920-1938" (Cambridge 1954) and the Blue Book.

For Sweden : R. Bentzel and K. Eklof : "Private consumption in Sweden, 1931-1965" (Stockholm 1957), Wold. H. " Demand analysis : a study in econometrics" (New York 1953).

For a fuller bibliography see the F.A.O. publication "Bibliography of demand analysis and forecasts" (Rome 1959).

The purpose of examining the consumption structures, at a particular time, of countries with different standards of living is not to conclude for example, that present consumption structures in the United States will be repeated in the European countries when they reach the current level of American incomes. It is simply to provide a basis for comparison which will insure forecasters against the worst errors of interpretation in matters for which national data are inadequate.

Section III — First comparison of forecasting hypotheses for supply and demand

A — INTRODUCTION

80. By this stage, the procedure so far outlined will have provided forecasting hypotheses covering:

— gross domestic product and its distribution between agriculture, housing services, government and the product of non-agricultural undertakings;

— private consumption by categories of needs;

— government expenditure, with final consumption expenditure and investment as separate items;

— gross capital formation of undertakings and households, possibly subdivided into non-agricultural undertakings, agriculture and housing;

— changes in stocks;

— the foreign trade balance, with exports and imports as separate items in many cases.

These estimates will not have been obtained by resolving a single model of simultaneous equations but by a process of successive approximations.

It is, therefore, necessary, as pointed out in Chapter II, to check that estimates for the same variable at different stages of the forecast are identical; if they are not, the procedure must be repeated as many times as necessary, both for the variable in question and for all other variables linked significantly with it.

At this stage, therefore, it is advisable to bring together all the estimates so far worked out and to check the consistency of the results obtained. This critical survey will cover both the level of the individual components of supply and demand and the level of the overall balance between the various categories of resources and uses.

We shall consider in turn:

i) The aggregation of forecasts of private consumption by categories of needs.

ii) The compatibility of production forecasts for sectors treated as exogenous in Chapter III (agriculture, government, housing services) with the corresponding final demand items.

iii) The balance between overall resources and uses.

B — AGGREGATION OF FORECASTS OF PRIVATE CONSUMPTION BY CATEGORIES OF NEEDS

81. The various explanatory consumption patterns described in the previous section do not necessarily aggregate correctly.

Adjustment is obviously required when the sum of the estimates by classes of needs is not the same as the original estimate for private consumption as a whole. If the volume of total consumption is regarded as a fixed premise, the components of this item will have to be adjusted until the weighted average of the elasticity of

the various categories of consumption expenditure in relation to total consumption is unity (1). If, on the other hand, the growth of consumption expenditure is considered to be more or less autonomous, the adjustment may extend to elements of final demand other than private consumption, such as fixed capital formation and/or the foreign trade balance. It is then implicitly assumed that the growth of consumption will prevent internal or external investment from reaching the figure originally estimated. Some members of the group hold the view that the estimate of domestic product may also have to be revised at this stage as a result of the adjustments made.

82. In addition to the overall volume of private consumption, the main point to be verified is whether *changes in the structure* of private consumption, between the base year and the terminal year — as indicated by a comparison of estimates by categories of needs — appear plausible, having regard to the rate of general growth, recent consumption trends, the aims of economic policy and recent experience in other countries.

In the case of a forecast at constant prices, only a very rudimentary check on plausibility will be made. The chief point to be checked is whether the "apparent" elasticities obtained by comparing the estimated relative increase for a particular class of goods with that for total consumption can be regarded as probable.

The actual process of correction is made easier by the fact that the extent to which consumption growth laws can be satisfactorily adjusted by statistical method to past series, varies greatly from one category of needs to another. By reference to the standard deviation representing the quality of the statistical adjustment, it is possible, therefore not only to make a choice among the various possible explanatory patterns for a given class of needs but also to identify the element or elements in total consumption most suitable for correction because the relevant estimates are the least certain. However, considerations of statistical technique constitute only one element in an overall judgement which must also take account of economic, sociological and political factors.

C — COMPATIBILITY OF OUTPUT FORECASTS FOR EXOGENOUS SECTORS WITH THE CORRESPONDING ITEMS IN FINAL DEMAND

83. A consistency test is essential when the first output estimates for agriculture, government and housing services are not produced in the same way, and at the same time, as the estimates for the corresponding elements in final demand (demand for food products, government expenditure on salaries and rent).

There can hardly be any serious problem of compatibility in the case of *housing services*. The estimates of both supply and demand will be based on the number and quality of dwellings and on rent policy. If the two estimates are not made simultaneously, the one forming part of the demand forecasts will generally have been carried further and can be used to revise supply hypothesis.

Similar considerations apply to the *government* sector. If a functional analysis has been made of government expenditure, the magnitude of anticipated government expenditure on staff will be known and can be used to revise the hypothesis postulated for value added by this sector. The trend of the proportion of government output (value added) to total government consumption expenditure will also be examined. This proportion at present varies from 40 % to 80 % according to country. The trend during the period covered by the forecast will have to be justified and the functional analysis can provide the necessary elements for this purpose. Thus it may be assumed that total government expenditure will increase more rapidly than value added when, under

(1) Although some estimates by categories of needs will have been arrived at without elasticities, "apparent" elasticities can be deduced, at the end of the calculation, expressing the relationship between the estimated relative increase for a given category of needs and that for total consumption. The weighted average of these "apparent elasticities" must then be unity.

the heading of national defence, this analysis shows the consequences of a change from a conscript army to a regular army with modern equipment. The reverse trend is logically to be expected when the forecast includes the effects of a largescale educational development programme.

Studies of the consistency of the forecasts for value added by *agriculture* and by *food consumption* come up against more difficulties.

From the accounting standpoint, value added by agriculture is only one element in food consumption, which also includes value added by the food industry, distribution services and net imports of agricultural products.

Value added by agriculture and food consumption, respectively, cannot, therefore, be expected to show an exactly parallel trend. The time series, in fact, show a declining trend in the *relative* importance of value added by agriculture. They reveal no marked tendency towards a reduction in the share of food expenditure in total household consumption because of the increasing value added to each physical unit of agricultural output by the processing and distribution sectors.

The consistency tests are, therefore, more complicated than for government and housing services. They logically imply a hypothesis concerning distribution channels for agricultural products, and the processing, import and export of such products. In particular, it may be assumed that, as living standards rise, value added by the food industries will continue to rise slightly faster than food consumption, because more value will be added to each physical unit in the form of preparation, preservation, display and advertising and because consumers are showing a growing preference for pre-packed goods.

When, at this stage, the data available are not sufficient to postulate such hypotheses for distribution, processing and foreign trade — as will often happen in the last case — a check will simply be made to establish whether the estimated relationship between the trends of value added and food consumption corresponds to previously observed facts. If this is not so, the reasons for such a break in the trend must be considered.

D — BALANCE BETWEEN OVERALL RESOURCES AND USES

84. Here, the aim of the consistency check will be to try and establish an exact balance supply and demand, which will also guarantee, at least approximately, consistent relationships between the various components.

Re-examination of *overall private consumption* is an important element in this study.

When this quantity has been calculated as a remainder, supply and demand clearly balance automatically, but the economic and political implications of the result and its conformity with previous experience must still be considered.

Special account will be taken of the parallelism frequently observed in the past between the trend of the domestic product and that of private consumption.

However, if the forecast anticipates a relatively large, regular increase, it may be assumed a priori that the growth of consumption will not exactly parallel that of the domestic product — say, between 4 % and 6 % for a general 5 % increase.

In some cases the need not only to invest fairly substantial sums to ensure rapid growth, but also to provide for a rapid increase in public consumption to meet growing collective needs, and further to create a substantial surplus of exports to non-industrialised countries will postulate a smaller increase in private consumption.

In other cases, the opposite trend appears likely *a priori*, either because major past investments will in future allow consumption to increase more rapidly than production, or because internal demand must take over from external demand which will no longer sustain a rapid rate of growth or finally because a reduction or slower

rate of increase in certain government expenditure — on national defence, for example — will allow private consumption to increase quickly.

Such a check of political and economic implications and of conformity with past experience is even more necessary when private consumption has been calculated independently.

The process will already have been started during aggregation of the estimates by categories of needs.

85. The conclusions drawn from examination of the overall volume of private consumption can be used as a basis for analysing the other components of supply and demand.

Here, a distinction must be made between the *endogenous variables*, particularly the output and investment of non-agricultural undertakings, and those exogenous variables which are wholly or partly *"target variables"*, namely, government expenditure and the foreign trade balance.

As regards the former, it should first be recalled that the output and investment of non-agricultural undertakings are linked by the investment function and that any adjustments to one of these variables will affect the other. In general, the check for these variables will consist of answering the following question : Taking as given the results obtained for private consumption and the values adopted for the exogenous variables, can the numerical values estimated for the endogenous variables be regarded as likely, having regard to previously observed rates of growth,the share of national expenditure accounted for by undertakings investments and any imbalance revealed between supply and demand when the estimates are compared ?

86. In this connection, we wondered whether this first comparison of supply and demand forecasts might already call for a substantial modification of the estimated volume of output $Y + Ti$. The views of the group are divided on this point. Some consider that such a modification is only possible as part of a detailed forecast by sectors of production. In their opinion, the estimate of final demand described in this chapter should simply indicate the *use* of the volume of output and income at the end of the period covered by the forecast, the volume of output being computed by the methods set out in Chapter III. With the possible exception of minor changes to allow for the product of the exogenous sectors, adjustments should therefore be confined to the elements of final demand.

Other members of the group hold that the estimates of final demand can call in question the accuracy of the output volume forecast as early as this stage. According to this view, relatively independent estimates of private consumption, for example, might lead to a revision of the investment hypothesis, which would affect the growth of output through the action of the investment function.

87. This leaves the *exogenous variables*, and in particular those like government expenditure and the foreign trade balance, which are wholly or partly targets. Although only a very summary assessment is possible at this stage, it will be necessary to consider whether the numerical values adopted for the target variables should be re-examined in the light of the analytical forecast for the other variables. Consideration will clearly be given to whether any accounting imbalance revealed between supply and demand by comparison of the results so far obtained should be taken up by modifying the *foreign trade balance* (X-M). The problem then becomes more complicated when the foreign trade balance (X-M), exports (X) and imports (M) have all three been estimated separately, by the methods outlined in Section II of this chapter and an adjustment is necessary to reconcile the different estimates.

To this end, the plausibility of the relationships between the growth of internal demand (consumption and investment) and that of imports, and between the growth of exports and that of output in countries where the two variables are closely linked, will be studied, particularly with reference to past experience.

In the case of final government demand, the targets for public investment can be checked for compatibility with the estimate for the other elements in final demand. If they are not compatible and an adjustment bearing on government expenditure is preferred to the restriction of private consumption, for example, it will have

to be decided whether the rate of growth of output itself is affected by such an adjustment. Certain government expenditures can, in fact, be essential for the growth of output, particularly through their effect on the value of the trend term ν in the production function for non-agricultural undertakings. Clearly, such modifications are only possible if it is accepted that the study of final demand may lead to revision of the production hypotheses. As already noted, the group holds differing views on this point.

E — CONCLUSIONS

88. Checks need not be carried out exactly in the order indicated in this section.

The existence of multiple interrelationships between the variables has the dual consequence that, while it is usually impossible to consider any one variable *separately*, it matters very little where the check is started.

The number of repetitions needed and the order in which they are performed will be determined by the individual features of the case, such as flagrant incompatibility between certain estimates and the varying probabilities of the different values obtained.

A series of operations will virtually produce an accounting balance between supply and demand, which will already have been submitted to a preliminary consistency test. A slight difference is allowable if it has no economic significance and is only of a technical character.

This comparison of the *overall* supply and demand hypotheses must not be given too much significance as a consistency test. It is a first application of the principles laid down in Section II of Chapter II. Detailed consistency tests are only possible as part of a *detailed* forecast by products and sectors of production.

By this stage, numerical values will have been computed for all components of the equation $Y + T_i = C + A + I = S + (X - M)$. These values will give an overall picture, briefly checked for consistency and providing a basis for more detailed studies. An example of such a study is given in the next chapter.

APPENDIX

CONCLUSIONS DRAWN FROM FORECASTS OF PRIVATE CONSUMPTION BY CATEGORIES OF NEEDS

89. *Introduction*

We have already indicated in sub-section 67 why we decided, in the case of private consumption, that we could not recommend forecasting methods applicable uniformly, by the same procedure, in all member countries.

We thought, however, that it might be useful to include, for guidance, the conclusions drawn from work on this subject in one member country.

The divergence from one member country to another not only of factors affecting the trend of private consumption but also of available statistical material nevertheless prevents us from deducing rules from these conclusions for uniform application in all member countries.

French forecasts of private consumption by categories of needs are based on the following classification:

1 — Food

2 — Clothing

3 — Accommodation
- i — Housing
- ii — Household equipment

4 — Health and welfare
  i — Health and personal attention
  ii — Medical treatment and supplies

5 — Transport and communications
  a) Private transport
    i — Purchase of vehicles
    ii — Running expenses
  b) Public transport and postal, telephone and telegraph services

6 — Culture, leisure and recreation
  a) Services
  b) Durable goods
  c) Tobacco

7 — Hotels, cafes, restaurants and miscellaneous.

Such forecasts by classes of needs are only one stage in an iterative procedure, the later stages of which involve a forecast of consumption by products.

The explanatory diagrams used for the estimate by classes of needs can be grouped into three main types, the first of which can be broken down into a number of sub-types :

1) Structural relationships
  a) Relationships with one explanatory variable (income represented by total consumption of households)
    i) Constant elasticity relationships
    ii) Decreasing elasticity relationships.
  b) Relationships with several explanatory variables (total consumption, total stock, time)
2) Time trends
3) Economic policy targets.

The diagrams used for the various classes of needs are summarised in table 14 on page 618, while the individual items are commented on in sub-sections 90 to 96 below.

90. *Food*

Family budget inquiries showed that there is a saturation point for the consumption of most foodstuffs at high income levels. Food consumption can be adjusted fairly satisfactorily in relation to total consumption by means of *semi-logarithmic* expression.

When considerable growth is forecast, the application of this type of hypothesis gives a substantial reduction in the share of food in total expenditure. This may appear a surprising result, particularly as the time series show an apparent elasticity only slightly below 1 in certain countries, over the last few years.

The reasons for this difference between static and dynamic elasticity are discussed in sub-section 78 above.

Here, it will be sufficient to underline the importance of the quality factor. Leaving aside differences of quality, at a given time, between products bought by the various social and occupational groups, it must be noted that the volume of goods purchased at two fairly widely separated periods comprises goods varying in quality in time and, therefore, correspondingly, in the supplying sectors, to a structure of intermediate demands and value added differing from that of trade between industries as shown by the table for the reference year.

With the successive approximation procedure used in France, the hypothesis adopted on this point can only be used in the later stages of the forecast; first, when the relevent intermediate demands have to be made to correspond to a final demand expressed in constant prices and later when a price variation hypothesis has

to be postulated because of changes in the structure of the table for trade between industries. At this point, the variations in the volume of food consumption forecast in the initial study, can be translated into values and used for a clear comparison with the time series.

Finally, another fact which may help, to a minor extent, in explaining the discrepancy between the results of a static analysis of family budgets and those given by the time series, is that, in the family budget inquiries used, expenditure on food proper does not include meals away from home (restaurants, canteens). Such meals, which form a separate item, may not have been correctly computed and classified in the time series. During a period of rising living standards they would, however, be expected to show a high rate of increase, with the result that the volume of food products consumed would be greater than that shown directly under "Consumption of food products".

91. *Clothing*

As for many Western countries, the time series for France show changes in consumption of *clothes* which can be represented by a law of constant income elasticity (or slightly decreasing elasticity because of the effect of saturation). An elasticity of 1.2 was used for the forecasts covering the years 1959-1965. Saturation is probable over a longer period.

In the case of *footwear*, however, some family budget inquiries show a relation between consumption and income similar to that observed with food consumption, with a saturation point at high income levels.

As with food, allowance must be made for a quality factor when converting expenditure so calculated into demand expressed in physical quantities. At the moment not a great deal of information is available for measuring this factor, which, in any case, is less simple in concept than that applying to food products.

To try and resolve this problem of quality, a number of characteristic types must be defined for each category of clothing (outer clothing, underwear, knitwear and hosiery; ready-made and bespoke goods and fabrics) and an attempt then made to establish their relative importance, varying with time, in total expenditure. Each type would be characterised by the structure of value added during its production (part attributable to natural, artificial or synthetic fibres; part attributable to weaving; part attributable to subsequent processing operations). In this way, a hypothesis for the structure of intermediate demands and wage charges in the textiles branch might be made to correspond with expenditure on clothing originally estimated in physical quantities. By applying this hypothesis to the table for inter-industry trade, it would be possible, as shown in the example discussed in Chapter V, to determine the expected trend of average prices of goods purchased, having regard to their nature and quality, and thus to determine the future course of expenditure.

92. *Accomodation*

i) *Housing*

In countries where the market for housing is in balance and can develop without any disruption, variations in expenditure on housing could be validly represented by a law of constant income elasticity based on a time series or an analysis of family budgets.

The position is totally different in a country like France where the government intervenes to a major extent in the housing market.

In such cases, expenditure on housing cannot be forecast without reference to *government programmes*, tending towards:

— the progressive elimination of the housing shortage;

— the replacement of old dwellings, usually with rent-controlled accommodation, by new dwellings at relatively high rents;

TABLE 14

Explanatory lay-outs used in forecasts of private consumption by classes of needs

	Food	Clothing	Accommodation	Health and Welfare	Transport and communications	Culture, leisure and recreation	Hotels, cafes, restaurants and miscellaneous
	1	2	3	4	5	6	7
1 *a*) Relationships with one explanatory variable (total consumption)							
i) Constant income elasticity		Clothes	Maintenance products	Health	Public transport	Cultural services, recreation, tobacco, books, etc.	Holiday expenditure
ii) Decreasing income elasticity	Food	Footwear					
1 *b*) Relationships with several explanatory variables (income, stock, time)			- Household equipment - Heating and lighting		- Purchases of private transport vehicles - Vehicle running expenses	- Purchases of radio and television sets	
2 Time trends				Medical attention and supplies			
3 Economic policy targets			Housing				

— the modification of the quality and floor space of dwellings constructed.

Calculations must also allow for expected changes in the *number and composition of households*. Exclusive consideration of this element might lead to the fixing of a normative target for housebuilding but it can only be included in the forecast if allowance is also made for the measures taken to further the achievement of this target in practice. In fact, observations from another source suggest that families are not spontaneously prepared to pay house rents corresponding to the target fixed.

The preliminary result so obtained can be used to estimate *output of new dwellings*. Together with an estimate of major maintenance charges, this gives gross capital formation for housing.

Despite the provisional hypothesis of fixed prices, calculations of total rents take account of the difference between rents of old houses and those of houses built since the war, reflecting the difference between controlled and non-controlled premises. More generally, the forecast may have to take account of the effects of an anticipated change in the *average quality* of premises, quality being defined, principally, by reference to floor space and, secondly, by a coefficient representing the standard of comfort (nature and quality of materials used, extent of sanitary fittings).

ii) *Household durables*

The most satisfactory method of calculation is one based on a study of the total stock of household durables, and its growth following the same principle as the study described below for motor vehicles. Studies of this kind are by no means universal and in their absence the procedure adopted is to try and estimate an elasticity, bearing in mind that the latter is high when houses are initially furnished but tends to decrease when replacement demand forms a high proportion of total demand.

With this class of needs, saturation, leading to a lower elasticity, occurs with only a few articles and very little for needs as a whole. Moreover, in the case of certain items of household equipment, such as radio sets, several saturation points may appear in succession (appearance of a second or third set per household).

Demand for power depends largely on the number of household appliances. When no reliable data are available, the calculation will be based on an estimate of the elasticity of this item in demand (value of ϵ 1.3 for the period 1956-1965, but only 0.9 in coal equivalent).

Demand for *maintenance products is also estimated by calculating elasticity* (*value of* ϵ *in the forecasts* : 0.7).

93. *Health and welfare*

i) *Health*

The item of expenditure can be computed on the basis of the elasticity observed in past series (value of ϵ in the forecasts : 1.3).

ii) *Medical attention and supplies*

Neither the population factor, nor the relationship between medical consumption and income, as assessable from family budget enquiries only. The past few years, can provide a picture of the future trend of medical consumption in countries where a social security system has been introduced progressively since the war and hospital facilities are developing rapidly. Fresh studies (regional factors, technical equipment, hospital facilities, etc.) are required before a reliable forecast can be made.

As these studies have not been completed in France, previously observed trends have been extended empirically. The calculation must, of course, be linked with the study of government expenditure (social expenditure N° 64).

94. *Transport and communications*

a) *Private transport*

This item comprises purchases of new vehicles and the cost of running existing vehicles.

i) *Purchases of vehicles*

The proportion of families in each income group owning a motor car is generally known for a previous year or series of years. For the forecast year, the total stock of *private cars* is computed by estimating the trend of ownership percentages and by postulating at this stage the hypothesis of constant distribution of incomes. The difference in the total stock of vehicles represents the increase in the number of vehicle owners from one year to the next.

Theoretical annual replacement must then be calculated from survival curves.

Furthermore, the total stock is increased by the introduction of more powerful or less powerful, and therefore dearer or cheaper, vehicles (at constant prices).

In France, family budget inquiries reveal a tendency towards the purchase of more powerful vehicles as income increases. They can be used to calculate an elasticity for the quality of vehicle purchases (1).

In this way indices of expenditure on vehicle purchases are obtained.

ii) *Running expenses*

These depend on:

— the increase of the total stock and changes in average cost per mile

— the influence of income on average mileage.

The relationship between income and mileage can be assessed from family budget inquiries. It must vary according to type of locality (rural or urban) and social and occupational grouping. Specific costs per mile are assumed to be stable for the next four or five years; a longer period would be neccessary to allow for an increase, linked with a slow shift of demand from small to bigger capacity cars.

In the long run, this movement will of course depend on the price of motor fuel.

b) *Public transport and postal, telephone and telegraph services*

Because of competition from private transport, the growth of public transport has been slow.

Because of the development of telecommunications, the growth of expenditure can, in general, be represented by a hypothesis of constant elasticity (value of ϵ in forecasts $= 0.6$).

95. *Culture, leisure recreation*

This item comprises services (cultural services and recreation), durable goods (radio and television sets, books, etc.), and tabacco.

a) *Services*

This item of expenditure can be calculated on the basis of an estimated elasticity (value of ϵ in forecasts of financial and banking services, cost of functions $= 0.5$).

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(1) This is by no means a general trend. In some countries the small car is becoming increasingly popular. This is attributed to various factors, such as the difficulty of parking in towns, and the increasing number of purchases by lower-income families who mainly favour small cars. In that case, a trend factor will have to be introduced.

b) *Durable goods*

Expenditure on radio and television sets should be calculated on the basis of the assumed increase in the total number of sets.

As there are no exact behaviour laws for purchases of books and the like, constant elasticity is assumed ($\epsilon = 1.0$).

c) *Tobacco*

Demand for tobacco can be forecast on the basis of constant elasticity ($\epsilon = 0.6$). Experts consider that any increase in expenditure is almost exclusively attributable to changes from one quality to another.

96. *Hotels, cafes, restaurants and miscellaneous*

The laws of increase of expenditure in hotels, cafes and restaurants are not well understood; such expenditure has been very substantial in recent years and should normally increase considerably.

Family budget inquiries show holiday expenditure to be highly elastic. Meals eaten away from home should increase, thus offsetting the relative drop in household expenditure on food.

CHAPTER V

TRANSITION TO OUTPUT BY SECTORS AND RETURN TO THE OVERALL FORECAST

Section I — General considerations

A — INTRODUCTION

97. The significance of the detailed forecasts of output by sectors in each country, and a suggested pattern for such studies, were discussed in Chapters I and II.

We then stressed the difficulty of constructing and applying a complete model of simultaneous equations and recommended a method of forecasts by sectors, using an iterative procedure. Following up this idea, the present chapter gives an example, taken from current French practice, of a procedure for making the transition, within an iterative pattern, to output by sectors and to the factors of production needed by each.

As the actual methods used are closely linked with the aims of French forecasts and with the status of the bodies responsible, the information in the paragraphs which follow is given for guidance only and commits only the French members of our group.

We recommend, however, that the nomenclatures used by individual member countries should be comparable, if not completely identical with the very condensed classification used in the synthesising documents. A model classification is suggested in sub-section 99.

B — STAGES OF THE PROCEDURE

98. The methods so far studied allow the provisional definition of a growth hypothesis (or a choice of hypotheses) in which final demand is estimated by classes of needs. The subsequent stages of the process are as follows:

i) The subdivision of the main elements of final demand *into categories of products*, at constant prices;

ii) The transition from final demand by products to *output by sectors*, involving:

— a study of intermediate demand on the basis of final demand broken down into categories of products;

— a study by sectors of the expected future course of output and the conditions of such growth: capital and labour requirements.

iii) *A return to the overall forecast* on the basis of the partial information previously collected. This stage involves revision of the basic hypotheses and a study of alternative solutions. Study of the consistency of estimates is of primary importance.

Within this framework, an attempt is made to move forward from the initial arbitrary assumption of invariable relative prices to a study of variations in relative prices, linked with expected economic and technical progress; this is combined with a study of the machinery of transfer payments, financing and income distribution.

Section II — Breakdown of final demand by classes of products

A — CLASSIFICATION OF PRODUCTS

99. A detailed list of goods and services is clearly necessary for the study of the breakdown of the elements of final demand by classes of products and for the subsequent study of intermediate demand. The results of these studies will only be internationally comparable to the extent that the classifications used by national forecasting bodies are comparable after regrouping, if not in all details.

In its most succinct form the classification to be used is a list of sectors. Each category is the product of the activity of, if not undertakings (many of which are integrated to a greater or less extent and cover activities resulting in widely-differing products), at least establishments, i.e. complete productive units, characterised by the nature of their main activity and relatively easy to identify and classify by normal methods of statistical investigation.

The following classification is suggested:

01 — Agriculture, forestry
02 — Agricultural and food industries
03 — Solid mineral fuels and gas
04 — Electricity
05 — Petroleum, natural gas and motor fuels
06 — Building materials and glass
07 — Iron-mining and iron and steel industry
08 — Non-ferrous ores and metals
09 — Engineering and electrical industries
10 — Chemicals
11 — Textiles, clothing, leather
12 — Wood, paper and miscellaneous industries
13 — Building and civil engineering
14 — Transport
15 — Housing services
16 — Other services
17 — Commercial activities

This very succinct classification can only be understood if each of the above categories is expanded along the lines suggested in Appendix 8. The first column in the latter gives the appropriate reference to the above list, which is expanded (65 items) in the second column and further expanded in the third column, each item in which is referred to the international customs nomenclature, known as the S.I.T.C.

The example given is taken from the French national accounts, but most member countries have similar tables which can be used to establish an exact correspondence between the national classification and that of other countries. They are, therefore, useful instruments for the international co-ordination of forecasts.

B — BREAKDOWN OF THE MAIN ELEMENTS IN FINAL DEMAND INTO CLASSES OF PRODUCTS, AT CONSTANT PRICES

100. *Private consumption*

In Chapter IV we saw how the overall forecast of private consumption could be broken down into classes of needs.

The transition from a breakdown by classes of needs to a breakdown by products requires a special table, for a previous year or series of years, linking these two analyses of expenditure. It may be of the type shown in Appendix 9, where the significant entries, corresponding, for a particular function, to purchases of a specific class of products, are marked with a cross.

Projection of this table is difficult, because the breakdown of expenditure by products cannot be assumed to be invariable for each class of needs. Within each such class, the problem of the substitution of one product for another necessarily arises.

Some substitutions of this kind are already known, at least qualitatively, an example being the changeover from coal to oil for domestic heating. In most cases, however, the degree of substitution will depend on the relative prices of the competing products, for which exact hypotheses cannot be formulated at this stage. In general,this breakdown has to be effected by reference to previously observed trends and any other available data, even without quantities.

101. *Government consumption and investment*

We also saw in Chapter IV that government expenditure, and particularly consumption of goods and services, can be studied by functions. To obtain an analysis by products corresponding to the analysis by functions, a cross-reference table showing this correspondence for a previous year or series of years is required. The structure of such a table — that is the proportionate distribution, between classes of products, of purchases corresponding to a given function — does not necessarily remain stable over a period of time : it can, however, be used as a reference basis for forecasting.

The same method can be used for gross fixed capital formation by government departments.

102. *Gross fixed capital formation of undertakings and households*

a) *Gross fixed capital formation of undertakings (industrial equipment)*

By this stage of the study, a provisional overall estimate has already been made for this element in final demand. It corresponds mainly to two sectors in the 17-item list, namely, engineering and electrical industries and building and civil engineering.

With a more detailed list of products and branches, gross fixed capital formation cannot easily be broken down by capital goods, because the sectors which will invest are not known at this stage. Investments in the textile industry do not cover the same equipment items as the investments of the electrical and engineering industries. It is therefore considered preferable to treat investments by sectors as *endogenous variables* and to calculate them at the same time as outputs. Under the French procedure, however, an exception has been made in the case of investment by sectors for which there are concrete programmes. These include nationalised or concentrated sectors such as power, iron and steel and transport other than by road.

b) *Gross fixed capital formation of households (housing).*

This element in final demand concerns the building industry almost exclusively.

103. *Foreign trade, basic hypotheses*

i) The study of foreign trade involves the examination of a number of political assumptions, which may consist in the application of more general hypotheses to foreign trade or may relate directly to such trade. They must be mentioned, even if, in practice, the forecast can only cover, as principal items, a very small number of all the theoretical possibilities, i.e. those which not only are both reasonable but at the same time offer the maximum prospects for growth, and will thus require the greatest economic effort.

a) It must be assumed that international political life will continue without serious tension or general hostilities. Essential supplies should, however, continue to include a minimum provision for security;

b) In the case of international economic relations, it must be assumed that the agencies of the European Economic Community will be set up in accordance with the time-table laid down in the international agreements, or more quickly; that the national economies covered by the Treaty of Rome will be integrated with a sufficient degree of co-ordination to prevent any upset or any threat to the machinery of growth. The progressive international liberalisation of trade must also be assumed, while the possibility of a major world economic recession must be rejected;

c) As regards the economic relations of the countries covered by the forecast with under-industrialised countries, it must be assumed that all European countries will have to contribute to joint aid. Clearly, however, a greater and more systematic effort will be required from those countries which still have political and currency links with certain under-industrialised nations. In such cases, aid forms part of a trading complex which will remain preferential for the next few years but will leave room for the development of commercial relations with other countries, and particularly with the members of the European Economic Community.

ii) Formulation of hypotheses for relationships linking the various elements affecting foreign trade.

These relationships are as follows:

a) between output of sectors and imports of raw materials and intermediate products;

b) between private consumption and imports of final consumer goods;

c) between exports and the absorption capacity of foreign markets;

d) between the final balance of exports and imports by currency areas, on the one hand, and equilibrium targets for current balance of payments and financial aid to under-industrialised nations, on the other.

At this stage of the forecast, it is impossible to study the full extent of international specialisation and the growth of trade in manufactured goods, which will result from the establishment of the Common Market and the liberalisation of trade. The simplest possible patterns must be considered, limited to the following:

— stability of the propensity to import of the various sectors, whether importing raw materials and intermediate products for branches engaged in further processing or supplying final consumer goods partly of foreign origin;

— progress of exports to foreign markets which is linked with the growth of the latter.

However, even at this stage, the forecast may have to take account of:

— major current achievements (or projects) likely to modify the import requirements of certain sectors for raw materials, energy and intermediate products;

— current trends in export flows and imports of manufactured goods;

— the anticipated relative trend of internal and external prices;

— equilibrium targets. The forecast may show that action is necessary to promote export flows and to divert, certain current trends in this field. Consequently, whether the forecast is "pure" or of the "decision" type

it thus formulates a condition for the fulfilment of the prospects outlined. When the forecast includes a large element of "decision" it must specify ways and means of implementing the action required. Possible ways and means will be discussed later.

It should be noted that the calculation of imports linked with sectoral levels of activity can only be completed after intermediate outputs have been estimated. An iterative calculation is necessary, therefore, because intermediate outputs are not computed until a later stage.

The results of such schematic reasoning must be compared with observed or anticipated trends of past and future European and world trade, as determined by :

— *institutional changes* affecting the volume of trade (removal of customs duties within the European Economic Community; entry into force of the common external tariff; organisation of the Six-power agricultural market; organisation of the Seven, assuming a Customs agreement between the two areas);

— obvious trends affecting *the composition of international trade by products* (general expansion of trade in chemicals and manufactured goods; relative decline in agricultural trade and in sales of raw materials and finished textile goods);

— changes in the *composition of foreign trade by origin and destination* (diversion of trade through the establishment of major productive complexes in the franc zone countries; effect of the essential industrialisation of the African countries, as regards supplies of capital goods from Europe and the reduction of European textile exports).

Generally speaking, the various forecasting patterns and trend indications used in forecasting foreign trade provide only a foundation. It is then necessary :

— to make as accurate an international comparison as possible of national forecasts;

— to consider possible variants and their consequences, with particular reference to risks of imbalance and checks to growth.

Section III — Transition from final demand by products to output by sectors

A — GENERAL PROCEDURE

104. The French procedure is at present based essentially on the use of a previously-inverted Leontief matrix and the consultation of sectoral experts. In the production model used all sectoral productions (outputs) and all intermediate consumption (inputs) are endogenous variables, with final demand as the exogenous element.

In its simplest form, the solution of the problem is given by a model with equations of the type :

$$X_i = \sum_{j=1} a_{ij} X_j + Y_i$$

Where :

X_i, X_j = outputs of sectors i and j
a_{ij} = current input coefficient
Y_i = autonomous final demand for product i

However, as investment in the various sectors has not been included in final demand, it now forms part of the endogenous variables of the detailed production model and must be treated as such.

In these conditions, the theoretical solution of the problem is given by a *dynamic model*, with equations of the type :

$$X_i = \sum_{j=1} \left(a_{ij} X_j + b_{ij} \frac{d X_j}{d t} \right) + Y_i$$

where b_{jj} is the net marginal capital-output coefficient of capital goods i invested by branch j.

In the absence of adequate information, particularly as regards future prospects, it will often be difficult to construct a matrix for capital coefficients (b_{ij}). Under the French procedure, this is remedied by an iterative method described in sub-section 107 below.

In general, the production model is mainly a framework for the questioning of branch experts. The basic data can be improved with the information so obtained.

Having outlined the principles on which the detailed analysis of output is based, we shall now consider actual working methods in the paragraphs which follow.

B — STUDY OF INTERMEDIATE DEMAND

Now that the various elements of final demand have been broken down by classes of products by the methods briefly described above, the intermediate consumption of each sector can be estimated and broken down into classes of products by means of an input-output table.

Basis of study

105. The study is based on an input-output table.

Using the list of sectors proposed in sub-section 99, the group constructed the diagram shown on page 107 as a means of regrouping the various items from the input-output tables of member countries.

Using this model, we tried to regroup the data from input-output industry trade tables compiled in the countries of the Community. Although no major degree of harmonisation was achieved, we give our results in Appendix 10.

The table for France is used as a basis for the forecasts described in this chapter. Its main features are as follows :

i) It subdivides total output between 16 sectors, each corresponding to an item on the list of products given in its most concise form in sub-section 99. Under the French system, item 17 "Commercial activities" does not constitute a sector comparable with the sixteen others; see iv) below. It is recalled that sectors are not necessarily groups of undertakings because the activities of integrated undertakings can be spread over several branches.

ii) So that the links connecting final demand and intermediate consumption can be represented by the same diagram, whatever the distribution of final demand between its component elements, exports are reckoned at domestic prices, thus including internal taxes. Estimated value added for each branch therefore contains a fictitious element (which could, moreover be shown separately).

iii) The transport item included in the expenditure of each sector represents the cost of public transport required by the sector concerned to carry the raw materials and the intermediate products it purchases. However, the cost of transporting oil products and building materials to the point of sale is charged to the selling sector in the table. Transport of exported goods to the frontier is treated in the same way. In addition, transport and telecommunications are combined as a sirgle item.

iv) The trading margins reckoned among the expenses of each sector correspond principally to the value added by distribution at the consumer stage. Correlatively, purchases of products in the "households" column are estimated at retail prices. Interpretation of the table thus provides a basis of assessment which can be used to formulate hypotheses for the growth of commercial sectors linked with consumption. The table used for the forecast differs from the standard pattern on this point.

With few exceptions (steel merchants, building materials) trade in raw materials and semi-finished products is not itemised. The expenditure and value added of such activities are counted with those of the sector with

Overall interrelations between resources and uses

RESOURCES \ USES		UNDUSTRIES																	Capital formation		Public sector	Households	Rest of world		Total uses	
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	Total intermediate uses	Stock variations	Gross fixed capital formation	Consumption	Consumption	Exports to EEC countries	Exports to rest of world	Final goods and services	Intermediate and final goods and services
SECTORS	01 Agriculture, forestry	-																									
	02 Agricultural and food industries		-																								
	03 Coal, coke and industrial gas			-																							
	04 Electric power				-																						
	05 Petroleum and fuels, natural gas					-																					
	06 Building materials and glass						-																				
	07 Iron ore, iron and steel (E.C.S.C. products)							-																			
	08 Non-ferrous ores and metals								-																		
	09 Engineering and electrical industries									-																	
	10 Chemicals										-																
	11 Textiles, clothing, leather											-															
	12 Timber, paper and miscellaneous industries												-														
	13 Building													-													
	14 Transport														-												
	15 Housing services															-											
	16 Other services																-										
	17 Commercial activities																	-									
	Total intermediate resources																										
	Value added (a)																										
	Total output																										
Rest of world	Imports from E.E.C. countries																										
	Imports from rest of world																										
Public sec.	Indirect taxation, less subsidies																										
	Total resources																										

(a) Includes : Households, wages, profits, other income; capital formation; depreciation.

which they are associated. This, at least, is the provisional solution adopted in the French document. It is clearly the result of statistical difficulties, but is not fully satisfactory. In the French table, therefore, the item "Commercial activities" is not strictly a sector of production.

v) Finally, transactions within sectors are not recorded. The main diagonal spaces are, therefore, left blank.

106. *Problem of technical coefficients*

At this stage, the technical coefficients for the base year are generally used to interpret the table for forecasting purposes. In some cases, however, the direction of anticipated technical progress is sufficiently clear to allow modification of technical coefficients for the terminal year of the forecast. Some modifications may be specific to one sector : progress of coke and use of oil products in the iron and steel industry; electrification and diesel conversion of railways; development of prefabrication techniques in building; cutting down of transport needs in the case of petrol (pipe lines) and cement (geographical location); continuously increased processing and wrapping of food products. Other modifications may be of a more general nature : more efficient use of fuels; replacement of coal by hydrocarbons; reduction of specific steel consumption by the introduction of lighter machinery and the substitution of light metals and alloys. Nevertheless, as calculations are at constant prices, no systematic allowance can be made at this stage for the influence of relative price changes on the choice of techniques. Certain clearly-localised consequences of the relative price variations appearing most likely *a priori* can, of course, be anticipated. But the combined effect of all variations of the price system on the technical coefficients can only be taken into account at a later stage.

107. *Adjustment of the input-output trade table for the terminal year*

Adjustment is made easier by the definition of sectors in the table compiled for the base year (see sub-section 99). Relatively homogeneous sectors, whose level of activity is determined approximately by general economic activity, final demand, intermediate demand or demand for capital goods can be shown separately as a result. This simplifies the problem of adjustment.

i) Sectors with outlets shared between final and intermediate demand and output prospects roughly dependent on the gross domestic product :

Sector 3 — coal and gas
Sector 4 — electricity
Sector 5 — petroleum, natural gas and motor fuels
} Power group
Sector 14 — transport and telecommunications

ii) Sectors producing mainly for final consumption demand :

Sector 1 — agriculture, forestry
Sector 2 — agricultural and food industries
Sector 11 — textiles, clothing, leather goods
Sector 12 — timber, paper, miscellaneous industries
Sector 15 — housing services
Sector 16 — other services
Sector 17 — commercial activities (1)

Expenditure on housing services comprises all actual or notional rent paid by households; expenditure on commercial activities consists of the trading margins paid by households on their purchases (1).

(1) This classification of commercial activities derives from the treatment of trading margins in the French system of inter-industry relationships. If, as in certain countries, all trading margins (and not only those paid by households) are included, commercial activities must be listed under (i).

iii) Sectors serving intermediate consumers

Sector 6 — building materials, glass

Sector 7 — iron ore, iron and steel industry

Sector 8 — non-ferrous ores and metals

Sector 10 — chemicals

Sector 6 is linked mainly with building; the other three are linked with all intermediate consumption by all sectors and, therefore, have an approximate connection with the gross domestic product.

iv) Sectors producing capital goods :

Sector 9 — engineering and electrical industries

Sector 13 — building and civil engineering.

The output-investment adjustment mainly affects these two sectors, but sector 9 also supplies consumer goods.

In each case, therefore, output will be calculated from the corresponding outlets and the necessary productive investment will also be computed.

For investment in nationalised or concentrated industries the actual programmes laid down are used. For other sectors, gross marginal capital-output coefficients of fixed capital are used or, in their absence, rates of investment in relation to turnover.

In all cases, investment in engineering and electrical equipment (including transport equipment) and building and civil engineering are shown separately.

Group iv) is the most difficult to handle, particularly as regards the engineering and electrical industries. Their rate of production will depend not only on the quantity of equipment supplied to other sectors but also on the quantity produced for their own use.

A series of iterations will be necessary and, even if the calculations coincide, may involve the revision of certain technical coefficients for capital, especially to reconcile the results obtained with the information supplied by the experts of the sector concerned (2).

108. It is apparent that the adjustment procedure described above can only give a preliminary allocation of the principal volumes of intermediate consumption and a preliminary breakdown of investment by industries. This must be followed by a closer study, using (particularly for manufactured goods) a much more detailed framework than the seventeen-item table. With this more detailed pattern, the relationships determining sectoral outputs are obviously less simple; but once the principal volumes have been allocated, the remaining adjustments are smaller.

It must be stressed that these operations cannot be reduced to the mechanical application of an inverted matrix, however well-constructed. They, in fact, constitute only one stage, to be used for questioning industrial experts and to provide them with a framework. It must, therefore, be possible to explain each figure by explicit relationships linking it to other figures; at this stage, the relationships used must be formulated by reference to all available information and, in particular, the economic and technical content of the data used must be clear enough to be easily understood by the experts.

For this reason, the adjustment of the table cannot be limited to the application of the general stability pattern of the technical coefficients to the seventeen-item table. It must be obtained by a process of trial and error, during which all the information available can be applied. Furthermore, the successive approximations required

(2) See J. Bénard "Communication au colloque économique franco-polonais" (Paris, May 1960).

for this process are partly merged with those applying to foreign trade, because imports of raw materials required for the expected volume of output, and imports of competing products both have to be considered. In particular, the hypothesis that imports are proportionate to the output of consumer sectors is only a provisional basis which will very quickly have to be revised. This applies particularly when certain outputs are liable to run up against *bottlenecks* which cannot be cured even by long-term investments, either because deposits are becoming worked out or, most frequently, because the estimated cost of production is much too high to warrant such investments, having regard to conditions of international competition. It is then better to make up the supply deficit by imports and to direct domestic production towards more profitable lines. This applies for example, both to coalfields and to certain agricultural activities.

If output ceilings $\overline{X_i}$ have to be adopted, they can be incorporated in the model by inequalities of the type :

$$X_i \leqslant \overline{X_i}$$

When inversion of the input-output matrix gives a value exceeding the upper limit for X_i, the value of $\overline{X_i}$ will have to be substituted. The maintenance of equilibrium between resources and uses will then require a reduction in autonomous final demand Y_i, which may be the result either of an increase in imports of commodity i or of a fall in exports or domestic consumption of the same commodity.

C — RELATIONSHIP BETWEEN OUTPUT AND MANPOWER

109. The detailed output and investment forecasts must be supplemented by an estimate of the future manpower requirements of each branch.

A neat method would be to compute labour input coefficients and try to assess their future trend.

At this stage, a more empirical procedure would be to estimate the growth of productivity by sectors, at a given level of investment, and then deduce the demand for hours of work. By applying a hypothesis regarding the trend of hours of work, manpower requirements can be calculated sector by sector.

The first method will necessarily be based on incomplete data but the calculation must be made to give a preliminary idea of the possible employment equilibrium, taking into account possible hypotheses regarding emigration and immigration.

An estimate of the likely growth of productivity, as indicated by purely technological mechanisms, is not sufficient, because some changes in employment are linked with sociological factors. In agriculture, for example, the decline in the labour force, caused mainly by the departure of young workers, cannot be so great as to raise average age too far, because too old an agricultural labour force is in general unlikely to adopt technical advances and thus to achieve the increase in productivity which can be expected on purely technological grounds.

The growth of productivity, particularly when rapid, implies the raising of workers' living standards and calls for an educational and vocational training programme which should be included in government targets. According to whether the forecast is "pure" or of the "decision" type, these programmes should be formulated either as a condition of achieving the anticipated growth or as a necessary instrument for the implementation of the development policy.

D — STUDY OF THE EXPECTED GROWTH OF OUTPUT AND DEMAND BY SECTORS

110. The forecasts established for categories of product and sectors by the short methods just described, now have to be combined in a synthesizing document showing equilibrium between resources and uses at constant prices during the terminal year of the forecast. These more detailed studies may, of course, involve re-casting the original pattern, particularly as regards the distribution of final demand between its main elements.

This synthesis can serve as a basis for an even more detailed study of the machinery of growth. It can be used to question industrial experts or to carry out inquiries to improve the basic data.

111. *Contribution of industrial experts.*

The data used can be substantially improved by calling in experts from each sector who are both capable of taking an overall view of the particular sector (past and present trends, general factors determining future growth) and have a detailed knowledge of its techniques (through precise knowledge or direct experience of the management of individual undertakings). They should be asked the following questions:

i) The basic forecast refers to only a very small number of highly aggregated sectors. The first requirement is, therefore, *a breakdown of the outlets for each sector*, as far as possible according to the nature and use of the product, and the type of utilisation.

ii) The industrial experts can try to make a *direct estimate of outlets* for each sub-category of products so identified:

— taking into account the general growth hypotheses (distribution of households' consumption by classes of needs and classes of products; growth of government consumption and investment; growth of gross fixed capital formation of undertakings and households; growth of exports);

— taking into account observed relationships between the general growth premises and outlets for the sub-category of products in question.

iii) On the basis of the targets so specified, an attempt should be made to estimate, for each basic sector, *consumption of the main intermediate products* and *variations in technical coefficients* due to the introduction of new manufacturing techniques or the substitution of one raw material for another.

iv) Examination of the factor inputs required leads on to an assessment of the probable future growth of *productivity* and, therefore, of the *size and qualifications of the labour force* required to achieve the targets of the sector in question. Past experience should be analysed to try and identify the relationship linking the growth of productivity with the level of investment and, thus, to determine, on the basis of productivity hypotheses compatible with output targets, the volume of investment required, the nature of the goods invested (buildings, civil engineering works, machinery) and the nature of the installations involved (major repairs, replacement, extensions).

The items listed above imply a price hypothesis (prices of sector products, and of the raw materials and capital goods it uses).

112. *First approach to the problem of prices*

As already noted, the first forecasts assume constant prices of goods and services. This is merely a preliminary convention and studies of individual sectors must necessarily be carried further:

i) In the case of *wages*, the hypothesis of an average increase of rates follows necessarily from the anticipated growth of consumption:

ii) Even if certain general premises of price formation remain constant (taxation, welfare charges, method of financing), the various *relative prices* will show different trends under the influence of expected technical progress.

Knowledge of the prices of capital goods and raw materials in relation to labour can obviously play a very important part in selecting a hypothesis for technical progress. It is, therefore, necessary:

i) To try and specify it. The problem cannot be treated systematically when the study is confined to the conditions of progress in a particular sector. A method of dealing with this problem is discussed later.

Industrial experts can, however, be asked to indicate :

— their assumptions regarding prices of the raw materials and capital goods they expect to be used;

— their expectations regarding variations in prices of the products of their sector (or at least regarding major anticipated price variations).

ii) In the field of possible variations in the relative prices of raw materials, labour and capital goods, to define *thresholds* at which a change should be made from one technique to any of the other techniques which could be introduced later.

It may be noted in passing — the subject is too extensive to discuss in detail — that the price concept alone is not usually sufficient for forecasting long-term technical trends. It has to be supplemented by information regarding associated changes in the nature of the product supplied, leading to a change in the way of using the products concerned. These phenomena are automatically apparent in the case of intermediate products and capital goods. Their consequences are more difficult to analyse in the case of consumer goods, which shows that a study of the effect of innovations on the laws of consumption would be of the greatest value.

Section IV — Return to the overall forecast

A — INTRODUCTION

113. The overall forecast can now be revised completely on the basis of the analysis of output and employment by sector, supplemented by the information obtained from the experts. Several processes are involved and the detailed data can first be used to *revise the hypotheses postulated in the preliminary forecast.*

Furthermore, the studies of technical growth indicate a number of technical options and the *possibility of alternative solutions*, which must be studied as far as possible. This procedure for "returning" to the overall forecast must logically be accompanied by "consistency tests" both to revise the preliminary hypothesis and as a means of choosing between various alternative solutions.

These aspects are considered in the paragraphs which follow.

B — REVISION OF THE BASIC HYPOTHESES

114. All hypotheses which, in the preliminary forecast, were postulated through a very simplified model or by extrapolation of past data, on the basis of information supplied by industrial experts, can be replaced by *new hypotheses* relating directly or indirectly to the effects of current or expected technical progress. This applies particularly to :

— gross fixed capital formation by sectors;

— requirements of energy, raw materials and intermediate products by sectors;

— corresponding labour requirements (and, therefore, the growth of output per person employed).

The overall hypothesis for the rate of growth is then determined by the composition of these preliminary hypotheses and an analysis of their mutual compatibility.

In addition, the information collected regarding the conditions of growth in each sector provides a basis for studying *intermediate years*, as well as the terminal year of the period covered by the forecast. It is then possible to observe the structure of economic equilibrium over the whole period of growth and to identify difficulties likely to occur in the nearer or more distant future. A rate of growth compatible with all the relevant economic and technical premises on which it depends can then be selected on a satisfactory basis.

115. *A number of technological options* are bound to come to light during studies of the technical progress of sectors, even when they are not very detailed.

i) A first series of choices relate to *relative price variations.* We have already noted that, in the field of possible variations in the relative prices of raw materials, labour and capital goods, a definition will be required of the thresholds at which a change may have to be made from one technique to any of the other techniques which could be introduced later;

ii) Even in a forecast which does not take account of "decisions", allowance must be made for variants linked with *hypotheses which are still uncertain.* For example, what is the likely development of the international competitive capacity of the basic sectors in view of current prospects ? What are levels of output likely to be as a result and what effect will these levels have on the choice of techniques and on operating and investment costs ? What spontaneous changes will there be in the structure of sectors and the size of establishments ? What prospects are there of spontaneous changes in the rates and commercial structure of the energy and transport sectors ?

In all these cases, different behaviour hypotheses can be linked to different forecasts of technical progress.

iii) In the case of a *forecast allowing for "decisions"*, the government may plan action in a particular sector to bring about, for example :

— *international specialisation,* involving the reduction or abandonment of production of certain goods, offset by increased exports of certain other goods. Beyond given thresholds, a change in output targets may lead to a change in technique, a non-proportionate variation in the sector's requirements of raw materials and labour and a change in investment programmes. In the case of the main export sectors, an estimate must also be made of the sums which undertakings occupying a strong competitive position on foreign markets should be capable of spending on technical research and commercial expansion.

— *a change in structure.* The number of undertakings and establishments at present forming the sector may determine the direction of its future technical progress, which is that compatible with the present size of establishments. Action to change the number and, thus, the size of establishments may sanction the introduction of new techniques, linked with other technical coefficients, and other labour and capital requirements.

Again in the case of a forecast allowing for "decisions", the various possible lines of technical progress may open up a much wider field of analysis; particularly in the energy and transport sectors, collective requirements can be satisfied by several possible assumed distributions of total demand between the various sources of power and the various transport systems. These hypotheses are not necessarily equivalent in the matter of operating and investment costs for the community. It is possible to select an optimum hypothesis and then apply a scale of charges (or regulations) which will encourage demand to conform as closely as possible with the optimum distribution. When, in fact, the authorities are not completely free to fix charges and lay down regulations for energy and transport, a choice can still be made between all possible scales of charges and regulations, selecting those which will channel demand towards a distribution involving the lowest total cost.

These, briefly, are the uncertainties and alternative possibilities associated with the technical progress of sectors. Inevitably, anticipated changes in the income pyramid and overall consumption also contain uncertain elements. They will remain uncertain, even when the data for previous years contain no gaps and have been correctly interpreted. Consumers' reactions to innovations and the various measures adopted by the government in matters for which it is responsible (road infrastructure; hospital facilities) will continue to be unknown. Finally, forecasts of foreign trade are largely conjectural, even when compiled and discussed by international bodies in such a manner that a number of variants can be considered.

Numerous combinations of elementary variants are theoretically conceivable. They must be studied as fully as possible by means of econometric models and computing methods with which syntheses can quickly be obtained. A choice must then be made according to the criteria discussed in the following description of consistency tests.

D — CONSISTENCY TESTS

116. The purpose of consistency tests is either to reconcile two or more estimates of the same variable made at different stages of the iterative process and follow their effects on all variables, or to ensure fulfilment of certain conditions not explicitly stated in the models forming the iterative pattern. From this second standpoint they might be called "probability tests" because they most frequently relate to psychological or institutional limits, which must be adhered to in order to give reliable forecasts from the standpoint adopted.

The first type of test is concerned with the "physical consistency" of the flows forecast while the second, which relates mainly to the use which economic agents make of their incomes and savings, is concerned chiefly with the "financial consistency" of the forecast.

a) *Physical consistency*

117. Equilibrium of resources and uses of goods and services.

The input-output trade table is a strict double-entry table requiring that there shall be such an equilibrium for a given final demand, previously broken down by products.

The compatibility of all the data collected can, therefore, be checked by their incorporation in this table.

At overall level, a check must be made to ensure that total value added (at market prices), as shown by the calculation of outputs and inputs, in fact coincides with the relevant gross domestic product.

A further check will be made to verify whether total productive investments computed sector by sector, either with a dynamised Leontief model or by an iterative procedure, also correspond to the total of such investments computed overall for the whole economy during the preliminary estimate of the main components of final demand.

118. Equilibrium of labour resources and requirements.

The detailed forecast gives an estimate of future demand for labour, on the basis of the forecasts of output and productivity for the various sectors. The figure so obtained for demand has to be compared with the supply of labour indicated by the population forecasts.

Such a comparison, confined to *overall* labour supply and demand, will necessarily be rudimentary but will bring to light any significant imbalances. In such cases, the position will most frequently be adjusted by modifying labour supply; this will be done by correcting the forecasts for migration and the hours of work or rate of participation of certain categories of the labour force — women, old persons, etc. Logically, the factors in economic and social policy liable to produce such changes should be defined at this point.

b) *Financial consistency*

119. In this context, the term "test of financial consistency" means a study which starts from the physical equilibrium of resources and uses of goods and services and attempts to determine the structure of incomes, expenditure and liabilities produced by the combination of forecasting targets and the financial behaviour of economic agents. The "consistency" of this structure will be judged by considering whether the differences it shows as compared with the present position are probable or not, having regard to the institutional hypotheses on which the whole forecast is based.

The basic hypothesis of constant prices can be retained at the start of the study of financial consistency, but the equilibrium of income and expenditure, and of savings and capital requirements can then only be analysed in broad outline.

As a result, a more detailed study has recently been undertaken in connection with the preparation of the fourth French plan, introducing *changes in relative prices* by means of a supplementary model.

Analysis at constant prices will first be briefly described, and attention will then be concentrated on the study in question.

120. Overall study at constant prices.

If the hypothesis of constant prices is retained, a whole economy table will be compiled, showing the structure of the capital account of each group of agents (undertakings, households, government, foreign), allowing for hypotheses regarding the distribution of incomes and taxation. In this account, assets comprise the savings and the balance of current income and expenditure of the group of agents concerned; liabilities consist of the expected investments of the same group. A credit balance will represent the available surplus savings of the group and, therefore, its lending to other agents; a debit balance will represent the group's borrowing to finance its investments.

Forecasters will then consider whether the structure of the capital accounts so established is compatible with what is known of the traditional financial behaviour of the various economic agents (propensity of households to save, proportion of self-financing and borrowing by undertakings, size of government budget deficit or surplus considered "permissible" etc.).

121. Study by sectors at variable relative prices.

In the long run there is generally considerable risk of inconsistency with a forecast at constant prices, first because the formation of operation revenues, transfer payments and financing can only be studied very broadly and, secondly, because there is no means of analysing:

— prices elasticities of demand, in the study of consumption;

— the effects of substitution and the technical variants linked with them, in the study of production.

The equilibria obtained in constant price forecasts are, therefore, of doubtful economic significance.

This shortcoming has been remedied by constructing a model which, for each sector studied, expresses the price of the corresponding product in terms of the technical input coefficients and prices of intermediate products, of the labour coefficient, interest charges and taxation, and of distributed dividends or profits and self-financing by the sector.

Wage rates by sectors are not included explicitly in the formula, because they are used as a standard for measuring prices which are, therefore, wage prices.

The fundamental hypotheses on which this price system is based relate to:

i) Changes in current operating costs as a result of technical progress, producing *modified input coefficients for intermediate products and labour.*

ii) *Fiscal charges* connected with operating activities;

iii) *Financial costs* arising from the need to finance an investment programme, taking into account:

— norms based on the behaviour and traditions of financial institutions and the financial behaviour of undertakings, as regards the proportion of self-financing and opportunities for obtaining external finance in the form of equity and debenture issues or bank loans;

— charges in respect of external finance, including debenture interest and repayment and dividends;

— direct fiscal charges.

When the forecast covers a long period, the criteria (particularly financial) to be fulfilled by these hypotheses are obviously not very strict. However, over a period of 5 or 10 years, there are not many possible choices for the taxation system, in view of the inertia of control techniques and the weight of public opinion in the matter of taxation.

Similarly, the standards applied by bankers and other capital market institutions regarding the proper balance between funds held and funds loaned to provide a sector with capital, result in very stable behaviour. The view expressed by an experienced financier on the means proposed for financing an industrial programme when it is drawn up, can be regarded as a fairly sound premise; such a judgement will take account of the credit status of firms in the industry and the fact that the earnings of capital must be more or less the same in all industry, allowing for the risks peculiar to each.

It must be noted, however, that the behaviour of financial institutions is not the only factor involved here. Firms themselves may have preferences regarding the various possible methods of financing and evidence of this may be found by a study of their past behaviour. For example, in sectors consisting mainly of medium-sized firms — generally speaking those not run by managers who are virtually independent of the shareholders — undertakings may refuse to increase their borrowing or raise more capital for fear of losing control of the business.

122. When the model has been constructed as described, the system of equations can be resolved and the forecaster can examine whether the structure of the household and government capital accounts arrived at with the prices so obtained is compatible with the known facts regarding the financial behaviour of households and governments. If not, the model is repeated in reverse, starting this time with the financial behaviour of households and governments and finishing with the capital account of undertakings, sector by sector.

This study cannot, of course, produce a complete price hypothesis. At the most, it can give an idea of possible discrepancies between price indices with a common base year for the classes of products in each sector. The hypothesis obtained is, nevertheless, valuable and it can be used, in conjunction with the more detailed information which industrial experts can supply regarding the scatter of price indices for the various items in a given class of products :

— to make a systematic approach to the problem of substitutions of intermediate products and the relevant technological choices;

— to allow for the consequences of price variations in the analysis of consumption;

— to study the problem of the distribution and utilisation of incomes, household savings, taxation and the balance of government finances,

All these studies may involve changes in the initial model, not only because they may call for modification of the hypotheses for final demand by classes of products but also because they may reveal incompatibilities between :

— the expected mechanisms of savings formation;

— the means of financing investment in the various sectors of production, having regard to expected financial behaviours;

— an equilibrium of government finances (allowing for taxation) not completely different in structure from that generally regarded as permissible, and compatible with a prudent financial and monetary policy.

For example, if firms in sectors with heavy investment programmes show some unwillingness to borrow, the machinery of price formation must be modified towards increased self-financing and correspondingly towards taxation of weaker undertakings.

The deficit on public finances then tends to increase and may go beyond the limit considered acceptable.

123. No further detailed discussion is possible of a method which has not yet been fully tried in practice.

It may simply be noted that the French attempt forms one of a series at present being made in various quarters to allow for the effect of anticipated variations in relative prices. One example is the use in forecasts of the method suggested by Rasmussen (1) for determining transfers of income between sectors as a result of variations in the structure of relative prices.

Considerable further research along the lines indicated is, however, necessary before all the problems listed above can be treated satisfactorily. Such research is essential not only for an accurate study of prices and incomes but also to obtain objective information on the reactions of financiers to investment programmes and to bring to light the cases where the expected growth appears to be impossible without some change in financial norms and behaviour.

Section V — Conclusion

Significance of detailed long-term forecasts in the light of French experience

The conclusions set out below are at present only provisional, being the theoretical extension of a study which at the time of completion of this report, has only reached the stage of consultation of industrial experts.

A — FORECASTS INCLUDING "DECISIONS"

124. When hypotheses have been formulated for price movements (as we have just seen, only a rough approximation is possible), a first criterion of probability can be applied to all foreseeable possibilities and a selection can be made. But there is no reason to suppose that this selection will leave only one growth forecast, which would then be the only likely prospect. On the contrary, there may be numerous different forecasts, which can be dealt with in two ways:

— as a complex from which an *optimum* forecast should be selected, by criteria to be defined; the government would then try to implement the selected forecast by using all appropriate instruments;

— as a complex from which a choice should, if possible, not be made immediately but later, for example, when the technical data at present unknown become available, when details are known of the price determination mechanisms which can at present only be approximately analysed and when the still unknown trends and choices of consumption are understood. The problem is then to define a kind of *package solution*, such that decisions determining the future, which must be taken here and now (major investments, training of technicians and operatives, orientation of foreign trade, fiscal policy and rate of wage increases) are compatible with all, or at least most of the growth prospects considered possible. Such a package solution is the only true guarantee of collective economic freedom (that is, not jeopardised by ill-advised fundamental decisions preventing a possible course of development which collective opinion might consider desirable when the time came).

These two concepts of long-term forecasting are, in fact, complementary rather than exclusive. It must be possible to evaluate and classify the various growth possibilities, but it would be a mistake to suppose that by formulating classification criteria, the range of possibilities can be reduced to a single growth prospect

(1) "Studies in inter-sectoral relations", Amsterdam, 1956, Chapter 6.
Under this method a comparison is made between two input-output tables for the same year (in this case, the terminal year of the forecast), the first *at constant prices* and the second *at current prices*. Value added by each sector, first, at current prices and, secondly, at constant relative prices is used to calculate the gains (or losses) which would be produced in each sector by variations in the structure of relative prices adopted as forecasting hypotheses. It is then decided whether these gains (or losses) are reasonable.

which would be both possible and desirable. Two final points must, therefore, be considered. How is the optimum to be identified ? and how can the package solution be determined by reference to a series of possible growth prospects ?

125. These two problems cannot be discussed in detail and we shall confine ourselves to a brief survey of the instruments which must be used in solving them :

a) *Identification of the overall optimum*

i) First of all, *how is the optimum defined* ? Not exclusively in economic terms of course; but, partially at least, it can only be defined as the maximisation of one or more economic aggregates (consumption, for example);

ii) The maximisation of the one or more aggregates characterising the optimum must not be sought exclusively for the terminal year of the forecast. Some of the possible alternatives may in fact show a different rate of growth for those aggregates over a number of successive years. The comparison must, therefore, cover the *whole period of the forecast* and the aggregates for successive years must be made comparable by calculating actual value.

The forecast must also cover the whole period of growth, as well as the terminal year, so that all conditions for fulfilling the potential studied can be determined; some of these conditions may relate to intermediate years as well as to the terminal year.

iii) Finally, *an actualisation factor must be fixed beforehand* in order to compare actual values. This difficult problem will not be discussed here.

b) *Determination of the package solution*

The package solution is not necessarily one of the growth alternatives which appear separately possible. It is conceivable — and even probable on *a priori* grounds — that it may involve heavier expenditure on investment than each of the separate possible alternatives, precisely because it aims at making such investment *polyvalent.* Moreover, the wider the field of possibilities, the heavier the weight of such polyvalency. This means that :

— the cost of immediate decisions determining the more distant future will be proportionately higher, the greater the freedom of manoeuvre the community wishes to retain for the future;

— the charges which must be accepted to-day to insure against inconsistent economic activity and an adaptation crisis at some later date are increased by the lack of sufficient information, which makes growth forecasts less precise. This emphasizes the great importance of all methods of obtaining more information and particularly of international procedures which allow detailed comparison of national forecasts relating to foreign trade and industrial specialisation and thereby reduce forecasting hazards in this particularly difficult field.

B — FORECASTS NOT INCLUDING "DECISIONS"

126. The foregoing remarks on forecasts including "decisions" clarify the significance and scope of "pure" forecasts.

A forecast of the first type aims at defining a consistent body of targets and means of action. A badly-conceived forecast is merely a programme of action, the effects of which are uncertain. On the other hand, when it demonstrates that the means are generally sufficient and can certainly be applied, the targets fixed have a forecasting value.

A pure forecast does not, however, *specify the means of implementing a development policy*. It can only postulate the conditions of such a policy and weigh the chances of their being fulfilled, on the basis of what is known concerning the behaviour of all centres of decision on which growth depends. It is possible, moreover, that the various centres of decision, on which economic development depends, may be guided towards consistent growth by the mere existence of such a forecast indicating conditions of growth. This is a by no means negligible possibility, but with "pure" forecasts there is the chance that decentralised decisions, however enlightened, may be incompatible both with each other and with prospects of regular growth. This applies particularly when decisions involve risks of partial imbalances between sectors of activity, social groups, regions and productive factors. The forecast must then weigh these risks and their effect on rates of growth.

It is at this stage that the systematic interpretation of the past, by the methods described in the previous chapters, again becomes important. The past we know is precisely the period when the decisions governing growth were not always consistent. The actual rate of growth therefore reflects the influence of such inconsistencies and must play a large part in any "pure" forecast.

It can, however, serve only as a starting point for a forecast including "decisions", which has the specific purpose of reducing the risk of inconsistency.

APPENDICES

APPENDIX 1

Hourly productivity in industry

(Figure 1, Chapter II, Sub-section 12)

Our data were obtained from a number of sources which are given, together with our results, in this appendix.

Symbols: v = volume of net output
a = number of workers per year (man-years)
h = average number of hours per worker
v/a = output per man-year
v/ah = output per man-hour.

The figures in Figure 1 relate to output per man-hour, except in the cases of the United Kingdom, the Netherlands and Sweden, for which no continous series are available for the number of hours worked. The following tables show, however, that the difference between annual and hourly productivity is so small that it can safely be ignored.

1*a* — Germany

Year	v	a	a.h.	v/a	v/a.h.
	1	2	3	4	5
1929	82	85	83	96	99
1930	72	74	69	99	104
1931	59	61	55	97	107
1932	48	51	45	94	107
1933	53	56	51	95	104
1934	67	71	67	94	100
1935	78	78	74	100	105
1936	86	86	83	100	104
1937	95	94	92	101	103
1938	100	100	100	100	100
		1*b* — Germany (R.F.)			
1949	74	78	74*a*	95	100
1950	86	88	81	98	106
1951	112	93	90	120	124
1952	119	96	93	124	128
1953	132	100	96	132	138
1954	148	107	103	138	144
1955	172	117	113	147	152
1956	186	124	118	150	158
1957	197	128	115	154	171

(*a*) Second half-year doubled.

Sources:

v: 1929-1938: "Die Deutsche Wirtschaft zwei Jahre nach dem Zusammenbruch, Tatsachen und Probleme"; D.I.W. Berlin 1947, page 264.
1949-1957: "Statistisches Jahrbuch 1955", page 227; idem 1958, page 187 (1936 series = 100), converted on the basis 1938 = 100, with indices for the whole of Germany.

a: 1929-1938: "Statistisches Handbuch von Deutschland", 1928-1944, page 480, table 6a.
1949-1957: "Statistisches Jahrbuch Deutschlands 1953", page 239; *idem* 1955, page 204; *idem* 1958, page 174.
Series for processing industry. Employment figures for the period 1949-1953 calculated from numbers of "occupied persons" on the basis of the relationship existing from 1954 to 1957 (see Stat. Jahrbuch 1958). The statistics for before and after the war are linked on the basis of the number of "occupied persons" in Western Germany in 1936 (Stat. Handbuch 1928-1944, page 272).

ah: 1929-1938: "Statistisches Handbuch Deutschlands 1928-1944", page 480, table 6b.
1949-1957: "Statistisches Jahrbuch 1953 and 1958". Statistics for before and after the war linked as for a.

1938 *base figures*:

a: All Germany: 7,404,000 workers;
Federal Republic of Germany: 4,203,000.

ah: All Germany: 17,589 million hours;
Federal Republic of Germany: 9,985 million.

2 — France

Year	v	a	h	v/a	v/a.h.
	1	2	3	4	5
1930	121	130	124	93	75
1931	105	121	120	87	72
1932	90	107	113	85	75
1933	102	104	117	98	84
1934	96	101	115	95	82
1935	94	98	115	96	84
1936	102	100	118	102	87
1937	109	97	104	113	108
1938	**100**	**100**	**100**	**100**	**100**
1939	118	102	105	116	100
1947	90	103	115	87	76
1948	108	107	115	101	88
1949	117	109	113	107	95
1950	120	110	115	109	95
1951	133	114	115	117	101
1952	136	114	113	120	106
1953	133	111	114	120	105
1954	145	111	115	131	114
1955	159	112	115	142	123
1956	176	113	117	156	133
1957	192	117	118	165	140

Sources:

v : O.E.E.C. : "Industrial statistics 1957", table 4, manufacturing industries.

a : I.L.O. : Yearbook of labour statistics.
1947-1948, table VI.
1951-1952, table 7A i).
1954, table 7A i).
"General statistics" (O.E.E.C.) Nov. 1953, May 1959. (Employment in manufacturing industries). The years 1930 and 1932-1935 interpolated with the help of "International economic statistics, 1930-1936", chapter France, column 67 (employment in undertakings employing more than 100 workers).

h : "Yearbook of labour statistics" (I.L.O.), 1947-1948, 1951-1952 and 1954, table X A.
"General statistics" (O.E.E.C.). Nov. 1953 and May 1959.

1938 *base figures*:

a : 6,667,000 workers.

h : 38.8 hours per week.

Year	v	a	h	v/a	v/a.h.
	1	2	3	4	5
1929	91	90	106	101	95
1930	84	88	102	96	94
1931	75	80	101	94	92
1932	68	71	101	96	95
1933	73	72	108	102	95
1934	75	75	105	100	95
1935	87	85	96	103	106
1936	88	86	96	103	107
1937	101	94	105	107	102
1938	**100**	**100**	**100**	**100**	**100**
1939	111	103	101	108	107
1947	89	115	102	78	76
1948	97	112	101	86	86
1949	108	111	102	97	95
1950	123	111	108	111	103
1951	140	111	108	126	117
1952	145	111	106	130	123
1953	159	111	106	143	135
1954	177	113	109	156	143
1955	192	115	109	168	153
1956	205	117	108	176	163
1957	220	119	108	185	172

Sources :

v : O.E.E.C. : "Industrial statistics 1957", table 4, manufacturing industries.

a : 1929-1939 : I.L.O. : "Yearbook of labour statistics", 1947-1948, table VA 2; *idem* 1951-1952, table 7A i) "Statistisches Handbuch Deutschlands 1949", chapter X, table 17.
1947-1957 : "O.E.E.C." : "General statistics", Nov. 1953 and May 1959, "Employment in manufacturing industries".

h : 1931, 1933, 1935, 1937-1939 : "Monthly hours of work x 12/52 Yearbook of labour statistics 1947-1948", table XI. Interpolation by means of "Yearbook of labour statistics" (I.L.O.), 1942, pages 72 and 73.
1947-1957 : „Monthly hours of work x 12/52", from O.E.E.C. "General statistics", Nov. 1953 and May 1959 (figures already converted to hours per week).

1938 *base figures* :

a : 1,473,000 workers.

h 36.5 hours per week.

4 — Netherlands

Year	v	a	h	v/a	v/a.h.
	1	2	3	4	5
1923	55	84	107	65	61
1924	60	88	108	68	63
1925	66	92	108	72	67
1926	69	95	107	73	68
1927	74	98	107	76	71
1928	82	104	104	79	76
1929	87	109	102	80	78
1930	89	109	—	82	—
1931	84	99	—	85	—
1932	76	85	—	89	—
1933	79	85	95	93	98
1934	82	87	—	94	—
1935	82	85	98	96	98
1936	87	88	98	99	101
1937	98	97	99	101	102
1938	**100**	**100**	**100**	**100**	**100**
1939	111	105	101	106	105
1947	94	129	102	73	71
1948	111	146	102	76	75
1949	126	153	103	82	80
1950	142	160	102	89	87
1951	147	164	102	90	88
1952	147	161	102	91	89
1953	161	164	103	98	95
1954	177	172	103	103	100
1955	190	177	104	107	103
1956	198	180	104	110	106
1957	203	182	103	112	109

Sources :

v : "1899-1959, Zestig jaren statistiek in tijdreeksen", C.B.S., 1959, chapter K, industry column 1 (including mines and public utilities, excluding building).

a : "Ongevallenstatistiek", Rijksverzekeringsbank (annual). Total typical workers in industry, excluding building.

h : 1923-1929 based on : P.J. Verdoorn, "Arbeidsduur en welvaartspeil", table 33, column 2 (daily hours of work) x 6.
1933 : *idem*, table 37.
1935-1939 : "Yearbook of labour statistics", 1947-1948, table XA.
1947-1957 : O.E.E.C., "General statistics". Nov. 1953 and May 1959, "Hours of work in manufacturing industries".

1938 *base values* :

a : 856,304 typical workers.

h : 47.7 hours per week.

5 — United Kingdom

Year	v	a	h	v/a	v/a.h.
	1	2	3	4	5
1924	68	98	99	69	70
1925	67	98	—	68	—
1926	60	99	—	61	—
1927	74	101	—	73	—
1928	73	100	—	73	—
1929	78	102	(100)	76	(76)
1930	72	95	—	76	—
1931	66	87	—	76	—
1932	68	86	—	79	—
1933	74	89	—	83	—
1934	82	94	—	87	—
1935	91	95	103	96	93
1936	100	101	—	99	—
1937	108	107	—	101	—
1938	**100**	**100**	**100**	**100**	**100**
1947	118	109	97	108	111
1948	127	114	97	111	114
1949	136	116	97	117	121
1950	147	120	99	123	123
1951	153	124	98	123	126
1952	147	121	99	121	123
1953	157	124	99	127	128
1954	170	128	100	133	133
1955	180	131	100	137	137
1956	179	131	99	137	138
1957	182	131	99	139	140

Sources :

v : O.E.E.C. : "Industrial statistics 1957", table 4, manufacturing industries.

a : 1924-1938 : L. Rostas "Comparative productivity in British and American industry", 1948, table 13 (*a*).

1947-1957 : O.E.E.C. : "General statistics". Linked to the pre-war figures with the help of the "Yearbook of labour statistics 1947-1948", table VA2.

h : 1924 and 1935 : Rostas, see above.

1929 : Taken as 100 because there was no change in hours of work from 1920 to 1938 (see A.L. Bowley : "Wages, earnings and hours of work, -1914 1947, U.K.".

1938 : "Yearbook of labour statistics", table 13A i).

1947-1957 : "O.E.E.C. General statistics", Nov. 1953, May 1959.

1938 *base figures* :

a : 6,700,000 workers.

h : 46.3 hours per week.

Year	v	a	h	v/a	v/a.h.
	1	2	3	4	5
1923	98	114	152	86	64
1924	92	106	136	87	68
1925	102	109	142	94	72
1926	108	112	146	96	74
1927	107	109	142	98	75
1928	113	109	141	104	80
1929	127	117	150	109	85
1930	105	101	124	104	85
1931	86	86	100	100	86
1932	67	73	79	92	85
1933	78	81	86	96	91
1934	86	94	91	91	95
1935	100	100	103	100	97
1936	118	109	119	108	99
1937	130	119	129	109	101
1938	**100**	**100**	**100**	**100**	**100**
1939	121	110	116	110	104
1947	224	163	191	137	117
1948	231	164	190	141	122
1949	213	151	172	141	124
1950	250	159	187	157	134
1951	268	172	203	156	132
1952	277	174	206	159	134
1953	302	184	216	164	140
1954	281	171	197	164	143
1955	313	177	209	177	150
1956	322	181	212	178	152
1957	325	177	206	184	158
1958	305	165	188	185	162

Sources :

v : O.E.E.C. "Industrial statistics 1957", table 4, manufacturing industries 1939 and 1958 : Federal Reserve Board Indices.

a : 1923-1939 : S. Fabricant : "Employment in Manufacturing 1899-1937", N.B.E.R. 1942, page 331, column "Wage earners".
1947-1958 : "Statistical Abstract of the U.S. 1956", table 242 and *idem* 1957, table 247, "Employment, manufacturing". Linked to the pre-war figures with the help of figures for 1939 and 1947 from "Statistical Abstract 1957," table 1010, "All employees".

ah : 1923-1939 : S. Fabricant, *idem*, page 331, column "Man-hours, wage-earners".
1947-1958 : "Employment x" Indices of weekly hours of work from "Statistical Abstract 1957", table 266 "Net output per man-hour, current year prices", 1939 = 88.7 (1947 = 100).

1938 *base figures* :

a : 8,661,200 wage-earners.

h : 35.6 hours per week.

Year	v	a	h	v/a	v/a.h.
	1	2	3	4	5
1929	64	84	103	76	74
1930	66	84	—	79	—
1931	63	85	—	74	—
1932	59	74	—	80	—
1933	61	72	99	85	86
1934	72	81	102	89	87
1935	81	87	102	93	91
1936	88	92	103	96	93
1937	99	99	102	100	98
1938	**100**	**100**	**100**	**100**	**100**
1939	109	105	98	104	106
1947	140	124	100	113	113
1948	149	125	100	119	119
1949	155	126	100	123	123
1950	161	126	100	128	128
1951	168	130	100	129	129
1952	164	127	100	129	129
1953	166	124	100	134	134
1954	174	124	100	140	140
1955	184	128	100	144	144
1956	191	129	100	148	148
1957	196	130	100	151	151

Sources :

v : O.E.E.C. "Industrial statistics 1957", table 4, manufacturing industries.

a : 1929-1939 : I.L.O. "Yearbook of labour statistics", 1947-1948 : table VA 2, "U.N. Statistical Yearbook 1948", table 9.
1947-1957 : "U.N. Statistical Yearbook 1955", table 8. O.E.E.C. : "General statistics", May 1959, Employment in manufacturing industries.

h : 1929 and 1933 to 1939 : "Yearbook of labour statistics", 1942, pages 72 and 73. P.J. Verdoorn "Arbeidsduur en welvaartspeil" (table 34).
1951 to 1955 : "Yearbook of labour statistics", 1958, table 13. Approximate figures calculated for the remaining post-war years with the help of the table "Normal hours of work in 43 occupations" published in the various issues of labour statistics.

1938 *base figures* :

a : 543,000 wage-earners.

h : 46.3 hours per week.

APPENDIX 2

Results of calculations relating to production functions

$$\left(\text{Function : } v = a\ k^{\lambda}\ e^{\mu\, v_t} \right)$$

TABLE 1

Analysis of time series

(Italy, Canada, Norway, United Kingdom, United States)

(Chapter III, Sub-section 33)

Equation	Country	Period	Sector	Log β	λ	μ	$\lambda + \mu$	v	R
1.1 *Free adjustment (without trend)*	Italy	1922-1939	Non-agricultural undertakings	- 0.106	0.769 (0.162)	0.298 (0.071)	1.067	—	0.973
	Canada	1870-1938	Industry	- 0.61	0.07 (0.24)	0.18 (0.12)	1.25	—	0.993
	Norway	1900-1955	Whole economy	- 3.03	0.92 (0.08)	0.91 (0.24)	1.83	—	0.994
	United Kingdom	1870-1912 and 1924-38	Whole economy	- 0.85	1.73 (0.89)	0.18 (0.44)	1.91	—	0.990
	United States	1909-1949	Non-agricultural undertakings	- 3.15	1.85 (0.08)	0.69 (0.05)	2.54	—	0.989
1.2 *Free adjustment (with trend)*	Italy	See 1.1	See 1.1	- 0.752	0.916 (0.297)	0.476 (0.308)	1.392	-0.0085 (0.0141)	0.972
	Canada			0.26	0.75 (0.27)	0.09 (0.12)	0.84	0.012 (0.003)	0.996
	Norway			3.88	0.30 (0.11)	- 0.39 (0.12)	- 0.09	0.035 (0.001)	0.999
	United Kingdom			- 5.64	5.03 (0.77)	- 0.74 (0.32)	4.29	0.013 (0.001)	0.995
	United States			- 0.88	1.51 (0.03)	0.06 (0.03)	1.37	0.015 (0.001)	0.999
2.1 *Limiting value* $\lambda + \mu = 1$ *(without trend)*	Italy	See 1.1	See 1.1	0.029	0.675 (0.049)	0.325 (0.049)	1.000	—	0.962
	Canada			0.003	0.62 (0.08)	0.38 (0.08)	1.000	—	0.989
	Norway			- 0.89	(0.29) 0.05	1.29 (0.05)	1.000	—	0.989
	United Kingdom			0.96	- 0.05 (0.05)	+1.05 (0.05)	1.000	—	0.987
	United States			0.79	0.54 (0.18)	0.46 (0.18)	1.000	—	0.796
2.2 *Limiting value* $\lambda + \mu = 1$ *(with trend)*	Italy	See 1.1	See 1.1	0.028	0.724 (0.092)	0.276 (0.092)	1.000	0.0013 (0.0004)	0.979
	Canada			- 0.09	0.90 (0.11)	0.10 (0.11)	1.000	0.009 (0.001)	0.996
	Norway			0.13	0.84 (0.11)	0.16 (0.11)	1.000	0.018 -0.001)	0.998
	United Kingdom			0.95	- 0.35 (0.21)	1.35 (0.21)	1.000	(0.003 (0.001)	0.987
	United States			0.85	1.12 (0.01)	- 0.12 (0.01)	1.000	0.019 (0.000)	0.999

Equation	Country	Period	Sector	Log β	λ	μ	$\lambda + \mu$	ν	R
3.1 *Limiting value* $\mu = 1/3\,\lambda$ (*without trend*)	Italy	See 1.1	See 1.1	− 0.163	0.822 (0.046)	0.274 (0.015)	1.096	—	0.973
	Canada			− 0.37	0.86 (0.04)	0.29 (0.01)	1.15	—	0.993
	Norway			− 4.50	1.81 (0.04)	0.60 (0.01)	2.41	—	0.991
	United Kingdom			− 0.36	1.25 (0.03)	0.42 (0.01)	1.67	—	0.989
	United States			− 3.22	1.89 (0.06)	0.63 (0.02)	2.52	—	0.983
3.2 *Limiting value* $\mu = 1/3\,\lambda$	Italy	See 1.1	See 1.1	− 0.177	0.827 (0.254)	0.276 (0.085)	1.103	0.0001 (0.0067)	0.972
	Canada			0.54	0.55 (0.17)	0.18 (0.06)	0.73	0.013 (0.003)	0.995
	Norway			0.61	0.23 (0.14)	0.08 (0.05)	0.31	0.024 (0.001)	0.998
	United Kingdom			− 1.96	1.84 (0.13)	0.61 (0.04)	2.45	0.009 (0.001)	0.993
	United States			− 1.92	1.40 (0.08)	0.47 (0.03)	1.87	0.008 (0.0005)	0.993
4. *Limitnig values* $\lambda + \mu = 1$ $\mu = 1/3\,\lambda$	Italy	See 1.1	See 1.1	0.036	0.75	0.25	1.000	0.0019 (0.0003)	0.971
	Candaa			− 0.06	0.75	0.25	1.000	0.005 (0.001)	0.994
	Norway			− 0.47	0.75	0.25	1.000	0.017 (0.000)	0.997
	United Kingdom			1.00	0.75	0.25	1.000	0.007 (0.0000)	0.981
	United States			− 0.26	0.75	0.25	1.000	0.016 (0.001)	0.979

For sources and methods see Appendix 3.

TABLE 2

Cross-section analysis of the industrial sector and the whole economy

(Chapter III, Sub-section 35)

Industry : 11 observations relating to : (i) Western Germany, 1929-1956
(ii) Australia, 1927-1928 and 1953-1954
(iii) Canada, 1870-1956
(iv) United States, 1910-1956
(v) Finland, 1929-1956
(vi) Norway, 1929-1956
(vii) United Kingdom, 1929-1956

Total product : 22 observations relating to : (i) Western Germany, 1913-1955
(ii) Australia, 1903-1949
(iii) United States, 1880-1949
(iv) France, 1880-1954
(v) Norway, 1900-1955
(vi) United Kingdom, 1870-1953
(vii) Sweden, 1908-1952

Equation	Sector	λ	μ	$\lambda + \mu$	ν	R
1.1 *Free Adjustment (without trend)*	Industry	1.15 (0.24)	0,25 (0.13)	1.40	—	0.636
	Whole economy	0.48 (0.34)	0.58 (0.22)	1.06	—	0.480
1.2 *Free Adjustment (with trend)*	Industry	0.72 (0.29)	0.17 (0.12)	0.89	1.50 (0.73)	0.772
	Whole economy	0.29 (0.22)	0.31 (0.15)	0.60	1.35 (0.25)	0.784
2.1 *Limiting value* $\lambda + \mu = 1$ *(without trend)*	Industry	0.50 (0.11)	00.50 (0.11)	1.00	—	0.441
	Whole economy	0.37 (0.14)	0.63 (0.14)	1.00	—	0.510
2.2 *Limiting value* $\lambda + \mu = 1$ *(with trend)*	Industry	0.83 (0.11)	0.17 (0.11)	1.00	1.23 (0.30)	0.767
	Whole economy	0.79 (0.17)	0.21 (0.17)	1.00	0.87 (0.23)	0.658
3.1 *Limiting value* $\mu = 1/3\,\lambda$ *(without trend)*	Industry	1.00 (0.06)	0.33 (0.02)	1.33	—	0.615
	Whole economy	0,90 (0.08)	0.03 (0.03)	1.20	—	0.420
3.2 *Limiting value* $\mu = 1/3\,\lambda$ *(with trend)*	Industry	0.63 (0.17)	0.21 (0.06)	0.84	1.53 (0.69)	0.770
	Whole economy	0.49 (0,09)	0.16 (0.03)	0.65	1.40 (0.25)	0.770
4. *Limiting value* $\lambda + \mu = 1$ $\mu = 1/3\,\lambda$	Industry	0.75	0.25	1.00	1.09 (0.23)	0.752
	Whole economy	0.75	0.25	1.00	0.83 (0.17)	0.656

For sources and methods, see Appendix 3.

APPENDIX 3

Basic data, sources and methods used for calculating production functions

(Chapter III, Sub-sections 33 and 35)

A. BASIC DATA

1. *Analysis of time series*

Italy : Non-agricultural undertakings

Year	Net Capital (at 1938 prices) 1922 = 100	Employment man/years 1922 = 100	Value added at factor cost (at 1938 prices) 1922 = 100
1922	100.00	100.—	100.—
1923	102.03	102.92	105.74
1924	104.65	105.84	116.30
1925	109.43	106.40	120.39
1926	115.63	106.95	118.04
1927	112.20	107.51	120.29
1928	127.45	109.22	126.44
1929	135.32	109.28	129.59
1930	142.36	108.44	127.53
1931	147.61	107.63	124.81
1932	150.72	106.79	125.35
1933	151.91	110.72	132.75
1934	153.10	114.64	132.96
1935	155.25	118.55	139.61
1936	159.55	122.48	143.41
1937	166.83	126.42	148.60
1938	175.42	130.33	149.20
1939	182.82	134.24	160.56

Canada : Industry

Year	Fixed capital (*a*) Million 1935-1939 dollars	Employment 1 000 men/years	Value added (*d*) Million 1935-1939 dollars
1870 (*b*) (*c*)	62	140	103
1880 (*c*)	129	190	153
1890 (*c*)	289	260	282
1900 (*c*)	422	309	357
1910 (*c*)	1.106	541	647
1920	898	602	657
1930	2,430	615	857
1939	2,120	658	1.346 (*e*)
1950	2,444	1,183	2.117

(*a*) Value of industrial equipment and sites.
(*b*) Four provinces only.
(*c*) Until 1910 "Manufacturing industries" include parts of building, handicrafts and power stations.
(*d*) Value added 1870-1920 and net earnings of manufacturing industries 1930-1950.

Norway : Whole Economy

Year	Fixed capital Million 1938 kr.	Employment 1 000 man/years	Net domestic product Million 1938 kr.
1900	7,417	977	1,821
1901	7,583	987	1,860
1902	7,724	993	1,882
1903	7,840	996	1,858
1904	7,970	999	1,850
1905	8,075	1,002	1,860
1906	8,212	1,005	1,931
1907	8,395	1,008	2,019
1908	8,581	1,013	2,085
1909	8,746	1,023	2.119
1910	8,961	1,027	2,213
1911	9,239	1,041	2,302
1912	9,567	1,055	2,406
1913	9,905	1,071	2,528
1914	10,224	1,090	2,589
1915	10,550	1,107	2,726
1916	10,904	1,124	2,870
1917	11,098	1,142	2,605
1918	11,340	1,161	2,455
1919	11,745	1,178	3,084
1920	12,203	1,202	3,171
1921	12,403	1,107	2,734
1922	12,573	1,122	3,037
1923	12,804	1,179	3,127
1924	13,070	1,201	3,099
1925	13,351	1,173	3,245
1926	13,536	1,097	3,241
1927	13,736	1,096	3,380
1928	14,082	1,151	3,573
1929	14,500	1,188	3,888
1930	14,990	1,187	4,196
1931	15,317	1,153	3,791
1932	15,482	1,178	3,999
1933	15,662	1,192	4,093
1934	15,926	1,213	4,253
1935	16,319	1,240	4,480
1936	16,851	1,276	4,808
1937	17,564	1,309	5,012
1938	18,192	1,330	5,102
1939	18,874	1,358	5,353
1940	17,157	1,394	5,555
1946	17,157	1,394	5,555
1947	18,256	1,441	6,311
1948	19,311	1,467	6,567
1949	20,413	1.489	6,772
1950	21,587	1,499	7,073
1951	22,760	1,509	7,322
1952	24,051	1,522	7,629
1953	25,435	1,522	7,812
1954	26,868	1,537	7,915
1955	28,284	1,534	8,323

United Kingdom : Whole Economy

Year	Fixed capital Million 1912-1913 £	Employment 1870 = 100	Net earnings at factor cost Million 1900 £
1870	2,800	100.00	768.4
1871	2,857	102.94	794.7
1872	2,918	103.33	789.2
1873	2,983	105.09	844.9
1874	3,060	107.24	896.4
1875	3,144	107.83	889.3
1876	3,239	107.63	899.9
1877	3,346	108.41	904.1
1878	3,442	108.22	937.0
1879	3,521	105.09	918.9
1880	3,607	111.55	929.8
1881	3,695	112,92	983.2
1882	3,788	115.07	1,031.2
1883	3,877	116.83	1,056.2
1884	3,953	116.63	1,065.7
1885	4,022	114.87	1,118.0
1886	4,096	116.05	1,160.5
1887	4,160	118.00	1,203.7
1888	4,234	121.14	1,288.6
1889	4,320	124.07	1,363.0
1890	4,404	125.64	1,430.5
1891	4,487	127.20	1,417.2
1892	4,573	125.64	1,376.1
1893	4,655	125.24	1,359.9
1894	4,752	128.18	1,474.3
1895	4,862	130.33	1,581.1
1896	4,986	134.05	1,611.8
1897	5,112	134.05	1,626.3
1898	5,272	136.20	1,655.6
1899	5,452	139.33	1,769.3
1900	5,623	140.31	1,756.0
1901	5,790	140.70	1,743.2
1902	5,946	141.88	1,757.3
1903	6,103	142.07	1,714.0
1904	6,257	148,66	1,723.0
1905	6,418	145.99	1,798.2
1906	6,559	148.92	1,897.3
1907	6,673	151.66	1,949.2
1908	6,782	149.51	1,884.5
1909	6,894	150.10	1,910.0
1910	7,003	153.82	1,955.4
1911	7,099	155.37	2,007.5
1912	7,193	—	2,063.7
1924	7,580	160.74	2,038.0
1925	7,678	162.00	2,069.7
1926	7,772	163.10	2,070.9
1927	7,881	164.75	2,258.8
1928	7,890	165.78	2,277.4
1929	8,101	167.20	2,318.5
1930	8,206	168.38	2,293.9
1931	8,300	170.35	2,270.0
1932	8,384	171.70	2,271.2
1933	8,473	171.85	2,422.4
1934	8,576	171.93	2,503.9
1935	8,685	173.98	2,615.5
1936	8,810	175.87	2,717.0
1937	8,945	176.66	2,728.1
1938	9,076	178.54	2,725.2

United States

Year	Fixed capital Billion dollars at 1939 prices	Employment		Gross product Billion dollars at 1939 prices
		1 000 man/years	Hours per year	
1909	102.588	23,483	2,747	40.2
1910	103.995	24,261	2,737	40.9
1911	109.597	23,919	2,726	42.2
1912	112.683	24,930	2,703	44.0
1913	115.032	25,251	2,677	46.0
1914	120.902	24,449	2,667	44.4
1915	123.925	24,623	2,660	43.8
1916	126.680	25,853	2,655	49.9
1917	129.537	29,449	2,628	52.6
1918	132.317	31,252	2,537	57.8
1919	132.758	29,464	2,430	54.9
1920	133.135	29,844	2,346	50.5
1921	138.084	26,365	2,306	46.8
1922	139.437	28,083	2,389	52.9
1923	139.591	21,082	2,387	60.0
1924	149.293	30,538	2,338	59.7
1925	154.389	31,340	2,399	65.6
1926	161.379	32,532	2,425	68.5
1927	171.632	32,646	2,441	69.4
1928	181.747	32,589	2,470	70.4
1929	186.791	34,114	2,477	75.6
1930	198.807	31,991	2,416	68.0
1931	203.361	28,846	2,354	61.4
1932	204.137	25,545	2,294	51.5
1933	194.900	25,503	2,274	50.4
1934	186.831	27,692	2,235	57.0
1935	182.597	28,673	2,284	61.7
1936	177.373	30,748	2,355	71.1
1937	177.994	32,731	2,346	74.6
1938	182.315	30,654	2,280	69.9
1939	179.709	32,153	2,320	77.1
1940	177.863	33,788	2,338	85.5
1941	179.802	36,628	2,413	99.2
1942	186.224	39,069	2,455	109.0
1943	187.196	39,341	2,547	118.2
1944	184.737	38,984	2,552	125.9
1945	184.023	38,273	2,480	123,0
1946	177.034	41,323	2,364	118.8
1947	189.332	43,305	2,311	122.3
1948	194.695	45,791	2,267	126.7
1949	208.933	44,847	2,221	127.0

2. *Analysis by cross-sections*

TABLE 1

Basic data for cross-section analysis of industry

Country	Year	Fixed capital	Net Output	Employment	Percentage average annual increase			Units		
					Capital	Output	Employment	Column (3)	Column (4)	Column (5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
United States	1910 1929 1956	16.3 49.9 88.0	17.43 40.20 100.50	7.609 10.600 16.900	5.9 5.95 1.99	4.47 3.45	1.76 1.74	Billion 1950 $	Billion 1950 $	Million man-years
United Kingdom	1929 1956	7.6 18.4	8.0 18.9	6.0 8.3	3.28	3.24	1.21	Million 1950 $	Million 1950 $	Million man-years
Canada	1870 1890 1910 1929 1956	62 289 1.106 2.221 3.292	119 325 722 1.076 3.333	140 260 541 667 1.431	8.00 6.94 4.02 1.47	5.17 4.24 1.96 4.28	2.86 3.73 0.64 2.87	Million 1935-1939 $	Million 1935-1939 $	1.000 man-years
Germany (F.R.)	1929 1956	13.82 29.37	29.20 60.60	2.873 4.842	2.83	2.74	1.95	Billion 1950 DM	Billion 1950 DM	Million man-years
Norway	1929 1956	2.285 5.067	77 220	78 164	3.00	3.99	2.88	Million 1938 kr.	Index 1938=100	Index 1938=100
Australia	1927-1928 1953-1954	224 582	148 435	450 990	3.74	4.23	3.08	Million 1939 £ A	Million 1939 £ A	1.000 man-years
Finland	1929 1956	149 598	136 525	117 236	5.28	5.13	2.63	Index 1925=100	Index 1925=100	Index 1925=100

TABLE 2

Basic data for cross-section analysis of the whole national economy

Country	Year	Stock of Capital	National product	Employment	Percentage average annual increase			Units		
					Capital	Output	Employment	Capital	Output	Employment
United States	1880	24.9	11.56	8.20						
	1890	45.04	17.75	12.65	6.10	4.38	4.43		Billion 1929 $	
	1900	76.71	26.92	17.22	5.74	4.01	3.13	Billion 1929 $		Million man-years
	1910	118.42	40.08	24.57	4.44	4.30	3.62			
	1910	103.99	40.9	24.26					Billion 1939 $	
	1929	186.79	75.6	34.11	3.06	3.29	1.89			
	1949	208.93	127.0	44.85	0.56	2.63	1.38			
United Kingdom	1870	100	768.4	100						
	1890	157.29	1,430.5	125.64	2.03	3.16	1.15	Index (1870=100)	Million 1900 £	Index (1870=100)
	1910	250.11	1,955,4	153.82	2.30	1.71	1.02			
	1929	289.32	2,318.5	167.20	0.71	0.76	0.41			
	1938	23,805.6	10,920	20.07				Million 1948 £	Million 1948 £	Million man-years
	1953	26,076	12,720	23.30	0,89	1.48	0.93			
Germany (F.R)	1913	215	63	11.57						
	1929	245	68	15.62	0.82	0.48	1.90	Billion 1950 DM	Billion 1950 DM	Million man-years
	1955	306	150	23.42	0.86	3.10	1.57			
France	1880	185	184.7	14.6						
	1900	220	245	16.2	0.88	1.42	0.52	Billion 1913 fr.	Billion 1938 fr.	Million man-years
	1913	261	328	17.5	1.31	2.27	0.60			
	1929	254	453	17.9	—0.17	2.04	0.14			
	1954	290.8	530	16.76	0.55	1.50	—0.26			
Norway	1900	7,417	1,821	977						
	1910	8,961	2,213	1,027	2.67	1.96	0.53	Million 1938 kr.	Million 1938 kr.	Thousand man-years
	1929	14,500	3,888	1,188	2.57	3.01	0.77			
	1955	28,284	8,323	1,534	2.60	2.97	0.99			
Australia	1903	5,631	1,370	1,584						
	1915	8,093	1,869	1,756	3.07	2.62	0.86	Million I.U.	Million I.U.	Thousand man-years
	1929	12,636	3,151	2,395	3.23	3.80	2.24			
	1949	19,341	5,270	3,279	2.25	2.54	1.58			
Sweden	1908	98.72	10.908	1,766						
	1952	238.6	33.800	2,930	2.03	2.61	1.16	Billion 1952 kr.	Billion 1952 kr.	Thousand man-years

Germany

1. SOURCES

(*1*) R. KRENGEL : *Anlagevermögen, Produktion und Beschäftigung der Industrie im Gebiet der Bundesrepublik von 1929-1956, Berlin* 1958.

(*2*) *Statistisches Jahrbuch für die Bundesrepublik 1957, Wiesbaden,* 1957.

(*3*) *Statistisches Jahrbuch für die Bundesrepublik 1955, Wiesbaden,* 1955.

(*4*) *Wirtschaftskunde der Bundesrepublik Deutschland, Wiesbaden,* 1955.

(*5*) *Statistisches Handbuch von Deutschland 1928-1944, München,* 1949.

(*6*) F. GRÜNIG, *Versuch einer Volksvermögensrechnung der Deutschen Bundesrepublik, Berlin,* 1958.

(*7*) COLIN CLARK, *The Conditions of Economic Progress,* 3rd edition, London, 1957.

2. UTILISATION

2.1. *Cross-section analysis.* a) *Industry :*

Capital figures : (*1*) p. 96 (Industrie, gesamt, minus Bergbau, Grundstoff und Produktionsgüterindustrie).

Net output : (*1*) p. 82 Industrie, gesamt, minus Bergbau, Grundstoff- und Produktionsgüterindustrie).

Employment : (*1*) p. 90 (Industrie, einschliesslich Bergbau, Grundstoff- und Produktionsgüterindustrie). As there are no separate figures for the investment in and capital stock of mines, the whole group was excluded. Employment in this group in 1956 is taken from (*2*). p. 207. The corresponding figure for 1929 is calculated from the 1936 census of businesses, the results of which are given in (*5*) pp. 270-272 and (*4*) p. 22. Correcting the 1936 figures for "small undertakings" and accepting the fact that employment in such undertakings in Western Germany was the same in 1936 as in 1954 [45,000 workers according to (*3*), p. 214], we find :

Employment in industry mines in 1936, according to (*1*) p. 90 : 3.910 million,

of which "Bergbau, Grundstoff- und Produktionsgüterindustrie", according to (*5*) etc : 1.143 million.

Employment in industry mines in 1929 according to (*1*), p. 90 : 4.060 million,
of which "Bergbau, Grundstoff- und Produktionsgüterindustrie" $4060/3910 \times 1.143 = 1.187$ million.

Employment in "Industrie, gesamt" less "Bergbau, Grundstoff -und Produktionsgüterindustrie" in 1929 is, therefore, computed to be 2.873 million. "Small undertakings" (less than 10 workers) have been separated because the figures for net production and employment in (*1*) relate exclusively to this category.

2.2. *Cross-section analysis.* b) *Whole economy :*

The *figures for capital* (fixed capital, excluding land and stocks) and *output* (gross national product) are taken from (*6*) p. 38 (Nettoanlagevermögen and Bruttosozialprodukt) in billion 1950 DM).

Figures for employment :

The 1955 figures are taken from (*2*).

The figures for 1929 and 1913 are based on the results of the 1936 census of businesses quoted in (*4*) p. 22, while the working population of the whole of Germany, within the frontiers fixed by the Treaty of Versailles, in 1913, 1929 and 1936 is calculated from (*7*) table XXII, p. 131.

The 1936 census of businesses gives the percentage distribution of the labour force in the various parts of the German Reich as it then was; the percentage share of the territory of the present Federal Republic is used for 1913 and 1929.

Australia

1. SOURCES

(*1*) *Statistical Yearbook of the Commonwealth of Australia*, 1948 *and succeeding years*, 1941, 1933 *to* 1938, Canberra.

(*2*) COLIN CLARK : *The Conditions of Economic Progress*, 3rd edition, London, 1957.

2. UTILISATION

2.1. *Gross-section analysis.* a) *Industry :*

The figures for capital, output and employment are taken from the chapter on "Manufacturing" in (*1*). The figures for capital relate to the book "value of land and buildings, plant and machinery". The figures for output relate to the "Net value of product".

Annual variations in the figures for capital were reduced by applying the index of building costs in the case of "Value of land and buildings" and by applying the price index for "metals and coal" in the case of "Value of plant and machinery". The same price indices were then used to combine the reduced variations with 1924 book values.

The "net value of product" is reduced by means of a weighted average based on the general cost of living index (1927-1928 : weighting factor 60 %; 1953-1954 : weighting factor 70 %) and on general index for raw materials (excluding foodstuffs) (weighting factor 1927-1928 : 40 %; 1953-1954 : 30 %). The weights are based on the ratio of salaries and wages on the one hand to depreciation and profits on the other; in 1932-1938 the ratio was practically 50 : 50, while from 1944 to 1953-1954 it was 65 : 35. A part of profits was also reduced in proportion to the cost of living.

2.2. *Cross-section analysis.* b) *Whole economy :*

The figures for *capital* (reproducible productive capital including stocks) and output (net national product at market prices) are taken from (*2*) table I, page 572. Those for employment are taken from (*2*), table IX, page 90.

Canada

1. SOURCES

(*1*) O. J. FIRESTONE, *Canada's Economic Development 1867-1953*, Income & Wealth Series VII, London 1958.

(*2*) *National Accounts, Income & Expenditure 1929-1956*, Ottawa, 1958.

(*3*) *United Nations Statistical Yearbook 1957*, New York, 1957.

2. UTILISATION

2.1. *Analysis of time series.* a) *Industry :*

Source : (1)

Capital : Table 74, page 202.

Employment : Table 76, page 207.

Value added : Table 80, page 221.

2.2. *Cross-section analysis.* b) *Industry :*

1870, 1890, 1910, 1929 : (*1*), tables 74, 76 and 80. As the figures quoted in (*1*), table 80, refer to value added excluding depreciation, the above mentioned figures for 1870, 1890 and 1910 were increased by a percentage

corresponding to the difference between value added, including depreciation, in 1929 and value added excluding depreciation. Value added, including depreciation, is taken from (*2*) table 2 and reduced by applying the general index of wholesale prices quoted in (*1*), table 63.

Extrapolation of the figures quoted in (*1*), tables 74, 76 and 80, which go as far as 1953 inclusive, on the basis of (*2*), table II, page 100 (figure for employment), table 21 (gross domestic product at factor cost by industry) and table 25 (gross investment). Depreciation was calculated as a percentage of capital with the help of the figures given in (*1*) for capital at current prices (table 74) and in (*2*) for gross investment at current prices (table 25). For 1945 to 1953 inclusive this percentage showed a relatively constant increase, which was extrapolated to 1956. Net investment at current prices from 1954 to 1956 was then calculated by applying the extrapolated depreciation percentages. These net investment figures were reduced by applying the price indices for capital goods taken from (*1*), table 63, page 168, extrapolated by applying the trend of the price indices for finished products, raw materials and semi-finished products given in (*3*) table 160, page 463. The values added for 1954-1956 given in (*2*) table 21 were reduced by applying the general index of wholesale prices quoted in (*3*), table 160. The same index is used in (*1*) to reduce values added.

United States

1. SOURCES

(*1*) *The Economic Almanac 1953-1954*, New York 1953.

(*2*) R. M. SOLOW, *Technical Change and the Aggregate Production Function*, "The Review of Economics and Statistics, 39, (1957).

(*3*) R. W. GOLDSMITH, D. S. BRADY and H. MENDERSHAUSEN, *A Study of saving in the United States*, volume III, Princeton, 1956.

(*4*) J. W. KENDRICK, *National Productivity and its Long-Term Projection from* "Long-Range Economic Projection, Studies in Income and Wealth", volume 16, Princeton, 1954.

(*5*) T. BARNA, *Investment in Industry — has Britain lagged* ? N.I.E.S.R., "Reprint Series" N°. 10, London, 1957.

(*6*) *Industrial Statistics 1900-1957*, O.E.E.C., Paris 1958.

(*7*) *Definitions and Methods of Indices of Industrial Production*, O.E.E.C., Paris, 1957.

(*8*) P.H. DOUGLAS : *The Theory of Wages*, New York, 1934.

(*9*) *Statistical Abstract of the United States 1956*, Washington, 1956.

(*10*) BURTON WALL : *A Cobb-Douglas Function for the United States Manufacturing and Mining*, "Econometrica", 16, 1948, p. 211 et seq.

(*11*) S. KUZNETS : *Long Term Changes in the National Income of the United States of America since 1870*, Income & Wealth Series II, Cambridge, 1952.

(*12*) COLIN CLARK, *The Conditions of Economic Progress*, 3rd edition, London, 1957.

2. UTILISATION

2.1. *Analysis of time series.* a) *Whole economy :*

Output : "Private, non-farm gross product", taken from (*1*), pp. 490 et seq.

Capital : "Private, non-farm wealth", excluding land and stocks, taken from (*2*) table 1, column 2, less items 17, 22, 23 and 24 therein, which are taken from (*3*), table W-3.

Employment : Hours per year taken from (*2*). The information given in (*4*) was used to break down this figure and reconstitute the basic data, namely man/years and average hours of work.

2.2. *Cross-section analysis.* a) *Industry :*

1929-1956 : The figures for *capital* (reproducible fixed capital), *production* and *employment* are taken from (*5*), tables III, IV and V.

1910-1929 : Output figures calculated on the basis of (*6*) by applying the weights in (*7*).

Employment figures taken from (*8*), p. 126 (indices 1899-1922) and (*9*), p. 791 (absolute figures).

The absolute figures for capital for 1923 and 1929 are taken from (*5*), table III and the capital indices for the period 1899-1922 from (*8*). An index for 1923, for industry alone, was estimated from the growth of output and fixed capital in industry and mines in 1923.

Absolute figures for the three factors of production in 1910 were computed from the calculated annual percentage increases and from the absolute figures given by (*5*) for 1928.

2.3. *Cross-section analysis.* b) *Whole economy :*

1910-1949 : See 2.1 above. Hours per year were selected for employment.

1880-1910 : Source (*11*).

Calculation of output :

Column 2 in table 1 gives ten-yearly averages for the net national product in billions of 1929 $. Column 1 in table 17 shows the share of agriculture in the net national product (N.N.P.).

Table 1, column 2 × table 17, column 1 = "non-farm" N.N.P. As the ten-yearly figures in tables 1 and 17 partly overlap, we were able to compute weighted averages for 1880, 1890, 1900 and 1910.

Calculation of capital :

Table 25, column 3 × table 1, column 2 (fixed capital excluding land in billions of 1929 $, end of 1878, 1888, 1898 and 1908), less the share of agriculture as shown in column 1 of table 21C. As we are concerned with percentage increases, it matters very little whether the base years are 1878, 1888, 1898 and 1908 or 1880, 1890, 1900 and 1910.

Calculation of employment :

For the overlapping ten-year periods, column 1 in table 9 gives figures for the working population corresponding to those in (*12*), table XL, which also gives ten-yearly averages for the labour force. These ten-yearly figures partly overlap; employment in 1880 etc. was computed by using the weighted arithmetic mean of the ten-yearly figures, less the percentage of agricultural in total labour force, as given by (*11*), table 19, column 1 for 1880, 1890, 1900 and 1910.

Finland

1. SOURCES

(*1*) Leo Tornqvist : *Utvecklingen av Industriproduktionen i Finland åren* 1925-1926, Statistiska Institutionen Helsingfors Universitet Särtryck Series, N°. 1. Helsinki, 1958.

(*2*) Olavi Niitamo, *The Development of productivity in Finnish Industry* 1925-1952, Productivity Measurement Review (O.E.E.C.), No. 15, November 1958, page 30.

2. UTILISATION

Cross-section analysis. Industry

The indices quoted relate to industry, mines and power stations and are taken from (*1*), table 4. The figures for "capital" are based on power consumption in kWh. The figures given by (*1*), table 4 agree with those quoted in (*2*), table III, for *employment* and *output*. The sectors of activity covered by the figures are indicated in (*2*).

France

1. SOURCES

(*1*) COLIN CLARK, *The Conditions of Economic Progress*, 3rd edition, London, 1957.

(*2*) F. DIVISIA, DUPIN and ROY : *A la Recherche du Franc perdu*, Fortune de la France, volume III Paris 1958.

(*3*) J. DUMONTIER et A. MALTERRE : *Conjoncture economique*, 1956-I, Paris 1956.

(*4*) *Etudes statistiques* (INSEE), July-September 1956, pp. 3 et seq.

2. UTILISATION

Cross-section analysis. Whole economy

The *figures for capital* are taken from the graph on page 62 in (*2*). They relate to national assets, including durable consumer goods but excluding sums due from abroad.

Output figures : (*3*), page 400 (Net national income), extrapolation to 1954.

Employment figures : (*1*), table XXI (not including women employed in agriculture) and (*4*), table 2 for 1954. The figures (excluding women employed in agriculture) in (*4*) table 2, correspond to those in (*1*), table XXI.

Italy

1. SOURCES

a) *Capital and net investment*

(*1*) B. BARBERI : *Evaluation à prix 1938 des séries du capital productif dans l'ensemble de l'économie, l'industrie, No. 3* 1960

(*2*) *Indagine statistica sullo sviluppo del reddito nazionale dell'Italia dal 1861 al 1956 : Annali di Statistica*, Series VIII, Vol. IX, Rome 1957.

b) *Employment :* Industrial censuses for 1921, 1927 and 1937-1938.

c) *Output :* See a) (*2*).

2. UTILISATION

1. *Capital :* Construction and conversion to 1938 constant prices of the series for net investment in fixed assets by non-agricultural undertakings (excluding, housebuilding public works and private transport; including, railway and port installations and public transport).

2. *Employment :* Free interpolation of data for total employment taken from industrial censuses.

3. *Output :* Conversion to 1938 constant prices of the gross product of the sector studied, with a lag of one year as compared with the capital series. (Including the gross product of the building sector but excluding income from housing).

Norway

1. SOURCES

(*1*) Odd AUKRUST and Juul BJERKE, *Real Capital and Economic Growth 1900-1956*, Oslo 1958.

(*2*) *National Accounts of Norway 1930-1939* and *1946-1951*, Oslo, 1952.

(*3*) *National Accounts of Norway 1938 and 1948-1953*, Oslo 1954.

(*4*) *Economic Survey of Norway, 1956*, Statistisk Sentralbyra, Oslo 1957.

(*5*) *Economic Survey of Norway*, 1957, Statistisk Sentralbyra, Oslo 1958.

(*6*) *Industrial Statistics 1900-1957*, O.E.E.C., Paris, 1958.

(*7*) *Definitions and Methods of Indices of Industrial Production*, O.E.E.C., Paris 1957.

(*8*) *United Nations Statistical Yearbook 1957*, New York, 1957.

2. UTILISATION

2.1. *Analysis of time series. Whole economy*

The figures for capital, output and income are taken from (*1*).

2.2. *Cross-section analysis.* a) *Industry :*

The figures quoted relate to industry and mining. The figures for capital were obtained by extrapolating the figures given in (*1*), table B, for 1939 and 1953. The extrapolation for 1939 is based on (*2*) pp. 262-3 (net investment 1930-1939 in millions of 1938 kroner, by sectors of activity); the extrapolation for 1953 to 1956 is based on (*3*) pp. 168 et seq. (gross and net investment in fixed capital and at constant prices, 1951-1956), p. 93 (percentage distribution of gross investment in fixed capital between sectors of activity 1953-1956) and p. 96 (total net investment 1950-1956 in millions of 1938 kroner). The corrected figures for the same items in 1955 and 1956 are taken from (*5*).

Production indices : (*6*) quotes production indices for industry, including power stations. The weight used for power station output in computing the total index of production is based on (*7*). The production indices are obtained after deducting power output.

Employment indices : Calculated on the basis of (*2*) (employment in thousands of man-years 1930-1939), (*3*), table 39 (employment in thousands of man-years 1948-1953), (*6*), table d p. 6 (employment 1954-1956) and (*8*) p. 71 (employment indices for industry and mining, 1929 to 1938).

2.3. *Cross-section analysis.* b) *Whole economy*

Figures for capital, output and employment taken from (*1*).

United Kingdom

1. SOURCES

(*1*) E.H. Phelps BROWN and B. WEBER : *Accumulation, Productivity and Distribution in the British Economy*, Economic Journal, LVIII, 1953, pages 263 et seq.

(*2*) E.H. Phelps BROWN and S.J. Handfield JONES, *The Climateric of the 1890's* Oxford Economic Papers, 4, 1952, pages 226 et seq.

(*3*) A.R. PREST, *National Income of the United Kingdom 1870-1946*, Economic Journal, LVIII, 1948.

(4) J. TINBERGEN, *Business Cycles in the United Kingdom*, Amsterdam, 1951.

(5) T. BARNA, *Investment in Industry — Has Britain lagged ?* N.I.E.S.R., Reprint Series No. 10, London, 1957.

(6) COLIN CLARK, *The Conditions of Economic Progress*, 3rd edition, London 1957.

2. UTILISATION

2.1. *Analysis of time series. Whole economy*

Fixed capital, excluding land, in millions of 1912-1913 £. The figures for capital (excluding "land and farmers capital" and "non-revenue yielding government property") including stocks, are taken from (1), table III, column 3 for 1924-1938 and from table II, colums 3 and 4 for 1870-1912. Stock variations at current prices are given in (1) table III column 8, for 1924-1938 and (2), table IV, column 3 page 305. Stock variations were reduced by applying a price index for capital goods, except buildings, taken from (1), table II column 2 and table III, column 4 and then added to the figures for stocks for 1911 and 1924, representing 40 % of national income at factor cost during those years (national income) according to (3), table II. Stocks so calculated were deducted from the figures for capital,

Employment indices

For the years 1870-1911, we computed an index on the basis of (4), table I A (1870 = 100). This corresponds to the index based on ten-yearly figures in (2), table III, column I, extended for the years 1924-1938 in (1), table III column 12. We, therefore, extrapolated (4) with the help of (1).

Net national income at factor cost : (3), table II, column 7.

2.2. *Cross-section analysis.* a) *Industry*

The figures for *capital, output* and *employment* are taken from (5) table III (figure for capital for end 1930 extrapolated from 1929 by applying table V) and table IV.

The figures for capital relate to fixed capital, excluding land, while those for output relate to net output.

2.3. *Cross-section analysis.* b) *Whole economy*

1870-1938 : see 2.1. above (the figures for capital were converted to an index).

1938 and 1953 : (6) table XXIII page 136 (figure for employment) and table I, page 576; *gross national product* at market prices in millions of 1948 £ and *reproducible capital* expressed as a multiplier of net national product. The part of stocks in this capital output ratio is also given so that we were able to compute reproducible fixed capital in millions of 1948 £.

Sweden

1. SOURCES

(1) Karl ENGLUND : *Försök till un uppskattering av Sveriges National Formogenhet omkring år 1952*, Statistisk Tidskrift. 1956 (Oct.), pages 493 et seq.

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2. UTILISATION

Cross-section analysis. Whole economy:

The *figures for capital* are taken from (*1*) which gives estimates of national capital assets at current prices for the years 1908 and 1912 (excluding durable consumer goods). Gold and currency reserves were deducted from the totals given in (*1*). As more than half the national fortune consisted of dwellings and buildings in 1952 we decided to use the "Krona in terms of the index of building costs" as reducing factor (1 1952 kr. = 0.15.1908 kr.).

Output figures: Gross national product at market prices taken from (*2*), table XXXVII, reduced by applying a weighted average of the general index of wholesale prices, the index of building costs and the cost of living index, as given in (*1*). The real development so computed corresponds to "Real Income, millions of I.U." as shown in (*2*), table XXXVII.

Employment figures: (*2*), table XXXVII.

APPENDIX 4

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APPENDIX 5

Percentage of agricultural to total labour force

(Graph 4)

1. *Italy :*

1881	57	1931	51
1901	59	1936	48
1911	55	1950	45
1921	56	1957	39

Sources : 1881-1939 : *The working population of the world,* International Labour Review, May 1956.

1950-1957 : European Economic Community, *Report on the economic situation of the Community,* September 1958.

2. *United States :*

1870	53	1920	27
1880	49	1930	21
1890	43	1940	17
1900	38	1950	12
1910	31	1957	10

Sources : 1870-1950 : *The working population of the world* op. cit.

1957 : *Statistical Abstract of the United States,* 1958.

3. *France :*

1866	51	1921	41
1881	48	1931	35
1896	45	1936	36
1906	43	1954	28

Sources : The working population of the world, op. cit.

1931 : *Report on the economic situation of the Community,* op. cit.

4. *Germany :*

	1934 *4a territory*	*Territory 4b of the Federal Republic*
1882	43	
1907	35	
1925	31	
1929		30
1939	26	27
1950		25
1956		18

Sources : 1892-1939 : *The working population of the world,* op. cit.

1950 : *Statistisches Jahrbuch,* 1958.

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5. *Netherlands :*

1899	29.6	1930	20.1
1909	27.3	1947	19.4
1920	22.9	1956	12.4

Source : C.B.S. : 1899-1959, *Zestig Jaren Statistiek in Tijdreeksen,* 1959.

6. *Belgium :*

1910	23.2	1947	12.4
1920	18.5	1956	10.3
1930	17.6		

Sources : 1910, 1930, 1947 : C. Carbonnelle, *Recherches sur l'évolution de la production en Belgique de 1900 à 1957,* Cahiers économiques de Bruxelles, April 1959.

1920 : *Annuaire statistique de la Belgique.*

1956 : European Economic Community. *Report on the economic situation of the Community,* Sept. 1958.

7. *United Kingdom :*

1881	13	1921	7
1891	11	1931	6
1901	9	1951	5
1911	9		

Source : The working population of the world, op. cit.

APPENDIX 6

Calculation of the volume of output of the endogenous sector

(Chapter III, Sub-section 51)

This volume can be estimated either by a year-to-year calculation or by direct approximation of output in the terminal year. An example of each method is given below:

1. *Year-to-year calculation*

Output in year 1 is computed from the data for year 0 by applying the following equations:

— the production function for the non-agricultural sector:

$$\frac{v_1}{v_0} = \left(\frac{a_1}{a_0}\right)^{2/3} \left(\frac{k_1}{k_0}\right)^{1/3} \left(\frac{h_1}{h_0}\right)^{\tau} e^{\nu} \qquad (1)$$

— the investment relationship for non-agricultural undertakings. According to equation (30) in sub-section 50:

$$\dot{k}_1 = \alpha v_0 + \delta k_0 + q_0 + \iota \qquad (2)$$

— the equation expressing the growth of the capital stock of non-agricultural undertakings in terms of capital formation:

$$k_1 = k_0 + \dot{k}_1 \qquad (3)$$

Equations (2) and (3) give:

$$k_1 = k_0 + \alpha v_0 + \delta k_0 + q_0 + \iota \qquad (4)$$

or:

$$k_1 = \alpha v_0 + (1 + \delta) k_0 + q_0 + \iota$$

Equations (1) and (4) give:

$$v_1 = v_0 \left(\frac{a_1}{a_0}\right)^{2/3} \left(\frac{h_1}{h_0}\right)^{\tau} e^{\nu} \; k_0^{-1/3} \left[\alpha v_0 + (1 + \delta) k_0 + q_0 + \iota\right]^{1/3} \qquad (5)$$

Where:

v_0 and v_1 = volume of non-agricultural output in years 0 and 1 respectively. In billions of national currency units and millions of $ at year 0 prices.

a_0 and a_1 = non-agricultural employment in years 0 and 1 respectively. In millions of persons employed. Estimated as described in Chapter III sub-section 44.

h_0 and h_1 = Average number of hours worked in non-agricultural undertakings in years 0 and 1 respectively.

k_0 = stock of capital of non-agricultural undertakings in year 0. In billions of national currency units and in $.

q_0 = investment surplus or deficit of exogenous sectors in year 0. In billions of national currency units and in millions of $.

ι = variation of q_0 from year 0 to year 1.

τ = elasticity of output in relation to hours of work.

ν = annual rate of increase of the residual trend.

α = net investment rate.

δ = capital depreciation rate.

The same procedure is repeated for each succeeding year up to the terminal year (1).

2. *Direct approximation*

Sandee suggested a method of approximating volume of output at the end of the forecasting period (v_t). It can be applied to our exogenous sector. Sandee stipulates that:

$$k_o + \frac{t}{2}\dot{k}_o = k_t - \frac{t}{2}\dot{k}_t \qquad (6)$$

where t is the number of years covered by the forecast, $\dot{k}_o$ the increment of k at the start of the forecasting period and $\dot{k}_t$ the increment at the end of the period. This condition leads to very accurate results, even for the very high increments of the post-war period. The system is solved as follows:

According to equation (30) in sub-section 50, we find for $\left(k_o + \frac{t}{2}\dot{k}_o \right)$:

$$k_o + \frac{t}{2}\dot{k}_o = k_o + \frac{t}{2}\left(\alpha v_o + \delta k_o + q_o \right) \qquad (7)$$

and as $v_o = \frac{k_o}{\kappa_o}$, where κ is the capital-output ratio, (7) becomes:

$$k_o + \frac{t}{2}\dot{k}_o = \left[1 + \frac{t}{2}\left(\frac{\alpha}{\kappa_o} + \delta \right) \right] k_o + \frac{t}{2} q_o \qquad (8)$$

On the basis of equation (30) we also have:

$$k_t - \frac{t}{2}\dot{k}_t = \left(1 - \frac{t}{2}\delta \right) k_t - \frac{t}{2}\alpha v_t - \frac{t}{2}\left(q_o \iota t \right) \qquad (9)$$

---

(1) Example: the basic data relate to development in the Federal Republic from 1955 to 1956, simplified by treating depreciation as equal to replacement investment.

Basic data:

$v_o = 135$ billion
$k = 176.5$ billion
$q_o = -11$ billion
$a_o = 15.915$ millions
h_o = (hours per week) = 48.8

Value of parameters:

$\tau = 0.7$
$\alpha = 0.15$
$\delta = 0.066$
$v = 0.02$

"Forecasts" exogenous to the model:

$\frac{a_1}{a_o} = 1.056$

$\frac{b_1}{b_o} = 0.985$

$\iota = -1.2$ billion

We apply equation (5):

$$v_1 = 135(1.056)^{2/3} \cdot (0.985)^{0.7} \cdot e^{0.02} \cdot (176.5)^{-1/3} \left[(0.15 \times 135.6) + (1.066 \times 176.5) + (-11 - 1.2) \right]^{1/3}$$

$$v_1^3 = 135^3 \cdot (105.6)^2 \cdot (0.985)^{2.1} \cdot e^{0.06} \cdot \frac{196.289}{(176.5)}$$

$v_1 = 146.4$ billion, an increase of 8.4% (real increase 1955/56, about 10%). The same procedure can be used to compute v_2, v_3 .. up to v_t.

in our production function : $\frac{v_t}{v_o} = \left(\frac{a_t}{a_o}\right)^{2/3} \left(\frac{k_t}{k_o}\right)^{1/3} e^{\nu t}$

and since the labour supply function is $a_t = a_o e^{\pi t}$, we postulate :

$$2/3\,\pi + \nu = \beta \qquad (10)$$

$$\frac{v_t}{v_o} = \zeta \qquad (11)$$

ζ the unknown in our problem can then be written

$$\zeta_t = \left(\frac{k_t}{k_o}\right)^{1/3} e^{\beta t} \qquad (12)$$

while the corresponding value of k_t can be obtained from :

$$k_t = \zeta_t^3\, e^{-3\beta t}\, k_o \qquad (13)$$

Substituting (13) in (9) and replacing v_o by $\frac{k_o}{\alpha_o}$

$$k_t - \frac{t}{2}\dot{k}_t = \left(1 - \frac{t}{2}\delta\right) k_o\, e^{-3\beta t}\, \zeta^3 - \frac{t}{2}\frac{\alpha}{\kappa_o} k_o \zeta - \frac{t}{2}\left(q_o + \iota t\right) \qquad (14)$$

Applying (8) = (14) we finally have a single third-degree equation, from which the required variable can be determined directly :

$$\left(1 - \frac{t}{2}\delta\right) e^{-3\beta t}\, \zeta^3 - \frac{t}{2}\frac{\alpha}{\kappa_o}\zeta = 1 + \frac{t}{2}\left(\frac{\alpha}{\kappa_o} + \delta\right) + \frac{q_o}{k_o}t + \frac{\iota}{2k_o}t^2 \qquad (15)$$

(15) is solved by treating ζ as an exponential or linear function of the initial increase in v_o ($t = 0$). Therefore :

$$\zeta = e^{\psi t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \qquad (16a)$$

or

$$\zeta = 1 + \psi t \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \qquad (16b)$$

where

$$\psi = \frac{\dot{v}_o}{v_o} = \frac{2}{3}\pi + \frac{1}{3}\frac{\dot{k}_o}{k_o} + \nu \quad . \quad . \quad . \quad . \quad . \qquad (17)$$

The substitution in equation (15) of the value so obtained for ζ shows whether a higher or lower value should be selected for ζ. The value satisfying equation (15) can be checked very easily with a cube table.

Example and check

The accuracy of the approximation with equation (15) is most easily checked by applying the investment relationship (24), described in sub-section 49 of Chapter III, to a single-sector economy. It that case the real value of ζ is obtained by integrating equation (14) for $\frac{\dot{v}}{v}$ as given in Chapter III sub-section 28 :

$$\zeta = \frac{v_t}{v_o} = \left\{1 + \frac{\alpha}{\kappa_o}\frac{1-\mu}{\pi\lambda + \nu}\left[e^{(\pi\lambda + \nu)t}\right]\right\}^{\frac{\mu}{1-\mu}} e^{(\pi\lambda + \nu)t} \qquad (18)$$

We postulate : $\alpha = 0.20$; $\kappa_o = 2.0$; $\pi = 0.01$; $v = 0.015$; $\mu = \frac{1}{3}$; $\lambda = \frac{2}{3}$; $t = 20$.

We then have : $\frac{\alpha}{\kappa_o} = 0.10$; $\pi\lambda + \nu = \beta = 0.02167$; $e^{(\pi\lambda + \nu)t} = 1.544$.

Substituting these values in (18) we have : $\zeta = 2.56$.

In the case considered, where there are no depreciation and replacement investment, and no second sector, (15) is much simpler in form because $\delta = 0$ and $q = 0$.

Substitution of the values postulated above in equation (15) then gives the following approximation formula :

$$0.272\,\zeta^3 - \zeta = 2 \qquad (19)$$

A first approximation of ζ according to the linear equation (16b) in which $\psi = 0.06$, gives a value of 2.20 Substitution of this value in equation (19) gives the following result :

Approximation of ζ according to (19)

ζ	ζ^3	$0,272\ \zeta$	$0,272\zeta^3 - \zeta$
2.20	10.65	2.90	0.70
2.50	15.63	4.25	1.75
2.55	16.58	4.50	1.95
2.56	16.78	4.55	1.99
2.60	17.58	4.78	2.18

The value of ζ which gives a value of 2.0 after substitution in the left-hand term of equation (19) is approximately 2.56. The deviation as compared with the value computed by equation (18), which gives an exact approximation, can safely be ignored.

APPENDIX 7

Cross-breakdown of government expenditure

Table used in French national accounts

ECONOMIC BREAKDOWN / FUNCTIONAL BREAKDOWN		Non-itemised expenditure	Government and general administration	Justice and internal security	International relations	National defence	Education and culture	Welfare	Economic action	Housing	Non-functional expenditure	Total
		0	1	2	3	4	5	6	7	8	9	
EXPENDITURE STUDIED												
1. *Entry in accounts*												
— Internal movements												
— Sales of goods and services												
— External receipts	Overseas countries / Saar / Foreign countries											
— Expenditure from accounts												
2. *Account charged*												
— Net consumption												
— Interest												
— Wages in cash												
— Wages in kind												
— Welfare contributions												
— Welfare benefits												
— Taxation												
— Assistance in cash												
— Assistance in kind												
— War damage												
— Subsidies to departments												
— Subsidies to undertakings												
— International co-operation												
— Net expenditure	Overseas countries / Saar / Foreign countries											
— Miscellaneous transfers												
	Total account charged											
2. *Elements of capital account*												
— Changes in stocks												
— Gross fixed capital formation												
— Self-financing												
— Financial operations												
	Total capital account											
	GENERAL TOTAL											

APPENDIX 8

Expansion of the list of sectors of activity

Table used in the French national accounts

(Chapter V, sub-section 99)

17-item list	65-item list	Corresponding items in the SH list attached to the standard international classification for international trade
01 Agriculture and forestry	010 Agricultural products	01 Animals for slaughter 03 Eggs, poultry and game 07 Cereals 09 Fresh and dried vegetables 10 Fresh and dried fruit 13 Miscellaneous agricultural and stock-raising products 140 Hay, fodder and carobs 150 Ordinary wines 151 "Named" wines 152 Champagne and sparkling wines 153 Fortified wines
	011 Raw material for chemical and miscellaneous industries	512 Shellac, gums, resins and balsams 513 Other vegetable materials for the chemical industry 514 Animal raw materials for the chemical industry 78 Raw materials for miscellaneous industries
02 Agricultural and food industries	020 Products of agricultural and food industries	02 Meat 04 Fish, crustacea and molluscs 05 Preserved meat and fish 06 Dairy products 08 Flours, semolinas and edible pastes 11 Vegetable and fruit preparations 12 Sugar 14 Animal feeding stuffs except 140 15 Wines and spirits except 150, 151, 152 and 153 16 Other beverages 17 Products for food industries 18 Miscellaneous products for food industries 19 Industrial alcohol, manufactured tobaccos, matches 50 Fats 510 Starches
03 Solid mineral fuels and gas	030 Solid mineral fuels	20 Solid mineral fuels
	031 Coal gas	230 Coal gas
04 Electricity	040 Electricity	235 Electricity
	041 Water and miscellaneous	

17-item list	65-item list	Corresponding items in the SH list attached to the standard international classification for international trade
04 Petrol, natural gas and fuels	050 Crude petroleum	210 Crude oil
	051 Natural gas	211 Natural gas
	052 Refined petroleum products	22 Refined petroleum products
06 Building materials and glass	060 Building materials	264 Magnesian products 28 Quarry and building materials 29 Ceramics and manufactured building materials 307 Iron and steel slag, sinter, scale and residues 309 Roasted dolomites
	061 Glass	56 Glassware
07 Iron ores, and iron and steel	070 Iron ore	301 Iron ore 306 Pyrite ash
	071 Scrap iron	303 and 305 Scrap iron 304 Scrap rails 485 Ships for breaking up
	072 Iron and steel products	31 Pig iron 32 Steel
08 Non-ferrous ores and metals	080 Non-ferrous ores	24 Non-ferrous ores and metal waste (except 247 and 248) 302 Manganese ore
	081 Non-ferrous metal waste	247 Copper slag, scale and waste 248 Other ash, residue and waste of non-ferrous metals
	082 Aluminium	250 Aluminium, unworked, whether or not alloyed
	083 Copper	251 Copper, unworked, whether or not alloyed
	084 Other non-ferrous metals	25 Non-ferrous metals, unworked, except 250 and 251
09 Engineering and electrical industries	090 Aluminium semi-finished products	340 Aluminum semi-finished products
	091 Copper semi-finished products	341 Copper semi-finished products
	092 Semi-finished products of other non-ferrous metals	34 Semi-finished products of non-ferrous metals except 340 and 341
	093 Products of the first transformation of steel, foundries, metal-working	33 Steel first-transformation products 35 Foundry products 36 Miscellaneous metal articles
	094 Machinery and mechanical apparatus	37 Miscellaneous large and medium-sized machinery 38 Machinery for chemical and food industries Textile machinery Paper-making and printing machinery

17-item list	65-item list	Corresponding items in the SH list attached to the standard international classification for international trade
		39 Equipment for mining, public works and iron and steel making 40 Agricultural machinery and equipment 41 Machine tools 42 Precision equipment 43 Non-electric railway rolling stock
	095 Electrical machinery and apparatus	45-46 Electrical equipment
	096 Motor vehicles and cycles	44 Motor vehicles and cycles
	097 Shipbuilding	48 Ocean and river transport equipment except 485
	098 Aircraft construction	47 Air transport equipment
	099 Arms and munitions	49 Arms and munitions
10 Chemicals	100 Miscellaneous ores	260 Asbestos 261 Uncut industrial diamonds 262 Salt 263 Miscellaneous ores 27 Unprepared fertilisers 308 Basic slag 515 Crude sulphur and pyrites 516 Crude natural borates 517 Natural sodium nitrate 517 Other mineral raw materials for the chemical industry
	101 Mineral chemical products	52 Mineral chemical products, except 528
	102 Organic chemical products	528 Gelatins and glues 53 Organic chemical products except 536 and 538
	103 Para-chemical products	54 Para-chemical products
	104 Pharmaceutical products	536 Pharmaceutical products
	105 Rubber	511 Crude natural rubbers 538 Synthetic rubber
	106 Manufacturers of rubber and asbestos	55 Rubber and asbestos articles
11 Textiles, clothing, leather	110 Wool	57 Wool and hair, waste and shredded material
	111 Cotton	58 Cotton, raw, linters and waste
	112 Other natural textile materials	59 Other natural fibres and rags
	113 Artificial and synthetic textile materials	60 Continuous or discontinuous artificial and synthetic raw materials

17-item list	65-item list	Corresponding items in the SH list attached to the standard international classification for international trade
	114 Threads and yarns	61 Woollen thread 62 Cotton, linen and hemp thread 63 Threads of silk and discontinuous artificial and synthetic fibres 690 Jute thread 691 Threads of coconut, other vegetable textile fibres, and paper
	115 Articles made of thread	64 Woollen fabric, felt and carpeting 65 Cotton, linen and hemp fabrics 66 Fabrics and ribbon of silk and artificial and synthetic textiles 67 Knitwear 68 Tulles and laces, embroidery, point lace and trimmings 69 Fibres and fabrics of jute and hard fibres, bags, ropes and string, except 690 and 691 71 Other made-up articles of fabrics
	116 Clothing	70 Clothing and clothing accessories, headgear
	117 Raw hides and skins	72 Hides, skins and undressed furs
	118 Dressed hides and skins	730 Finished leathers and skins 736 Dressed furs
	119 Leather goods	731 Footwear, other than wholly of rubber 732 Gloves of leather and skin 733 Morocco wear and travel goods 734 Other leather goods 735 Postal packets containing leather goods
12 Wood, paper and miscellaneous industries	120 Rough and sawn wood	74 Rough and sawn wood, cork
	121 Semi-finished and finished articles of wood	75 Wood worked, wooden articles, furniture, except 755 and 756
	122 Furniture, bedding	755 Furniture 756 Bedding
	123 Waste paper	764 Waste paper
	124 Paper pulp	76 Paper pulp, except 764
	125 Paper and board	77 Paper and board
	126 Printing and publishing	81 Books, newspapers, printed matter
	127 Products of miscellaneous industries	79 Products of miscellaneous industries 80 Perfumery, musical instruments, jewellery, objets d'art and collector's items 832 Currency 833 Gold currency and specie
13 Building and civil engineering	130 Building and public works	

17-item list	65-item list	Corresponding items in the SH list attached to the standard international classification for international trade
14 Transport and telecommunications	140 Rail, road and river transport 141 Sea and air transport 142 Telecommunications	
15 Housing services	150 Housing services	
16 Other services	160 Services rendered principally to undertakings 161 Services of craftsmen, mechanics 162 Health services 163 Other services rendered principally to individuals 164 Miscellaneous hirings and rents	
17 Commercial activities	170 Commercial activities	

APPENDIX 9

Breakdown of private consumption by products

Table used in the French national accounts
for the transition from private consumption by classes of
needs to consumption by categories of products (the significant compartments are marked x)

	Products with cereal base	Fruit and vegetable	Meats, poultry, eggs, fish	Dairy products and fats	Miscellaneous food products	Beverages and stimulants	**Food**	Clothing	Footwear	**All clothing**	Housing	Housing equipment	Maintenance products and power	**All housing**	Health and personal attention	Medical consumption	**All health**	Personal transport	Public transport and postal services	**All transport and communications**	**Culture and leisure**	**Hotels, cafes, restaurants ans miscellaneous**	**Total (households proper)**	Non-residents	Institutions	**General total**
1. Agriculture and forestry		x	x	x		x	x														x		x	x		x
2. Agricultural and food industries	x	x	x	x	x	x	x						x	x							x		x	x		x
3. Solid mineral fuels and gas													x	x									x			x
4. Electricity													x	x									x			x
5. Petroleum, natural gas and motor fuels													x	x				x		x			x	x		x
6. Building materials and glass												x	x	x									x			x

9. Engineering and electrical industries												x		x	x	x	x	x		x	x	x	x	x		x
10. Chemicals													x	x		x	x	x		x			x			x
11. Textiles, clothing, leather								x	x	x		x		x								x	x	x		x
12. Wood, paper and miscellaneous industries												x	x	x	x		x				x	x	x	x		x
13. Construction and civil engineering											x			x									x			x
14. Transport and telecommunications																		x	x			x	x			x
15. Housing services											x			x									x	x		x
16. Other services and miscellaneous								x		x					x	x	x	x		x	x	x	x	x	x	x
TOTAL																								x		
Non-residents	x	x	x		x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x			
GENERAL TOTAL	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

APPENDIX 10

Table of resources and uses by sectors in the countries of the Community

(Chapter I, sub-section 5 and Chapter V, sub-section 105)

The tables in this appendix are the outcome of the group's efforts to construct a synthesising pattern for detailed forecasts by sectors for the countries of the Community.

To establish whether it would be possible to recommend the use of the seventeen-item list and a simplified table of inter-industry relationships of the type proposed in Chapter V, sub-section 105, we tried to regroup the available statistical material on inter-industry relationships in the countries of the Community in accordance with the items in table 1.

As our studies showed that, with few exceptions, the available data could be regrouped in this way, we did not go so far as to construct identical for all countries.

We decided, however, to include this statistical documentation which summarises the present position regarding the construction of input-output tables in the countries of the Community. The defects in these tables show the direction which further studies should take.

The tables should, therefore, be interpreted with great caution, particularly as regards comparisons between countries. In addition to the specific comments on each table, a number of more general differences should be noted.

i) *Reference year :*

Federal Republic, Belgium, Italy : 1953

France, Netherlands : 1956

ii) *Sources of data :*

The tables for France, Italy and the Netherlands were compiled by government departments. The figures in the Italian table in appendix 10.4 are slightly revised as compared with those given in the report on the country's economic position in 1954.

The table for Belgium is based on studies by the Department of Applied Economics at the University of Brussels. The table for the Federal Republic was compiled from the tables in Prof. Dr. W. Krelle's study : Volkwirtschaftliche Gesamtrechnung, Berlin 1959. This table has some gaps and relates to national accounts data which have been quite substantially revised since the table was compiled.

iii) *Classification :*

The classification used in table 1 has been followed in general, with minor differences from country to country. For all countries it was found impossible, without very detailed studies, to subdivide the various items of foreign trade into E.E.C. countries and other countries.

iv) *Bases of computation used in tables :*

The German, Belgian and Netherlands tables are based on *sellers'* prices, and the purchasing branches are debited separately for the sums corresponding to :

— purchase of the actual commodity or service at factory value (or value at frontier) from the producing (or importing) branch;

— purchase of any distribution service from the "Commercial Services" branch;

— purchase of transport service from the "Transport" branch;

— payment of indirect taxation (including customs duties).

In the French table, transactions are also expressed at sellers' price, except in the case of consumption by households which is shown at retail prices. Indirect taxes, which under the French fiscal system are based on value added by the selling branch, are also included in sellers' prices. Consequently:

— the item "commercial activities" is not a sector like the others. In the input-output table it appears only as a column showing its own consumption. The line "trading margins" covers only margins on products for sale to households; other trading margins are ignored;

— the line "indirect taxation" comprises only duties and taxes on imports.

For the Italian table, the basis of computation is the opposite of that used in the German, Belgian and Netherlands studies. All transactions are computed at *buyers'* prices, including indirect taxation. The lines "transport" and "commercial activities" show total transport charges and trading margins in respect of sales of the products of each sector.

These values are, therefore, entered twice, but the total amount of taxation on each sector is not affected.

v) *Breakdown of imports*

In the German, French and Italian tables, the figures for imports by sectors relate to products *analogous* to those produced by the sector concerned. The tables, therefore, assume that this sector notionally re-sells the products imported to each user sector.

In the Belgian and Netherlands tables, imports are as far as possible booked directly to the *user* sector. In the Belgian table, this principle is not applied in the case of imports with many users who cannot easily be identified.

vi) *Transactions within sectors:*

Such transactions are excluded from the Belgian, French and Italian tables but included in those for Germany and the Netherlands.

Annex

Table showing correspondence between the classification in table 10.1 and that used by the author

Table 10.1	Krelle table
01	1, 2
02	3, 26, 27, 28
03	4
04	6
05	5
06	19,20
07	7
08	8
09	9, 10, 11, 12, 13, 14, 15
10	17, 18
11	23, 24, 25
12	16, 21, 22
13	29
14	33, 34, 35, 36
15	38
16	32, 39, 40, 41, 42, 43, 44, 45, 46
17	30, 31

Resources and uses by

Federal Republi

RESOURCES \ USES			INDUS							
			Agriculture, forestry	Food industries, tobacco and fisheries	Coal	Energy (Electricity, gas, water)	Other extractive industries, extraction of petroleum, peat, natural gas	Building materials, ceramics glass	Iron and steel	Non-ferrous metals	Engineering and electrical industries
	No.		01	02	03	04	05	06	07	08	09
		No. E.C.S.C. Nomenclature	01	02	ex 0.3	ex 0.3 ex 0.4	ex 0.5 ex 0.6	ex 0.6 ex 12	ex 0.7	ex 0.8	ex 0.9
	01	Agriculture, forestry	(21)	12,812	0 —	0 —	—	—	—	—	—
	02	Food industries, tobacco and fisheries	(1,122)	(5,772)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
	03	Coal	44	293	(—)	1,378	43	471	962	58	177
	04	Energy (Electricity, gas, water)	176	224	(—)	1,188	38	235	349	239	481
	05	Other extractive industries, extraction of petroleum, peat, natural gas	130	10	—	12	(—)	—	923	453	5
	06	Building materials, ceramics, glass	41	(—)	51	(2)	(—)	448	165	55	304
	07	Iron and steel	(—)	30	176	(—)	48	(—)	1,873	7	6,141
	08	Non-ferrous metals	(—)	28	52	133	5	1	138	440	1,723
	09	Engineering and electrical industries	499	(511)	541	113	76	60	220	45	7,692
INDUSTRIES	10	Chemicals (including artificial fibres, oil refining, coal byproducts)	973	192	124	28	51	343	139	16	1,137
	11	Textiles, clothing, leather	145	(42)	(4)	(—)	(1)	(—)	(1)	(—)	(161)
	12	Wood, paper and miscellaneous industries	34	602	264	8	23	156	19	4	444
	13	Construction	(343)	(—)	(—)	(—)	(—)	(—)	(—)	(—)	(—)
	14	Transport	(489)	(419)	(62)	(—)	232	(1,352)	618	(37)	(324)
	15	Housing services (rent)									
	16	Other services	(360)	(518)	(163)	(195)	(39)	(100)	(192)	(78)	(900)
	17	Commercial activities	293	1,861	103	184	22	165	521	127	1,332
	18	TOTAL Intermediate resources	4,610	23,314	1,540	3,241	578	3,331	6,120	1,559	20,821
	19	Value added (and adjustments)	13,248	2,915	5,333	2,866	526	2,487	3,819	1.219	17,985
	20	Total output (at factor cost)	17,858	26,229	6,873	6,107	1,104	5,818	9,939	2,778	38,806
	21	Imports	5,514	2,460	623	103	1,508	337	665	894	2,050
	22	Direct taxation, less subsidies	998	6,105	806	158	97	338	489	101	1,923
	23	TOTAL Resources (at market prices)	24,370	34,794	8,302	6,638	2,709	6,493	11,093	3,773	42,779

Notes :

1. The figures in brackets refer to items including components which were not negligible but could not be evaluated.
2. The item "value added" includes statistical adjustments and generally tends to over-estimate the share of value added.

Source :

W. Krelle : Volkswirtschaftliche Gesamtrechnung, Duncker and Humblot, Berlin 1959. See the attached table for correspondance of the classification used with that of the author.

sectors of delivery and utilisation

1953 (millions of DM)

TRIES									Capital Formation		Govern-ment	House-holds	Rest of world	TOTAL Uses	
Chemicals (including artificial fibres, oil refining, coal by-products)	Textiles, clothing, leather	Wood, paper, rubber and miscellaneous industries	Construction	Transport	Housing services (rent)	Other services	Commercial activities	Total intermediate uses	Stock variations	Gross fixed capital formation (private and public)	Consumption	Consumption	Exports	Final goods and services	Intermediate and final goods and services
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10 ex 0,5 ex 11	ex 11	ex 12	13	14	15	16	17								
15	1,548	1,487	—	—	—	22		15,905	– 298	255	510	7,438	560	8,465	24,370
(427)	(515)	(—)	—	(—)	—	(14)	(—)	7,850	313	103	341	24,596	1,591	26,944	34,794
745	158	143	(—)	617	—	(96)	26	5,211	189	75	463	501	1,863	3,091	8,302
485	227	179	10	(210)	—	121	125	4,287	1	110	314	1,622	34	2,081	6,368
1,008	—	—	—	—	—	—	—	2,541	3	20	—	48	97	168	2,709
197	9	188	3,192	(21)	(—)	(95)	—	4,768	53	357	166	401	748	1,725	6,493
(—)	—	15	863	(—)	—	(—)	—	9,153	52	669	20	33	1,166	1,940	11,093
250	—	24	162	47	—	(18)	—	3,021	– 19	20	20	—	731	752	3,773
432	372	303	763	(647)	—	356	249	12,879	1,537	12,264	2,131	4,312	9,656	29,900	42,779
2,387	1,538	784	523	1,106	—	(314)	604	10,199	152	445	811	2,180	2,816	6,413	16,612
(302)	(8,376)	(338)	(—)	(11)	—	(136)	(27)	9,544	443	342	454	9,969	1,581	12,789	22,333
326	168	3,487	2,436	72	9	(529)	338	8,919	113	958	1,018	3,505	996	6,590	15,509
(—)	(—)	(—)	(—)	(—)	767	(28)	(—)	1,138	—	12,314	1,854	—	66	14,234	15,372
(676)	(146)	(404)	52	(—)	—	(114)	(2,185)	7,110	—	380	(545)	2,493	1,160	4,578	11,688
					—	—		—	—		476	5,676	—	6,152	6,152
(308)	(473)	(264)	(166)	(339)	1,191	(377)	(1,521)	7,184	—	45	11,984	7,316	647	19,992	27,176
686	979	587	905	235	1	142	105	8,248	—	681	362	11,166	1,379	13,588	21,836
8,244	14,509	8,203	9,072	3,305	1,968	2,362	5,180	117,957	2,539	29,038	21,469	81,265	25,091	159,402	277,359
5,548	5,230	5,277	5,457	7,484	3,557	(22,888)	13,235	119,074							
13,792	19,739	13,480	14,529	10,789	5,525	25,250	18,415	237,031							
929	1,261	1,224	39	441		510	528	19,086							
1,891	1,333	805	804	458	627	1,416	2,893	21,242							
16,612	22,333	15,509	15,372	11,688	6,152	27,176	21,836	277,359							

Resources and uses by

Belgium 1953

RESOURCES \ USES			INDUS								
			Agriculture, forestry	Agricultural and food industries	Coal, coke and gas	Electricity	Petroleum and petroleum products	Building materials and glass	Iron ores and iron and steel	Non-ferrous ores and metals	Engineering and electrical industries
	No.		01	02	03	04	05	06	07	08	09
INDUSTRIES	01	Agriculture, forestry	—	22,58	—	—	—	—	—	—	—
	02	Agricultural and food industries	2.27	—	—	—	—	—	—	—	—
	03	Coal, coke and gas	0.12	0.40	—	1.87	0.01	1.23	4.93	0.57	0.52
	04	Electricity	0.30	0.22	0.69	—	0.04	0.40	0.29	0.11	0.62
	05	Petroleum and petroleum products	0.33	0.83	0.17	0.03	—	0.30	0.24	0.08	0.41
	06	Building materials and glass	0.12	0.70	0.07	0.03	—	—	0.64	0.03	0.24
	07	Iron ores and iron and steel	0.11	—	0.67	—	—	0.09	—	—	7.43
	08	Non-ferrous ores and metals	—	0.06	—	0.08	—	—	0.20	—	2.73
	09	Engineering and electrical industries	0.16	0.41	0.50	0.17	0.05	0.19	0.40	0.08	—
	10	Chemicals	1.84	0.10	0.35	0.02	0.27	0.44	0.05	0.07	1.53
	11	Textiles, clothing, leather	0.10	0.16	0.04	—	—	—	—	—	0.39
	12	Wood, paper and miscellaneous	0.24	1.26	0.74	0.13	0.05	0.48	0.93	1.59	2.04
	13	Construction	0.31	0.22	0.19	0.05	0.01	0.09	0.05	0.03	0.22
	14	Transport	0.69	0.75	0.82	0.29	0.24	0.83	1.69	0.15	0.86
	15	Housing services	—	—	—	—	—	—	—	—	—
	16	Other services	0.59	1.10	0.42	0.18	0.04	0.14	0.18	0.04	0.93
	17	Commercial activities	1.58	0.67	0.02	—	—	0.13	0.05	0.02	0.14
	18	Total intermediate resources	8.76	29.46	4.68	2.85	0.71	4.32	9.65	2.77	18.06
Rest of world	19	Imports (mainly products used by the branch)	4.44	13.05	1.69	0.32	7.21	0.96	4.07	4.83	10.78
	20	Value added	33.89	26.89	21.99	6.15	1.35	9.40	9.39	3.23	28.34
Govern-ment	21	Net indirect taxation	0.34	2.50	– 0.54	0.13	4.91	0.25	0.49	0.28	1.80
	22	TOTAL RESOURCES	47.43	70.90	27.82	9.45	14.18	14.93	23.60	11.11	58.98

Notes:

1. See general remarks in this appendix, with special reference to imports.

2 The figures in this table differ in some respects from those in the national accounts. Some of these differences are due to differences in definition, others to the fact that the national accounting dates have been revised since the table was compiled.

Source:

Department of Applied Economics, University of Brussels.

ectors of delivery and utilisation

illions of francs)

RIES									Capital Formation		Govern-ment	House-holds	Rest of world	TOTAL Uses	
Chemicals	Textiles, clothing, leather	Wood, paper and miscellaneous	Construction	Transport	Housing services	Other services	Commercial activities	Total intermediate uses	Stock variations	Gross fixed capital formation	Consumption	Consumption	Exports	Final goods and services	Intermediate and final goods and services
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
—	0.50	0.82	—	—	—	—	—	23.90	0.43	—	0.03	21.30	1.77	23.53	47.43
0.41	0.17	—	—	—	—	8.08	—	10.93	–0.46	—	—	54.55	5.88	59.97	70.90
1.27	0.19	0.30	—	1.20	—	0.52	0.49	13.62	0.93	0.12	0.83	8.10	4.22	14.20	27.82
0.67	0.52	0.47	—	0.47	—	0.46	0.64	5.90	—	0.37	0.31	2.55	0.32	3.55	9.45
0.21	0.28	0.20	0.55	0.95	—	0.53	1.92	7.03	–0.14	—	0.80	4.39	2.10	7.15	14.18
0.19	0.07	0.19	6.95	0.08	—	0.10	0.02	9.43	—	—	0.15	0.50	4.85	5.50	14.93
—	—	0.05	2.00	0.21	—	—	—	10.56	0.10	0.20	—	—	12.74	13.04	23.60
0.68	—	0.25	1.55	—	—	0.13	—	5.68	0.07	—	—	—	5.36	5.43	11.11
0.12	0.25	1.16	2.31	1.18	—	0.83	0.11	7.92	1.44	18.70	1.78	5.23	23.91	51.06	58.98
—	0.86	0.94	0.70	0.29	—	2.44	0.42	10.32	–0.25	—	0.39	3.30	8.28	11.01	22.13
0.32	—	0.18	0.07	0.03	—	0.26	0.09	1.64	–0.15	—	0.22	20.73	20.85	41.65	43.29
1.34	0.84	—	3.77	0.27	—	1.17	2.12	16.94	—	– 0.41	1.08	7.87	7.54	16.08	33.05
0.08	0.19	0.55	—	0.15	4.38	0.20	0.33	7.05	—	33.43	3.90	2.14	0.86	40.33	47.38
0.73	0.42	0.30	1.10	—	—	0.39	1.51	10.77	—	0.69	0.75	7.87	9.79	19.10	29.87
—	—	—	—	—	—	—	—	—	—	—	0.24	36.11	—	36.35	36.35
0.38	0.55	1.31	1.16	0.98	0.92	—	5.20	14.12	—	1.35	35.89	66.00	2.65	105.89	120.01
0.08	0.24	0.32	0.20	0.04	—	0.57	—	4.06	—	1.30	0.13	44.29	5.49	51.21	55.27
6.48	5.08	7.04	20.36	5.85	5.30	15.68	12.85	159.90	1.97	55.75	46.50	285.02	116.61	505.85	665.75
7.31	18.68	8.98	1.44	1.80	—	3.05	2.61	91.22	—	13.91	0.33	16.40	—	30.64	121.86
7.38	17.36	16.02	24.52	25.42	31.05	100.77	31.15	393.30	—	—	—	—	—	—	393.30
0.96	2.17	1.01	1.06	– 3.20	—	0.51	8.66	21.33	—	8.19	—	3.69	—	11.88	33.21
22.13	43.29	33.05	47.38	29.87	36.35	120.01	55.27	665.75	1.97	73.35	46.83	309.61	116.61	548.37	1214.12

Resources and uses b

France 19

RESOURCES \ USES			INDU							
			Agriculture, forestry	Agricultural and food industries	Solid mineral fuels and gas	Electricity, water and miscellaneous	Petroleum, natural gas and by-products	Building materials and glass	Iron ores and iron and steel	Non-ferrous pores and metals	Engineering and electrical industries
	No.		01	02	03	04	05	06	07	08	09
INDUSTRIES	01	Agriculture, forestry	—	14,564	—	—	—	—	—	3	—
	02	Agricultural and food industries	1,044	—	—	—	62	—	—	—	—
	03	Solid mineral fuels and gas	—	185	—	351	—	183	1,001	30	187
	04	Electricity, water and miscellaneous	80	127	14	—	16	104	72	113	374
	05	Petroleum, natural gas and motor fuels	654	356	48	110	—	216	90	31	427
	06	Building materials and glass	34	216	5	3	13	—	87	11	208
	07	Iron ores and iron and steel	—	—	50	12	—	13	—	—	4,147
	08	Non-ferrous ores and metals	—	—	—	—	—	2	479	—	1,683
	09	Engineering and electrical industries	100	470	275	128	50	40	59	—	—
	10	Chemicals	1,262	202	182	7	105	192	71	76	1,586
	11	Textiles, clothing, leather	210	50	3	6	—	—	—	—	241
	12	Wood, paper and miscellaneous industries	15	555	105	43	65	138	40	2	583
	13	Construction and public works	—	—	—	—	—	—	—	—	—
	14	Transport and telecommunications	157	819	156	69	344	217	390	21	930
	15	Housing services	—	—	—	—	—	—	—	—	—
	16	Other services	3,000	764	52	97	107	82	72	5	771
	16a	Trade between final users									
	17	Total intermediate resources	6,556	18,308	890	826	762	1,187	2,361	292	11,137
	18	Value added	17,883	13,289	2,961	2,193	5,846	2,678	3,686	904	20,950
	19	Output	24,439	31,597	3,851	3,019	6,608	3,865	6,047	1,196	32,087
Other resources	20	Imports	3,161	2,794	1,482	17	2,226	235	992	1,350	3,146
	21	Duties and taxes on imports	106	491	- 93	—	11	67	107	260	1,068
	22	Trading margins	5,654	7,518	1,135	—	—	989	190	—	1,810
	23	TOTAL RESOURCES	33,360	42,400	6,375	3,036	8,845	5,156	7,336	2,806	38,111

Notes:

See Chapter V, sub-section 105 and the general introductory remarks to this appendix.

Source:

Ministry of Finance, Division of Economics and financial studies.

ectors of delivery and utilisation

millions of NF)

RIES									Capital formation		Govern-ment financial instit.	House-holds	Rest of world	TOTAL Uses	
Chemicals	Textiles, clothing, leather	Wood, paper and miscellaneous industries	Construction and public works	Transport and telecommu-nications	Housing services	Other services	Commercial activities	Total intermediate users	Stock variations and ad-justments	Capital formation	Consumption	Consumption	Exports	Final goods and services	Intermediate and final goods and services
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
112	669	807	—	—	—	1,237	—	17,392	771	—	– 78	15,698	1,119	15,968	33,360
242	93	45	—	30		3,389		4,905	517		592	34,443	1,943	37,495	42,400
292	180	112	37	326		195	134	3,213	33		281	2,713	135	3,162	6,375
257	196	123	46	141	—	178	175	2,016	—	—	27	972	21	1,020	3,036
214	134	221	508	995	—	555	683	5,242	103	—	534	2,206	760	3,603	8,845
83	—	78	3,222	57	—	—	50	4,067	101	—	325	320	343	1,089	5,156
61	—	—	530	36	—	—	—	4,849	339	140	– 56	—	2,064	2,487	7,336
107	—	112	40	—	—	—	—	2,423	94	—	—	—	289	383	2,806
324	162	211	1,888	544	—	582	70	4,903	2,005	15,159	4,489	6,841	4,714	33,208	38,111
—	947	971	525	264	—	433	85	6,908	461	—	221	3,094	1,505	5,281	12,189
323	—	283	10	64	—	150	140	1,480	704	—	387	17,467	3,055	21,613	23,093
427	503	—	704	192	—	864	810	5,046	456	187	850	7,901	1,251	10,645	15,691
—	—	—	—	—	—	—	—	—	—	18,086	1,783	1,190	—	21,059	21,059
341	387	488	210	—	—	694	2,492	7,715	—	—	1,161	3,129	1,773	6,063	13,778
—	—	—	—	—	—	—	—	—	—	—	– 30	4,287	—	4,257	4,257
232	295	315	732	517	—	—	1,000	8,041	—	—	1,063	19,108	16	20,187	28,228
3,015	3,566	3,766	8,452	3,166	—	8,277	5,639	78,200	– 294	184	–1,404	1,019	495	—	—
5,688	11,356	7,897	12,607	10,612	4,257	19,933	20,774	163,514	3,748	33,756	10,145	120,388	19,483	187,520	265,720
8,703	14,922	11,663	21,059	13,778	4,257	28,210	26,413	241,714							
1,648	2,749	1,223	—	—	—	17	—	21,040							
514	249	185	—	—	—	1	—	2,966							
1,324	5,173	2,620	—	—	—	—	–26,413	—							
12,189	23,093	15,691	21,059	13,778	4,257	28,228	—	265,720							

		USES / RESOURCES	INDU								
			Agriculture, forestry	Food industries, tobacco and fisheries	Coal, coke and gas	Electric power (generation and distribution)	Petroleum, natural gas and by-products (production and distribution)	Building materials and glass (extraction and processing)	Iron ores and iron and steel	Non-ferrous ores and metals	Engineering and electrical industries
	No.		01	02	03	04	05	06	07	08	09
INDUSTRIES	01	Agriculture, forestry	3264	111 5,202	370	—	—	5,348	407	—	—
	02	Food industries, tobacco and fisheries	189,000	3,288	—	—	3,100	472	375	172	—
	03	Coal, coke and gas	—	3,762	75,107	6,632	18	13,760	38,598	10,598	10,003
	04	Electric power (generation and distribution)	12,850	17,879	1,539	—	2,119	14,504	14,583	2,765	19,083
	05	Petroleum, natural gas and by-products (production and distribution)	20,330	16,027	662	7,992	169,855	9,431	6,856	1,685	13,363
	06	Building materials and glass (extraction and processing)	3,547	11,212	—	2,538	455	4,849	1,729	4,231	20,700
	07	Iron ores and iron and steel	2,364	12,159	—	1,594	—	—	52,087	—	340,925
	08	Non-ferrous ores and metals	360	—	—	—	—	—	8,799	25,663	89,571
	09	Engineering and electrical industries	9,118	24,603	4,852	12,475	9,961	6,802	13,612	2,516	1,236
	10	Chemicals (excluding artificial fibres)	107,875	20,915	1,019	590	7,736	6,813	7,639	1,722	59,334
	11	Textiles, clothing, leather	6,223	4,697	—	—	—	—	—	—	12,556
	12	Wood, paper, rubber and miscellaneous industries	602	21,106	500	86	1,000	9,202	561	104	55,511
	13	Construction (dwellings and public works)	—	—	—	—	—	—	—	—	—
	(14)	(Transport) (c)	(97,429)	(139,431)	(5,518)	—	(26,556)	(33,045)	(15,075)	(4,562)	(30,291)
	15	Housing services (rent)	—	—	—	—	—	—	—	—	—
	16	Other services and telecommunications (d)	—	—	—	—	—	—	—	—	—
	(17)	(Commercial activities) (c)	(390,395)	(296,763)	(9,454)	(3,207)	(40,358)	(20,371)	(19,411)	(5,530)	(125,000)
	18-1/1	TOTAL INTERMEDIATE RESOURCES	355,533	1,250,850	84,049	31,907	194,244	71,181	145,246	49,456	622,282
	19-20-18	Value added	2,675,120	674,240	50,163	228,386	155,262	194,715	215,570	53,222	841,090
	20	Total output (at factor cost)	3,030,653	1,925,090	134,212	260,293	349,506	265,896	360,816	102,678	1,463,372
Rest of World	21	Imports	426,112	134,742	123,951	1,850	163,701	40,718	108,042	55,078	239,950
Govt.	22	Indirect taxation less subsidies (e)	—	—	—	—	—	—	—	—	—
	23	TOTAL RESOURCES (at market prices)	4,102,929	3,028,036	295,739	302,872	745,829	406,670	504,787	171,287	1,944,663

Notes :

(*a*) Including cost of transport by private vehicles of private undertakings (Lire 113.1 million).

(*b*) The figures in each line and column represent transactions in nationally-produced and imported goods and services, except in the case of the figures in the spaces along the main

(*c*) The figures in brackets for services supplied to production sectors by *transport* and *commercial activities* are not included in the totals in line 18 because they as they represent the values at the *market price* for the materials for each sector.

(*d*) The figures for services purchased for each productive sector are included in the corresponding *added value* (line 19).

(*e*) The figures for indirect taxation charged on manufacture and on purchases of products in each sector are included in the figures for each transaction and in total figures recorded

Sources :

Revision of the table published in : Relazione Generale sulla Situazione Economica del Paese per l'anno 1954.

ectors of delivery and utilisation

nillions of lire)

RIES									Capital formation		Govern-ment	House-holds	Rest of world	TOTAL uses	
Chemicals (excluding artificial fibres)	Textiles, clothing, leather	Wood, paper, rubber and miscellaneous industries	Construction (dwellings and public works)	Transport	Housing services (rent)	Other services and telecommunications	Commercial activities	Total intermediate uses	Stock variations (and statistical adjustments)	Gross fixed capital formation (public and private)	Consumption	Consumption	Exports	Intermediate and final goods and services	
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
15,471	276,014	75,277	2,754	—	—	752	940	1,495,799	+ 75,684	26,600	18,421	2,337,186	149,239	2,531,446	4,102,929
32,512	36,308	6,230	—	—	—	—	780	272,237	+ 15,755	—	46,713	2,596,276	97,055	2,740,044	3,028,036
21,469	3,584	2,343	18,312	24,112	—	2,185	4,498	234,981	+ 4,481	—	1,940	51,983	2,354	56,277	295,739
21,870	15,014	11,157	1,779	11,745	—	7,026	27,005	180,918	—	—	8,562	110,292	3,100	121,954	302,872
18,125	12,504	5,076	6,928	188,807	—	824	1,104	479,569	+ 8,243	—	18,864	145,227	93,926	258,017	745,829
742	33,839	4,522	161,024	—	—	7,841	2,890	260,119	% 15,182	66,000	1,400	39,877	24,092	131,369	406,670
14,978	—	1,123	45,555	—	—	—	—	470,785	— 51,133	62,000	—	—	23,135	85,135	504,787
13,803	—	11,510	415	—	—	—	—	150,121	— 3	—	—	—	21,169	21,169	171,287
19,819	21,343	27,305	44,902	46,360	—	18,498	7,614	271,016	— 25,273	1,052,700	115,800	330,000	200,420	1,698,920	1,944,663
44,199	43,139	38,659	10,840	36,907	—	16,975	3,400	407,762	+ 2,073	—	11,600	262,041	63,141	336,782	746,617
13,125	52,966	35,835	655	—	—	—	4,627	130,684	+ 142,184	—	45,000	1,067,000	218,661	1,330,661	1,603,529
19,006	15,114	25,936	96,857	3,500	—	21,450	21,000	291,535	+ 26,197	79,000	39,600	357,189	31,597	507,386	825,118
—	—	—	—	—	—	—	—	—	—	967,700	—	—	—	967,700	967,700
(13,571)	(33,549)	(33,012)	—	—	—	—	(1,105)	(a) (546,244)	+ 700	—	10,700	213,398	—	224,098	771,042
—	—	—	—	—	—	—	—	—	—	—	—	174,100	—	174,100	174,100
—	—	—	—	—	—	—	—	—	+ 35,160	—	86,400	585,900	262,340	934,640	969,800
(68,500)	(242,797)	(71,702)	(8,000)	—	—	—	—	(1,301,488)	— 319,793	—	—	42,000	—	42,000	1,023,705
235,119	509,825	244,973	390,021	311,431	—	75,551	73,858	4,645,526	— 70,533	2,254,000	405,000	8,312,469	1,190,229	12,161,698	18,584,423
334,032	571,487	373,958	554,679	459,612	174,100	894,249	948,742	9,398,627							
569,151	1,081,312	618,931	944,700	771,043	174,100	969,800	1,022,600	14,044,153							
90,766	88,965	53,478	—	(179,000) (b)	—	—	—	1,527,353							
—	—	—	—	—	—	—	—	1,165,185							
746,617	1,603,529	825,118	967,700	771,042	174,100	969,800	1,023,705	18,584,423							

diagonal of the inner section of the table, which represent only sales and purchases of imported materials supplied by the foreign sectors corresponding to the national using sectors.
the cost of transport and trading margins added to the *sales* of products in each sector are only an accountancy duplication of these costs that have already been included in

in *line* 23.

RESOURCES \ USES			INDU							
			Agriculture	Food and agricultural industries, fisheries	Coal	Electricity, gas, water	Mineral products	Metal-working	Metal products	Chemicals, including petroleum
	No.		01	02	03	04	05	06	07	08
		No. E.C.S.C. Nomenclature	01	02	ex 03	ex 03 04	06	07 et 08	09	05 et 10
INDUSTRIES	01	Agriculture, forestry	847	2,867	4	—	1	—	—	1
	02	Food and agricultural industries, fisheries	1,005	1,699	—	—	—	—	—	88
	03	Coal	2	12	8	88	3	9	14	233
	04	Electricity, gas, water	12	57	2	56	26	26	86	61
	05	Mineral products	4	19	—	—	20	—	15	15
	06	Metal-working	6	2	1	17	10	691	608	7
	07	Metal products	100	234	49	45	9	114	1,129	77
	08	Chemicals, including petroleum	249	101	14	65	18	22	117	315
	09	Textiles, clothing, leather	8	17	—	1	—	1	34	7
	10	Wood, paper, miscellaneous extractive and processing industries	51	193	12	16	32	11	202	163
	11	Construction	56	24	12	18	8	13	57	24
	12	Transport	6	42	12	2	3	6	35	14
	13	Housing services	—	—	—	—	—	—	—	—
	14	Other services	99	68	8	13	13	32	139	55
	15	Commercial activities	110	299	18	15	26	173	258	47
	16	Non-itemised	15	38	—	19	26	38	144	33
	17	Total intermediate resources	2,570	5,672	140	355	195	136	2,838	1,140
Rest of world	18	Imports of goods and services	183	2,360	65	296	105	628	1,758	1,877
	19	Value added	3,042	1,611	475	590	360	277	3,321	880
Government	20	Indirect taxation less subsidies	– 14	652	9	27	35	49	299	284
	21	Total resources	5,781	10,295	689	268	695	2,090	8,216	4,181

Notes :
See general remarks introducing this appendix.
Sources :
Netherlands Government departments.

ectors of delivery and utilisation

nillions of florins)

RIES									Capital formation		Govern-ment	House-holds	Rest of world	TOTAL Uses	
Textiles, clothing, leather	Wood, paper, miscellaneous extractive and processing industries	Construction	Transport	Housing services	Other services	Commercial activities	Non-itemised	Total intermediate uses	Increases in stocks and work in progress	Gross fixed capital for-mation	Consumption	Consumption	Exports of goods and services	Fixed goods and services	Final and intermediate goods and services
09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
11	12	13	14	15	16	17									
26	68	—	2	—	32	—	1	3,849	4	—	10	745	1,173	1,932	5,781
13	13	—	11	—	304	1	2	3,136	– 36	—	5	4,831	2,359	7,159	10,295
4	10	6	6	—	21	11	10	437	5	10	18	152	67	252	689
35	40	21	64	—	68	57	—	611	2	68	75	499	13	657	1,268
—	2	496	—	—	6	—	3	580	—	4	31	37	43	115	695
1	8	51	1	—	1	3	6	1,413	43	18	3	—	613	677	2,090
38	87	399	357	—	78	116	27	2,859	324	1,679	644	611	2,099	5,357	8,216
120	108	167	125	—	74	83	9	1,587	21	25	96	401	2,051	2,594	4,181
1,177	47	3	20	—	19	21	—	1,355	94	10	22	2,149	790	3,062	4,417
163	903	246	45	—	106	297	167	2,607	47	40	121	605	456	1,269	3,876
23	27	384	50	261	52	44	—	1,053	—	3,597	256	166	35	4,054	5,107
24	29	22	91	—	47	940	22	1,295	—	30	87	418	3,056	3,591	4,886
—	—	—	—	—	—	—	—	—	—	—	—	1,023	—	1,023	1,023
79	130	73	152	11	416	268	92	1,648	—	185	356	2,754	339	3,634	5,282
133	169	256	34	—	55	66	—	1,659	—	509	37	3,936	1,483	5,965	7,624
38	60	27	71	3	70	10	71	663	65	33	– 218	– 484	498	– 106	557
1,874	1,701	2,151	1,029	275	1,349	1,917	410	24,752	569	6,208	1,543	17,840	15,075	41,235	65,987
1,159	672	799	1,351	—	116	348	147	11,864	247	1,856	319	1,789	368	4,579	16,443
1,334	1,366	1,980	2,415	771	3,661	4,194	—	26,277	—	10	3,051	—	—	3,061	29,338
50	137	177	91	23	156	1,165	—	3,094	—	—	—	—	—	—	3,094
4,417	3,876	5,107	4,886	1,023	5,282	7,624	557	65,987	816	8,074	4,913	19,629	15,443	48,875	114,862

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