Joyce:

The French visitors will come in June 30 at 10 am, visit a few minutes with HS and then go down the hall to Murray Foss, Phil Cagan and Frank Ripley.

Their names are (for clearing) Claude Seibel
Michel Aglietta
Raymond Courbis

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MINISTERE DE L'ECONOMIE ET DES FINANCES

INSTITUT NATIONAL DE LA STATISTIQUE ET DES ETUDES ECONOMIQUES
(National Institute of Statistics and Economic Studies)

(I.N.S.E.E.)

Division des Programmes

AN OVERALL DESCRIPTION OF THE PHYSICAL-FINANCIAL MEDIUM-TERM FORECASTING MODEL (FIFI MODEL)

This work has been undertaken for the

COMMISSARIAT GENERAL DU PLAN

within the preparation of the French VIth Plan

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FOREWARD

The FIFI model was built in 1967-1968. The speed of its building up is in part due to the fact that we could profit by the experience gained during the preparation of the former Plans. This concerns the overall projections (cf. "Méthodes de programmation dans le Vème Plan", Division des Programmes de l'I.N.S.E.E Etudes et Conjoncture - Décembre 1966) (1) as well as the sectorial projections (cf. R. COURBIS - "Prévision des prix et étude sectorielle des entreprises pendant la préparation du Vème Plan", Etudes et Conjoncture, Novembre 1968 (2).

The model has been conceived by the Division des Programmes of I.N.S.E.E. under the leadership of Philippe BERTHET and, later on, Paul DUBOIS: it is particularly due to M. AGLIETTA, R. COURBIS, A. SAGLIO, C. SEIBEL, B. ULLMO.

For some parts, the help of other Divisions of I.N.S.E.E. and of the "Direction de la Prévision" of Ministry of Finance must be acknowledged.

The model was used according to the lines laid down by the "Commissariat Général du Plan" and under the technical responsability of "Division des Programmes" of I.N.S.E.E. together with.

Many other Divisions within the I.N.S.E.E., the "Direction de la Prévision", the "Commissariat Général du Plan" have taken an active part in the operation of the model as well as in the permanent bringing-up-to-date of the relations and the data of the model.

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Bibliography (figures in brackets in the text sent back to bibliography B.1

The fonctional equations which are listed and numbered in the Appendix I are meant to illustrate the presentation of the model in part B. They show the main relationships of the model. No numerical figures are given, as these relations sum up in a simplified way a very great number of behavioural patterns and institutional mechanisms.

Some accounting identities have been left out of part B exogenous variables and parameters are overscoreded.
The following rules have been used :

Firms by sectors of activity

index wright	
	1. "regulated" price
	2. "exposed" sectors
	3. "sheltered" sectors

Economic Agents

letter wight	
	(i) firms
a	public departments
m	menages

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A. Basic principles [4], [5], [11]

(1) Medium term economic projection model which simulates all economic interdependences for the final year of the VIth French Plan (1975). We do not optimalize but we seek a solution approaching progressively all the targets set by the government, taking into account the behavioural patterns of economic agents and the constraints of the economic system.

(2) The utilization of the descriptive framework provided by national accounts is used as a support for the definition of explaratory schemes describing the medium-term behaviour of economic agents, assumed to be homogeneous (households, firm divided into activity sectors (1). These behaviours are subjected to pressures the evolution of which we attempt to forecast (for instance impact of international competition, economic policy decisions made by the government).

(3) The model describes in some detail the tools of economic policy (fiscal policy, price policy, economic subsidies, social transfers ...). The targets and the choices made by governmental authority are tested in the model for economic value. Therefore the model makes a contribution to the continuing elaboration of economic policy.

B. Main assumptions and fonctional equations

I. A competing economy [8], [9], [15]

(4) The opening of the borders a basic fact for the french economy is an essential feature of the FIFI model.

A competing economy is one which is opened to international trade : taking into account the conditions of their production, the enterprises in the sectors having to compete internationally are subjected to pressures which are due to the prices on world markets.

(1) The economy is described as including 7 sectors of production : agriculture, food processing industries, energy, industry, transports and telecommunications, housing, construction - services and trade. The sectors are taken as homogeneous from the production and price formation points of view.

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(5) A series of assumptions introduce those pressures into the model :

1. Fixed exchange rate between various currencies.

2. On a medium-term basis and on a given market, a tendancy to equality between the prices of the various producers (internal or external)

Equation (2) :
pressure of international competition

$$p_2 = \overline{p_{imp}} + \overline{\varepsilon}$$

This means a strong competition between producers and a research for the best prices by the consumers (one accepts differences in composition and quality between all imported products and all nationaly produced products : consequently there is a possible structural difference ($\overline{\varepsilon}$) between the internal production prices and imported products prices).

3. The economy is actually subjected to competition ; in fact certain sectors are exposed to international competition and have to bear a price pressure ; others are sheltered from competition : no external pressure on the price. This criterium is basic.

4. The mobility of production factors between the country under consideration and the rest of the world is limited :

   - the flow of immigrants is limited by bilateral agreements; and this sharing of labor markets makes possible the establishment of durable differences in wages between countries.

   - foreign assets makes direct investments possible but subsidiaries of foreign companies play the normal competitive game on the internal market.

5. On different markets, price differences can go on existing : they play a part in the arbitration by the producers in of their sales on the various markets. They can be found in the explanation of exports mouvements (in so far as trade with foreign countries can be expressed by export functions) (see below exports).

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(6) II. The behaviour of economic agents [4], [5], [11]

It is important to recall that the behaviours described in the model correspond to specific evolutions on a medium term basis, through the short-term fluctuations. A model of comparatively static nature cannot describe temporal sequences. This medium-term aspect is going to have an influence on the behaviour of companies in terms of self-financing, of implementation of production factors, of wages and prices determination, of household behavioral patterns and of determination of external trades.

(7) 1. The self financing behaviour of enterprises [6], [2]

A medium-term regularity can be found in the ratio between own ressources and investments (within a given company). Firms accept to contract debts up to a certain level only. The rate of self financing, resulting from it is only an indicator of more basic behaviours in the firm : maximilisation of profit and requirement of solvency modified(or not)by institutionnal or financial constraints.

There appears an antagonism between :

- anticipation of high rate of growth requiring fast increasing investments.

- risk of losing part of the firm's independence because of the weight of debts which have to be incurred owing to the need for growth.

(8) For a given company population, the existence of an average self-financing rate is postulated. The competitivepressure in non-monopolistic sectors can lower the self-financing rate in relation to the virtual rate which is sought after by each company (if this constraint does not exist).

(9) 2. Impact upon price determination [9], [2], [11]

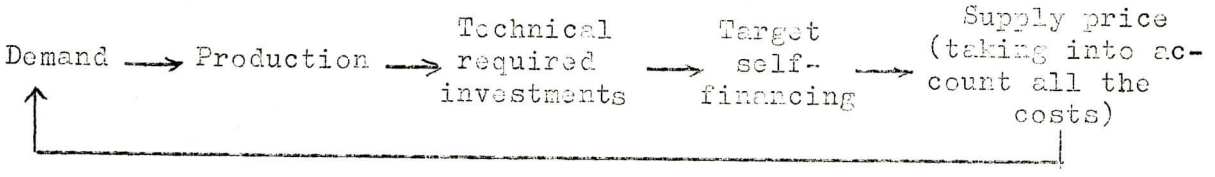
The same type of self financing behaviour can lead to different schemes of price determination according to the constraints weighing upon each sector. A distinction is made between three types of mechanisms :

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(10) a) sectors "sheltered" from foreign competition

The absence of trading in goods and services with the external world makes demand the guide for decisions making in terms of investments and production by firms. The self-financing behaviour leads this type of firms to determine a supply price which, taking into account their costs, makes it possible to finance the technical investments required by production. The balance price for the product is the result of the supply - demand confrontation on the market.

(11) Thus one sees the interdependences :

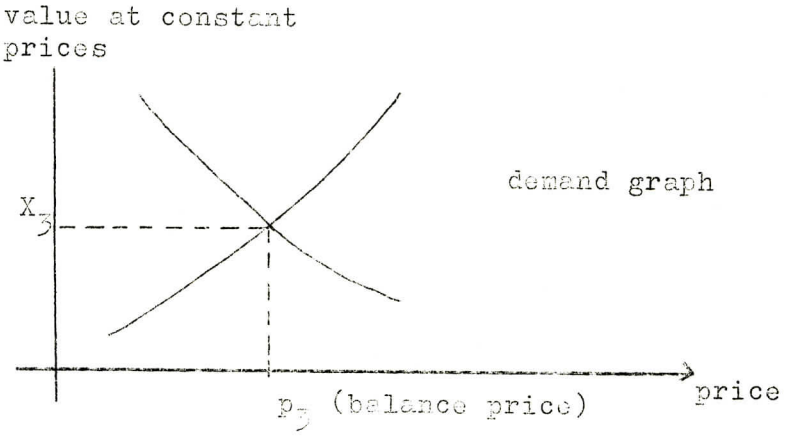


Equation of balance for "sheltered" sectors (17)

$$p_3 = f(X_3, I_3, E_3, TW, \bar{\alpha}_3, T_3)$$

Sectors thus defined
food transformation industries
Construction-services-trade

Balance of "sheltered" product markets



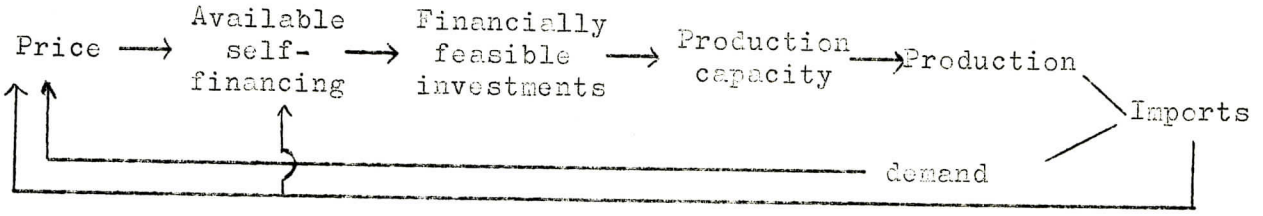
(12) b) Sectors "exposed" to international competition

The prices imposed by foreign competition determine the amount of self-financing available in these sectors, taking into account their burdens ; therefore this defines their production capacity as a result of international competition. A sharing of the market is then made between national production and imports in order to fit demand. Nevertheless producers react to this constraint by endeavouring to improve their productivity and tokeep down their wages cost, while at the same time accepting to get into debt to increase their investments

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thus they improve their share of the market (1) (Marginally speaking, the price of imports can be modified by the intensity of internal demand : foreign producers endeavour to improve their margin).

The interdependencies appear therefore much far.. complex :



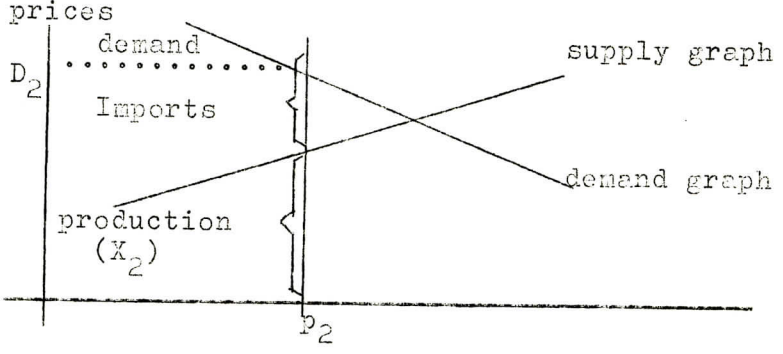
They can be found in the equations

pressure of international competition

Balance of "exposed" product markets

② $p_2 = p_{imp}(\pi) + \bar{\varepsilon}$

value at constant prices



market sharing

③ $X_2 + Imp_2 = D_2$

competition indicator

④ $\pi = f\left(\frac{Imp_2}{D_2}, p_{imp}\right)$

Sector thus defined
- Industry

investments and balance for the exposed sector

⑦ $f(I_2, X_2) = 0$

⑯ $I_2 = [f \; X_2, E_2, TX, g_2(\pi), p_2, \alpha_2(\pi), T_2]$

(1) These reactions are represented in the sectorial balance equation by the fact that some parameters representing the beaviour of the "exposed" firm are a function of a competition indicator (π), measured according to the share of imports in demand (equation 4).

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(14) c) "regulated" price sectors

For an important number of activities, the Government intervenes in price determination ; in some cases, they are sectors where an important part of the added-value proceeds from national companies (energy, transports) partly subsidied by Government funds. In other cases, price decisions are made internationally (for instance Agriculture within the framework of the Common Market).

The price having been defined, we obtain in the model financial conditions which are estimated from the point of view of institutional mechanisms.

balance for "regulated" sectors

(15) $\alpha_1 = f(X_1, I_1, \overline{P_1}, TW, T_1, S_a, E_1)$

Sectors thus defined
- Agriculture
- Energy
- Transports-telecommunications
- Housing rents

(15) 3. Utilisation of production factors [14], [15]

All sectors, except industry, are dealt with in complementary production functions ; their cohesion is obtained by making an econometrical estimate on the basis of past series from 1949 to 1968.

(16) . Investments have been estimated on the basis of productive capital resources. We used a marginal gross capital output ratio leading to a projection of the gross productive investment rate as a function of the rate of growth of the added value.

Investment for each sector :

⑥⑦⑧ $\frac{I}{V} = a\gamma_v + b$

- γ_v : rate of growth of the added value
- b : represents the turn-over of capital rate

(17) . Employment is connected to production by the use of a productivity indicator (added value per man-hour) estimated on the basis of past figures.

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Labor for each sector :

(9) (10) (11) $\boxed{E_{(i)} = f\left[X_{(i)}, \overline{\text{productivity}_{(i)}}, \overline{DT_i}\right]}$

In the case of industry (exposed sector), the consistence in projection between productivity and per capita capital (thus investment) is obtained by a COBB-DOUGLAS production function estimated on the 1949-1969 period.

(18) 4. Employment balance and wages determination [7], [11]

The position of the labor market results from actual employment compared with the available active population (taking into account exogeneous employment in public departments) Consequently the rate of unemployment is endogeneous and defined by equation (12).

(12) $\boxed{TCH\emptyset = f\ (E_1, E_2, E_3, \overline{E}_a, \overline{PA})}$

The situation on the labor market has an influence on wage determination because a certain competition is assumed between the unemployed and the employed labour. The possible balance on labor market becomes apparent through a slow down in the increase of wages according to a PHILLIPS - LIPSEY relationship, estimated on the 1953-1969 period.

Wage rate

(14) $\boxed{TW_t = a\ p_{G_t} - bpG_{t-1} - CTCH\emptyset_t + d}$ (one takes it that during a regular growth $p_{G_t} = pC_{t-1}$)

(19) 5. Behaviour of households [13], [23], [11]

To the income given to households by firms, social transferts (W_s) and wages provided by public departments (W_a) are added.(equation 18).

a) The available income after taxes (R_m) is shared in a first stage between savings and consumption.

We suppose that the arbitration between savings and consumption depends on level of income, prices and housing investments ($\overline{I}_L$).

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(19) $$Ep_m = a\,R_m - b\,p\,G + c\,\bar{D}_L + d$$

We can show that the savings rate of households is a growing function of available real income (price level unchanged) and a decreasing function of price increase (real income unchanged).

b) Consumption behaviour for a total given expenditure

The KLEIN-STONE double affectation linear model is used :

- a "permanent" consumption, which depends on time, is predistributed in volume terms ; thus it remains independent of the price system.

- a "residual" consumption distributes the balance, expressed in value terms, according to budgetary coefficients which are themselves functions of time.

(22, 23, 24 1st part)

$$D_{jt} = \overline{D_{j(t)}} + \frac{\alpha_j(t)}{p_j}\left[D_m - \sum_i p_i\,\bar{D}_i(t)\right]$$

for each product j

t stands for time

with $D_{jt} \geqslant D_j$ (+)

and $\sum \alpha_j(t) = 1$

(20) 6. Exports [16], [9]

An export function describes the choices operated by national producers as well as the results of competitions for a share of external markets.

Several effects are simulated :

- evolution of foreign demand ($\overline{GE}$), ("pull" effect).
- competitivity indicator measured by the ratio between french price of exported products and price of exports on the international market,
- the export " push" effect due to the dynamism of growth.
- The "anti push" effect expresses the fact that the "push" effect is slowed down by a fast increase of internal demand.

The coefficients were estimated by a conditional regression method from international data.

(22, 4th part)

$$\log E = a \log \overline{GE} + b \log(X_2) - c \log(D_2) + d \log\left(\frac{\overline{P_e}}{p_2}\right) + e$$

exports — "pull" effect — "push" effect — "anti push" effect — competitivity effect

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(21) III. Part played by governmental Authority [4], [5], [16]

The considerable importance given to this influence in the model springs from the importance of government made medium-term decisions. This importance is the main justification for the considerable size of the model (1.500 equations, 3.000 data) and particularly for the detailed description of economical operations.

The State is taken as being an economical agent with its own behaviour but having aims sufficiently different from those of other agents to justify a separate treatment. Four characteristics can be displayed:

(22) 1. This agent defines for itself general targets which are mostly endogeneous variables in the model ; they are considered as particularly important when projections are examined and discussed, but they are not predetermined. We can quote for instance some very important targets:

- insuring a sufficent growth (PIB) to limit the level of unemployment (TCHØ) ;

- avoiding a rise in prices (p_G) higher than that of foreign countries with which trading is important ;

- allowing for a balance of payment equilibrium, consequently limit (and if possible give a negative value to) the external financing capacity ;

- guiding some extent the distribution of demand according to the needs in housing and public equipments ;

- influencing on income distribution by using levies and government expenditures.

(23) 2. In order to reach these targets, the State has means at its disposal which are very numerous and diverse ; their direct effect occurs in different fields in the economic system. Thus the study of governmental actions supposes that the means and their points of impact should be analysed finely (this makes necessary to break down firms into sectors of activity and to analyse their operations in detail). These means of interventions can be classified according to institutional criteria which characterize types of policy :

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- <u>autonomous demand</u> policy : investments and consumption by public departments ($\bar{D}_a$) ;

- <u>fiscal</u> policy : studies the effect of various types of taxes (T_1, T_2, T_3 subdivided into type of taxes, Tm) and their various points of insertion into the overall patterns (the effects vary according to the variation of the different taxes) ;

- <u>price</u> policy : influence of public utility tarifs ($\bar{p}_1$) according to the sectors concerned (there are in fact several sector prices which are regulated or partly regulated) and study of price modulation according to the types of users (firms, households ...) ;

- <u>transfer</u> policy : subsidies to enterprises (S_a) and benefits to households (W_s) ;

- <u>control or support of certain types of income</u> : either through the use of price and transfert policies (i. e. farmers income) or through a direct action (wages paid to public enterprises and depart - ments (W_a), taking into account the employment in public departments ($\bar{E}_a$).

- <u>financial</u> policy : they cannot be studied ut present by the use of the model by itself , but through a dialogue between the model and an pother study tool (flow of funds table) which makes possible to modify some parameters of the model (i.e. self-financing rate) as a function of financial flows and thus to implement an iterative method.

(24) 3. The coordination of the types of policies is not a result of a predetermined behaviour of the Government. We try to define, by successive approximations and by studying various alternative solutions, the satisfactory combinations taking into account the purposes in each specific situation. Each situation must be studied specifically and in the study we give precisions concerning international environment, technical conditions of growth, behavioural pattern of private economic agents in the economic policy. The targets are, in fact, a function of the existing position : there is neither a rigid economic policy, nor any preference function preestablished by the Goverment once and for all.

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(25) 4. The use of economic policy tools is hampered down by the existence of certain constraints which the Government is supposed to respect and which concern the principles of its overall management. These policy constraints are reflected upon the economic variables in the model. They are all introduced as representing targets, but they can change during the preparation of the Plan as the politicy discussion matures. Let us think in terms of :

- the budgetary balance (BF_a) (equation (31));
- the total fiscal pressure $PF = \frac{T_1+T_2+T_3+T_m}{PIB(\text{in value terms})}$;
- the means used to intervene in public entreprises (limitation of subsidies and financial aid) ;
- the reaching of a financial balance in Social Security ;
- the role of the Treasury in the financial circuits.

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C. Utilisation of the model for the preparation of the VIth French Plan

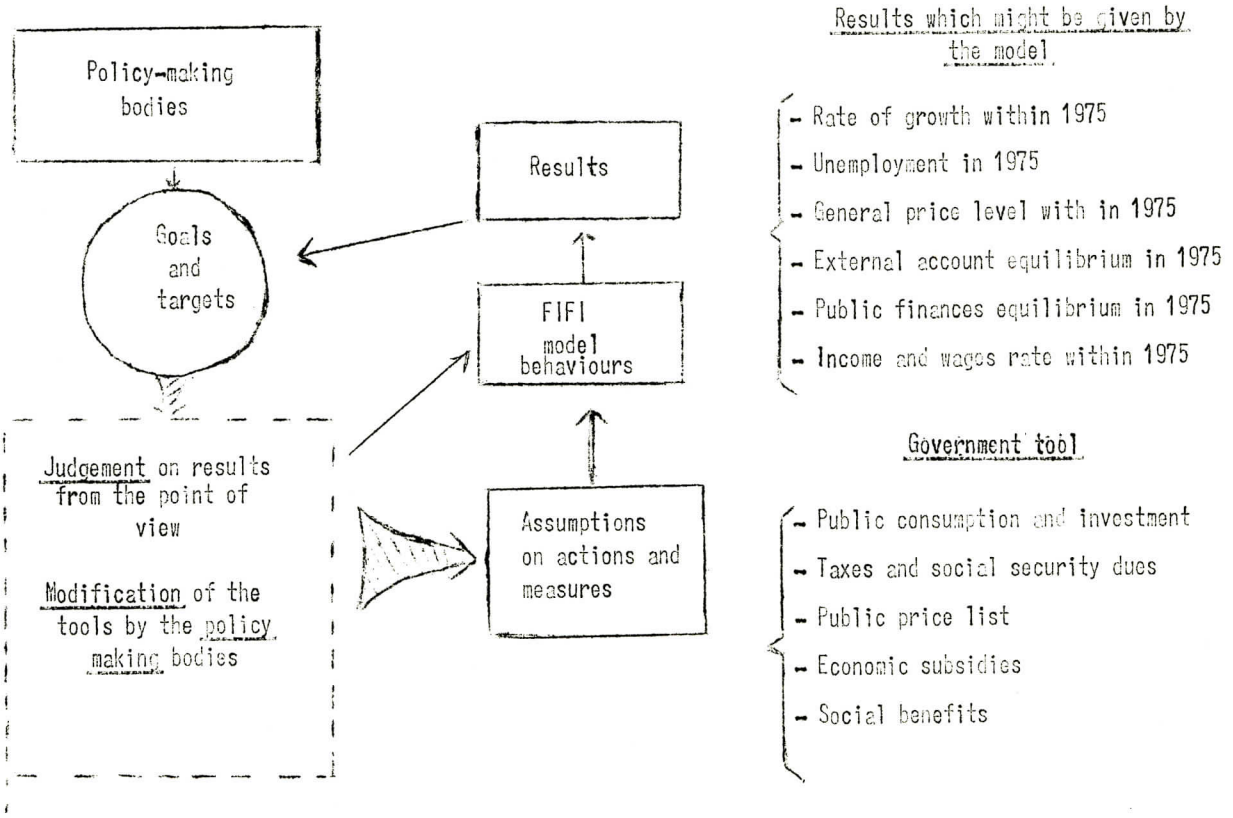
I. Principles for the use of the model

As a simulation model, FIFI makes it possible to define the main characteristics of an economic balance within the framework of the Plan. Thus it makes it permits to judge the actions-to-results cohesion of the means and targets of economic policy implemented by the Government. In order to achieve these targets, it is necessary to define the appropriate actions to reach them. The most delicate point from the point of view of economic analysis will be to translate into the model the effects of the measures taken on the behaviour of agents (for instance a fiscal alleviation program for households : how this will affect the savings to consumption ratio).

The use of the model requires to have an answer, even as a first assumption, to these questions. We can thus give the outline of the use of the model.

Schéma 2

USE OF THE MODEL TO ACHIEVE THE TARGETS OF THE PLAN



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(26) In order to make this approach operational it is necessary for the policy-making bodies, (that is the Government but also the social partners, Employers, Trade-Unions, farmers etc ...) to know the model and to have been able to criticize it. The model is improved as a result of these discussions (in terms of economic mechanisms and also for the figures used in the model).

The model is adapted to open discussion in official circles.

(27) This procedure requires considerable flexibility in the use of the model, and makes constant access to the model necessary.

The tools used are - a FORTRAN writ tan PROGRAM 5.000 instructions (which correspond to 1.500 equations).

- a central data index representing roughly by 1.500 parameters.

- an "alternative programming mode" using an "alternative data index" so that any parameter can be modified at will.

The computing-time is 7 minutes using an IBM 360/65.

Calculation time for one alternative costs 40 $.

(28) II. Work done in connexion with the preparation of alternative targets for the VIth Plan [17], [18], [19], [20]

The final setting up of the model was carried out between 1967 and 1968, at the Division of Programming of I.N.S.E.E. with the assistance of large number of Divisions of the Statistical Institute and of the Direction de la Prevision of Ministry.

This work was ordered by the Commissariat General du Plan.

First trend forcasts which we call the "point of departure account" (september 1969). They correspond to a projection into which are incorporated the behaviour of economic agents as observed in the past, and a Governmental policy which is supposed to be unchanging. To this projection are associated a certain number of uncertainty alternatives which show the response of the balance to modified assumptions concerning:

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- international environment ;
- the physical factors of growth ;
- the behaviour of economic agents.

This work was discussed and criticized within the planning Committees (the sector Committees and the Synthesis Committees). Other alternatives (taking into account uncertainty or risks were studied upon requests by the various Committees.

(29) . Little by little, we turn towards the definition of the economic policy means which would allow to solve the problems which arise within the "point of departure account" (real rate of growth expressed in volume, high level of prices, external deficit, public finances deficit, slow growth of real income and wages).

. In a first stage, economic policy analytical alternatives were elaborated for each of the tools under consideration. In a second stage were built synthetic economic policy alternatives.

On of them studied at the request of the French employers Federation aimed to increase growth (it is know as the Japanese alternative")Another was devised on strict balance of public expenditure, it was studied upon the request of the Budgetary Bureau of the Ministry of Finances.

. The work done by the Committees came to an end in February 1970, culminating in the elaboration of three synthetic accounts which correspond to three possible growth paths to be followed in the course of the sixth Plan : with different hierarchics of goals, with different values accorded to the constraints, to the effects expected from the economic policies and to the aptitude to change of the French economy.

- The account with a growth of G.N.P. of 5,5 % can be characterized by a deliberately prudent estimation of the evolution of the international environment and of the growth potential of the French economy. It corresponds to an economic policy which would be based essentially on reaching balance of payments equilibrium and public finances equilibrium.

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- The 6 % growth account, which is known as the basic account, would make for growth at a slighly increased rate in comparison with the past, making use of available labour, thanks to a policy based on stimulating supply while controlling the growth of public expenditure.

The 6.5 % account describes a growth which will be much more rapid than in the past, based on vigourous actions taken to accelerate structural transformations.

This work has overall as made possible for the Commissariat Général du Plan to base its report on the main targets for the VIth Plan which has just been discussed by the French Parliament.

(30) Many other works go into the preparation of the VIth Plan. The FIFI model in relation to these more detailled studies, plays the part of synthesis framework (1) giving the basic initial data, thus making it possible to work on the decentralized tools (2) and gathering the results of the more detailled studies as a modification in the figures of exogeneous parameters of the model. This is a very important aspect of the utilisation of the model as a tool which makes it possible to circulate and to mobilize economic information relating to medium-term projections.

(31) D. Possible improvements and existing loop holes 5 , 17 , 29

- The description of the financial circuits is not integrated into the model. This makes the examination of financing problems rather slow and limits the effect of this examination(an effect which is obvious in fact, but difficult to calculate in terms of number). Work done jointly by I.N.S.E.E. and the Direction de la Prévision is at present being done in order to integrate the economic and financial medium-term behaviour of the main agents ;

- The model does not provide a path to be followed by the Plan between 1970 and 1975 not does it give any idea of the long-term consequences of the medium-term trend evolutions ; here again, additional work is being done either in the Direction de la Prévision or in the I.N.S.E.E. ;

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- The equantification of economic flows does not take into account the qualitative aspects of the problems or gives only an incomplete description of these factors. For instance the collective equipements are only taken as a part of final demand, though effects on productivity of labour or on the environment are neglected. Thus the model has only a very imperfect grasp of the interdependance between market and non market economy.

- More generally speaking, the model is only an economic outline mic in nature, of the actual facts. Therefore it is a mechanism which tends to oversimplify in relation to the true social and political facts. It cannot bring about any modification to the structure of the economy (such as the concentration of the production tool, modification of the relationship between public and private sectors). At most, if one knows how to measure them in terms of the langage used in the model, one can take into account the structural changes by modifying some of the exogenous parameters in the model.

*

* *

(32) We have not yet been able to determin precisely what is the outcome of the use of FIFI in the preparation of the VIth Plan. We are conscious of the fact that the utilization of a large model in a public discussion sets problems of language and of different economical education which can be solved only little by little.

We nonetheless have the impression that the use of this type of model will never be given up and that, even though one must learn to make use of this tool as of any new tool brought to us by technical progress, the positive aspects outweigh the negative aspects.

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ANNEXE I

OUT LINE OF THE MAIN INTER-RELATIONS OF MODEL FIFI

Conventions

Exogenous variables and parameters overscored :
(for example : $\overline{PA}$, available active population)

index 1. "regulated" economic sectors Economic agents: -firms : (i) ⟶ :
2. "exposed" " " -households : m ⟶ :
3. "sheltered" " " -public departments: a

A. FUNCTIONAL EQUATIONS

Determination of supply

"regulated" sectors production : (1) $X_1 = D_1$

"exposed" sectors production :

pressure of international competition (2) $p_2 = \overline{p_{imp}} + \overline{\varepsilon}$

market sharing (3) $X_2 + Imp_2 = D_2$

competition indicator (4) $\pi = f\left(\frac{Imp_2}{D_2}, \overline{p_{imp}}\right)$

"sheltered" sectors production (5) $X_3 = D_3$

Complementary production functions

for each sector Investment (6 à 8) $[I_{(i)}, X_{(i)}] = 0$

Labor (1) (9 à 11) $E_{(i)} = f\left[X_{(i)}, \overline{productivity_{(i)}}, \overline{DT_i}\right]$

Labor market balance

definition of an unemployment indicator (12) $TCH\emptyset = f\ (E_1, E_2, E_3, \overline{E_a}, \overline{PA})$

(1) In the sector which is exposed to foreign competition, certain parameters are modulated relative to the intensity of the international competition represented by the value of the indicator π (equation 4) : this applies to productivity (2), drift of wages relative to the mean $g_2(\pi)$ and mainly the self financing rate $\alpha_2(\pi)$.

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Prices, wages, balance of sector accounts

general price level (13) $p_G = f(X_1, X_2, X_3, \bar{p}_1, p_2, p_3)$

wages rate (14) $TW = a.p_G \quad b.\ TCH\emptyset + c$

balance for "regulated" sectors (15) $\quad_1 = f(X_1, I_1, \bar{p}_1, TW, E_1, T_1, S_a)$

"exposed" sectors (16) $I_2 = f[\bar{X}_2, E_2, TW, \varepsilon_2(TW), p_2, \alpha_2(TW), T_2]$

"sheltered" sectors (17) $p_3 = f(X_3, I_3, E_3, TW, \overline{\quad_3}, T_3)$

Household income and consumption

available income (18) $R_m = f(E_1, E_2, E_3, TW) + W_a + W_s - T_m$

consumption to savings ratio (19) $Ep_m = a\,R_m - bp_G + c\,\overline{D_2} + d$

over all consumption (in value terms) (20) $D_m = R_m - Ep_m$

Determination of final demand by product (in volume terms)

"regulated" price products (21) $D_1 = f_1(D_m, \bar{p}_1, p_2, p_3) + f'_1(\overline{D_a})$ (Exports)

"exposed" sector products (22) $D_2 = f_2(D_m, \bar{p}_1, p_2, p_3) + f'_2[I_{(i)}] + f_E(\overline{GE}, p_2\bar{p}_e)$

"sheltered" sector products (23) $D_3 = f_3(D_m, \bar{p}_1, p_2, p_3) + f'_3(\overline{D_a}) + f''_3[I_{(i)}] + DL$

final demand ⟶ (households) (public departments) (Investments) (housing)

Public departments

taxes and social security duties (24 à 26) for each sector: $T_{(i)} = f(X_i, p_i, Ei, TW)$

taxes paid by households (27) $T_m = f(R_m)$

main expenditures (28) $W_a = f(\overline{E_a}, TW)$

wages in public departements

goods and services $\overline{D_a}$ exogenous variable (public utilities)

social benefits (29) $Ws = f(\overline{PA}, \overline{PT}, p_G, TW)$

economic subsidies (30) $S_a = f(X_1, \bar{p}_1, TW)$

balance of public departments accounts :

finance requirement (31) $BT_a = T_1 + T_2 + T_3 + T_m - \overline{D_a} - W_a - W_s - S_a$

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Foreign trades, tourism, transferts

external financing means (32) $CF_2 = f(Imp_2, Imp_1(X_1), Imp_3(X_3), \overline{GE}, \bar{p}_e, RM$

B. LIST OF THE 32 ENDOGENOUS VARIABLES (ACCORDING TO FIFI OUT LINE)

D_1 D_2 D_3	final demand by product (volume terms)
X_1 X_2 X_3	production by sector (id.)
E_1 E_2 E_3	labour by sector
TCHØ	unemployement indicator
I_1 I_2 I_3	productive investment by sector
p_2	"exposed" sectors ex-works price (taxes enclosed)
p_3	"sheltered" sectors ex-works price (taxes enclosed)
p_G	general price level
TW	wage rate
α_1	"regulated" sectors self financing ratio
π	competitive indicator ("exposed" sector)
Imp_2	competitive imports (id.)
Rm	household income available (after taxes)
Ep_m	" savings
Dm	" total consumption (in value terms)
T_1, T_2, T_3	taxes and social security duties by sector
Tm	taxes paid by households
Wa	wages in public departments
Ws	social benefits
Sa	economic subsidies (only those of the "regulated" sector)
BF_a	finance requirement of public departments
CF_e	external financing means

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C. MAIN EXOGENOUS PARAMETERS AND VARIABLES

$\overline{PT}$ total population

$\overline{PA}$ available active population

$\overline{Productivity_{(i)}}$ labour productivity by sector (see note page I.1)

$\overline{DT_i}$ hours worked by sector

External indicators

$\overline{p_{imp}}$ price of imports (world market)

$\overline{\varepsilon}$ structural difference between internal market price and price of imported products

$\overline{GE}$ growth of foreign countries (weighing GNP of main trading partners)

$\overline{p_e}$ price of exports on the international market ($\neq \overline{p_{imp}}$)

Sector accounts

$\overline{p_1}$ "regulated" prices

.....

$_2(\pi)$ self-financing ratio of "exposed" sectors (see note page I.1)

.....

$g_2(\pi)$ drift of wages relative to the mean in "exposed" sectors (id.)

$\overline{\gamma_3}$ target self-financing ratio in "sheltered" sectors.

Public departments

$\overline{D_a}$ goods and services public demand : public utilities (health, education, infrastructures, ...) and general civil and, military consumption)

$\overline{E_a}$ public department employement

$\overline{D_L}$ Housing (financed by households, public departments and firms).

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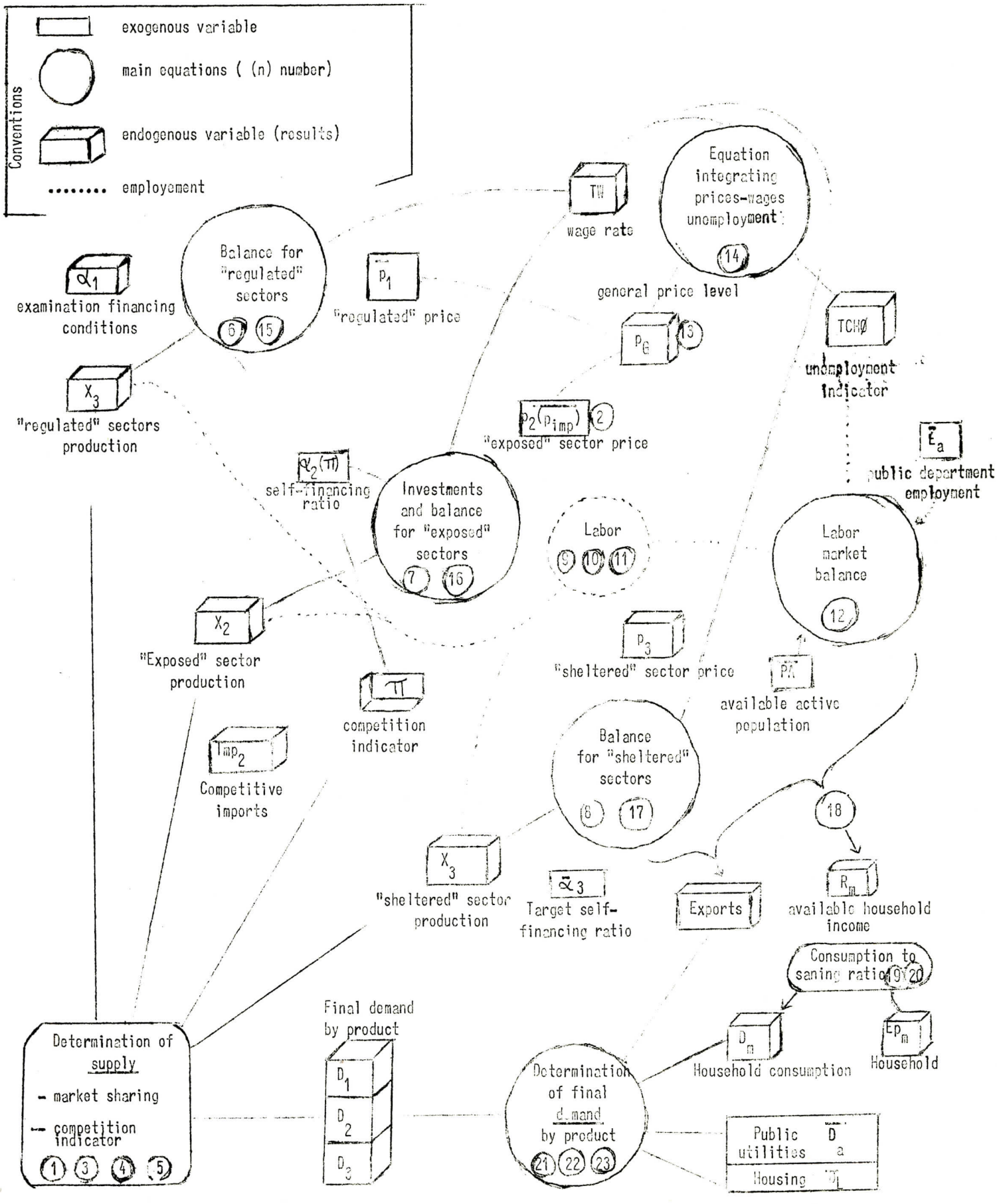
D. MAIN RESULTS

PIB $f(X_1\ X_2\ X_3)$	rate of growth
pG	general price level
TCHØ	indicator of unemployment
TW	wages rate
$P_F = \frac{T_1+T_2+T_3+T_m}{PIB\ (value)}$	total fiscal pressure
BF_a	finance requirement of public departments
CF_e	external financing means

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ANNEXE II

DIAGRAM OF THE MAIN INTER-RELATIONS OF FIFI MODEL

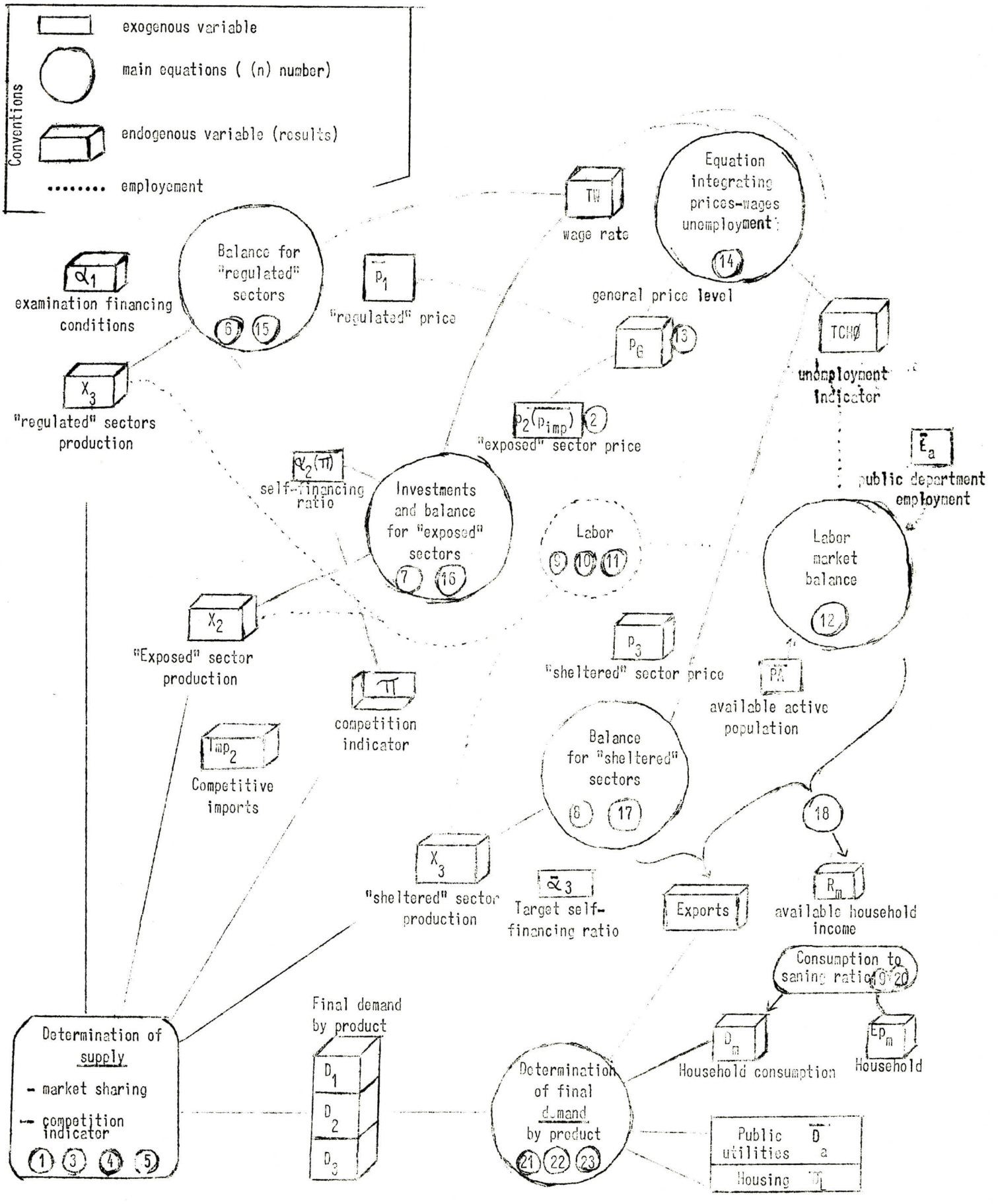


This diagram does not take into account the equations (24à32)
(public departements and external balance)

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ANNEXE II

DIAGRAM OF THE MAIN INTER-RELATIONS OF FIFI MODEL



This diagram does not take into account the equations 24à32
(public departements and external balance)

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BIBLIOGRAPHIE RESUMEE SUR LE MODELE FIFI

(au stade actuel de son développement)

Travaux antérieurs

[1] Méthodes de programmation dans le Vème Plan. Division des Programmes. Etudes et Conjoncture - I.N.S.E.E. - Décembre 1966.

[2] R.COURBIS - Prévisions des prix et étude sectorielle des entreprises pendant la préparation du Vème Plan (premiers rapports ronéotés 1966). Publication Etudes et Conjoncture - I.N.S.E.E. - Novembre 1966.

[3] M.AGLIETTA et C.SEIBEL - National Account in the Vth French Plan préparation. IARIW - Juin 1969.

Principes généraux

[4] Propositions pour un modèle physico-financier à moyen terme. Note de projet de la Division des Programmes rédigée par M.AGLIETTA - Janvier 1967 (ronéotée).

[5] M.AGLIETTA et R.COURBIS - Un outil pour le Plan:le modèle FIFI. Economie et Statistique - I.N.S.E.E. n° 1 - Mai 1969 pp. 45-63.

[6] R.COURBIS - Le comportement d'autofinancement des entreprises. In : Economie Appliquée (Archives de l'I.S.E.A.), Tome XXI, n° 3-4 (Juillet-Décembre 1968), pp. 749 - 821.

[7] M.AGLIETTA - L'évolution des salaires en France au cours des 20 dernières années : apports et insuffisances des schémas explicatifs globaux. Economie et Statistique - I.N.S.E.E. (à paraître).

[8] R.COURBIS - Développement économique et concurrence étrangère. Revue Economique, vol. XX, n° 1 (Janvier 1969), pp. 37 - 83.

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Schématisations du modèle

[9] R.COURBIS - La détermination de l'équilibre général en économie concurrencée. Séminaire d'économétrie ROY - MALINVAUD du C.N.R.S. - Janvier 1970.

[10] Ch.SAUTTER et M.AGLIETTA - Utilisation d'un modèle à moyen terme dans la planification : présentation d'un modèle simplifié. Options de macro-économie - Ecole Polytechnique - 1969 - 1970.

Présentations détaillées du modèle

[11] R.COURBIS - Le modèle physico-financier de projection à moyen terme FIFI. Contribution au cycle d'études de Varna. Commission Economique pour l'Europe. Nations-Unies - Septembre - Octobre 1970.

[12] Présentation détaillée des équations du modèle FIFI. Rédaction collective. Collections de l'I.N.S.E.E. "Comptes et planification" (à paraître).

Travaux par domaine

[13] Ph.NASSE - Analyse de la demande, étude des équations de MM. FOURGEAUD et NATAF. Séminaire d'économétrie ROY - MALINVAUD du C.N.R.S. - Décembre 1969.

[14] MAIRESSE - Estimation du capital productif en France. Département de la Recherche - I.N.S.E.E. - 1969.

[15] A.SAGLIO - Dossiers "productivité" - Août 1969 ; dossier "investissements productifs" - Janvier 1970 ; "cohérence entre productivité du travail et taux d'investissement productif" - Avril 1970 - Division des Programmes - I.N.S.E.E. (notes ronéotées).

[16] B.ULLMO - Les échanges commerciaux en 1975. Résultats de l'exploitation du modèle physico-financier - Division des Programmes - I.N.S.E.E. Octobre 1969 (ronéoté).

Résultats de l'utilisation dans la préparation des options du VIème Plan

[17] M.AGLIETTA et C.SEIBEL - L'utilisation du modèle FIFI dans la planification française. Contribution au cycle d'études de Varna. Commission économique pour l'Europe - Nations Unies - Septembre-Octobre 1970.

[18] Projections économiques tendancielles de l'économie française pour 1975. Division des Programmes - I.N.S.E.E. - Septembre 1969 (document ronéoté interne - Commissariat Général du Plan).

Reproduced at the Richard Nixon Presidential Library

[19] Variantes relatives à certains moyens de politique économiques (P.DUBOIS et C.SEIBEL). Commission de l'économie générale et du financement du Plan (groupe technique)- Novembre 1969 (documents ronéotés).

[20] Sensibilité de l'équilibre économique en 1975 aux principaux paramètres du modèle FIFI. (Ch.SAUTTER) - Division des Programmes - I.N.S.E.E. Avril 1970.

[21] Présentation de quelques variantes de politique budgétaire (J.P.PAGÉ). Commission de l'économie générale et du financement. Commissariat Général du Plan - Décembre 1969.

[22] Nouvelles perspectives financières pour 1975. Présentation d'un TCF associé au compte de référence (P.VAJDA). Document présenté au Comité de Financement. Direction de la Prévision. Division des Opérations Financières - Février 1970.

[23] R.COURBIS - Comportements financiers et développement économique. Economie et Statistique n° 12 - I.N.S.E.E. - Mai 1970.

Références théoriques

[24] C.FOURGEAUD et A.NATAF. Consommation en prix et revenu réels et théorie des choix. In : Econométrica, vol. 27, n° 3, Juillet 1959 (Le modèle linéaire de consommation est un cas particulier du modèle FOURGEAUD-NATAF).

[25] L.R.KLEIN and H.RUBIN - A Constant Utility Index of the Cost of Living. In : Review of Economic Studies, vol. XV (2), n° 38, 1947 - 1948, pp. 84 - 87.

[26] R.C.LIPSEY - The relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1862 - 1957 : A Further Analysis. In : Economica, Vol. XXVII, n° 105 (Fév. 1960), pp. 1-31.

[27] A.W.PHILIPPS - The Relation Between Unemployment and the Rate of Change of Money Wages in the United Kingdom, 1861 - 1957. In : Economica, vol. XXV, n° 100, novembre 1958, pp. 283-299.

Reproduced at the Richard Nixon Presidential Library

28 R.STONE, A.BROWN and D.A.ROWE. Demand Analysis and Projections for Britain, 1900 - 1970 ; a Study in Method. In Europe Future Consumption (J.SANDEE, ed.), North Holland Publishing C° Amsterdam, 1964.

29 R.COURBIS - Monnaie, financement et croissance en économie de concurrence. Août 1969. A paraître in : Travaux et Recherches de la Faculté de Droit et Sciences Economiques de Paris. Série Sciences Economiques.

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AMBASSADE DE FRANCE
AUX ETATS-UNIS

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AF-
EFR/mcv

June 23, 1970

Mrs Gray
Council of Economic Adivsers
Executive Office of the President
Room 312
WASHINGTON, D.C.

Dear Mrs Grey :

This is the brochure I promised to send you on the Model FIFI. It has just been translated into English and that is the reason for the delay.

Would you please find enclosed the biographical sketches of our three Econometricians : M. Raymond Courbøis, M. Claude Seibel and M. Michel Aglietta.

I am keeping Tuesday June 30 free for their visit to the Council.

I would be very happy if you could call me and confirm the arrangement you would be able to make.

Thank you very much.

Sincerely yours,

Evelyne Rovani

Evelyne ROVANI

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Claude SEIBEL

Born : March 28, 1934
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Degrees obtained : - graduate of Ecole Polytechnique (1956)
- graduate of Ecole Nationale de la Statistique et de l'Administration Economique (1959)

Functions :

Administrateur de l'Institut National de la Statistique et des Etudes Economiques (INSEE) ; Chief Assistant, Division of Programming, I.N.S.E.E.

Professional experience :

- Statistical work in ALGERIA (1959-1961) : specializing in census and employment surveys as well as preparation of the "Plan de Constantine".

- Assistant to the Director of Regional Statistics of RENNES (Brittany) ; member, synthesis group of regional planning, Brittany: specializing in short-term regional analysis ; industrial census ; regional planning (1961-1964).

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- Between 1964 and 1969, member, Division of Programming, INSEE and since 1969, Chief Assistant, Division of Programming, INSEE and member, Planning Coordination Groups "Finances - Plan". During the preparation of the fifth French Plan (1964-1966), responsible for the synthesis of medium term forecasting on employement, housing and regional planning. After 1967 one of the authors of the physical-financier (FIFI) model used for the VIth with particular responsability for coordination of the practical use of this model for the preparation of the Plan ; analysis and computer programming for several economic agents.

Publisheds works :

- Active population in Algeria ; Results of the Census
  Statistique générale de l'Algérie 1960.

- Work and workers in Algeria - Editions Mouton 1963 (with P.BOURDIEU, A.DARBEL, J.P.RIVET) (Statistical and sociological sample servey in Algeria).

- Description and forecast in agricultural demography. Etudes Rurales 1964.

- Income disparities in France in Darras "Profit sharing : growth and ineualities". Editions de Minuit 1966 (Collective economic and socilogie writing).

- National Accounting in the Vth French Plan (with M. AGLIETTA) published by IARINW, June 1969).

Authored jointly several other documents :

- Programming methods within the Vth Plan (Etudes et Conjoncture - INSEE - Décembre 1966) (III^{d} Part).

- Forecasting first trends for 1975 (internal document).

- Detailed presentation of the FIFI Model (texte presently being written).

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Degrees obtained :
- Ancien Elève de l'Ecole Polytechnique (graduated 1961)
- Ancien Elève de l'Ecole Nationale de la Statistique et de l'Administration Economique (graduated 1964)

Professional Experience

In October 1964 I was appointed Administrator of the National Institute of Statistics and Economic Studies (INSEE) and assigned to the Division of Programming. Within the Direction of Economic Syntheses, this Division

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is in charge of elaborating methods of medium term forecasting and of making a synthesis of the various quantitative projections carried out within the framework of the French Plans.

After two years of progressive training during the preparation of the Fifth Plan, I was appointed at the end of 1966, along with three other members of the Programming Division, to undertake the elaboration of a medium term physico-financial forecasting model (FIFI). As a member of the central team, I participated directly to the different stages of the building of the model in 1967 and 1968 : working out its general concept, its resolution and programmation on computor, elaborating the principales of its use, animating and achieving some of the studies required for a precise formulation of each block of the model and for the codification of its data.

From 1969 to now, I have worked in two directions : ou one hand settling the projections and participating to the active phase of preparing the VIth Plan, on the other hand going on working on possible further developments of the projection methods.

Apart from this direct professional activity, I have applied myself to the teaching of economics and statistics as a lecturer of animator of laboratory work in various higher level schools :

Ecole Nationale de la Statistique et de l'Administration Economique (ENSAE)

Centre d'Etude des Programmes Economiques (CEPE)

Ecole des Hautes Etudes Commerciales (HEC)

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Published Works and Participation at International Conferences

I can quote two contributions :

- one to the Conference of the International Association for Research in Income and Wealth (Dublin - August 1967)

- the other, still to come, to the seminar organised by the UN (Economic Commission for Europe) at Varna (Bulgaria) in September 1970, concerning the problems raised by the utilisation of a large size model.

As to my published works, I can quote :

- National Accouting in the Vth French Plan
  (published by I.A.R.I.W., June 1969, Written with Claude SEIBEL)

- A tool for the Plan : the FIFI model
  (In collaboration with R. COURBIS)
  Economie et Statistique - INSEE, May 1969 ;

- The Evolution of Wages in France during the past 20 years. Contribution and Insufficiency of Aggregate Explanatory Schemes ;

- The use of the FIFI model in the French Planning
  (Economic Commission for Europe - UNO, Written with Claude SEIBEL)

- Programming Methods Within the Vth Plan
  (Etudes et Conjonctures - INSEE, Dec, 1966)

- First Tendential Forecasts for 1975 (internal document),

- Detailed Presentation of the Equations Used in the FIFI Model and its Resolution
  (text presently being written).

These three last documents have been written collectively with my active participation

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Raymond COURBIS

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Degrees : - Ingénieur Civil des Mines (Ecole des Mines de Paris 1958-61
- D.E.S. Sciences économiques
- D.E.A. Mathématiques économiques

Chargé de mission at the French Ministry Of Finance

Chargé de cours à l'école des Mines de Paris

Chargé de maitrise de conférences à la Faculté de Droit et Sciences Economiques de Paris-Ouest

---

Professional experience :

- member of the "Division des Entreprises" of INSEE (1964-1966), next of the "Division des Programmes of INSEE (since 1967)

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- During the preparation of the Vth Plan (in 1964-65), responsible for research on price forecasting and projection of firm's account by activity.

- research in 1966 on firm's behavipr and price forecasting

- 1967-70 : one of the authors of the physical-financial model used for the VIth Plan (FIFI) with responsability for price and wage determination ; analysis of firms ; determination of production and foreign trade ; problems of financing.

Published works :

1. Comptes économiques nationaux à prix constants. Etudes et Conjoncture. July 1964

2. Prévision des prix et étude sectorielle des entreprises pendant la préparation du Vème Plan. Etudes et Conjoncture. Nov. 1968

3. Productivité globale des facteurs, prévision des prix et politiqu des revenus. Revue Economique. July 1968

4. Le comportement d'autofinancement des entreprises. Economie Appliquée. 1968. N° 3-4.

5. Développement économique et concurrence étrangère. Revue Economique. January 1969

6. Comptabilité Nationale à prix constants et à productivité constante. Review of Income and Wealth. March.1969.

7. Un outil pour le Plan : le modèle FIFI (in collaboration with M. AGLIETTA). Economie et Statistique. Mai 1969.

8. Monnaie, financement et croissance en économie de concurrence. August 1969. To be published in : Travaux et Recherches de la Faculté de Droit et Sciences Economiques de Paris.

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9. La détermination de l'équilibre général en économie concurrencée. Séminaire d'Econométrie du CNRS. Jan. 1970. To be published.

10. Comportements financiers et développement économique. Economie et Statistique. May 1970.

11. Le modèle physico-financier de projection économique à moyen terme FIFI. Report for the ONU's Seminar on mathematics applied for economics. To be published by ONU and INSEE.

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Introduction

(of November 1969)

Except for the updating of a few methodological points, the following text reproduces in full an article published by Mr. Michel Aglietta and Mr. Raymond Courbis in the first issue of the review "Economie et Statistique" (INSEE, May 1969). The article describes the physical-financial model ("FIFI") which was developed by the Division of Programs of INSEE in collaboration with INSEE's and the Forecast Department's various specialized divisions,[1/] as part of the preparations for the Sixth Plan.

1/ Divisions: "Consumer Research, Household Accounts", "Employment", "General Demography", "Agriculture", "Public Construction and Works", "Research by Firms", "Synthesis of Goods and Services and Firms' Accounts" of INSEE.

Divisions: "Administration", "Fiscal Research", "External", "Public Economic Action" of the Forecast Department.

In addition, the Financial Programs Division of the Forecast Department and the Quantitative Studies and Synthesis Division of the Commissariat Général du Plan participated in outlining the over-all approach to the development of the model, and in the discussions on assumptions, relationships, and results at all stages of the project.

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The structure of the model, as presented in Part I of this text, corresponds to the model in its present form, but the quantities used in the examples of possible applications of the model, described in Part II, are out of date.

These figures date back to 1968, and today the extent to which the results of the model are affected by changes in the assumptions underlying the model is no longer exactly equal to that shown in the tables in this text, even though the direction of the resulting variations remains the same.

There are two reasons for the obsolescence of the figures chosen at that time. Firstly, the original figures used in all the assumptions and reactions of the model have been changed in the meantime. The new figures are based on the new series of the National Accounting Department (base year 1962) and new population data obtained from the 1968 census. These new figures change both the central account, used to calculate the variants, and the marginal variations which are determined by the value of the parameters of the principal relationships. Secondly, some equations have been reformulated, particularly with regard to determination of exports.

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A MODEL--FOR WHAT PURPOSE?

All authors of economic forecasts strive to indicate different possible developments of the economy (expressed in figures), to find out where there is harmony and where there are discrepancies between political aims and given constraints, and finally to study possible solutions to the problems which have thus been revealed. Such forecasts will be the more useful, the more they take into account the interdependence between the developments they describe. The best way of doing this is to develop an over-all model, that is, a schematic representation covering all aspects of economic activity.

This mathematical expression of reality relies first of all on the national accounts as a synthetic instrument. But this by itself is not enough to make possible the economic analysis required for the preparation of a Plan. To project national accounts into the future, it is indispensable to resort to the diagrams developed by macro-economic theory. These two types of instruments are combined in the medium-term forecasting model.

With such a model, it is possible to link a coherent set of results to each set of assumptions concerning the development of the "environment". The model thus provides us with a picture of the French economy in 1975--a

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presentation in figures guaranteed to be compatible from the point of view of accounting. The quality of the forecasts is the better, the wider the field of activities covered by the model and the better the presentation of the interdependent relationships in it. Their usefulness increases with the number of assumptions expressing future uncertainties and that of alternative economic policies to be studied.

The Fifi model [2] aims at meeting all these requirements. It now comprises about 1,500 equations, 3,500 data, and 5,000 programming instructions. With Fifi, it is possible to make all "volume" and "value" forecasts simultaneously and to obtain numerous "variants", as well as a reference forecast.

Exploring the Economic Future

There are, of course, no direct links between the model and the big issues of the preparation of the Plan, such as land improvement and urbanization policies, or qualitative social policies. Fifi's contributions to the over-all planning work are nonetheless very important.

Its direct contributions consist in the close scrutiny of general economic equilibria, the study of the impact which the structure of

---

2/ This name is an abbreviation for "Physical-financial model".

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production costs has on the competitiveness of industrial firms, and a measure of the influence exercised by certain instruments of economic policy (charges for community services, tax system, financial policy, etc.).

This close scrutiny is of great pedagogical value. With models it is easier than with detailed forecasts to discover a certain number of problems that are inherent in economies growing in a competitive world, and to work out measures by which such problems might be solved. It is, of course, necessary to indicate specific measures which cannot be studied with Fifi, but the model will nonetheless help determine the scope of application and the impact of such measures. On the other hand, a semi-global model is a superior tool for verifying the compatibility of the objectives and means to be examined by the political authorities.

Furthermore, Fifi constitutes a coherent framework around which will be arranged, in logical fashion, a large part of the detailed forecasts and some studies for the model, concerning economic mechanisms, structures, and political instruments. The model will be a starting point for these detailed forecasts and studies in that it will provide their authors with a coherent complex of assumptions, expressed in figures, with regard to the economic

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environment, thus making it possible to view specific problems in their relation to general development problems. In addition, the model also provides a common framework for the synthesis of detailed studies.

I. STRUCTURE AND PROPERTIES OF THE MODEL

1. THE FIFI APPROACH

In accordance with its role in the preparation of the Plan, Fifi is a simulation model intended, on the one hand, to determine and quantify problems of economic development and, on the other hand, to facilitate the choice of a medium-term policy by which these problems may be solved. 3/

The model is made for planning. Therefore, as we shall see in the next chapter, Government behavior and the choice of a policy are assumptions underlying the model. For a given economic policy specified in detail the model has purely the character of a forecast in that it describes the

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3/ The choice of a medium-term policy may be the result of an empirical "to-and-fro" procedure between forecasting experts and the political authorities, or of criteria of formal decisions leading to an optimization calculation. This article does not deal with this complex problem.

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consequences of the policy under consideration, taking into account existing constraints and the behavior of economic agents other than the Government.

No standards are imposed a priori upon any of the economic variables (growth rate, unemployment, wage rate, rate of inflation, etc.). The economic policy appropriate for reaching the desired aims is determined progressively by trial and error. This process implies the existence of close links with other instruments of analysis and with the political authorities. This dialogue contributes to the assumptions underlying the model, provides general perspectives for detailed work, and helps in the progressive determination of objectives and their order of priority.

Change in Concept

The preparation of the Fifth Plan also involved an iterative procedure consisting in a series of forecasts (called "Esquisses" [Outlines]) which were progressively supplemented by detailed works and political choices [1]*. But certain standards were set from the beginning, namely, for the first outline, full employment and external equilibrium. After that, the number of standards to be observed was progressively increased: growth rate and

*/ The numbers in square brackets refer to the bibliography at the end of the article.

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consumption-investment ratio, fixed total amount of exports appropriate for achieving an acceptable balance of payments equilibrium, determination of revenues in such a way as to ensure compatibility between value programming and volume programming, etc.

Naturally, the outlines of the Fifth Plan did more than merely respect the constraints imposed by the accounting equilibrium of resources and their utilization. Thus, for instance, the standards were set within certain limits considered acceptable on the basis of behavior observed in the past, and the growth rate was chosen following a detailed study of the physical factors of growth, and a qualitative reflection on the central role played by the labor market, which influences growth factors (productivity and, above all, activity) and the determination of wages.

These outlines thus provided an almost inextricable mixture of estimating considerations and choices of standards. The economic measures to accompany these choices were nevertheless only very insufficiently defined despite efforts to study the conditions under which the desired economic equilibrium might be attained. Those measures which were finally recommended were not really related to the aims to be attained. Particularly, certain very special measures (such as the fixing of charges for community services)

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were studied separately, without any possibility of fully appreciating their effects on the over-all economy.

The change in concept made possible by the Fifi model may be analyzed in three sections: willingness to carify the assumptions necessary for preparing quantitative outlines, concern for taking into account the new conditions prevailing in the French economy, and requirements in connection with the development of a formalized semi-global model.

Clarifying the Assumptions

Since the outlines of the Fifth Plan combined elements of estimates with those of standards, there was a certain lack of clarity in the arguments, which was aggravated by the limitations imposed on the development of the main variables. And these variables (growth rate, unemployment, general price level, balance of trade, wage trends, etc.) are exactly those which represent the results of compromises between conflicting projects of economic agents. They are thus not at the discretion of any one of these agents but, on the contrary, result from the simultaneous interaction of economic relations.

The Government can influence these variables only indirectly by an appropriate economic policy, but this policy needs to be well defined. If

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it is not, the normative approach of the Fifth Plan can no longer provide any information on future economic developments. If the revenue standards are not attained, for instance, because they are not compatible with the free interaction of behaviors, what will be the consequence? If the "transformation" of liquid capital, considered necessary, does not take place, how will this affect the development of the economy?

An answer to these questions is indispensable if we are to throw some light on the problems of development and decide on a strategy. This means that we must refrain from adopting an approach which gives exaggerated priority to the definition of quantitative macro-economic targets over that of the corresponding means.

Instead, we must determine the possible consequences of a clearly defined policy, taking into account the free interaction of behaviors. We have to decide on general aims to be specified in greater detail as the preparation of the Plan progresses. But these aims must not crystallize in a priori objectives. Each outline must be characterized by a group of economic policy measures, and the results must be such as to make possible an assessment of how well the means suit the ends.

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Taking into Account the New Situation of the French Economy

The setting up of the Common Market, the liberalization of trade, and the growth of foreign competition have produced a marked change in the economic environment, which has become more and more sensitive to events in foreign countries. Moreover, the growth that is physically possible can no longer be achieved ipso facto. In fact, at least in the case of firms exposed to foreign competition, production is determined much more by their competitiveness than by demand.

It is less and less possible, under these conditions, to adopt a priori a set of targets even if these are compatible both physically and from the point of view of accounting. As long as the economic policy measures which are vital for their achievement are not clearly specified there is no guarantee that these targets will be reached. The Fifi model was designed to take these considerations into account. Anybody using this model is, in principle, assured at the end of the interaction described above that the targets chosen are plausible--provided that the model is a good one. It is therefore essential that the model be a very accurate reflection of future economic structures and the principal relationships they will create. This definitely constitutes

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a problem. We shall see in Part II how we can approach it when we will be dealing with the subject of uncertainty.

Making Possible an Analysis that is both Global and Sectoral

This was one of the aims which the authors of the model tried to achieve, and it is reflected in Fifi's structure. With international competition having become such a dominant factor, the main emphasis was placed on the study of a firm with a view to determining not only prices but also production and foreign trade. Since not all firms are subject to the same constraints, a sectoral analysis was necessary [2]. This, however, would lose much of its effectiveness if it were not incorporated in an over-all system taking into account the principal relationships among all economic agents.

This double nature (sectoral analysis and global structure) is expressed in the description of Fifi as an integrated semi-global model. Such a model is necessarily complex as it must cover a large number of relationships simultaneously. With this tool, a normative approach would be trapped in a contradiction: the relatively high degree of detail would require a multiplication of standards, but the more standards are set, the more difficult will it be to achieve internal coherence within the model.

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The change in concept as compared to the preparation of the Fifth Plan is thus basically due to the desire to achieve a better adaptation of quantitative forecasting techniques to the new planning requirements. The Fifi model is one link in the process of developing planning methods. It seems to represent an incision. But this qualitative change is largely due to the combination, in one single structure, of all the results and the progress achieved during the research work for the Fifth Plan with regard to the construction of models and behavioral analysis for global [1] as well as sectoral [2] programming.

2. STRUCTURE OF THE MODEL

The concept underlying the physical-financial model used for the Sixth Plan is thus different from that of the implicit model for the Fifth Plan. This conceptual difference implies a difference in the structure of the model. To show this we shall first of all review the structure of the model used for the Fifth Plan, and later we shall examine the structure of Fifi, distinguishing between the case of a closed economy and that of an economy open to foreign countries, the latter being more realistic but also more complex. We shall finally examine the problem of including financial operations.

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The "Trichotomous" Structure of the Model for the Fifth Plan

In the implicit model used in the preparatory work for the Fifth Plan [1] top priority was given to the task of finding a coherent set of standards and targets. The model was thus based on physical equilibrium. This was obtained by assuming either a rate of growth of gross domestic product (GDP) or a fixed level of employment[a] (the growth rate could be deduced from the assumptions with regard to productivity). After the volume forecast (i.e., forecast at constant prices) had been made it was linked to a value forecast based on assumptions with regard to relative prices. Subsequently, the characteristics of the equilibrium between savings and investment were assume: distribution of savings per agent, taking into account the necessary investment and assumed behavior. From this were deduced increases or decreases in, or standards of, wages and incomes which were compatible, from the point of view of accounting, with the volume programming and the savings-investment equilibrium. The result was a value equilibrium (shown schematically in the general economic forecast) which was in harmony with the volume equilibrium. The next step was a forecast

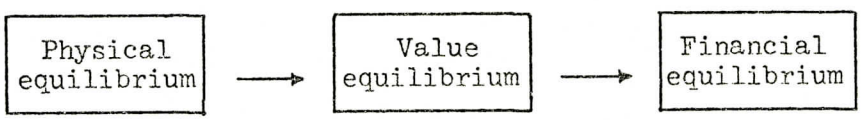
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a/ In the first few outlines, a normative assumption was made with regard to full employment while the rate of GDP growth was a result.

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financial operations, on the basis of which it was possible to determine the amount of liquid resources that would have to be converted into long-term resources in order to adjust the primary supply of capital to the primary demand for capital.

The final structure of the implicit model for the Fifth Plan was the following:



The three stages in this approach were entirely separate from one another. The "rise" of value programming toward volume programming was limited (change in the amount of collective equipment to attain equilibrium in the public finances, finding a standard level of exports at which a satisfactory balance of payments equilibrium could be reached) or discretionary and qualitative (efforts to make the rate of expansion compatible with that of inflation, and an easing of tension on the labor market with an increase in wages). The "rise" of financial programming toward the two other types of programming was practically non-existent.

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With such a structure it was nevertheless possible to obtain an image of the future consisting of a set of targets, standards, and forecasts which were compatible from the accounting point of view and physically possible. After that, there were discussions on their economic feasibility and the chances of their being achieved in reality, with many qualitative arguments being put forward. Following these discussions, certain standards or targets were changed and other outlines were prepared. But the interdependent relationships thus taken into account were weak, and not clearly specified.

The preliminary research work for a model which would specify the principal interdependent relationships, which was started at the time when the Fifth Plan was under preparation and was closely linked to the forecasts then made, bore fruit just in time for the preparation of the Sixth Plan. This research work concerned the forecasting of prices and the sectoral analysis of firms,[b/] the influence of prices on household demand and foreign trade, and methods of determining wages taking into account the degree of tension on the labor market.

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b/ The structural problems and the impact of a sectoral study of firms on the structure of a general economic model are analyzed in greater detail in [2], pp. 210-225.

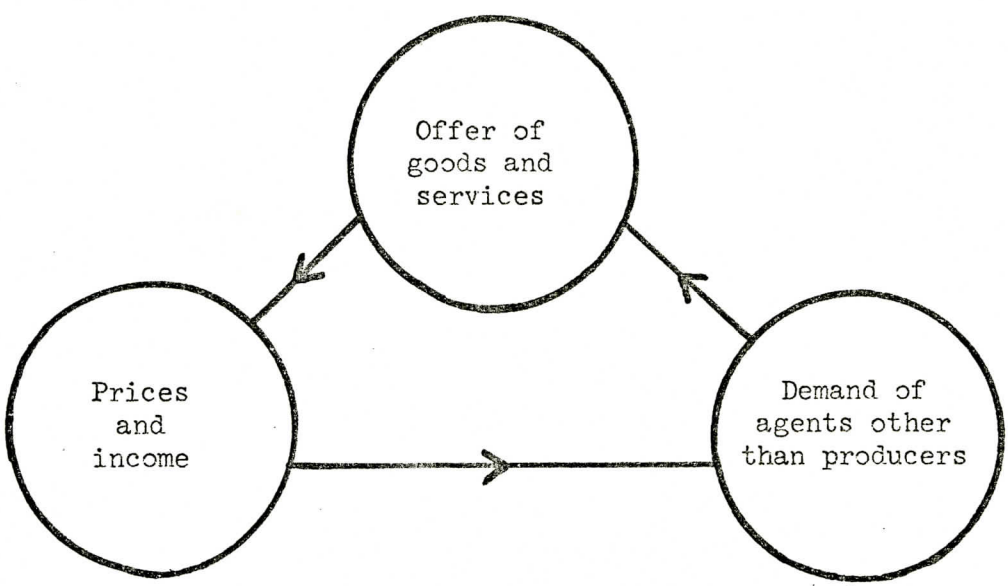
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Interdependent Structure in a Closed Economy

The general interdependence between physical variables and value variables is reflected in the price system. The latter depends, on the one hand, on the behavior of the producers (firms) who determine the supply of goods and services and, on the other hand, on the behavior of the users (particularly households) who determine the demand.

If there is no direct constraint on prices they constitute action variables for the firms.

The logical structure of the model is then a triangular one.



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It comprises three interdependent poles:

1. the supply of goods and services, determining simultaneously output, imports, production factors, and the situation on the labor market;

2. the complex of prices and incomes, determining the indexes of increases in prices and in the wage rate, and the value of total household income;

3. the volume of demand, one part of which is exogenous[4/] while the other (household consumption and exports) is a function of prices and incomes.

In such a system, the volume equilibrium is influenced by the value equilibrium through the demand schedules which in turn are a function of prices and incomes. The price system which is established eventually is compatible with the behavior of all agents:

The firms' behavior consists in fixing a system of "supply prices" for a given amount of output in each sector. These prices are a function[5/] of

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4/ Collective equipment is exogenous because its progression is not calculated in the model although its value is taken into consideration.

5/ It must be remembered, however, that some prices may be stipulated either in accordance with international agreements (agricultural prices) or directly as a result of Government decisions (rates for community services).

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the costs borne by the firms, and of their behavior with regard to self-financing [3]. The price system is such that, taking the costs into account, it leads to an appropriate degree of self-financing, obtained either directly for monopolistic sectors or sectors with weak internal competition, or through the mechanisms of the market.[6]

Output, on the other hand, adjusts to demand (and investment adjusts to production). Since demand results from the users' behavior and depends on the price system, it is the adjustment of supply to demand which makes the "supply price" system a system of equilibrium prices.

In such an economy, prices react to production not directly but through demand. This is not the case, however, if the entrepreneurs lose control over their prices.

6/ If there is no pressure on domestic producers' prices from international competition, the market mechanisms are such that in the medium term everything goes on as if the prices of one sector were "determined" by the firms of that sector so as to cover production costs and ensure a level of self-financing sufficient for the financing of investments in that sector at a certain rate (depending among other things, on domestic competition). See [3] pp. 756-758.

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Interdependent Structure in an Open Economy

The preceding system does not incorporate foreign competition (or does so only very indirectly through import and export functions--it is then part of demand). In actual fact, however, it imposes a powerful constraint on industrial firms, and this will be increased further by the full integration of the Common Market and the liberalization of trade. The causality of the preceding diagram, oriented from supply to prices, is reversed in the case of strong competition [4] where the price is actually determined by foreign competition.

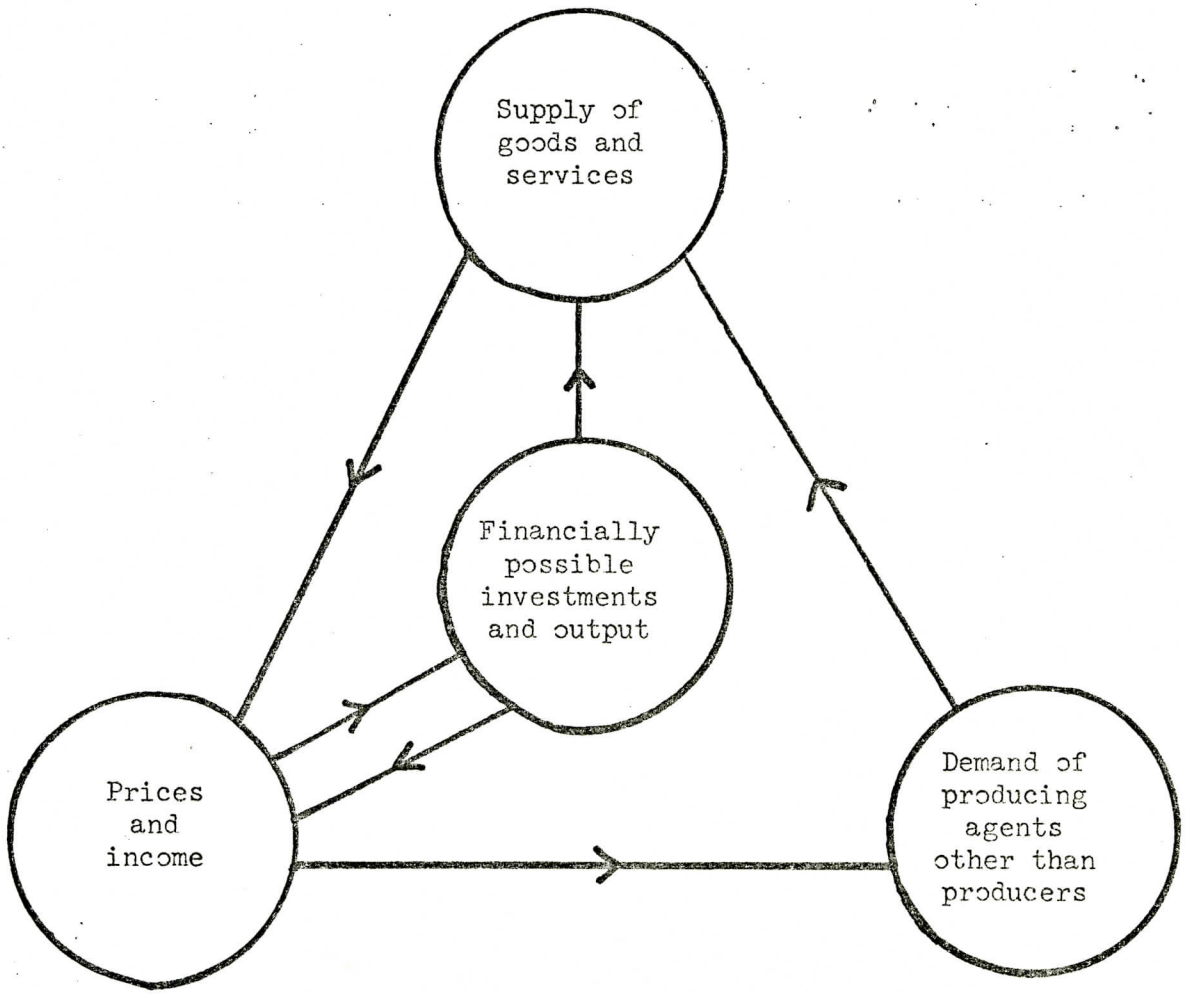
The level of profits (and thus of self-financing) determines investment and production capacity, and consequently, in the medium term, output. Output thus is no longer essentially a function of demand but, on the contrary, of the real competitiveness of domestic firms competing with foreign producers.

This global model is thus still based on self-financing behavior but, depending on possibilities offered in each sector, prices or investments are fixed so as to attain a certain level of self-financing.[7]

7/ By influencing either self-financing or investment, the firms can attain the equilibrium they desire between these two factors. For a more detailed analysis see [3] pp. 755-759.

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The diagram now looks like this:



In this diagram, there is a more complete interdependence between physical variables, prices, and value variables.

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INTRODUCING FINANCIAL OPERATIONS

The structure of the model as described so far cannot as yet provide a complete picture of real interdependence among economic factors. It is therefore necessary to bring financial operations into it.

The financial elements create--for a given physical equilibrium--a mutual dependence between "value" variables for firms and those for the other agents. It is then possible to assess the impact of financing possibilities on investment and output. While financial operations are not yet fully taken into consideration in the Fifi model, they are nevertheless part of its logical structure since, as the name indicates, Fifi is intended to be a "physical-financial model" reflecting as fully as possible the interdependence among economic factors.[8/]

It would, of course, have been possible, or so it seems at first sight, to show certain instances of financial interdependence by means of financial balances, such as specific relationships between the administrations' financing

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8/ The interdependence among various factors, taken into account at present, results mainly from the treatment of firms, prices, and salaries.

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requirements and borrowings by public enterprises, or between the financing capacity of households and the indebtedness of firms. But such relationships would presuppose--without actually specifying them--automatic adjustments of financial flows, and these in turn would imply that assumptions have been made with regard to the Treasury's policy and the behavior of financial intermediaries without any possibility of determining how much coherence there is between them, for lack of a complete forecast of financial operations.

Moreover, it is not sure that it would have been possible in this way to control the impact of financial variables on the value equilibrium or the physical equilibrium, and the financial forecast would thus have been merely an appendix of the physical and value forecasts. It therefore seemed wiser to introduce financial relations by means of accurately defined variants: some of the model's data (mainly each sector's rate of self-financing and the rate of household savings) are changed simultaneously and in a coherent fashion depending on financial assumptions. Let us briefly outline the principles underlying this method.

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Demand for and Supply of Capital

The starting point is the forecast of firms' financial accounts. Compatibility is established between interest payments and indebtedness, on the one hand, and distribution of dividends and issues of cash shares (the latter could either determine distributions or be determined by possible profit distributions, as the case may be).[9/] All the operations of each sector are thus fully compatible, which makes it possible to establish what the demand for foreign capital would be in each sector.

Here the question arises whether this demand for capital can be satisfied, and if not, what consequences this will have, especially with regard to self-financing and the investment. To get some indications as to a possible answer, we make assumptions concerning investments by economic agents, depending on their nature. Within the system of financial operations we describe the flows of loanable funds, taking into account the specialization of credit institutions, the existing regulations, and banking behavior.

9/ For a given level of self-financing, the possibilities of profit distribution determine--at least in the medium term--the distribution of financing between borrowing and capital (for given market conditions). See [2], pp. 196-199.

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We thus make assumptions with regard to the conversion of liquid savings so as to obtain a supply of capital subdivided by categories (issues of shares, bonds, different types of loans, etc.).

This work now being carried out is hampered by serious statistical difficulties. If the other parts of the model are to be influenced by financial behavior, it is necessary to know capital supply by sectors 10/ and clearly to specify the types of capital. This requires a fairly detailed description of financial flows.

Knowing the possible structure of the firms' indebtedness, especially the terms of loans, we can now study the impact of this indebtedness on investment and output, or on prices, as the case may be. This impact shows itself in various ways: change in interest and distribution of dividends, influence of the total amount of working capital on the fixing of wages and salaries (which, incidentally, is felt more strongly in the short term than than in the medium term), and, above all, compatibility between external

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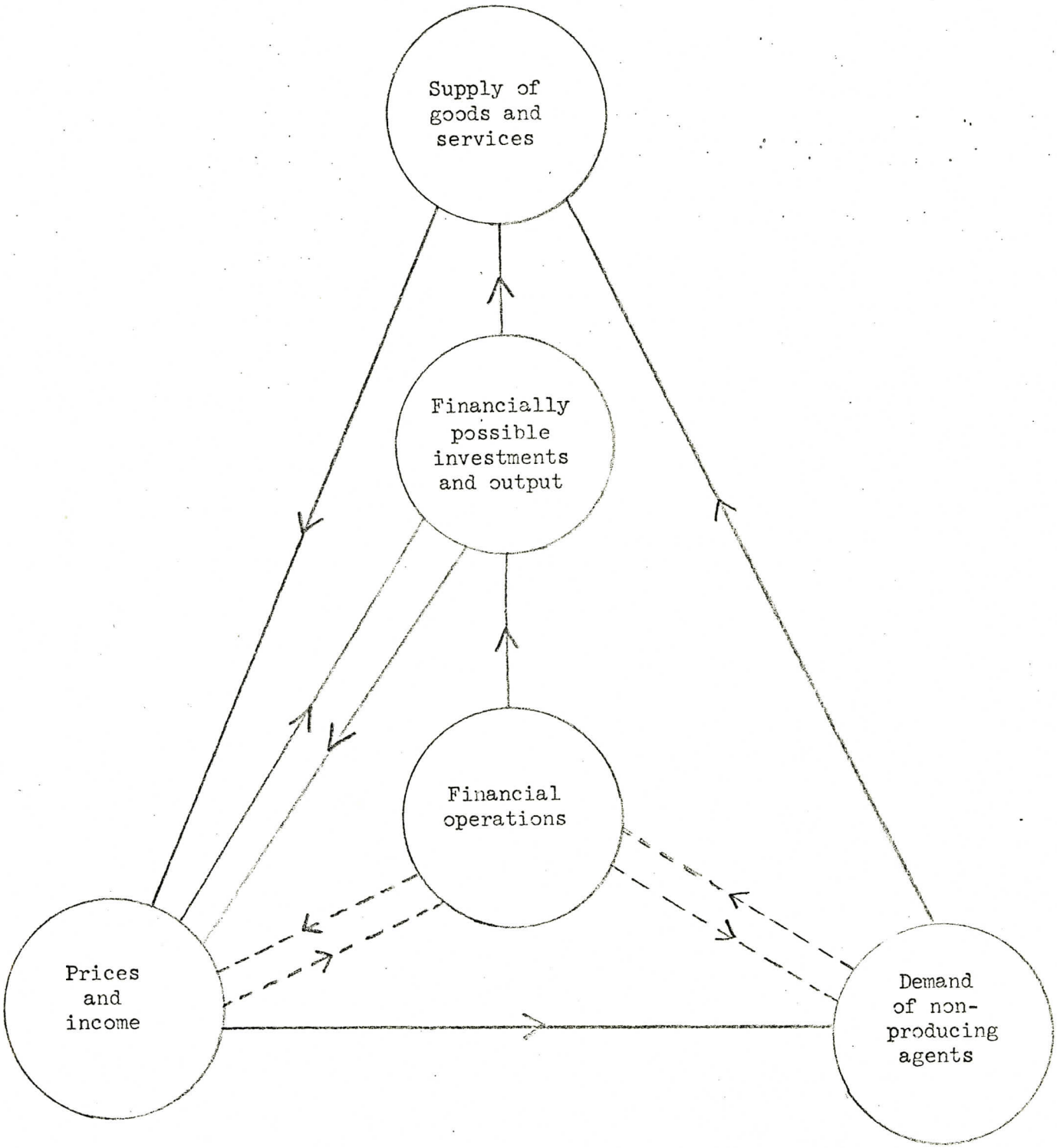
10/ It may be useful to distinguish, in each sector, between public enterprises, private companies, and individual entrepreneurs as they vary greatly in their behavior and their relations with financial institutions.

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financing and self-financing (/37, pp. 768-783). As we have seen previously, the firms react upon their prices or investments by changes in the rate of self-financing (desired or accepted).

The iterative process just described can be represented in a diagram which shows the complete structure of the physical-financial model. The structure has been only partly formalized at this point, and the present stage is one of theoretical reflection, collection of statistical data, and simulation of the principal patterns of reaction. The iterative process carried out manually, by correcting certain parameters of the model simultaneously and in a coherent fashion, makes possible a first analysis of the influence exerted by financial operations. With the experience thus gathered it will later be possible fully to formalize the integration of financial operations.

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Explanation of
Symbols: The dotted lines with arrows represent connections not yet fully formalized.

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3. ADAPTATION OF FIFI'S STRUCTURE TO THE SIMULATION OF BEHAVIOR PATTERNS

One of the important characteristics of the model is that it favors the unity of decision-making centers and makes possible a complete study of each of the big economic agents, owing to the establishment of completely integrated agents' accounts. With this method it is possible to take into account the coherence among the agents' different decisions, obtained step by step, without subdividing their patterns of behavior into different functions that are more or less loosely interrelated. From this point of view, the structure of the model is particularly well suited for describing the various behavior patterns, both of producers and users.

Producers' Behavior and Determination of Supply

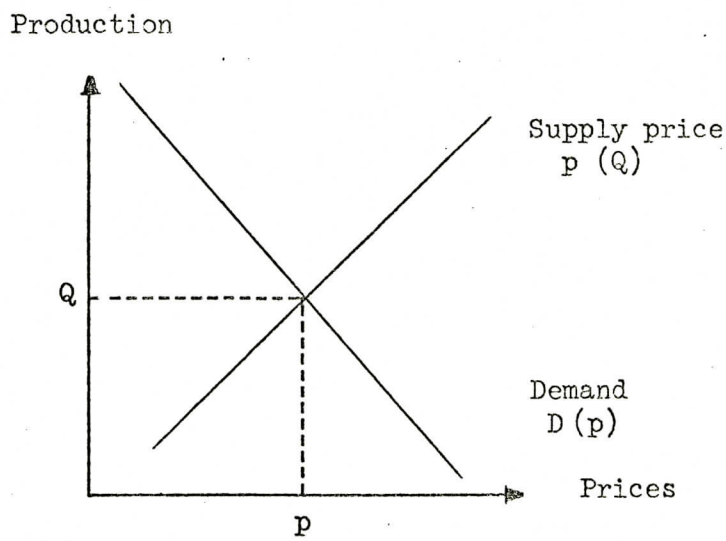
Considering first of all private enterprises (and leaving aside for the moment some individual sectors with which we shall deal later), we must distinguish between two fundamental situations:

If foreign competition is limited, production is determined by demand.

In that case, the producers' behavior consists in their searching (or at least it looks as if they were searching) for a price which would enable

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companies to finance out of their own resources a constant proportion of their investments--the latter being determined, technologically, by output--and which would at the same time make possible a satisfactory rate of increase in the incomes of individual entrepreneurs.[11] The model for determining production and prices thus corresponds to the following graph:



Any change in domestic demand leads to a marked change in production by domestic firms. Similarly, any variation in cost prices (or in the

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11/ This is more difficult in the case of sectors in which different categories of firms (particularly private companies and individual enterprises) co-exist. In this case it is necessary to consider the "internal" competition among such firms, and the resulting division of the market. See [2], pp. 71-73.

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desired profit margin) will, depending on a given demand situation, bring about a change in selling prices and will shift the equilibrium point along the demand curve.

If foreign competition is strong and controls market prices, domestic production depends on the competitiveness of French firms. On such markets there can be no major discrepancy between the prices of French and foreign producers, without a strong increase in the market share of one group at the expense of the other. Import prices (including customs duties) and production costs are the same except for structural effects (the structure of imports is different from that of domestic production). If prices are actually imposed on domestic producers by foreign competition, domestic production ceases to be a function of demand. Demand determines the total supply, rather than its domestic component. How is total supply divided between domestic production and imports? Enterprises no longer enjoy the same degree of freedom. Prices are imposed, and wages are determined by the situation on the labor market 12/ thereby determining profits for a given quantity of output (the tax system remaining unchanged).

12/ See page 31 for footnote.

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Since the behavior of the companies with regard to the distribution of dividends and the behavior of individual entrepreneurs with regard to savings is fairly rigid it determines the degree of self-financing which all private enterprises exposed to foreign competition can attain. In this

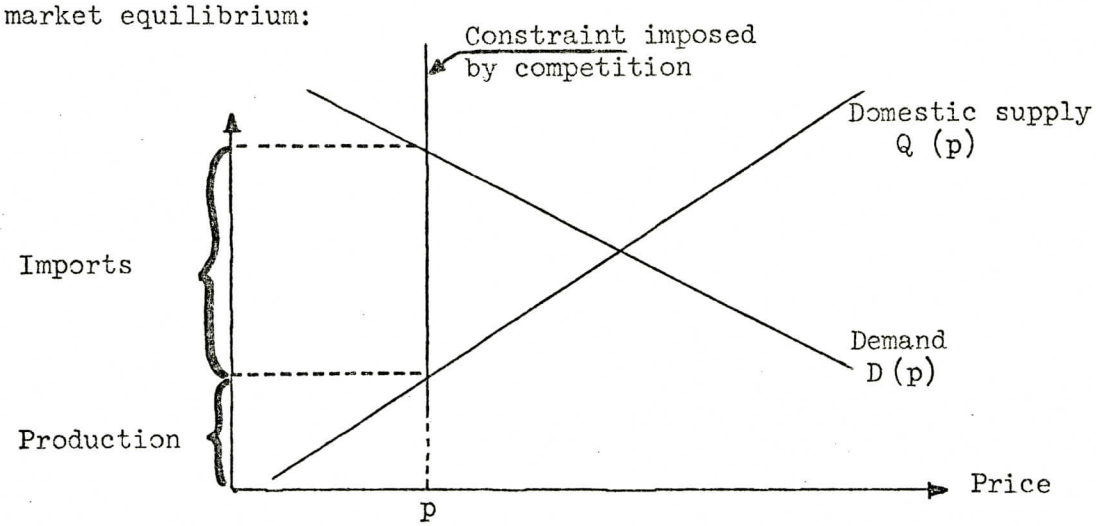
12/ Leaving aside any structural shifts and any brakes that may be applied by enterprises exposed to such competition, to which we shall come back later, the development of per capita wages is in this model a function of the general increase in prices and the situation on the labor market. This latter factor plays a very important role in the macro-economic mechanism by which the output of sectors exposed to such competition is determined. Their output is a function of the level of wages and, consequently, that of employment, but conversely the level of employment is determined by the level of output of the firms exposed to competition. These two variables are thus interdependent.

On the other hand, an autonomous trend shows the influence of factors not specifically taken into account (bargaining power of wage earners, importance of collective bargaining, distribution of the increases obtained within the leading sectors, etc.).

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case the self-financing behavior determines no longer the prices but production. The rate of self-financing which the firms consider necessary (this rate depends in part on the structure of the possible external financing [37]) determines the amount of investment that is financially possible and consequently, in the medium term, the available production capacity and the possible level of output. Imports fill in the gap to adjust supply to demand.

The "division of the market" between domestic output and imports thus depends on the competitiveness of domestic enterprises and the intensity of foreign competition. This gives us the following diagram for determining the market equilibrium:



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While this diagram is, in principle, a correct representation of the equilibrium that is obtained, it is too rigid to give an accurate description of reality. Therefore, certain elements of flexibility have been introduced into the model [4]:

The market price imposed by foreign competition is not constant. It increases with a rising share of imports in the domestic market, as foreign producers will tend to profit from favorable situations.

The domestic producers will not remain passive but will try to resist foreign competition by improving their productivity,[a] by accepting a lower rate of self-financing, and by trying to fend off any increases in wages (or at least to restrain them).

The two principal situations just described cannot, however, represent by themselves the diversity of all possible situations. In some cases,

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a/ For a group of firms, we must bear in mind that an increase in the pressure exerted by foreign competition can strangle marginal enterprises, thereby raising average productivity.

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production can result from the existence of an autonomous behavior pattern of producers, which is not related to any particular market (agricultural production in the model). It can also be strongly influenced by Government policy (in the model, rents as a function of the public authorities' investment policy).[b/]

The fixing of prices is also subject to certain regulations. Agricultural prices, for instance, depend on the common agricultural policy of the EEC, while other prices are instruments of economic policy (charges for community services, rents, administered prices).

There is in fact a great variety of situations and behavior patterns. Firms are therefore not treated as one single sector in Fifi but are

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b/ A similar case in the model is that of coal production which is a direct result of a Government decision--a compromise between economic necessities and social considerations. While this particular industry was not singled out in the nomenclature adopted for the different sectors, the assumptions made with regard to coal production, especially subsidies, are specifically taken into account in the process of projecting the factors of production and the accounts for the energy sector.

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subdivided into seven sectors.[c] This nomenclature, which is still relatively aggregative, is a compromise between the need for a certain degree of simplicity,[d] the desire for a good representation of reality, and the intention to study the fundamental problems of economic policy.

Users' Behavior Pattern and Determination of Demand

The sectoral analysis of the producers' behavior makes us understand the nature of the relationship between output and prices, and how the price determines the division of supply on the domestic market depending on the constraints imposed upon the various sectors. But the "supply price" does not become a market equilibrium price, and total supply is determined only after its

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c/ Fifi's nomenclature is the following: 1. Agriculture, 2. Farming and food industries, 3. Energy, 4. Manufacturing industry except building (sectors 4A-8A), 5. Transport and telecommunications, 6. Rents, 7. Building, services, trade (sectors 8B, 10B, and C11).

d/ In this first attempt at constructing a model, we did not want the model to be too detailed. The present Fifi model can therefore be considered as a prototype only. With the experience gained from Fifi it should now be possible to develop a more detailed model.

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confrontation with demand. The economic agents expressing this demand derive their income from the production process and from the transfer payments, the latter being determined by the Government's economic policy. e/ But the concept of demand varies with the agents. Thus, for the firms, investment demand is part of the behavior described above, while for the Government it is an instrument of economic policy, and for financial institutions it merely means operating expenses which, incidentally, are fairly low.

We will therefore limit ourselves to examining the behavior pattern of households, and will then turn to the determination of exports which play a somewhat special role in that they are not purely a function of demand.

Behavior Pattern of Households

We first have to determine the value of total household consumption and then, on the basis of this and with given prices, demand per product. Total household consumption is calculated by subtracting from total household income all expenses out of that income for purposes other than consumption.

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e/ These links are shown in the general economic forecast. Since they are highly dependent on the role of the Government we shall come back to them in the next chapter in which we describe how economic policy can be studied with the model.

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It could be argued that this method is not satisfactory and that households strive to raise their standard of living as measured by the increase in consumption. This would mean that consumption is determined first and that households try to adjust their incomes to the desired level of consumption. It should be noted that, while this behavior may exist, it still could not reverse the direction in which the link between consumption and income operates for all households taken together. Generally, it is not possible for households to determine the amount of their income. Only individual entrepreneurs in services and trade can to a certain degree fix prices at a level which is compatible with the desired increase in their standard of living. Wage earners, on the other hand, react in a more indirect fashion by exerting persistent pressure, varying in intensity according to the situation on the labor market, to obtain higher wages. This behavior is represented in the model by a major autonomous trend in the relationship determining the increase in the hourly wage rate.

Reactions to income are not the only ones. In the case of low-income households, the bulk of the income (except for mandatory expenses) is spent on consumption, the balance, if any, being held in the form of liquid funds.

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In high-income households, with incomes clearly above consumption expenses, the desired level of consumption is determined regardless of income, with savings constituting the balance. In these two extreme cases there is thus no real decision between savings and consumption. But as the model does not distinguish between various categories of households, it cannot show any differences in behavior resulting from differences in income (since all households strive to raise their standard of living).

With respect to certain expenses (such as income taxes and interest on housing loans) households have no option whatsoever. Their choice is mainly between savings and consumption. The savings behavior is reflected in the gross savings rate (ratio of gross savings to total revenue). In the pure Keynesian model this rate would be a constant[13/] or a rising function of income (as a result of a decreasing average propensity to consume). In addition to the predominant influence of revenue on the amount of savings we have

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13/ This is not an absolute constant. It varies with the population under consideration and depends, among other things, on the age structure and the distribution of income.

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have brought in two other factors so as to express the following two phenomena:[14]

1. The negative influence of prices on savings: the rate of savings declines with a rising consumer price index. We thus take into account the decline in the rate of household savings under inflationary conditions, as experienced in the past.

2. The effect of capital formation on the rate of savings.

In theory, the influence exerted by all forms of investment should be a function of their conditions and the rate of return on them. But in practice, it is difficult to assess the actual influence of financial investment (if there is such an influence at this general level). We have therefore limited ourselves to showing the influence of housing investment, which is positive. This means that a policy which stimulates housing investments by households will lead to a certain increase in the aggregate volume of their savings.

14/ These effects were introduced in successive stages. The relationship, with all its explanatory variables, has been estimated econometrically on the basis of the series of past national accounts.

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These relationships, which show the consumption per product for a given total consumption, result from the choices made by households. They are considered as laws of average consumption which explain the demand for each product on the market. In these laws, demand is expressed in terms of the value of each product as a linear, homogeneous function of total expenditure and of prices for all products [5]. These laws thus describe the proportion of total expenditure used for each product, and this in turn gives rise to an interesting interpretation of choices by all consumers taken together: a certain amount of inelastic expenses which correspond to priority needs is distributed in volume per product, regardless of the level of total expenditure and prices. This "unshrinkable" part of expenditure is a rising function of time and represents a certain proportion of the value of total expenditure. The difference between the "unshrinkable" part of expenditure and total expenditure is distributed among products according to their prices. This model thus describes a behavior which is different from that of the rational consumer in the theory of choices. The influence of prices is felt only in those expenses which are not considered absolutely indispensable.

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Exports

Exports at constant prices are determined by a function which is not so much a demand function but rather the result of competition for a share in foreign markets. It is, of course, true that foreign demand is an important expanatory variable in this respect,[15/] but the competitiveness of French producers compared to foreign producers also exerts a strong influence. This competitiveness is measured by the ratio between French production costs of export products and export prices on foreign markets, which are in turn linked to production costs of industrial products in these countries. To obtain a more complete picture of the French producers' behavior pattern, we also introduced an effect of pressure on exports arising from an increasing dynamism in foreign markets as their competitive position is improving. This effect is shown by a positive link between the increase in exports and that in domestic output. It is dampened by the negative influence of the rise in domestic demand since the search for foreign markets is less active when domestic demand is high.

15/ We shall see that the volume of exports is very sensitive to changes in foreign demand.

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This method of determining exports is, of course, open to criticism, but it was the only possible method since a general model of international trade was out of the question. In judging the results, we should therefore bear in mind that an aggressive attitude of French producers cannot bear fruit unless it expresses itself in a willingness on their part to establish themselves in foreign markets (creation of trade networks, of servicing agencies, etc.), and these are structural effects of which the model cannot assess either the cost or the effectiveness.

4. FORMALIZATION AND ECONOMIC POLICY

The formalization of an economic policy may give rise to a more or less concerted planning effort. But the final decisions are taken by the Government. In the model, these decisions appear in the economic and legislative relations between the Government and the public sector of the economy with the other agents. Since the Government pursues a large number of different aims and has many means of intervention at its disposal, and since the planning efforts must include a detailed study of both aims and means, the behavior of this agent, i.e., the Government, is treated differently from that of households and firms. 16/

16/ The reasons for this important property of this medium-term French forecasting model are explained in Part II.

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Decisions taken in the form of laws or regulations (e.g., rates of value-added tax, charges for community services, etc.) are expressed in the model by parameters related to Government institutions, while those decisions which are determined by current budget practice (e.g., collective equipment) are represented by exogenous variables. From the point of view of form, the use of these parameters and variables is thus entirely up to the person working with the model.

The Government's relations with the other agents are reflected in receipts and expenditures subdivided by categories of operations and combined in the general Government account. The complete forecast of this account makes it possible to assess the impact of the economic policy under consideration on the equilibrium in the public sector itself and, conversely, to take into account the constraints imposed upon economic policy by the principles of budget administration.

To understand the possibilities offered by the model, we shall examine the formalization properties so as to indicate which types of economic policy can be studied with the model.

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Methods for Studying Economic Policy

The general properties of the model, the classification of firms and administrative authorities, the graphic expressions of relationships, and the introduction of institutional parameters and variables--all these have been conceived in such a way that it is possible effectively to study a large complex of problems with regard to economic policy.

The general properties concern first of all the accounting framework. The fully articulated system of national accounts (combined with the complete interdependence of factors within the model's structure) makes it possible automatically to register a large number of repercussions, even very indirect ones, of an economic policy measure. This is an essential property since it is entirely impossible to understand these reactions and, above all, to assess their effect (e.g., consequences of a tariff policy) by partial reasoning or intuitive estimate.

On the other hand, there are many different instruments of economic policy, and future instruments are partly unknown since there may be drastic legislative changes. It is therefore impossible for any global model to introduce all of them. This is why the structure of the model was conceived

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in such a way that the detailed treatment of each operation is calculated independently from the others. It is thus possible, without prejudice to the major interdependent relationships and the degree of subdivision by agents, to change certain treatments (e.g., forecast of social contributions or each tax category) in order to take into account the effects of a new legislative decision as soon as it is known.

The classification of firms into seven sectors was partly due to economic policy requirements. It can be easily understood why agriculture and housing have been singled out. There is no special sector of Government enterprises, but the energy and transport sectors, in which they play a dominant role, are studied separately. It has been possible to go even further. The flexibility of relationships enables us to differentiate between price and wage developments of public enterprises from those of other enterprises in the same sector. For such operations as subsidies it is possible, by making certain assumptions with regard to the activity of these enterprises, to construct indicators for the growth of output, investment, etc. of these enterprises, depending on variables for the sector as a whole. We can then link the subsidies (and other operations) to these indicators and

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study the economic repercussions of certain problems within these enterprises (e.g., recession in coal mining, distribution of transport between rail and road) on the over-all equilibrium without studying them in every detail.

The classification of administrative authorities makes a distinction between the Government (in which the military budget is singled out), municipal authorities, semi-public bodies with economic influence, social security, and other administrative authorities. This subdivision makes it possible to study in a summary fashion such problems as the division of responsibility in investment or capital projects, depending on the equilibrium of local communities, the consequences of different administrative regulations concerning social security, and the impact of a policy of reducing or increasing the budgetary deficit according to the use that is made of such reduction or increase.

The graphic representation of relationships is intended to ensure the greatest possible flexibility in using the model. This concern is reflected in two characteristics: firstly, it is possible to calculate a variable by using several types of links depending on the policy applied (e.g., the development of per capita wages and salaries in the civil service may run

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parallel to that of private wages and salaries in the same sector or may be linked to it by a sliding mechanism, or it may be completely exogenous). Secondly, there are relationships for the calculation not of the value of a variable in the future but of its variations in terms of an exogenous average value, depending on a change in an economic policy assumption or a reaction caused by such a change (e.g., relationships between productivity of labor, working hours, and unemployment enable us to take into account any changes in productivity brought about by a policy of reducing working hours or by a change in the employment equilibrium). We thus get an impression of the flexibility and diversity of agents' reactions when small changes occur in the economic equilibrium situation.

The different institutional parameters representing the principal means of an over-all economic policy are introduced into the calculation of the operations which they influence (e.g., rate of the value-added tax, elasticity of the personal income tax with regard to household incomes, ceilings and rates of social contributions). A special effort has been made for prices. The cost of using a given product can be determined by exogenous factors, and may be adjusted according to the users of the product in the

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form of an absolute or relative deviation from an average cost of utilization. This enables us to obtain better price forecasts and to study selective policies (e.g., rates for merchandise/passerger rates, high voltage electricity/ low voltage electricity). For the same purpose, production costs can, where necessary, be determined exogenously. The model also provides for random variables to establish certain links which it does not verify automatically (e.g., link between the rate of household savings and that of self-financing to show the consequences of an expansion or restriction of long-term capital supply).

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TYPES OF ECONOMIC POLICIES

To recapitulate Fifi's characteristics, it is useful to give a survey of the main policies likely to be studied with this model, classifying them according to the type of means of intervention.

Autonomous demand policy: Investment and consumption of administrative authorities with a study of the division of responsibility in contracts between the Government and local authorities. Housing.

Fiscal and "parafiscal"*/ policies: All major categories of indirect and direct taxes are separated, and their amounts are calculated for each sector and for each of the other agents. This makes it possible to study relatively specialized and selective measures. The same applies to social contributions for which all customary instruments (rates, ceilings) can be used.

Price policies: The treatment and adjustment of prices according to users make it possible to study special policies with regard to charges for community services, policies of subsidizing agricultural prices, and policies of price control.

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*/ Tranlator's Note: "Parafiscal" policies concern taxes levied by means of regulatory powers and independent of legislative control.

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Transfer policies: The treatment of subsidies makes it possible to study the latter for Government enterprises and agriculture. Social security payments (forecast by categories according to parties entitled to them) and public assistance constitute the bulk of transfer payments to households.

Income policies: The different alternatives for treating incomes of agricultural and non-agricultural individual entrepreneurs, on the one hand, and wages, on the other, facilitate the formulation of general policies in this field. It is possible to study standard policies for the different income categories, policies concerning the relative development of civil service wages compared to that of private wages, and policies of subsidizing agricultural income.

Financial policies: As we have seen, these can be studied only by "simulation" of partly formalized relationships. The results are less accurate than those obtained for the other types of variants. With this reservation, it is possible to study the more general consequences of major trends with regard to the stimulation of capital supply, intervention by the Treasury, and conversion.

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II. PRINCIPLES GOVERNING THE USE OF THE MODEL

How should the results of the model be interpreted? What meaning should be attributed to the variants? Can the variants be compared with one another? To throw some light on these difficult questions it is important to understand the exact meaning of each economic equilibrium defined by the results (in figures) obtained from the model. These results correspond to a given set of assumptions and are affected by various uncertainties the nature and scope of which we have to determine. We must therefore evaluate the probability and accuracy of the forecasts, as well as the risk that real developments might turn out to be different. In our preparatory work for the Plan we then have to develop step by step an economic policy aimed at solving the problems that have been revealed, or at least mitigating their damaging consequences. It is therefore necessary also to show how the Government's policy may be taken into account in the model and how its effect on the over-all equilibrium may be analyzed.

1. UNCERTAINTY

Uncertainty is apparent both in the description of the various behavior patterns attributed to the economic agents and in the quality of the specific

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relationships of the model, as well as in assumptions with regard to the development of exogenous magnitudes forecast directly. The complexity of the simultaneous interaction of relationships makes it impossible to assess directly the size of the impact which this uncertainty has on the results. To measure this impact in quantitative terms it is first of all necessary to determine an initial equilibrium for the forthcoming year, on the basis of an accurate representation of behavior patterns. This equilibrium, referred to as initial account, serves as a point of reference for assessing the area of uncertainty and outlining possible situations, on the basis of a study of shifts in the equilibrium. We shall now analyze each of these stages.

The Concept of Behavior and its Ambiguity

We saw in Part I how the representation of behavior patterns contributed to the development of the model's structure. Let us recapitulate their main characteristics.

We more or less assumed in the model that firms and households, which are largely autonomous agents in our decentralized economy, apply decision-making rules which together constitute a type of behavior for each agent (or each subagent). These decision-making rules express the way in which the

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agents put their plans into action, taking into account any risks they run in view of future uncertainties and any constraints imposed upon them by their environment. The firms fix their prices in such a way as to maintain their rates of self-financing at a desired level or react, according to given "laws", to pressures on prices exerted by foreign competition. The amount of savings by households is a function of their incomes, consumer prices, and their housing investment.

These "laws" of behavior do not imply any rigidity of behavior. On the contrary, the behavior pattern varies with different situations. Thus the level of indebtedness considered acceptable by firms varies according to the intensity of competition, the situation on the financial market or the lending policies of financial institutions. The firms will fix either their prices or the amount of their investments, depending on whether or not they are exposed to international competition. Households' savings out of their incomes vary with the level of prices and the amount of housing investment.

In the model, as in the national accounts, the foreign sector is not treated as an agent. Besides the fact that it is extremely heterogeneous, it is impossible to define its behavior since we never study its over-all

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activity but only its relations with France. The foreign sector is merely an account that reflects all assumptions defining the international environment of the French economy. These assumptions are based on an empirical assessment of the probable trends in the development of the principal global economic magnitudes in Western countries, rather than on a detailed analysis of international economic relations. These assumptions having been stated, however, the model describes the division of the French market between domestic and foreign producers, which results from an adjustment process determined by their relative competitiveness.

As to the administrative authorities, to which we shall come back later, it is assumed in the model that one central body has full control over their activities or at least that part of their activities which the model describes. Consequently, instead of determining a priori its own rules of action, this agent is in fact the decision-making power in the model. Each of the parameters which stand for its behavior can be determined independently from the others.17/

17/ The Government is actually the central decision-making power. The other categories of administrative authorities follow the rules which are laid down for them by institutional provisions or which result from their different types of behavior.

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It is important fully to understand the nature of the assumptions which enable us to describe various behavior patterns in this model. There are many reasons for questioning the existence and medium-term duration of the decision-making rules used in it.

From Individual "Behavior" to Aggregate "Behavior"

First of all, any reference to decision-making rules in a macro-economic model presupposes the existence of homogeneous groups of agents, and thus of an adequate subdivision and level of aggregation. But the concept of the agents' homogeneousness, or of the unity of the decision-making center underlying the model, is more statistical than sociological in nature. Even if we go into the smallest detail, we cannot hope to cover in the model any groups with a behavior pattern the inner logic of which--as described by a set of decision-making rules--would be impossible to explain. The behavior patterns used in the model--at whichever level of aggregation--are those which have in the past shown a fairly reliable statistical stability. It is, however, preferable to keep these various behavior patterns at a rather advanced level of aggregation since the validity of the statistical laws discovered would be affected by any major change in the composition of the groups studied. Thus

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the rate of total household savings is a statistical result which is misinterpreted in a forecasting model as expressing a specific behavior.

This assumption becomes particularly risky when we try to attribute a specific meaning to any change in this rate. Such a change can imply a change in the distribution of income with a constant savings behavior in each category of household, rather than a change in the individual decision-making rules. We could even ask ourselves whether this savings behavior pattern does in fact exist for certain categories of households with particularly low levels of income, or whether total consumption is fixed directly with savings being merely a residual quantity which is the first to be affected by changes in income.

In addition to the difficulties arising from the "subdivision" of the agents into categories with homogeneous behavior, it is important to understand some implicit postulates.

In speaking of medium-term behavior, we imply that such behavior patterns are stable or develop in a continuous fashion, that there are medium-term laws, and that any given business situation represents a deviation from these reference trends. But in actual fact all of this is part of an economic

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system the change of which is not analyzed by the model. The assumed behavior patterns must, however, be linked to a nucleus of an analysis of this type outside the model. They cease to be valid if any major changes occur in international relations, if there are any changes with regard to the distribution of capital and the resulting forms of business administration, or if there is too large a discrepancy between the actual and expected rate of growth of production capacity. The total set of these assumptions and, consequently, that of the various behavior patterns resulting therefrom, determine the general conditions of economic interactions within the structural framework of the model. Any major misjudgment in this respect creates a profound uncertainty which is extremely hard to measure.

This uncertainty is aggravated by the difficulties arising from the observation of past behavior. In most cases, past behavior is not determined directly by corresponding research in the groups concerned but is established on the basis of ex post equilibria which indicate the results of interactions among various types of past behavior. Between the intentions of individuals and groups and their final actions as shown in the accounting equilibria, the constraints of the economic environment have exerted their influence. In

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directly interpreting a flow of expenditure or a price increase we do not explain a pure behavior but the result of a compromise.

In constructing the model we are thus forced to treat those reversible relationships in which neither cause nor effect are discernible as explanatory ones. The relationship which enables us to determine the average hourly wage rate thus represents the end of an adjustment process on the labor market in which the explanatory variables express neither the influence of supply factors nor that of demand factors but a combination of the two reflecting the final relationship between the two forces. To get around this difficulty we avoid, as much as possible, applying econometric adjustments to relationships that are the direct result of comparisons between groups of agents. The better the quantitative expression of the constraints (e.g., foreign competition, monopoly prices, financial disequilibrium, etc.), and the more detailed the description of the agents' reactions, the higher the quality of the model.

Determination of an Initial Account for 1975

By incorporating laws of behavior for households and firms as a result of price studies, by making conventional forecasts of the items in the administrative authorities' account without worrying, at this stage, about whether

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they constitute the quantitative expression of a global economic policy adapted to the problems of development, by making hypothetical forecasts with regard to the international environment, and by extrapolating certain trends, in particular those which concern physical growth factors, we obtain a global set of assumptions, relationships, and results which, after some further adjustments have been made constitutes an initial account.

This account shows how the simultaneous interaction of the behavior of households and firms as observed in the past can bring about situations which are unacceptable without an appropriate economic policy. It shows in particular that in the presence of strong international competition and without the benefit of a faster rate of technological progress, these behavior patterns are incompatible with a passive attitude of the Government which would be characterized by a rate of expenditure similar to that observed in the recent past, the maintenance of existing fiscal legislation except in the case of the tax on income where abatements are tied to the development of the general price level, and a certain restraint in transfer payments to Government enterprises. It also indicates a number of uncertainties, especially threats of price increases and of disequilibria in current payments despite an insufficient rate of growth.

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Thus the initial account established on the basis of these assumptions does not seem plausible, and this is hardly surprising in view of the fact that the adjustment of behavior to changing circumstances is not an automatic process. But we can now see how important it is to draw up an initial account. To obtain this first image of the future economic situation, it was necessary to commit an act of violence, that is, to disregard all uncertainties with regard to behavior, international environment, and technological progress, and to adopt an economic policy which is realtively independent of these new economic conditions. An initial account is, however, an indispensable link in our system of exploring the future. It shows us the significance and scope of the problems and enables us to find out where the assumptions do not hang together and, as a result, in which direction we have to go to get within the range of possible situations. It thus constitutes the point of reference for investigating shifts in equilibrium and discovering ways and means of obtaining satisfactory solutions.

Two Types of Uncertainty

The accuracy of the initial account is in part illusory. To find out whether the problems raised are in fact the problems arising in the medium

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term, it is necessary to establish whether, and to what extent, the developments about which we are concerned did not result from a misjudgment of behavior or of the general environment of the economy during the period under consideration. We therefore must determine how the principal variables of the model would be affected by different sets of assumptions. The uncertainties stem either from our imperfect knowledge of past reality or from our lack of knowledge with regard to new factors that may influence future behavior patterns. The distinction made here between two types of uncertainties is not a natural one but is merely of methodological importance for a model with a limited scope for explanation (we are not talking here about the problem of the degree of determinism in the development of the economic system).

1. The model has been constructed on the basis of an observation of the past which was limited to one particular field (essentially national accounts) and thus constitutes a set of imperfect elements. The relationships between variables do not always express causal links but can implicitly depend on factors outside the range of the variables observed (we have already mentioned the case of the average hourly wage rate). We can thus understand that there is a certain vagueness about all relationships used in the model and a

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certain inaccuracy in all estimates, that some relationships were given priority over other, no less likely, relationships, and that certain important phenomena had to be disregarded.

The global analysis of physical growth factors, for example, tells us not to study the links between changes in the unemployment rate and changes in the distribution of labor according to levels of qualification. Nevertheless anything can be improved a priori. The inaccuracy in any representation of economic reality is inevitable, but it can be reduced. Once our model has been devised it is important to determine the degree of this inaccuracy.

2. As we have seen, the model provides us with forecasts in a changing economic system. But for the model, these changes which it cannot describe constitute uncertainties. To determine an economically possible situation in the future we therefore have to develop a method of using the model and interpreting its results. We have to demonstrate that there is a certain compatibility between the behavior of autonomous agents and the decisions of the public authorities, taking into account the uncertainties relating to the international environment and the physical conditions of growth.

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This means that the model does not automatically provide us with the economic coherence we desire. This coherence requires more than merely verifying the various instances of interdependence expressed in the equations of the model.

It is possible to modify certain relationships which reflect an agent's reactions to given constraints or compromises between antagonistic forces in given structures. We assumed, for instance, that the way in which the average hourly wage rate is determined could be changed by new conditions in the labor market. To take another example: an increase in the rate of technological progress is likely to be accompanied by a behavior of enterprises reflecting a constant concern to keep costs down and a tendency to expand their fixed capital faster than production--effects which are not covered by the model.

These examples suffice to demonstrate the influence exerted by structural factors on the variables included in the model. This is reflected in the values of exogenous data (e.g., productivity of labor, coefficients of the relationship between wages, prices, and unemployment rate). We therefore try to establish a certain coherence between these data, the constraints which they represent, and behavior. This means that we establish genuine implicit relationships which make the model richer than we would assume from its formal structure.

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Quantitative Expression of this Uncertainty

Economic coherence as we understand it is not fully covered by the model and is thus not automatically achieved. An equilibrium provided by the model, which fails to verify any constraints not covered by the model (because they are not fully understood or because the agents' reactions are unknown) is referred to as a virtual equilibrium. Thus an equilibrium may be called virtual if it does not fall within the range of possible economic situations.

We have shown what, in our opinion, puts the initial account into this category. To understand the extent to which this is true we must make a full study of equilibrium shifts caused by uncertainties. It is very difficult to give a correct definition of these variants of uncertainty. Those which are purely technical and consist in determining the degree of vagueness with regard to any particular specific relationship hardly present any problems, while the opposite is true of those which are aimed at speculating on the nature of implicit relationships induced by structural changes.

The difficulty lies at the level at which the variant is defined. These variants cause shifts around the initial equilibrium situation. Such shifts can be virtual because the initial equilibrium is already outside the range

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of possible situations. Nevertheless, a shift around a virtual equilibrium can reflect a very real effect.

Two Simple Examples

Two simple examples of variants of uncertainty may help illustrate the preceding remarks.[18/] We do not wish to describe here the mechanisms by means of which the new equilibria are obtained, but rather to determine the extent to which some uncertainties may affect our assessment of the initial account.

First example: Uncertainty with regard to the international environment.

Let us take two variants as an example: one (V1) in which foreign prices are assumed to rise faster than in the initial account (3 per cent instead of 2.5 per cent per year), and another (V2) in which expansion and price increases in foreign countries are assumed to be slower than in the initial account (3 per cent instead of 4 per cent per year for GDP growth, 2 per cent instead of 2.5 per cent for the increase in prices). The main results are shown in Table 1.

18/ For a combined representation of the results of these variants we select the principal global indicators and indicate the deviations of these variables from their values in the initial account.

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Table 1. Two "Foreign" Variants

V1 = more rapid increase in foreign prices (3 per cent instead of 2.5 per cent per year).

V2 = foreign expansion and price increases slower (3 per cent instead of 4 per cent per year for GDP, 2 per cent instead of 2.5 per cent for prices).

	Deviations from initial account	
	V1	V2
Annual rate of GDP growth (in per cent)	+0.08	-0.45
Annual rate of increase in household consumption (in per cent)	+0.03	-0.29
Number of persons seeking employment [1] (in thousands)	-55	+205
Annual rate of increase in the general price level (in per cent)	+0.19	-0.34
Annual rate of nominal wage increase per capita (in per cent)	+0.20	-0.56
Industrial exports (in billions of francs 1965)	-0.6	-18.4
Industrial imports (in billions of francs 1965)	-3.6	-7.6
External financing capacity [2] (in billions of francs 1975)	-3.4	+11.1
Administrative authorities' financing requirements [3] (in billions of francs 1975)	-3.2	+10.8

1/ Defined in the census as unemployed persons seeking employment, including young persons seeking employment for the first time, adults having lost their job, and women or older persons seeking employment.

2/ Approximately equal to the deficit in the current balance of payments.

3/ Deficit of nonfinancial operations of all public administrations (the other administrations' account of nonfinancial operations is always approximately balanced).

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In the initial account, imports make up a major part of the domestic market, thereby causing a large deficit in the balance on current account The first variant shows that these conclusions are not drastically changed if the rise in prices, which has been particularly rapid in the United States since 1965, continues at the same rate as in the preceding years.

The second variation does not study the process of propagation but showns that a persistant slowdown of growth in at least one of the large industrial countries in the West would have far reaching deflationary effects on the French economy, while strongly increasing the deficit in the balance of payments and in public finances. If there is no coordination between the major countries with regard to their anticyclical policies, it seems doubtful whether a domestic economic policy using conventional methods could eliminate such disequilibria without seriously threatening growth. This shows very clearly how sensitive the development of the French economy is to the development of foreign economies. In noting this, we regret the oversimplification in the definition of these variants which are here considered as pure random values. The reason for this is that the foreign sector is not well covered by the model and, above all, that there

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is no synthesized representative of international relationships. The definition of such variants the purpose of which is to study the rigidity of constraints imposed by the international environment upon the French economy, should result from a detailed analysis of such possibilities as an international financial crisis, difficulties (more or less serious) with regard to European integration, or various possible reforms in the exchange system. The definition of these variants would then result from a work which can hardly be done without detailed research based on a set of relationships outside the model.

Second example: Uncertainty with regard to the productivity of labor.

The two variants described below are defined as follows: in the first (V3) the rate of productivity growth is assumed to exceed that which is indicated in the initial account by 0.5 per cent per year, this surplus being equally distributed among all industries.[19] In the second (V4), an increased productive investment effort is linked to the same assumption of a favorable development of productivity.[20] The main results appear in Table 2.

19/ Except agriculture and housing.

20/ The rate of productive investment (ratio of productive investment to value added) shows an average increase of 1 per cent above its value in the initial account.

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These variants are not based on detailed studies of the determinants of productivity. But they justify such studies because they show that changes in productivity have a major impact on the principal variables, particularly on the equilibrium of operations with foreign countries. The first represent the very type of a sensitivity variant. Increases in productivity in excess of those forecast in the initial account are obtained without any additional cost. The variantial shift represents the higher margin of error which we have to accept if it is assumed that the rate of productivity growth is known to within 0.5 per cent only.

The second variant is of greater economic significance. The 0.5 per cent deviation can be interpreted as a possible result of the firms' reaction to increasing international competition. Seen thus, the additional increases in productivity entail additional costs. To define such a variant we must make assumptions as to what factors are causing the increase in productivity, and try to establish what measures would modify these factors in the desired direction. In the V4 variant we have limited ourselves to assuming that the growth in productivity was linked to an increase in the rate of productive investment which enterprises have to finance with the same self-financing

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Table 2. Two "Productivity" Variants

V3 = autonomous increase of the rythms of productivity (0.5 per cent per year more than in the initial account).

V4 = same increase with an increase in the rate of investments of the productivity (1 per cent higher than in the initial account).

	Deviations from initial account	
	V3	V4
Annual rate of GDP growth (in per cent)	+0.33	+0.30
Annual rate of increase in household consumption (in per cent)	+0.25	+0.20
Number of persons seeking employment 1/ (in thousands)	+40 */	+70 */
Annual rate of increase in the general price level (in per cent)	-0.36	-0.30
Annual rate of nominal wage increase per capita (in per cent)	-0.10	-0.16
External financing capacity (in billions of francs 1975)	-9.0	-5.8
Administrative authorities' financing requirements	-4.5	-4.1
Rate of increase of industrial output (in per cent)	+0.7	+0.6
Industrial exports (in billions of francs 1965)	+4.2	+4.0
Industrial imports (in billions of francs 1965)	-5.1	-2.5

1/ See footnote 1/ of Table 1.

*/ It should be noted that this variant is based on the assumption of a uniform growth of productivity in all industries. If this growth occurs only in the manufacturing industry, the model will show a slight decrease instead of an increase in unemployment. In any event, a greater degree of equilibrium (external payments, government's financing requirements), if sufficient, will lead to an increase in demand and, as a result, in employment.

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behavior. It can be assumed that the variantial shift is virtual to the extent that there are any doubts as to the implicit relationship between the productivity of labor and the rate of productive investment, and that there is reason to believe that it involves other factors.

We can now understand why a systematic study of these variants of uncertainty is of great interest: it draws our attention to the existence of relationships outside the model. The difficulty arises from the fact that implicit relations are not discovered progressively. The study of virtual shifts causes us to examine the meaning and intensity of these links.

In addition, these variants give some indications which are valuable for the study of economic policies. We shall see later that the effectiveness of these policies depends on the situation which they are intended to change. A realistic assessment of the economy's sensitiveness to possible changes enables us to guide the Government's decisions in the right direction and to adjust them later to the discrepancies between actual observations and the estimates on which they were based. This shows that the achievement of a possible economic equilibrium is the result of thorough research based on the study of a large number of virtual shifts.

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2. ECONOMIC POLICY

In a macro-economic study, we can consider the Government as one single decision-making center related to each of the other agents and having at its disposal numerous means of intervention which have a major effect on the global magnitudes. If it can be assumed that the concept of behavior as defined earlier applies to the Government, its representation in a model might well be reduced to nothing more than a sketch, thus detracting from the model as a whole. The total complex of rules concerning decisions which the Government may adopt in a given situation is vast and of course strongly dependent on the Government's general line of policy. An accurate advance knowledge of this complex, which would be required for the formulation of policies, is thus impossible. In a forecasting model designed to throw some light on the main political alternatives which are characteristic of the options under the Plan we are therefore obliged to give priority to the study of Government actions as a means for determining acceptable situations.

How to Describe Government Action

As we have seen in Part I, the solution adopted consists in introducing instruments of economic policy with as much precision as the degree of detail

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in the model will permit. The institutional rules are formalized as accurately as possible,[21] but their simultaneous application, which constitutes implementation of a policy, cannot be considered as being the result of an automatic reaction to certain constraints. The only elements that are automatic in the model, once the rules have been laid down, are changes in receipts and expenditure due to increases in income. The problem is, of course, a complex one since the Government's behavior is not entirely flexible. The administrative rules which the Government may impose upon itself and which are difficult to violate (adjustment of various significant amounts), are important factors determining the rigidity of the Government's behavior.

This problem cannot be solved all at once by one model but rather by a systematic study of decision-making rules and their consequences. The use of the model in such a study requires close contact with the political authorities. Only this contact makes possible the gradual discovery of aims and decision-making rules. To use the model in this way it is further necessary to prepare detailed analyses of Government action so as to reveal any constraints imposed on it, and to make special and thorough studies to obtain a detailed description of its methods of intervention.

21/ It is even possible, without changing the structure of the model, to take into account any new--or not initially envisaged--institutional provisions.

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The preceding remarks help us understand the procedure to be adopted:

While the initial account is being prepared, primarily with an eye to the future, targets, constraints and degrees of freedom are unknown (or not well known) since, after all, the initial account is intended to be the starting point for thinking about these problems. But the Government is, of course, included in this forecast. Since the initial account is to serve as a point of reference for determining the principal trends of the economy until 1975, the Government's economic role in this account must be clearly specified. We therefore assume that all operations directly governed by laws or regulations are to be described on the basis of a constant legislation (the most recent one), except for income tax, and that all those which are determined by current budgetary practice are to be considered as continuing along recent trends ("recent" meaning 1965-1970). We can thus say that in the initial account, the Government's action is by its very nature not adapted to the economic situation described by this account.[22/]

22/ A posteriori it would be conceivable that the continuation of past policies might result in balanced growth, but this would, to say the least, be surprising in a rapidly developing society.

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The study of the public authorities' general aims and of the economic policies by which these aims may be reached causes us to make systematic use of the model. We therefore examine groups of so-called "economic policy" variants so as to define, in a gradual process, coherent economic policies adapted to the aims pursued. It should be pointed out, however, that the model can be helpful in choosing adequate means of action and determining their medium-term effects, but that it cannot indicate at which stage in the economic cycle the policy measures should be implemented, since the problems of disequilibrium and restoration of equilibrium, which are characteristic of the business cycle, are not covered by the model. The model's purpose is to work out economic policy trends but the exact timing of policy measures must be determined by other methods.

For a correct understanding of the impact of these actions by the public authorities it is important to make a distinction according to whether or not they affect the other agents' decision-making rules.

Intervention Not Affecting the Other Agents' Decision-Making Rules

The Government can first of all implement a policy which changes the economic equilibrium without, however, affecting the other agents' decision-

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making rules. The meaning of variants thus defined is quite different from their meaning in the virtual shifts due to uncertainty, described earlier. In the virtual variants, all agents, including the Government, behave in a given fashion, and changes of situation do not cause the agents to react in an appropriate manner.[23/] In this case, the equilibrium shift results from an agent's action. This intelligent action produces an economic continuity. All intermediate equilibria between the two extreme points of the shifts are solutions of the model. The variantial shift here is a real shift. Even if such a variant does not enable us to return to the range of possible developments, it can mitigate considerably any developments considered alarming and may thus be used within the framework of a general policy.

As an example to illustrate the preceding remarks, let us consider what happens if the Government abolishes the employment tax paid by nonfinancial enterprises subject to the value-added tax, and that this is offset by an increase in the value-added tax so as to keep constant the over-all tax

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23/ These reactions may be nonexistent (as in the case of the Government), or may reflect vague assumptions concerning links between behavior and structural phenomena.

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burden (and, consequently, tax receipts for a given level or production). Let us briefly examine the effects of this measure on the assumption--as indicated earlier--that it does not lead to any changes in the agents' decision-making rules described in the model.[24/]

For any firm exposed to foreign competition, prices are in fact determined by the market and competition. In the medium term these firms' output depends on their investment possibilities and their self-financing rate. Abolition of the employment tax thus enables the firms exposed to competition to increase self-financing, investment, and, in the medium term, production--at the price, without value-added tax, that is determined and fixed by foreign competition. The V5 variant thus corresponds to a policy of expanding supply [4] the results of which are shown in Table 3. As the table indicates, such a policy simultaneously promotes growth, employment, balance of payments equilibrium, and the equilibrium of public finances. There is a marked increase in prices, but this is offset by an increase in wages and other income.

24/ The opposite assumption will be described later.

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Table 3. Policy of Expanding Supply

V5 = abolition of employment tax for nonfinancial enterprises subject to value-added tax 1/ offset 2/ by an increase in the value-added tax 3/

	Deviation from initial account 4/ V5
Growth:	
Annual rate of GDP growth (in per cent)	+0.07
Annual rate of increase in household consumption (in per cent)	--
Number of persons seeking employment 5/ (in thousands)	-42
Prices-Wages:	
Annual rise in the general price level (in per cent)	+0.18
Annual rise in consumer prices (in per cent)	+0.20
Annual rise in average per capital wages (in per cent)	+0.18
Administrative Authorities:	
Total tax burden (in per cent of GDP)	--
Financing requirements (in billions of francs 1975)	-2.7
Foreign Sector:	
Financing capacity (in billions of francs 1975)	-3.2
Industrial Sector 6/ [Manufacturing industries 7/]:	
Annual rate of production growth (in per cent)	+0.20
Imports (billions of francs, 1965 prices)	-2.9
Exports (billions of francs, 1965 prices)	+0.5

1/ For nonfinancial firms partly subject to the V.A.T. the wages tax will be abolished in part only (in proportion to the amount of turnover that is subject to the V.A.T.).

2/ Globally neutral in 1975.

3/ The different rates are assumed to grow homothetically.

4/ The growth rates are average growth rates for the period 1965-1975. The absolute magnitudes or the ratios are related to 1975.

5/ See footnote 1/, Table 1.

6/ Iron and steel industry, heavy industry, constructional and electrical engineering, chemical and rubber industries, textile, clothing, leather, timber, miscellaneous industries, construction material. Not included are agriculture, food industry, energy, public building industry, and public works.

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While this policy leads to a marked decrease in the deficit of the balance on current account (by about F 3 billion in 1975), it cannot eliminate the major disequilibrium in the initial account. But it can be one of the leading elements in an over-all policy.

Intervention Affecting the Other Agents' Decision-Making Rules

This is a second type of intervention. Everything we said in the last chapter about the meaning of the variants is a fortiori also applicable to this type of intervention since here we are trying to take into account, in addition to other factors, the interaction between the Government's decisions and the other agents' behavior. The average behavior of the other groups of agents can be affected by the Government's decisions in two ways:

Firstly, the Government's decisions can influence the structure of the group which is considered as an homogeneous agent in the model. Thus, for instance, a major change in the policy of social transfer payments may lead to changes in the distribution of income, and these in turn may affect the savings rate, even if the savings behavior of each household category remains unchanged.

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Secondly, these decisions can change the behavior of each homogeneous agent taken as a whole. If we assume, for instance, that the scale of interest rates is sensitive to changes in the discount rate, any change in the latter may lead to a change in the level of savings for each group of households and firms.

The reactions to Government intervention are not always of a beneficial nature. Far from enhancing the expected effects of the policy adopted, they may in some cases present risks the scope and likelihood of which must be determined.

Before deciding on an economic strategy it is therefore imperative to consider the (uncertain) reactions of the economic agents to any drastic change in their environment. This gives us an idea of the gamut of the possible effects of a given measure.

Thus the results obtained by means of the V5 variant cannot be put into practice automatically, particularly if the changeover from the employment tax to the value-added tax is not a progressive but a sudden one. How can the agents react to this? Will the firms sheltered from international competition not take advantage of the abolition of the employment tax to increase

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their profits and earnings, rather than lower prices? We would then have a stronger price increase than expected (see Table 3). Furthermore this attitude could lead the wage earners to raise their wage claims. If these claims were met inflationary pressures would be stronger.

In these two cases, are the conclusions reached in the preceding paragraph changed? Does the measure under consideration continue to be of interest despite the risks involved, or will it have to be dropped? The results of the two variants which include the possible reactions of economic agents are shown in Table 4. As we can see, there is still a considerable improvement in the balance of payments and in the equilibrium of public finances, while in all cases we find a certain decline in unemployment and a slight increase in the rate of growth.

After examining the results of these variants we still come to the conclusion that the abolition of the employment tax, offset by an increase in the value-added tax, constitutes a beneficial measure since it reduces the amount of uncertainty in all cases.

From the point of view of economic policy, the analysis of the variants in Table 4 not only provides us with the necessary elements for defining a

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Table 4. Variants "With Agents' Reactions"

Abolition of employment tax (for nonfinancial enterprises subject to V.A.T.) offset by an increase in the V.A.T. 1/

V5 = the abolition of the employment tax leads to a decline in the price without tax. 2/

V8 = firms not exposed to foreign competition do not pass on the abolition of the employment tax to their prices without tax but instead increase their profits or earnings. The wage earners do not react.

V9 = Variant V8 with reaction by wage earners. 3/

	Deviation from Account of Reference 4/		
	V5*/	V6	V7
Annual rate of GDP growth (in per cent)	+0.07	+0.04	+0.01
Rate of increase in household consumption	--	-0.08	-0.07
Number of persons seeking employment 5/ (in thousands)	-42	-26	-12
Level of consumer prices (annual rise in per cent)	+0.20	+0.33	+0.35
Average wage (annual rise in per cent)	+0.18	+0.17	+0.24
Gross income of individual nonagricultural entrepreneurs per capita (annual rise in per cent)	+0.20	+0.52	+0.49
Financing capacity abroad (in billions of F 1975)	-3.2	-4.3	-3.2
Financing requirements of administrative authorities (in billions of F 1975)	-2.7	-4.9	-4.0

*/ From Table 3.

1/ Same detailed assumptions concerning tax measures as for the variant in Table 3.

2/ For firms exposed to foreign competition, the decrease in cost prices without taxes is offset by the increase in wage costs which is caused by the recovery of output and the ensuing greater tension on the labor market.

3/ It has been assumed that wage earners obtained a higher wage increase (2 points being deducted for hourly wages during the period in question), as a result of the stronger increase in consumer prices.

4/ The growth rates are calculated for the period 1965-1975. The absolute magnitudes are related to 1975.

5/ See footnote 1/, Table 1.

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economic
certain/strategy, but also enables us to define the appropriate tactics with regard to price policy. Thus a close control of prices for the sectors not exposed to foreign competition makes it possible to obtain better results from the measure adopted with regard to improving the employment situation and reducing unemployment.[25/]

From the Definition of a Rigid Policy to a Strategy

From this examination of the principles concerning the use of the model, illustrated by appropriate examples, we have obtained a clear impression of its possibilities. The first studies concerning medium-term economic development, which have been incorporated in concentrated form in the initial account, have shown that there is serious concern with regard to the simultaneous achievement of full employment, external equilibrium, and equilibrium of public finance. The model is an effective instrument for studying these problems if it is possible to create an imaginary situation in which economic policies must be progressively expanded and defined by political dialogue and detailed work. In

25/ We have chosen an example in which the agents' reaction is provoked by a policy linked to the problem of the external balance. It is, of course, possible to give other examples in which this reaction is linked to different types of policy: budgetary policy, incomes policy, etc.

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this respect, the model is not just at the receiving end. The study of series of variants governed by one guiding principle constitutes in itself a powerful factor of imagination.

These policies are bound to be complex. Even if there is no uncertainty about the developments shown in the initial account we cannot bend them satisfactorily by using partial measures. Elementary measures are often not sufficient to correct alarming developments, either because their impact is not strong enough or because partial measures can have unfavorable effects on some factors while having favorable effects on others.[26/] On the other hand, in a carefully chosen imaginary policy the favorable effects of the elementary measures which are part of this policy can enhance one another while their unfavorable effects may counteract, if not completely offset, one another.

But, as we have seen, the developments reflected in the initial account are not certain. We are not trying here to find a combination of means of

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26/ For instance, in a situation characterized both by a certain degree of underemployment and a balance of payments deficit, the exclusive use of the conventional measures of reducing demand in order to improve the balance of payments situation is bound to restrain growth and increase unemployment.

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Government intervention that would be absolutely preferable to any others and would guarantee the achievement of clearly defined aims. This increases the importance of complex policies even further. We are not only concerned with orienting the economy along trends corresponding to the Plan's purposes but we also wish to safeguard this orientation by protecting ourselves against any possible unfavorable risks and drawing the greatest possible profit from favorable circumstances. With regard to economic policies, we must distinguish between two categories of uncertainty.

Uncertainties of the first type are pre-existent to the economic policies that may be worked out. They concern the environment of the French economy as well as the general conditions for the functioning of the economic system and the impact of these on the agents' behavior. It is therefore necessary to evaluate the risks involved in these uncertainties, and to determine policies by which these risks can best be averted. In view of the number and size of risks which we must take into consideration we search for a set of conditional policies each of which would be considered effective in a given situation. This set of policies constitutes a strategy which ideally should enable us, in implementing the Plan, to adapt our means to the real situation.

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But such a strategy might turn out to be inoperative. We also must take into account the other uncertainties which are caused by the agents' reactions to the policies themselves. For a set of assumptions accurately reflecting the real situation in which the Government acts, a given economic policy does not produce any certain result. As we saw earlier, the agents' reactions to Government intervention can be important. To formulate assumptions on these reactions, to assess their chances of coming true, and to have an idea of the general atmosphere favoring some rather than others--these are essential tasks of the planning expert. The model is rich enough to simulate these reactions and study their consequences. The over-all policies envisaged can then to a certain extent anticipate the reactions they will provoke. It thus becomes possible to study not only a Government strategy in an uncertain but inert environment but even to bring into it considerations of strategy vis-à-vis partners reacting upon the Government's initiatives.

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ANNEX

Detailed Analysis and Solution of the Model

Having described the general structure and main characteristics of the model we are now going to describe it in greater detail[27] and give some indications as to its solution. The latter is, however, a complex iterative process[28] comprising different sections that are solved directly. We can therefore not give a full description of it here[29] but will limit ourselves to a broad outline. This will enable us to concentrate more on the economic content of the model.

27/ In view of the large number (1,000) of equations in Fifi, we will describe the model in words rather than equations. All equations will be shown in a technical paper to be published at a later date.

28/ This is actually not a linear model but a relatively complicated and large-scale model not without constraints.

29/ A detailed presentation of the solution algorithm will be published later.

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We begin with initial so-called "starting" values which correspond to the final demand for goods and services (not including productive investments and changes in inventories). One part of this final demand which is not modified during iterations is "autonomous" demand, i.e., investment in housing and collective equipment. On the other hand, among the other components of demand, household consumption per product and exports are first given and then adjusted at each stage of iteration according to the development of income and domestic prices per product.

From the table of interindustrial trade (TEI) we obtain levels of output and value added for each industry, corresponding to final demand. The following factors are then linked to these levels, in a coherent fashion: investments in each industry (obtained from the relationships between equipment and output), changes in inventories,[30] imports (taking into account demand, and prices or the "competitive pressure" calculated in the preceding

30/ Changes in inventories are calculated as a function of production (as "inventories of tools") except for agricultural products where they are defined as the difference between output (exogenous) and demand (endogenous).

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iteration).[31] To the extent that investment, imports, and inventories depend on output, an iteration will be necessary, output being determined--through the table of trade by net final demand--except in special cases where it is exogenous (agriculture, rents).

From Output to Employment and Prices

Once we know output per industry we can determine employment per industry (except for agriculture and housing where employment is exogenous) by working from assumptions with regard to the productivity of labor as a function of working hours[32] and exogenous assumptions on paid leave.

After calculating employment per industry we can deduce total employment from it, taking into account employment other than in industries (administrations, financial institutions, and household servants), which is exogenous.

31/ In the first iteration, prices are starting values and competitive pressure is zero.

32/ Since working hours are related to the tension on the labor market (or, more exactly, to the rate of unemployment) which in turn is a function of total employment, an iteration will be necessary since total employment is determined by working hours and productivity.

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By relating total employment to the available labor force we obtain the level of unemployment, taking into account immigration (which is a function of total employment and employment in certain industries) and the flexibility of the rates of activity of the available population (which depend on the tension on the labor market).

The principal results of the physical equilibrium per industry (value added, employment, investment, inventories) are applied to the different sectors,[33/] taking household production into account, and employment by sectors is further subdivided into categories (individual entrepreneurs, wage earners, family help).

We thus obtain from the table of interindustrial trade in volume the "physical" data of the next section of the model which comprises all sector accounts of firms and the link between wages, prices, and unemployment. From this section we can determine the development of wages and income, the general level of prices, the price of each product (per user), and accounts as a whole (up to the financial account) of firms, which are grouped in seven sectors.

33/ Since the nomenclature for industries /branches of industry/ and sectors is not the same, we need transition tables for industries and sectors.

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There are two different steps in this section[34] which may be described as follows:

1. We disregard the constraints which are imposed by foreign competition on the production costs of certain goods and determine the development of the system of "free" prices.

To this end, we calculate each item in the sector accounts on the basis of production costs, wage rates, rates of self-financing by sectors, and constant terms, taking into account:

discrepancies for one and the same product between prices per user,[35] and

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34/ For an explanation of the reasons for choosing this particular method of solution, see [2], pp. 91-93 and 112-114.

35/ Prices per user are different for one and the same product. For some users they may be exogenous or may show given discrepancies (in absolute or relative value). As we saw earlier, this is of interest from the point of view of economic policy. In addition, it is very important if we wish to take into account any heterogeneousness due to aggregation. See [2], pp. 125-132.

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the interdependence between different items in the accounts of one and the same sector (intra-sectoral interdependence) and between items in the accounts of different sectors (intra-sectoral interdependence), in particular beacuse of financial elements.

This is a complex series of operations in which we solve, successively, some systems of linear equations in which the unknown quantities are rectangular matrices. We cannot describe this here, but merely note that this approach makes it possible to deal with large-scale systems[36/] by progressively introducing the various interdependent relationships.

From this calculation, and from the accounting equilibrium, we obtain a set of linear relationships establishing links between production costs, wage rates, and self-financing rates. These relationships show that production costs cover the operating expenses while at the same time allowing for a certain level of income or a certain rate of self-financing (which, incidentally, can be adjusted later in the iterative process or can be determined from assumptions with regard to exogenous prices or prices otherwise known.

36/ This approach would be of even greater interest if more sectors were included.

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Bearing in mind that certain self-financing rates are exogenous, at least at this stage of iteration, and that certain production costs are exogenous,[37] we obtain seven equations linking the seven levels of production costs to one another and to the index of the increase in hourly wages.

The relationships defining GDP now enable us to calculate the index of the general price level[38] from the seven indexes of production costs, and as a result we obtain an equation between the index of the general price level and the index of the increase in hourly wages the coefficients of which (being a function of the physical equilibrium and the data in the sector accounts) are know at this stage of the process of solution.

37/ The production costs of different goods may be either exogenous (in nominal or relative value), endogenous (so as to be compatible with a given rate of self-financing) or parametric, based on the general price level. This is of interest for the study of economic policy.

38/ The general price level is an endogenous result of the model. It is not determined directly but results from the projection of the various prices (projection in nominal, not relative, value).

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We then determine the wage rate and the general level of prices, taking into account, on the one hand, this complex equation between the general level of prices and wages and, on the other hand, the link between the hourly wage rate, the general level of prices, and the unemployment indicator. As this latter equation is not linear the system is solved by iteration.

We now know the hourly wage rate and hence the production costs. From these we can deduce all prices and accounts by sectors.

2. We take into account the constraints imposed by foreign competition on the production costs of certain goods (here industrial products).

The index of production costs, which ensures the equilibrium of the sector accounts for a given physical equilibrium as well as an appropriate self-financing rate, is incompatible with the market price imposed by foreign competition. Even if we based our argument on the assumption that demand is constant, this would be the price which we would attain if imports were mainly a function of demand and if total output were adjusted to this demand, after deduction of imports. We thus link to this price a certain share of the reference market. From the difference between this price and the market price we obtain an indicator of the market share which shows the increase (or decrease)

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in the intensity of competition on the domestic market compared to the level of reference. At constant demand, the growth of that indicator increases the share of imports in domestic demand and reduces output with the result that the index of production costs will tend to approach the market price.

In reality output varies less than this mechanism appears to indicate since the firms' reactions is more complex. Depending on the indicator of the market share, the firms accept a decrease in their self-financing rate compared to the desired level while at the same time reducing their costs of labor and increasing their productivity. Meanwhile the import price rises with the growing foreign pressure. To take this into account we correct the import price, the productivity of labor, the shift in per capita wages in the sector under consideration compared to the average hourly wage rate, and the accepted rate of self-financing. These new estimates are used in the next general iteration, when the price system is redefined. By thus correcting these coefficients in each iteration we can eventually ensure compatibility between production costs and import prices (that is in fact between output and market price), as well as the adjustment of behavior.

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We thus superimpose on the general iteration process (supply--price--demand) a second iterative process[39] by which we determine the division of the domestic market and achieve equality between the supply price of industrial firms and the market price imposed by foreign competition.

In the last section of our structure for solving the model we adjust the final demand for goods and services, mainly in the light of the price system just calculated, and consequently the starting value for household consumption per product and exports, which were introduced at the beginning of the iterations.

We begin by determining the total resources of households on the basis of the data in the firms' sector accounts (wages, incomes of individual entrepreneurs) and of projections of other resources of transfer payments (social security benefits, welfare, various items), such projections being obtained by reasoned extrapolation of past trends with various explanatory variables. Household expenditure is then linked to total resources by special laws for each item (especially savings and personal income tax). The value of total household consumption is obtained by balancing these items against each other.

39/ This superposition of two iterative processes has given rise to major problems with regard to convergence.

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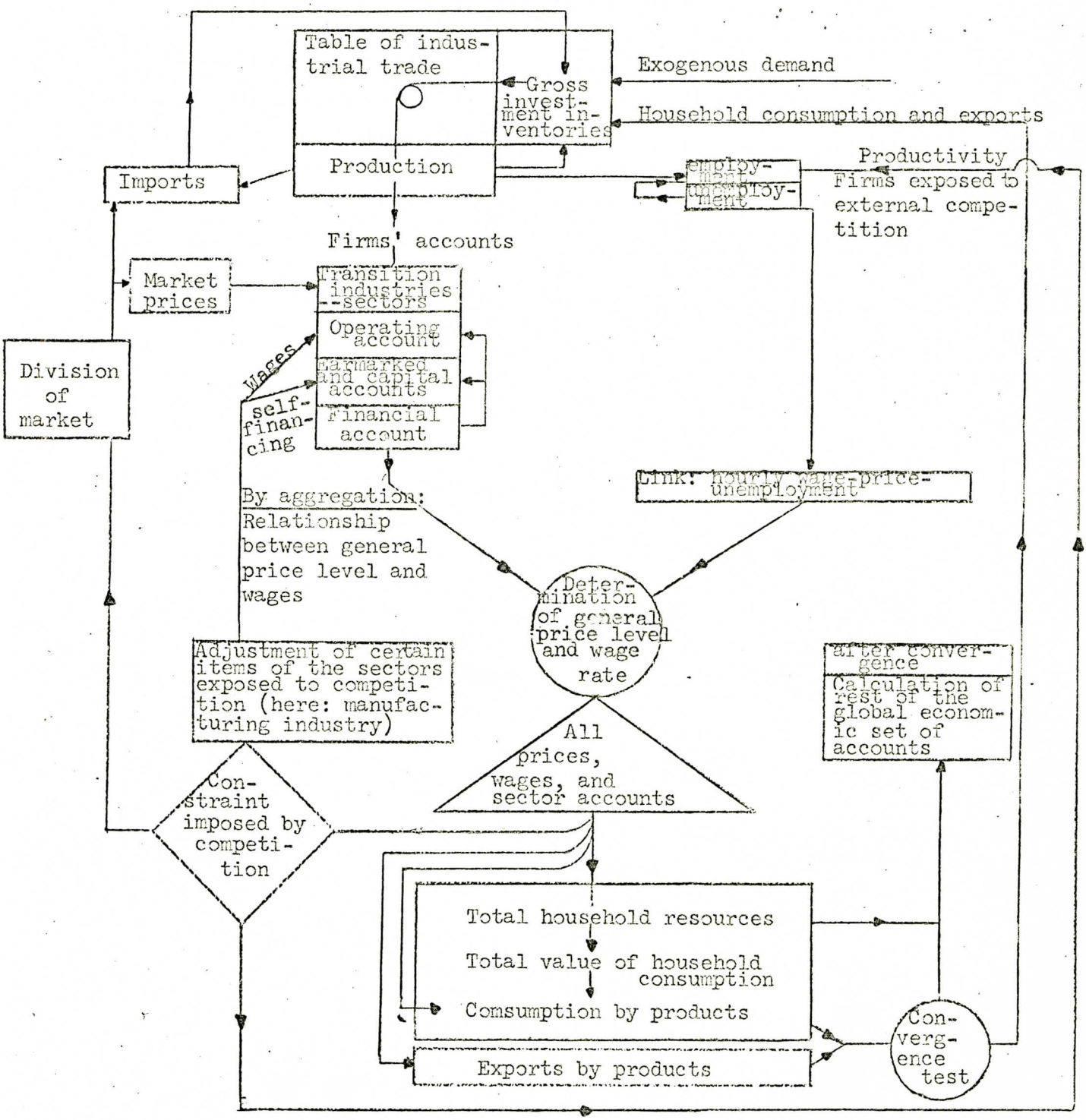
The model for projecting household consumption per product uses as explanatory variables the value of total consumption and the prices of each product. From this we obtain a new estimate of the volume of consumption per product.

Projections of exports are made on the basis of export functions estimated by regressions into the past, as well as the growth of foreign countries and indicators of competitiveness (ratio of French export prices to foreign prices). French export prices (calculated beforehand with all prices) are a function of French production costs, foreign prices, and the development of costs.

These new estimates of final demand (without productive investment and inventories) are reintroduced into the first section (physical equilibrium) of the next iteration. Equilibrium is reached when the difference between the starting values for two consecutive iterations becomes negligible. The calculation then continues by drawing up tables of results, tables in the form of national accounts (table of goods and services, firms' sector accounts, table of general economic forecast) or combined summarized tables (prices, principal results).

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STRUCTURE FOR SOLVING THE MODEL



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