OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

Introducing economic relationships into the MEPS-model

Paper prepared for PPD/PDSU of UNIDO

18501

Bernhard Böhm
Anna Gelei
György Molnár
(consultants)
January 1990

Contents:

A. The theoretical structure of the revised demand module of MEPS

B. The main features of the revised supply module of MEPS

C. Module of investment decision-making and selection of projects

D. Appendixes

1. The equation system of the revised demand module
2. List of variables and parameters of the demand module
3. Tables of input information and results of the demand module
4. Scheme of the current cost tables
5. Scheme of the investment decision-making table

Introduction

The total system is composed of three major modules which are consistent subsystems by themselves but - naturally - linked at certain points to assure communication and switches among them.

The three subsystems are in turn: A. Demand module, B. Supply module, and C. Investment project selection module. The appendixes contain the lists of equations and variables and the schemes of tables used in the computer program.

Part A:

The theoretical structure of the revised demand module of MEPS

1. Introduction

The revision of this module of MEPS concentrates on the determination of individual (ie. per capita) demand for final consumption goods. As policy oriented aspects, like planning the satisfaction of certain needs, will have to depend on the demand for commodities, the emphasis of demand analysis is placed on relations expressed in terms of goods (in physical units and prices of goods). Per capita demand for goods is determined by expenditure (income) and price variables. Expenditures and incomes are related to national aggregates which are taken as given for this module. Prices may be taken as being determined in conjunction with production modules, only in the production modules, or as being determined exogenously. The role for planning satisfaction of certain needs is changed as a consequence. Since quantities are determined in dependence of prices and incomes satisfaction levels can be calculated on that basis and the degree of realization of announced goals can be checked. Under certain circumstances regarding supply - demand interaction situations of demand rationing may occur. By manipulation of given restraints on supply and imports it is possible to change the degree of rationing and in turn that of the satisfaction achieved. The scope for satisfaction derived from one commodity is generalized to allowing the satisfaction of more than one need simultaneously. This permits consideration of multiple objectives and provides a link for policy analysis.

The basic theoretical considerations concerning the demand module itself as well as its relation to production modules are presented in the following sections.

2. Determination of per capita consumer demand for final goods

2.1.
Denote by c(i,g,t) the per capita consumer demand for the physical amount of good i, of consumer group g, in period t. In order to permit competition among domestically and imported consumer goods assume there are n consumer goods available of which m are imported from abroad:
$i = 1,\ldots,m-1,m,m+1,\ldots,n$ with $i = 1,\ldots,m$ imported goods, and
$i = m+1,\ldots,n$ domestically produced goods.
There may be cases where a commodity is available from domestic production and also imported. This may have two reasons:

a) There is no sufficient quantity from domestic production so that in order to fulfill demand some imports are necessary (possibly under some constraints),

b) there is sufficient quantity available from local production but the good is nevertheless imported because of some trading arrangements or price considerations (e.g. in case of the competitive situation without trade restrictions a foreign supplier may decide to enter the market).

The definition of goods above is sufficiently general. There may be some identical commodities in the set $G' = \{c_i;\ i=1,\ldots,m\}$ and in $G'' = \{c_i;\ i=m+1,\ldots,n\}$ too. What matters is the consumers demand for commodities which are supposed to be differentiated w.r.t. origin or price. A commodity is considered identical for the consumer if it carries the same price and is physically similar. The consumer is supposed to be indifferent between local and imported goods if the price is the same. If this assumption actually does not hold true (i.e. there is a difference in preferences for the same good depending on whether it is an imported one or locally produced) then they will be regarded as two different commodities which happen to have the same price. The decision about the appropriate treatment of commodities in this respect must be taken by the user of MEPS. See also section 3.

2.2.

For simplicity we shall assume that the price of one commodity will be the same for each group of consumers g=1,...,H. If necessary this assumption can be relaxed. This implies price discrimination which has to be handled in the price determination section either of the production module or the total system. If price discrimination prevails the respective commodity's group price must be considered.

Denote the price of good i in period t by p(i,t), or in the case of price discrimination distinguished also according to consumer group g as p(i,g,t).

In most applied cases this demand module will not relate to the entire set of consumer goods in one country. Therefore, we have to assume seperability of preferences for the subgroups of commodities considered with respect to all other commodities in the country. In addidtion, to permit adequate flexibility in the design of this module we have to assume seperability of preferences also for the goods considered within the given application. Thus, the following system of consumer demand equations is proposed:

$$c(i,g,t) = a(i,g) + (1/p(i,g,t))*b(i,g)*[y(g,t) - \Sigma_{j \in G} (p(j,g,t)*a(j,g))] \qquad (1)$$

with $G = G' \cup G''$ for the whole set of consumer goods i=1,...,n covered in the application; each consumer group g=1,...,H; and period t=0,...,T where T denotes the planning horizon and t=0 is the base period. y(g,t) denotes total expenditure on all consumer goods covered in the application. a(i,g) and b(i,g) are constants. Some further explanation follows.

This demand system corresponds to the "Linear Expenditure System" developed by R. Stone (cf. R. Stone (1954) "Linear Expenditure Systems and Demand Analysis: An Application to Patterns of British Demand", Economic Journal 64, 511-527). In our context the system is not applied to the whole set of consumer demand functions but to subgroups of consumer goods. Therefore, variable y(g,t) corresponds to the total amount spent on the goods in question, conditional on expenditures on those goods not covered in this application.

The interpretation of the constant parameters a and b which have to be supplied by the user seems to be rather appropriate for the present purpose of consumer demand planning:

a(i,g) can be interpreted as the minimal quantities demanded and should be related to what one may call subsistence levels of the demanded good. In fact, one may derive these figures from some available statistics reporting minimal needs and respective quantities of those goods required for survival.

Σ_i(a(i,g)*p(i,g,t)) is therefore the minimal total expenditures for the goods in question required for maintaining subsistence. One should have
$0 \leq a(i,g) \leq c(i,g,t)$ (all t)
to preserve a meaningful interpretation.

b(i,g) denotes the fixed proportions which are used to allocate the expenditure sums exceeding the necessary minimum among the goods covered in the model. b(i,g) is assumed to be positive and should sum to one over the goods in question for each group, i.e.
Σ_i b(i,g) = 1 for all g, i up to n.
They can also be interpreted as marginal budget shares i.e.
d[p(i,g,t)*c(i,g,t)]/dy(g,t).
The b(i,g)'s equal the actual budget shares if the a(i,g)'s are all zero. In the absence of proper estimates from time series or cross section observations or from consumer surveys one may try to use values which are close but not equal to average budget shares.

2.3.
It is important to supply adequate figures for y(g,t). In essence this variable is a fraction of total consumption expenditures corresponding to the commodities or groups under investigation. Note that the sum of the product of all these prices times physical quantities must add up to the expenditures y(g,t). The idea of the present implementation of such a system is to determine the available sum (per capita) in dependence of other known or given variables. Thus, an estimate for y(g,t) may be derived from simple consumption functions relating this quantity to the respective total per capita incomes. This variable will, therefore, provide the link between macroeconomic variables and the microeconomic ones. Details will be discussed below.

2.4.
Some further remarks on the properties of this demand system seem to be in order. The LES is somewhat restrictive as it assumes an additively separable preference structure. Apart from the fact that this assumption is the price paid for keeping the system flexible for different applications which may well be independent from each other, the implied comparative static properties do make sense in the present problem context. There are no specific substitution effects - referring to the intrinsic substitution relations between commodities. General substitution effect, of

course, exist and, therefore, imply that all goods considered must be regarded as (general) substitutes to each other in the sense that each commodity competes for the consumers money. These effects may be calculated as:

$$\frac{b(i,g)*b(j,g)}{p(i,g,t)*p(j,g,t)}*[y(g,t) - \Sigma_{k\epsilon G} (p(k,g,t)*a(k,g))] > 0.$$

The income (expenditure) elasticities are

$$e(i,g,t) = dc(i,g,t)*y(g,t)/dy(g,t)*c(i,g,t) = \\ = b(i,g)*y(g,t)/p(i,g,t)*c(i,g,t). \quad (2)$$

Prior knowledge of such elasticities will be of great help to determine parameters b(i,g) resulting from multiplication of e(i,g,t) by the relevant budget share w(i,g,t) = p(i,g,t)*c(i,g,t)/y(g,t).

Direct price elasticities are given by

$$dc(i,g,t)*p(i,g,t)/dp(i,g,t)*c(i,g,t) = \\ = [a(i,g)*(1 - b(i,g))/c(i,g,t)] - 1. \quad (3)$$

Indirect price elasticities are

$$dc(i,g,t)*p(j,g,t)/dp(j,g,t)*c(i,g,t) = \\ = -[a(j,g)*b(i,g)*p(j,g,t)]/p(i,g,t)*c(i,g,t) \quad (4)$$

Information on such magnitudes from consumer studies will be helpful in the calibration of the model i.e. the determination of the parameters a, given information on b.

2.5.
Summing up, the demand for physical consumer goods is determined by their prices and the sum available for their purchases (being itself dependent on incomes and other variables from the macro economy). The parameters in the equations refer to subsistence quantities and marginal budget shares which can be estimated from available statistics.

3. Aggregate demand and income

3.1.
The per capita variables c(i,g,t) and y(g,t) are converted to (group) aggregates by multiplication with the appropriate population variable:

$$C(i,g,t) = c(i,g,t)*pop(g,t) \quad (5)$$
$$Y(g,t) = y(g,t)*pop(g,t) \qquad \text{all } i,g, \text{ and } t. \quad (6)$$

Summing over the population groups will yield total consumer demand for physical good i in period t:

$$CT(i,t) = \Sigma_g C(i,g,t) \qquad \text{all } i \text{ and } t. \quad (7)$$

This is the quantity relevant for linking the demand module with the production module.

An important question which must be discussed now is about the kind of information available for the determination of the per capita expenditures on the goods under analysis. It will be different if one starts consumption planning at the macro level or at the individual (per capita) level.

1)
Assume for the first case that plans are drawn up from the national level. The variables available from national accounts are:
total disposable income at current prices, YDT,
total consumer expenditures at current prices, CNT,
a consumer price index (or deflator), PCT,
the breakdown of all these variables (with a possible exclusion of prices) into quantities relating to groups of the population g=1,...,H, denoted by indexing the total variables with (g).
Also, the breakdown of total (group) consumers expenditures into commodity categories must be known (e.g. from consumer surveys). Denote the share of consumer expenditure of population group g on all goods entering the analysis by v(g,t) to allow changes over time. Then

$$Y(g,t) = v(g,t)*CNT(g,t), \quad g=1,...,H. \tag{8}$$

$$CNT(g,t) = r(g,t)*CNT(t), \quad g=1,...,H, \tag{9}$$

will establish the relation between total expenditures and those of groups with r(g,t) > 0 denoting the ratio of population group consumption to total where

$$\Sigma_g \, r(g,t) = 1. \tag{10}$$

Assume a macroeconomic consumption function has the general form

$$CRT(t) = CNT(t)/PCT(t)*100 =$$

$$= f((YDT(t)/PCT(t)*100), Z(t)), \tag{11}$$

where Z(t) relates to a vector of macro-variables which may reflect demographic or social characteristics and could contain also lagged variables (e.g. incomes) and, of course, policy variables. Given nominal disposable income and the consumer price index total consumer demand at constant prices (CRT(t) will usually be the relevant dependent variable. Defining

$$CNT(t) = CRT(t)*PCT(t)/100 \tag{12}$$

we can determine the nominal amount of expenditures of population group g on all goods covered in the analysis by

$$Y(g,t) = v(g,t)*r(g,t)* CNT(t), \quad g=1,...,H. \tag{13}$$

The shares v and r must be given. Dividing by the respective population group produces the per capita expenditures y(g,t) which enter the demand functions.

2) If sufficient information on the population group level is available the consumption function may be set up to explain group consumption as dependent on group income and other macro-variables relevant for groups. This might be the case if planning starts with per capita information on the microeconomic level. The procedure to establish the link with macroeconomic variables proceeds with the following arguments:

Assume that per capita expenditures of group g on the commodities under investigation are related to their total per capita income according to e.g.

$$y(g,t) = f_g(yn(g,t), A(g,t)), \quad \text{all } g, \tag{14}$$

where yn(g,t) denotes per capita nominal incomes of group g in period t, and A(g,t) denotes a vector of group attributes relevant in determining the (per capita) income allocation to y(g,t). Inclusion of A(g,t) will permit macroeconomic policy measures to be transmitted to the actual sectoral or firm level. Careful specification of the variables to be included in A(g,t) at the implementation level of MEPS will be of great relevance in establishing a sound link between the macroeconomic sphere and the micro-(application) sphere. Examples of variables to consider may include taxes, age structure, proportion of land owners, educational variables, and dummy variables for various reasons.

Summing the product yn(g,t)*pop(g,t) over all groups g=1,...,H yields total nominal (disposable) income (YDT(t)) which is a key macro-variable:

$$\Sigma_g \, (yn(g,t)*pop(g,t)) = YDT(t) \tag{15}$$

3.2.
As CT(i,t) is total demand for good i in period t it is composed of quantities supplied domestically and imported:

$$CT(i,t) = CTd(i,t) + CTm(i,t). \tag{16}$$

CTd(i,t) denotes that part of physical demand for good i which should be satisfied domestically, CTm(i,t) that one which is satisfied by imports. Now, it may be argued that from the point of the consumer one cannot determine the size of each component unless commodity i belongs exclusively to one of the two sets G'or G''. For this reason we have permitted in section 2.1 that some goods might enter both sets even if they are considered identical. In such a case each of the two identical commodities will relate to a different index i=1,...,n. Enough information will be there to use the respective prices as instruments to determine and regulate domestic and imported quantities since they are treated as distinct goods. Therefore for each i CT(i,t) is either equal to CTd(i,t), and CTm(i,t) for this i is zero, or vice versa. I.e.

$$CTd(i,t) = CT(i,t) \quad \text{for } i=m+1,\dots,n \qquad (17)$$
$$CTm(i,t) = CT(i,t) \quad \text{for } i=1,\dots,m \qquad (18)$$

3.3
There may be the need to aggregate these identical goods in case available statistics do not report them in isolation. In this case the classification of goods in 2.1. cannot be maintained and must be simplified. We shall then have i=1,...,n goods but cannot determine import demand directly via the demand system. Satisfying total demand for good i (CT(i,t)) domestically or by imports will depend on the users choice of the import regime for the particular commodity (mentioned under a) and b) in 2.1.

Case a) Import demand may be determined according to:

$$CTm(i,t) = CT(i,t) - SUP(i,t) \quad \text{if } CT(i,t) > SUP(i,t)$$
$$= 0 \text{ otherwise,} \qquad (19)$$

where SUP(i,t) is domestic supply of good i for period t. Should domestic supply exceed demand and i is a durable good then the production module must provide for running inventories. If i is a perishable commodity the production module must provide for a mechanism of (possibly costly) disposal. In both cases the surplus production may be exported if there is a corresponding demand from the foreign sector. The demanded magnitude may still not be satisfied by actual imports depending on policy restrictions and import prices. Note that CTm(i,t) corresponds to the notional demand for import of good i under the assumption that the price variable in the demand equation represents both the price domestically charged and the import price.

Case b) If imports are general substitutes and not restricted to serve as a buffer they will have to be determined by the consumers. Thus, the situation will be the same as in the case where imported goods are differentiated from local ones. This is the general case which we assume to be the dominating one. We must, therefore, require that information on imported goods be obtained separately and the analysis be followed as in the standard case.

4. Conversion of demand for goods into satisfaction of needs

4.1.
Using conversion coefficients denoted ncoef(i), expressing the amount of the measure of the satisfaction of needs per unit of commodity i, the actual per capita satisfaction level actual(g,t) of group g is given by

$$actual(g,t) = \sum_{i=1}^{n} c(i,g,t) * ncoef(i) \quad \text{all } g,\ t. \qquad (20)$$

This magnitude may be compared with a given goal satisfaction level (per capita) denoted goal(g,t). A deficit of the per capita satisfaction for group g is then defined as in the original version of MEPS by

$$Defsat(g,t) = goal(g,t) - actual(g,t). \quad (21)$$

If needed on may also define levels of satisfaction by multiplying actual(g,t), goal(g,t) and Defsat(g,t) with the appropriate group population figure pop(g,t). However, it appears not to make much sense of doing so in the present version because variables expressing needs are no longer converted to goods as in the original version. This fact also changes the possibility of consumption planning. Now, it is not possible to define quantities of goods demanded by defining the goal of needs to be satisfied. One can, however, check the extent to which goals are reached given the income-and-price-driven demand for goods and, thus, also the actual satisfaction. The degree of goal achievement can be expressed by

$$Sat\%(g,t) = 100-[(goal(g,t)-actual(g,t))/goal(g,t)]*100. \quad (22)$$

Sat%(g,t) is 100 if the goal has been reached. In the case of overfulfillment it exceeds 100 and it will be below 100 if the goal has not been reached.

4.2.

Sofar discussion was concerned with the satisfaction of one particular need specified. As commodities are usually capable of satisfying more than one need simultaneously (e.g. supply protein, fat and calories) we generalize the concept in allowing more than one need to be considered. We define the actual per capita satisfaction of need k by

$$Actual(k,g,t) = \Sigma_{i \in S}\, c(i,g,t)*ncoef(k,i) \quad (23)$$

for goods i in the index set $S = \{i;\ ncoef(k,i) > 0\}$ and for needs $k=1,\dots,K$.

Specifying the conversion coefficient as element of a (Kxn) matrix means that we can group commodities according to which needs they can satisfy. Also note that the ability of a commodity to satisfy more than one need simultaneously is an important property if one attempts to find an optimal mix of commodities satisfying multiple goals. This specification, thus, is intended to provide a link to policy analysis considering the possibility of multiple criteria which may be in conflict with each other. On this issue the reader is referred to the famous "diet problem" of linear programming which has a straightforward extension to multicriteria optimization (cf. Dorfman, Samuelson, Solow (1958), and Rogowski, Sobczyk, Wierzbicki (1988)). For an application to economic policy cf. Böhm/Brandner (1988)).

In analogy to above Goal(k,g,t) may denote a target per capita level of need k and the corresponding deficit can be defined

$$DefSat(k,g,t) = Goal(k,g,t) - Actual(k,g,t) \quad \text{all } k,g,t. \quad (24)$$

Expressed as a percentage ratio we have

$$DefSat\%(k,g,t) = 100-[(Goal(k,g,t)-Actual(k,g,t))/Goal(k,g,t)]*100 \quad (25)$$

for each need k and population group g at period t.

If aggregate average needs have to be considered the following definitions must be observed:
Actual average (per capita) satisfaction of need k in period t is

$$ACTUAL(k,t) = \Sigma_g(Actual(k,g,t)*pop(g,t))/(Tpop(t)) \quad (26)$$

with

$$Tpop(t) = \Sigma_g pop(g,t) \quad (27)$$

the total population in period t.

The corresponding percentage deficit of need k given an average (per capita) goal satisfaction GOAL(k,t) is defined analogoulsy as above by

$$DEF\%(k,t)=100-[(GOAL(k,t)-ACTUAL(k,t))/GOAL(k,t)]*100. \quad (28)$$

4.3.
Finally one may want to determine the degree of satisfaction by local goods and by imported ones. As goods i=1,...,m are imported and those i=m+1,...,n are domestically produced simply summing i over the relevant range will yield the desired amounts. We note that by using the conversion coefficients for each separate need we have produced homogeneous quantities able to be summed up. For need k the satisfaction level due to imports is

$$ACTUALM(k,t) = \Sigma_g \Sigma_{i \in S, i=1}^{m} (c(i,g,t)*ncoef(k,i))*pop(g,t) \quad (29)$$

and that due to domestic goods

$$ACTUALD(k,t) = \Sigma_g \Sigma_{i \in S, i=m+1}^{n} (c(i,g,t)*ncoef(k,i))*pop(g,t). \quad (30)$$

Again, one defines percentages of goal achievement as

$$DEFM\%(k,t)=100-[(GOALM(k,t)-ACTUALM(k,t))/GOALM(k,t)]*100 \quad (31)$$

and

$$DEFD\%(k,t)=100-[(GOALD(k,t)-ACTUALD(k,t))/GOALD(k,t)]*100. \quad (32)$$

These definitions may be used according to the basic objectives pursued by using this modified MEPS system. It is not necessary to compute all of the above magnitudes. An appropriate selection may be sufficient.

5. Excess demand and supply situations

5.1.
Obviously the demand for goods generated in the demand module is not necessarily matched by the corresponding supply of domestically produced and imported goods. The demand magnitudes are determined conditionally on given prices. It will be the responsibility of the production module to provide the relevant price information to the demand side.

Basically, one can think of the following regimes regarding price and quantity determination:

a) Prices are given, e.g. by the world market and the domestic producers act as price takers. If this holds for good i then a quantity-disequilibrium may occur. For the supply module this will imply that cost based pricing might possibly lead to a different price than the given one. As a consequence extra losses or profits will be generated by such differences.

b) Prices are not given externally but are determined in an iterative process involving successive solutions of supply and demand modules. This process requires a price adjustment mechanism depending on the mismatch of quantities. Prices are determined at the level where demanded and supplied quantities are equal (given some tolerance).

c) One could even think of a third way to link supply and demand within the MEPS framework: Assuming the producer of final goods sets the repective prices tentatively in order to find out the quantity of demand generated at these prices. This information is used to apply a different set of prices in case some of the expected results do not obtain. This technique represents a search for the relevant price-supply relationship of the producer where the process can be stopped at any time considered satisfactory by the planner. Disequilibria may or may not result. Therefore, this procedure is a variant of b) where equality of supplied and demanded quantities is not necessarily achieved but some other condition (e.g. profitability of production of the commodity in question) is fulfilled.

A combination of these mechanisms may also be contemplated. For different markets (means final goods produced and demanded) the price setting mechanism could very well be different. What is to be considered is the basic interdependence of demand for the set of final goods to which MEPS is applied. The prices of all relevant commodities will determine the demanded quantities for each good. On the production side this type of interrelatedness is not necessarily so crucial and definitely depends on the production structure.

Both cases a) and c) imply the possibility of rationing of consumers (or producers) under certain foreign trade restrictions. If no such constraints are there the foreign sector (imports and exports) can be regarded to act as a buffer in equilibrating demand and supply. Usually, howeve , there will be some constraints in effect on the foreign balance, if only on foreign exchange requirements. In the following we shall, therefore, investigate the situations under given prices when rationing can occur and trace out its consequences for the planning of final demand.

5.2
In the standard case domestic (CTd) and import demand (CTm) for good i is determined by incomes and prices. The general balance equation for physical good i taken from the production module is:

$$Df(i) + De(i) + Dr(i) + Dj(i) = SUP(i) + M(i) \qquad \text{all } i, \qquad (33)$$

where Df(i) denotes final demand, De(i) exports, Dr(i) demand of the rest of the economy (not covered in the analysis), Dj(i) intermediate demand for input i by the production of good j, covered in the analysis. SUP(i) should denote total domestic supply (which will be disaggregated further in the production part) and M(i) imports. For the following discussion we shall drop time subscripts.

We shall continue to assume good i is a final product if i=1,...,n. Good i will be called an intermediate product if i=n+1,...,q. Then,

$$Df(i) = CTd(i) \qquad \text{for } i=m+1,\dots,n \qquad (34)$$
$$Df(i) = CTm(i) \qquad \text{for } i=1,\dots,m \qquad (35)$$
$$Df(i) = 0 \qquad \text{for } i>n \qquad (36)$$

$$SUP(i) = 0 \qquad \text{for } i=1,\dots,m \qquad (37)$$

$$Dj(i) = 0 \qquad \text{for } i=1,\dots,n \qquad (38)$$
$$Dr(i) = 0 \qquad \text{for } i=1,\dots,n. \qquad (39)$$

The last equation holds because the demand module is supposed to cover the whole economy (system). The rest of the economy can, therefore, only demand a commodity as intermediary input into some components not covered in the MEPS analysis.

$$De(i)*M(i) = 0 \qquad (40)$$

if transit trade is excluded. The import quantity M(i) relates to final and intermediate goods. Assuming these categories as non overlapping we have

$$M(i) = Mf(i) + Mj(i) \qquad \text{where } Mf(i)*Mj(i) = 0, \qquad (41)$$

and Mf(i) relates to final good imports, Mj(i) to intermediate ones used in production of good j.

For domestically produced demanded goods i=m+1,...,n we have

$$CTd(i) + De(i) = SUP(i) + Mf(i) \qquad \text{with } De(i)*Mf(i) = 0 \qquad (42)$$

and free trade when it is permitted to satisfy excess demand for local goods by imported substitutes. If this is not permitted Mf(i) must be set to zero.

If trade restrictions are present then either

a) $CTd(i) > SUP(i) + Mf^{*}(i)$ (43)

where the starred variable denotes the upper bound of the import restriction for good i. In this case demand cannot be satisfied even by permitting some imported substitutes and consumers are rationed.

Or we have

b) $Ctd(i) \leq SUP(i) + Mf^{*}(i)$ (44)

and consumers get what they want. If $CTd(i) < SUP(i)$ then $De(i)>0$ is possible. Otherwise inventories or costly disposal must be taken into account.

For explicit import demand (i=1,...,m) demand CTm(i) determines actual imports Mf(i). If the imports are constrained by $Mf^{*}(i)$ consumers may get rationed in case $CTm(i) > Mf^{*}(i)$.

For the sake of completeness we may have to consider the case where goods cannot be exclusively categorized as final or intermediate and the equations:

$Dj(i) = 0$ for i=1,...,n
$Dr(i) = 0$ for i=1,...,n
$Mf(i)*Mj(i) = 0.$

not necessarily have to hold. This situation asks for a change in the balance relations with the consequence that it cannot be determined without further rules whether intermediate or final demand has to be rationed if the following situation arises:

$Df(i) + Dj(i) + Dr(i) > SUP(i) + M(i)$ all i. (45)

We shall not pursue this question in the present context.

5.3.

In the case of rationing the quantity demanded under given prices and incomes will not be realized. The constraint will eventually determine the quantity of the good available for consumers. This quantity is reported back to the demand module and should practically affect the variables there, in particular those influencing the degree of satisfaction. Therefore, the constrained quantities result from the excess demand equations:

$CEd(i) = CTd(i) - SUP(i) - Mf^{*}(i)$, for i=m+1,...,n (46)
$CEm(i) = CTm(i) - Mf^{*}(i)$ for i=1,...,m. (47)

Then we define:

$CT^{*}(i) = CTd(i) - CEd(i)$ for i=m+1,...,n and
$= CTm(i) - CEm(i)$ for i=1,...,m. (48)

Here, CEd(i) and CEm(i) are the excess demands for good i and $CT^{*}(i)$ are the restricted quantities of good i available for the entire population. How this quantity is distributed among the population groups is in principle quite arbitrary. Usually some groups are more powerful than others in getting what they want, so it will depend on social characteristics and their effects on allocation coefficients (reflecting the groups power) how the groups finally end up to be supplied with goods. Denote the allocation coefficient of group g in period t for commodity i as u(i,g,t). These coefficients may be selected exogenously or could be linked to variables entering the consumption functions. The coefficients obviously must obey

$$0 < u(i,g,t) < 1 \quad \text{and} \quad \Sigma_g u(i,g,t) = 1 \text{ all } i,t.$$

We shall, as an example use a simple proportional distribution where every person has the same weight. That implies

$$u(i,g,t) = pop(g,t)/Tpop(t) \text{ all } i,t, \text{ and } g=1,...,H. \tag{49}$$

Let excess demand for good i in period t be defined by

$$DIF(i,t) = CT(i,t) - CT^*(i,t) \tag{50}$$

which is the excess demand for i for the whole population. Group excess demand may then be derived from

$$dif(i,g,t) = u(i,g,t)*DIF(i,t) \quad \text{all } i,t, \text{ and } g=1,...,H. \tag{51}$$

The effectively rationed per capita demand for good i of people in group g in period t will be calculated from

$$c^*(i,g,t) = c(i,g,t) - [dif(i,g,t)/pop(g,t)]. \tag{52}$$

All measures of relative satisfaction achievement will now use $c^*(i,g,t)$ instead of c(i,g,t) and variables based upon them.

6. On further relationships between demand and production module and final remarks

6.1.
In the previous section we have analysed the situation between demand and production when prices are given e.g. by the world market. As this need not be the fact for all goods in question the following remarks should indicate how the relationship between the modules could be thought of otherwise.

We start from the assumption that each production component determines costs, investments, government effects and inputs for the production of one product. This product may be used as input to other components or as a final consumer good. We assume several stages of production on which several components may be active. The "total production system" is defined to consist of all stages and components. The resulting magnitudes are e.g. the effects on government accounts, on foreign trade, and will include the quantity produced and the price vector of finally demanded goods based on cost accounting. The quantity produced available for final demand may be considered as given by the demand module at the prices charged in the respective supply components.

The demand module determines quantities of goods demanded by consumers (i.e. groups), at given selling prices (as determined in the production module) and expenditures available for the vector of goods covered in the sectoral subsystem. The expenditures are derived from total incomes, population, social characteristics and possibly also lagged variables relating to the national economy.

At prices formed in the components the quantities demanded influence the scale of production of each component by determining the final product of each component. The intermediary demand for products is eventually also defined by the higher stages of production with the highest stages producing only final goods. Thus, intermediate demand for commodities produced in one component and used as input in another one are recursively defined.

At the demanded levels the production process may lead to either profits or losses for the operation of a single component. As a consequence the producer may be inclined to run the simulation system once again with changes in exogenous variables or parameters in order to improve the accounting statements. This will usually result in changed prices. Having in mind some sort of reaction mechanism corresponding to the "tatonnement process" in general equilibrium theory, it may indeed be possible to reach an "equilibrium" in a particular market. Due to the functional and practical interrelatedness of goods on the demand and production side such "equilibria" will only be partial ones. This makes sense from a practical perspective as different market forms usually prevail in different markets. The attempt to achieve some sort of a "general" equilibrium is bound to fail if only because of the restricted set of commodities usually considered in MEPS applications. On the other hand, the merits of the partial approach may be seen from the spectrum of information generated by the "groping towards equilibrium" approach. Not only will the effects of induced price changes shed light on the movement of quantities of the market itself - and thereby indicating wether there exists a tendency towards equality of supply and demand - but will show reactions throughout the commodities covered in the analysis. This is the consequence of considering substitution effects on the demand and price formation on the production side. Even for rationed goods the change in the degree of satisfaction will be revealed.

As mentioned previously, we may also have the case that the decision about the quantity to produce will result in a deviation from the demanded quantity. This will bring about a partial disequilibrium for certain final goods (or intermediary ones). This imbalance could be thought of stimulating foreign trade to bring about equilibrium in the respective markets (either by selling the surplus output abroad as exports or by buying the deficient quantities from abroad (i.e. imports)), provided there are no trade restraints. In case of restrictions on foreign trade either the consumers or the produceres may get rationed with the effect that desired needs cannot be fulfilled, inventories may have to be kept or some arrangement for disposal must be met. We have discussed this situation extensively in section 5.

6.2.
Finally, a short remark must be made with respect to the national economic level. Demand and production modules provide key relations to national economic aggregates. These links will provide the possibility to undertake tasks in national aggregate planning and some policy analysis. It will crucially depend on the size of the economic sector modelled with MEPS whether one has to provide feedback equations from the sectoral to the national level or whether one can safely do without. This question can not be answered generally for an abstract model but must be tackled within an application. An example may suffice. The price index PCT used in section 3 above is theoretically dpendent on the prices of the commodities entering the analysis and will vary with changes in their prices. This effect must be accounted for if the weights of the commodities in the basket used to construct the price index are sizeable, i.e. an influence of their price changes can be traced with reasonable accuracy. It will, therefore, depend on such information as well as the available degree of accuracy whether such feedback relations must be included.

References

Böhm B., Brandner P. (1988), Interactive Economic Policy Making with a Macroeconometric Model. The Case of Austria, Res. Rep. 85, TU-Wien

Dorfman S., Samuelson P. A., Solow R. (1958), Linear Programming and Economic Analysis, McGraw-Hill

Rogowski T., Sobczyk J., Wierzbicki A. P. (1988), Dynamic Interactive Decision Analysis and Support System Linear Version, WP-88-110, IIASA, Laxenburg, Austria

Stone R. (1957), Linear Expenditure Systems and Demand Analysis: An Application to Patterns of British Demand, Economic Journal 64, 511-527

UNIDO (1987), User's Guide of MEPS, PPD.33

UNIDO (1986), MEPS, Abridged Version, IS.643

Part B:

The main features of the revised supply module of MEPS

1. Introduction

The supply module covers the elaboration and calculation of both the direct outputs and inputs (in physical and value terms) of the product i (which is the target product) and the major indirect output and input linkages at a uniform level of aggregation of the products j and an additional sector, called rest of the economy embracing aggregated output and cost items to approximate a total accounting at the level of national economy.

The elaboration of the output-cost items for product i and the major linkages follows the same lines (with necessary modifications of the original MEPS construct). This means that the same tables have to be filled out as many times as is the number of linkages determined through the input chains, but not more in backward sense as three. (If for purely technical reasons - like the memory constraint of Symphony, etc.- this turns to be a too a large system, the chain will have to be reduced.) The other deviation from the logic of MEPS can be found in that separate full elaboration is required for the the existing capacities in the supplying of the products i and the new capacities necessary for answering the demand of i.

The basic system therefore will be composed of the following "tables":

1. Existing capacities

Full derivation of output, inputs (in domestic - imported breakdown*), their costs and returns elaborated completely for gross and net accounting.(*For the accounting of imported inputs see the uniform import table.)

2. New capacities

- Derivation of investment expenses (see special table for investments in part C);
- Derivation of output, inputs (in domestic - imported breakdown), their costs and returns elaborated completely for gross and net accounting (see the special table for the derivation of current account expenses).

3. Imports

Full derivation of the related cost items and policy type items (see special table for accounting the costs of imports).The results of these tables will be fed back to Tables 1 and 2.

4. Accounting for input linkages

The results of these tables will be fed back to Tables 1, 2, 3. See the course of compilations later under paragraph 8.

2. Basic considerations

Throughout the whole system the following principle has been followed: each variant (let it be investment, demand, etc.) is considered at a first stage as a discrete variable, independent of the other variants. Both the DTOT(i), the total demand of the need (product or anything else) and therefore the different variants of its possible satisfaction have been considered as increments relative to the economic system prevailing in the initial (base) period. Therefore the variants out of which the "best" has to be selected first are considered in turn as independent and discrete solutions of the target. Thus their full impact at the macro level is calculated within the system and thus a solid basis of comparison can be established. It is a consecutive stage of the calculations whereby the hypothesis of discreteness of the variants will be abandoned and replaced by a selection of mixed strategies.

Technically the system is decomposed into two major spheres: the spheres relevant for the decision-making problem are desaggregated on a high level and both the backward and forward linkages properly followed and elaborated, while the spheres of secondary importance from the point of view of the decision-making problem but relevant for the completeness at macro level have been treated in a highly aggregated manner. In these latter cases neither the linkages nor the policy impacts will be fully developed.

The time period covered by our analytical system goes from year t=0 to t=T, where t=0 is the base year, i.e. the year of the decision-making, and T is the target year.

3. Alternatives for Total Demand of Product i

The construction of our system starts from the following basic relationships from the point of view of Product i.

The system considered is composed of i = 1,..,q products, which can be used as final products (for consumption or investment), or as inputs in the production of products j (i = j allowed), exported and as for non-specified usages in the rest of the economy.

Product i is a final product if i= 1,..,n.
Product i is input (intermediate) product if i= n+1,..,q.
(See 5.2 in Part A.)

$$DTOT(i) = Df(i) + Dj(i) + De(i) + Dr(i) \qquad (1)$$

where Df(i) = demand for final product i (i=1,..,n), given by the demand module;
Dj(i) = demand for input product i induced by the production of j (i=n+1,..,q; j=1,..,q);
De(i) = export demand for i (i=1,..,q);
Dr(i) = demand for product i by the rest of the economy (i=1,...,q);
DTOT(i) = total demand for product i.

$$Dj(i) = const(i,j)^{\cdot} + a(i,j)^{\cdot} * X(j)^{\cdot} + const(i,j)\eta + a(i,j)\eta * X(j)\eta \qquad (2)$$

where $X^{\cdot}$ = production on old capacity;
$X\eta$ = production on new capacity;
$const(i,j)^{\cdot}$, $a(i,j)^{\cdot}$, $const(i,j)\eta$, $a(i,j)\eta$ = exogenous parameters;

$$SUP(i) = X(i)^{\cdot} + X(i)\eta \qquad (3)$$

the total domestic supply. About the possible relations among SUP(i), DTOT(i) and M(i) (imports) see paragraph 5 in Part A.

In the present version the calculations should run for each product separately.

4. Prices

All the calculations should be performed simultaneously at two prices, namely once at "cost plus" and second at market prices. In both cases all price components originating in policies (as the different taxes, subsidies, duties, etc.) should be elaborated and presented item by item, by which a direct link to the policy module can be established. In certain cases, which will be refered to at appropriate instances, nevertheless the item-by-item desaggregation will prove to be unnecessary and a higher level of aggregation will be applied instead. Still the explicit elaboration of the price components related to the budgetary accounts will be made possible, though not in a detailed way.

The intermediate products of less importance (i.e. not analyzed in details) have to figure at market prices.

Trade and transportation services related to the material inputs have been considered as separate inputs, thus their costs add up to the direct and explicit cost of material.

As far as price construction is concerned the present enhanced MEPS allows for two versions. In the first the producer plays the role of "price maker" in the market, while in the second that of the "price taker". Thus in the first case it is the mark-up plus price formation rule followed i.e. the mark-up is to be defined by the planner and the seller's price is derived, while in the second case, the market price is exogeneously given and that is the profit which is derived.

5. Fixed Capital Investments

To assure perfect comparability between the different variants the direct and - in a defined extent - the indirect costs incurred in relation with the fixed capital investments necessary to meet the need with products of domestic origin have to be taken into account. Here again, each new establishment is taken for a discrete variable, but with a view on technical feasibility, i.e. excess supply over or excess demand relative to the need in question may occur. (See e.g. an electric power-station where the sizes of the turbines are technical parameters and can not be changed.) In those cases exports of the excess supply or imports of the excess demand of the same product should be considered as for the complements.

As a principle the variants of technically different fixed capital investments should always compete with the imports of the quantity DTOT(i) - if no production-capacity i exists at all at the base period (t = 0); or for the new capacity needed for covering the [DTOT(i) - Cap(i)] = excess demand quantity. (Cap(i) is the existing productive capacity of product i). I.e. imports of product i should always figure as alternative to the new investment for the establishment of the failing production capacity to meet the DTOT(i) quantity required.

6. Production function

Within the capabilities of Symphony there is no possibility of using nonlinear production functions and optimizing the behaviour of the firms. We suppose that the production activities of the firms are linear in the sense that the quantity of input i required in the production of product j is a linear function of the output:

$$X(i,j) = const(i,j) + a(i,j)*X(j) \qquad (4)$$

Analogous relations hold for the different types of labour and for the inventories as well. The const(i,j) constants and a(i,j) coefficients are exogeneously given but may vary according to technical variants of the investment projects.

The system has been elaborated in such a way to allow for existing production capacity. In accordance with it, the user has to elaborate as many production relations as it is the number of new and existing project variants in the enlarged system altogether. (I.e.the elaborated linkages have to be taken into consideration.) The production - supply - is calculated for one year, but the time factor is taken into account (in a simple way).

In the case of existing capacities it is supposed that the tied up fixed capital is given and it is independent of the production level. (The reconstruction of an old capacity can be a possible variant among the new capacities in the investment decision-making procedure.) In the case of new capacities full capacity utilization is to be supposed with an equal number of shifts for each variant.

7. The time horizon

Different time horizons have to be defined depending on the variables in consideration. Still it is important that uniformity should be assured in the treatment of the time horizon. Therefore the following conventions will be applied throughout the decision -making system.

In the framework of this simplified system, the only possibility to introduce some dynamism in our decision-making has been assured by taking into consideration the whole of the gestation period, the running-in period and the expected full-capacity life time of a project and the yearly expected changes in the cost and revenue (production) conditions related to the given project on the one hand. These are then compared among the possible projects. On the other hand the calculations have to be made with respect the planner's time-horizon, the so-called target-year.

The basis of comparison is year t = 0, the planning year. The target year, t = T which is defined by the planner, thus must be long enough to allow for the establishment of the new capacity in sector i with the longest gestation period up to a one year full capacity operation of the same. Following this principle all possible technical variants can be properly evaluated and compared.

8. Definition of linkages related to supplying DTOT(j)

8.1. Backward linkages (inputs)

For the description and definition of the backward linkages we start from the production of product j, the target.

8.1.1. Definition of the lenght of the chain of linkages

If P(i)*a(i,j)/ P(j) > 0.1

the following calculations should be performed:

a. total amount of input i needed per year = Dj(i);
b. total production of i X(i);
c. exports of i E(i);
d. imports of i M(i);
e. X(i)-E(i) = Domestic Availability of i DA(i);
f. Dj(i)-DA(i) and [Dj(i)-DA(i)]/DA(i), both for t= -5,..,0
g. [DA(i)+M(i)]/DA(i) =TDR ratio of total supply to domestic supply for input i;

8.1.2. Demand for input i (in physical units first and in value terms second).

If a sector i is contributing by a relatively high portion of the inputs of the project j (min 10 %) i.e. the i's demand could represent a substantial increment in the total domestic demand for the i-th product, this effect has to be considered explicitly.

The first series of calculations aims at measuring whether there exists a domestic capacity available to meet this demand, or can it only be met by imports (or at the expense of diminishing exports) of the same. Therefore this should be calculated in physical units. The calculations shuold cover a five-year period for indicating the tendencies in sector i.

<u>Notation</u>: the upperindexes and η indicate the base year resp. target year values of the variable in question.

We always start from the hypothesis that $DTOT(i)^{\circ} > 0$.

Possible "branches":

a. There is no domestic production of i; i.e. $X(i)^{\circ} = 0$

$Dj(i)\eta = (1 + \delta)M(i)^{\circ}$ or
$Dj(i)\eta = M(i)^{\circ} + X(i)\eta$ with $X(i)\eta, M(i)\eta > 0$.

b. There is production but no exports and no imports of i in year 0; i.e. $DTOT(i)^{\circ} = Df(i)^{\circ} + Dj(i)^{\circ} + Dr(i) = X(i)^{\circ}$ (with the simplifying assumption involved that the market is cleared in i and no excess capacity exists).

$DTOT(i)\eta = (1 + \delta)X^{\circ} \pm M(i)\eta$

c. There is both domestic and import supply of i but there are no exports.

$X(i)^{\circ}, M(i)^{\circ} > 0$, $E(i)^{\circ} = 0$,
$DTOT(i)\eta = (1 + \delta)X^{\circ} \pm M(i)\eta$

d. There is both domestic and import supply of i and there are exports too, i.e.

$X(i)^{\circ}, M(i)^{\circ}, E(i)^{\circ} > 0$ but

$\delta D(i) > X(i)^{\circ} + M(i)^{\circ}$.

For all cases, when $X(i)^{\circ} > 0$ holds, the undermentioned relations have to be calculated and taken into account in the decision-making procedure.

If

I. $Dj(i)^{\circ}(1 + \delta)/ X(i)^{\circ} < 1.1$ then

I.1. if total supply is an increasing function of time because of X(i) increasing (with M(i) constant or decreasing) and

I.1.1 if $M(i)^{\circ}/X(i)^{\circ} < 0.2$, one should suppose that there is no inmediate need for further capacity installation in sector i for the sake of the project in sector i;

I.1.2 if $M(i)^{\circ}/X(i)^{\circ} > 0{,}2$, then

$\delta Dj(i) = \delta M(i) + \delta X(i)$, where $\delta M(i), \delta X(i) > 0$;

I.2. if total supply is an increasing function of time with X(i) decreasing or constant and M(i) increasing, then X(i) and $\Sigma_j M(i,j)$ have to be compared with $D(i)\eta$. Then

$D(i)\eta - D(i)^{\circ} = \delta X(i) + \delta M(i)$, with $\delta M(i), \delta X(i) > 0$, and
$I(i) \leq \delta D(i)$, where I(i) = investment in sector i.

II. If total supply is a decreasing function of time and

$Dj(i)(1 + \delta) / X(i)^{\circ} < 1.2$ then

$D(i)\eta - D(i)^{\circ} = \delta X(i) + \delta M(i)$, with $\delta M(i), \delta X(i) > 0$, and
$I(i) \leq \delta D(i)$.

8.2. Forward linkages (Supply of product i)

The forward linkage problem may be relevant for the decision-making in two major instances. First, when the target product j can be used as an input in other productive processes outside the branch of origin i.e. when it is an intermediate product by its physical qualities. Second, when the technological units of its production allows only for minimum quantities significally exceeding the target (excess) demand defined by the planner. (Typical example could be a decision problem on the production of electricity where the size of turbines can not be adjusted to the excess demand in electricity in general and certainly not to the most economic size of it. Therefore only more than necessary incremental production is possible. P.e. extra 70 MW is needed but only 100 MW can be produced, which means that 30 MW extra supply would be offered to the national economy. This quantity can be rather important relative to the total already existing national production and therefore would have a rather significant impact on the whole of the rest of the economy. Therefore this effect has to be taken into account when making the decision on the establishment of the new power-station.)

In these cases the planner should follow the undermentioned considerations:

If the target demand of this product i can be produced only in quantities exceeding it and the resulting excess new output is greater than the twenty percent of the total national demand of this product in the year of the decision-making, then explicit account should be taken of it by including the mostly affected other sectors into the system. This would mean that the major other user branches j of this product should be listed and their demand structure explicitly analyzed if their individual share in the national total demand of this product i in the year $t = 0$ is bigger than ten percent in turn.

That is: Let us call

$\delta D(i)$ the target demand,

$Dj(i)^{\bullet}$ the demand of the other sectors j of the same product in the year of the decision-making,

$DTOT(i)^{\bullet} = \Sigma_j Dj(i)^{\bullet}$, the total national demand of i of all other sectors,

$C\eta(i)$ the minimum new production capacity technically possible.

If

$C\eta(i) \geq 1.2\ \delta D(i)$, <u>and</u>

$Dj(i)^{\bullet} \geq 0.1\ DTOT(i)^{\bullet}$ <u>and</u>

$0.5\ DTOT(i)^{\bullet} \leq M(i)^{\bullet}$

sector(s) j have to be included in the decision-making procedure in such a way that this demand $Dj(i)^{\bullet}$ should be included in the total MEPS system and examined with the same procedure as described above. (Technically it means a loop back to the original chain of considerations.)

Part C:

Module of investment decision-making and selection of projects

1. The problematic of decision-making

In principle the selection of investment projects as a quantitative process is composed of two phases. During the first the variants are to be examined from the point of view of their rentability and at the end of this phase the ones which are not rentable have to be defined and excluded from the second part of the procedure. The second phase of the decision-making is for the selecting out of the rentable projects the best variant. Here the question of the criteria of selection is raised.
The literature on capital theory and investment decision-making offer a rumber of reasonable decisionmaking criteria. The selection of one out of the posssible ones is made rather difficult by the very fact that these are highly sensitive to the impacts of the different (macro) economic factors incl. policy variables and their changes. That very same characteristic of these criteria, on the other hand turns out to be rather advantegeous from the point of view of the so-called enhanced MEPS.
As it has been our intention to establish a certain linkage between the development political issues covered by MEPS (which by it very nature can be of micro-economic level depending on the view-point from which the exercise is to be made) and the macro-political issues the application of these criteria can establish a certain base for the realization of some of these our aims. The interest rate for instance could be refered to as the most important policy variable linking the two levels in our system. Without entering here into a detailed presentation of theoretical aspects and considerations a combination of criteria for the selection of the "best" project-variant has been suggested and the technical elaboration of their application within the enhanced MEPS has been resolved.

2. Conceptual issues related to the criteria

Nevertheless the criteria of selection can formally be different, all involve the same fundamental concept, namely the "maximization" of the opportunity cost of a given capital-investment. Thus the requirement of rentability raised against a project is that the net returns it can garantee should at least be equal to the investment of the same capital at any other field in the national economy.

Here, it is supposed, as it has to be also in the whole decision-making procedure, that the interest rate is given and is the same for each application and project. Just this is the point where one of the linkages of macro-policy and the selection can be established; namely the exercise can be repeated with a different interest rate and the impact of the change on the rentability of the different projects can be measured.

An other very important theoretical assumption involved in the methodology has to be mentioned : it is supposed implicitly that the investor has free choice in the allocation of his capital.

3. The criteria of the decision-making

The procedure suggested seems to lend itself well for the answering the double expectation vis-a-vis the decision-making, namely that it should be appropriate for both a macro and a micro level evaluation with possible linkages to policy variables.

3.1. The concept of rentability or capital value

An investment is considered as a rentable one if the following quantitative relationship holds:

Let an investment be composed of the expenses
$B_0, B_1, \ldots, B_n, B_{n+1}$
paid at the time-points $t=0,1,\ldots,n,n+1$ -these can be years and the net revenues
$R_u, R_{u+1}, \ldots, R_{u+m}$ accruing at time-points $t=u,u+1,\ldots,u+m$, where u is the first year of the running-in period (allowing for $u \leq n$).
Then the condition of the rentability of the total investment stream is:

$$\frac{R_u}{(1+i)^u} + \frac{R_{u+1}}{(1+i)^{u+1}} + \ldots + \frac{R_{u+m}}{(1+i)^{u+m}} -$$

$$- \left[B_0 + \frac{B_1}{1+i} + \ldots\ldots + \frac{B_n}{(1+i)^n} + \frac{B_{n+1}}{(1+i)^{n+1}}\right] \geq 0.$$

The left-hand side of the above expression is called the capital value of the investment.

3.2. The internal rate of return

The internal rate of return of an investment is the interest rate by which the present value of total expenses is made equal to the present value of all returns expected during the life-time of the project.

Let the investment expenses be $B_0, B_1, \ldots, B_n, B_{n+1}$ paid at times $t = 0,1,\ldots,n,n+1$ and $R_u, R_{u+1}, \ldots, R_Z$ the net return accruing at times $t = u,u+1,\ldots,Z$, where Z is the last year of full-capacity operation of the project established with the investment expenses.

Then r is the (unknown) internal rate of return, by which the following relationship is satisfied:

$$B_0+B_1/(1+r)+B_2/(1+r)^2+\ldots+B_n/(1+r)^n+B_{n+1}/(1+r)^{n+1} =$$

$$= R_u/(1+r)^u+R_{u+1}/(1+r)^{u+1} + \ldots + R_Z/(1+r)^Z.$$

In the special case when only one payment B_0 is done in time 0 the base time (the time of reference selected) and only one revenue R_T is accruing at t = T, the internal rate of return is given by the following expressions:

$$B_0 = R_T(1 + r)^{-T}, \quad \text{or}$$

$$r = (R_T/E_0)^{1/T} - 1.$$

$r \gtrless 0$ depending on the relationship between the expenses and returns and their relation to the time of reference.
It has to be mentioned that the exact mathematical determination of the internal rate of return can not be done in cases where the yearly investment expenses and/or the yearly revenues are not equal, but vary in their sum. For these cases, which are the most realistic and therefore frequent ones, methods of approximation are available and the calculus can be done. Our methodology also contains such a procedure, thus the user will not be limited in the work by this technical problem.

For the sake of simplifying the practical exercises, we will define throughout in our methology the t = 0 time as for the reference time point.

4. The decision-making procedure

4.1. The logical trees

When the total demand of the product i defined represents an excess demand relative to the existing supply available in the base year (year 0), i.e.new productive capacities have to be built or/and excess imports are needed to fulfill the target, the normal course of the calculations within the system has to be interrupted and an investment decision-making procedure has to be wedged in.

Taking the features of Symphony into consideration, incl. its memory constraints, we suggest to build a separate tree to organize the investment decision-making calculations outside and make the selection of the investment project(s) outside the basic system. After having made the selection within the separate investment decision-making lateral system, the planner returns to the basic system and follows the procedures of compilations using the real data of the variant(s) selected through the lateral system.

4.2. The investment project variants and their definition

To avoid unnecessary complications both technically and substantially it seemed to be rational to limit the number of technical variants to be incorporated into the investment decision-making process. Thus the maximum number should be three plus a compulsory import variable the value of which be equal to the total value of the excess demand.

These investment variants may be different from each other in three aspects, namely : 1.in the capacity of their technically determined units, 2.(partly related to the above) in the input and cost structure of their investment, and finally 3. in the input and cost structure of their products.

As the investment variants are always discrete (by their technical properties) on the one hand and it is hardly probable that the quantity of excess total demand aimed at would exactly be equal to the technologically possible capacity of one given investment variant on the other, the conditions of the comparability of the variants for their ranking had to be assured. This problem has been solved by the logic of operations by which the combination of a project variant's technically given capacity is to be complemented with imports of i to equal the quantity of the demand target (DTOT(i)).

4.3. The time factor

Variants for the solutions of the same problem may differ relative to their gestation period and their life expectancy.

These differences transform into cost differences if properly taken into consideration and therefore are factors influencing the selection of variants both at macro and micro levels. Here again comparability has to be assured.

The other problem related is the expression of the costs accruing during the gestation period and those originating from the foregone production i.e. returns or profits due to a longer gestation period.

These are reckoned for by taking precisely into account the number of years - and the yearly investment allocations - covered by the gestation period on the one hand and considering the expected number of years of both the running-in and the full capacity operation.

Therefore three different periods have been distinguished in connection with each project variant. Here are the three, project dependent time variables considered:

$t = 0,1,..,G$ for the gestation period,
$t = u,u+1,..,z$ for the running-in period,
$t = z,.., Z$ for the full capacity operation period

and

$Z = \max(Z1,Z2,Z3)$ is the basis of the calculations.

In case where the running-in period begins before G, that is before the total completion of the investment, this has to be taken into consideration.

In the framework of our enhanced MEPS, the following time horizons for the above time-variables have been defined:
it is supposed that

$G = \max.4$ i.e. five years investment period is the maximum, but can be shorter, i.e. even two years long;

u i.e. the running-in can start one year before the finalization of the whole investment.

$z = \max.\ u+3$, i.e the running-in period can not be longer than 3 years.

Z = max.20 years, i.e the whole life span of the project can not exceed 20 years.

4.4. Cost evaluation

The non-additivity of investment or capital expenses and of the costs of production and other flow type costs has been resolved in the usual way, i.e. by the application of the present value calculations in the investment decision-making procedure.

It will be supposed in the calculations that running costs during the whole full capacity utilization period of the project are invariant. (Depreciation costs should therefore be calculated with linear rate.)

5. The quantitative relations and the course of calculations

5.1 The definition of comparable variants

a. Consider $\delta DTOT(i)$ defined by the planner; and define M(i), the "calculative" variant expressing the alternative that the excess demand of i which is the macro-economic target, will be met completely by imports and no investment in new capacities will be made.

$$M(i) = \delta DTOT(i) \tag{1}$$

b. Rank the project variants according to their planned (technically determined) capacity. Call the variant with the largest production capacity considered Cap1(i), the second largest Cap2(i), and the third, Cap3(i); thus

$$Cap1(i) \geq Cap2(i) \geq Cap3(i) \tag{2}$$

c. Define and calculate:

$$\begin{aligned} M1(i) &= \delta DTOT(i) - Cap1(i) \,, \\ M2(i) &= \delta DTOT(i) - Cap2(i) \,, \\ M3(i) &= \delta DTOT(i) - Cap3(i) \,, \quad \text{where} \end{aligned} \tag{3}$$

$M1(i), M2(i), M3(i) < 0$ means exports, denoted later E1,E2,E3.

Thus we are left with the following variables for the investment decision-making compilations:
$\delta DTOT(i)$, Cap1(i), Cap2(i), Cap3(i), M(i), M1(i),M2(i), M3(i), E1(i),E2(i),E3(i).

d. Define the comparable variants by :

$$\begin{aligned} VAR1 &= Cap1(i) + M1(i) - E1(i) \\ VAR2 &= Cap2(i) + M2(i) - E2(i) \\ VAR3 &= Cap3(i) + M3(i) - E3(i) \quad \text{with} \end{aligned} \tag{4}$$

$M1(i) * E1(i) = 0$, etc.

Thus we have already:

$$VAR1 = VAR2 = VAR3 = \delta DTOT \quad (5)$$

5.2 The calculation of the costs of the investment

5.2.1. Direct investment costs

The following calculations have to be made for all the three variants in turn. In what follows the calculations for one investment project will be presented.

The data come from the Table of Investment Costs of the basic system , where the investment costs figure in "domestic" and "imported" breakdown.
1. Domestic Investments: BTOTd(0),...,BTOTd(G),
2. Imported Investments: BTOTi(0),...,BTOTi(G),

The sum of the above four investment expenses make up the total investment requirement of a given project variant and therefore have to be calculated for each in turn.

$$BTOT(t)_v = BTOTd_v(t) + BTOTi_v(t) \quad (6)$$

where v = 1,2,3 (variants), t= 0,...G.

Calculate the present value of their sum for t = 0, the base year:

$$BTOT_v(pres) = BTOT_v(0)+BTOT_v(1)/(1+r)+BTOT_v(2)/(1+r)^2+ \ldots + BTOT_v(G)/(1+r)^G \quad (7)$$

5.2.2. Current (operation and production) costs

The items of these costs have to be taken from the basic system with one important modification, namely long-term interest payments and taxes (resp.subsidies) must not be taken into consideration. The reason for this modification of the costs is due to avoid double accounting for investment expenses (these items are included in the BTOT) and not to anticipate the impact of any policy decision. This latter will be the subject of a separate exercise.
Here an other fundamental deviation of the real engineering data will take place here when for calculative purposes to modifications have to be done. First, the costs related to the production of a project with less than maximum life expectancy have to be complemented with the quantity of imports substituting the by shorter lifetime foregone production for imports. As it can be seen from the above paragraph. Second, the differences in yearly production quantity among projets have also be adequately either complemented by imports or diminished by the export revenues.

Then with analogy to the way investment expenses have been calculated, the cost series will have the following form.

Domestic costs (for direct and indirect costs separately):

$$Cd_v(pres) = Cd_v(u)/(1+r)^u + Cd_v(u+1)/(1+r)^{(1+u)} + .. + Cd_v(z)/(1+r)^z + Cd_v(z+1)/(1+r)^{(z+1)} + .. + Cd_v(Z)/(1+r)^Z \quad (8)$$

Imported inputs (for direct and indirect costs separately):

$$Ci_v(pres) = Ci_v(u)/(1+\sigma)^u + Ci_v(u+1)/(1+\sigma)^{(1+u)} + .. + Ci_v(z)/(1+\sigma)^z + Ci_v(z+1)/(1+\sigma)^{(z+1)} + .. + Ci_v(Z)/(1+\sigma)^Z \quad (9)$$

Current costs total:

$$CTOT_v\ (pres) = Cd_v(pres) + Ci_v(pres) \quad (10)$$

For export revenues (if they exist),

$$Re(pres) = Re_v(z)/(1+r)^z + Re_v(z+1)/(1+r)^{(z+1)} + .. + Re_v(Z)/(1+r)^Z. \quad (11)$$

The Present Value of Net Total Costs will then be:

$$NetCTOT_v(pres) = Cd_v(pres) + Ci_v(pres) - Re_v(pres). \quad (12)$$

6. Selection of alternative projects

It was mentioned that the maximum number of project variants allowed for comparison is three, as the process of calculations is rather requiring. (The import variant is then the fourth.)

First step:

The internal rate of return, r should be calculated for all the three comparable variants. Thus we get r_1, r_2, r_3.

Second step:

Compare the above with the long-term market rate of interest prevailing in the time of the calculations, let's call it i. And/or compare it to a so-called calculative interest-rate, selected by the decision-maker, μ. This is a rate of profitability the decision-maker would prefer to attain and can be higher than the market rate of long-term interest rate. That is check if

$r_1, r_2, r_3 \geq i$, and/or

$r_1, r_2, r_3 \geq \mu$.

Third step:

Define the project variants where the above relations hold as these are the profitable ones among out of which the most profitable has to be selected. Therefore these variants will be the subject of the selection procedure.

Fourth step:
Application of a given decision-making criterion. There are several but only the following will be suggested:

a. Maximum capital value

Calculate the capital value of the variants with the application of the lowest internal rate of return for all variants.

The best variant then will be the one with the highest capital value calculated with the lowest internal rate of return. The same could be done with the calculative interest rate.

b. Cost minimization

Sum up the investment costs and the gross current costs, i.e export revenues should not be deduced and select the one with the lowest total costs.
If for this variant the internal rate of return $r \geq \mu$, the calculative interest rate, then this variant also could be chosen as for best, if some other aspects, to be mentioned in the following paragraph do not contradict.

c. Consideration of other criteria

For many other important economic and/or policy type considerations other criteria should also be applied in addition to the above described basic decision-making criteria.

There is a rather high probability that in many cases the concrete alternative projects to be compared with decision-making procedures the technical differences - as the capacities - are not really significant but there are other important factors which differ. These can be due to their variation in their technical level(which is expressed for instance in the differences once in the share of imported equipments or certain intermediate products necessary, or second, in the capital intensity or skilled labour requirements of the installed new facility). It might also be a very important aspect - partly related to the above - that there exist constraints on macro-economic level both of capital and (skilled) labor or opposite to it, the job creation capacity of an investment might be quite relevant from the point of view of employment policy, etc.

In all these cases, which are specific to a given country and to a concrete decision-making problem the planner should take these criteria into consideration in combination with the relevant abovementioned basic rentability or cost-minimalization criteria.

7. Measuring impacts of certain policy parameters

A further possibility offered by the system is the measuring the impacts of macro-economic policies.
The planner (be it a planner in a central organ of the government or in an enterprise) can introduce modified economic-political parameters into the system and repeat the calculations using these one in turn and check and compare the result of the ranking on the basis of the modified version.

The relevant policy parameters for this purpose should be the different taxes, duties, exchange rates, etc. The important is

that the planner should modify only one parameter at once as within (even in the framework of the enhanced) MEPS the impact of individual modifications can be traced.
The new parameters should be introduced and figure in the different cost and revenue tables, modifying the relevant items and the decision-making procedure re-run with these new items.

8. Return to the basic MEPS system

After having selected the project variant to be realized, the planner has to go back to the Supply Module of MEPS and fill out the necessary tables with the real information relative the selected project and execute all the calculations incorporated in it.

Part D:
Appendixes

Appendix 1:

The equation system of the revised demand module

1. General remarks:

The following indices are used:

- i commodity, if i=1,...,m imported commodity only,
  if i=m+1,...,n domestically produced (may be imported under rationing scheme)
- g population group, g=1,...,H
- t time period, t=0,...,T, t=0 base period, t=T final period
- k need to be satisfied, k=1,...K

The numbering of equations does not follow the one in part A. The following equation system represents one possible example among several others which could be deduced fom the text above. One basic alternative specification relating to the link to the macroeconomic sphere is presented explicitly.

2. Equation system:

A) Demand system:

(1) per capita consumer demand for physical amount of good i, consumer group g, in period t:

$$c(i,g,t) = a(i,g) + (1/p(i,g,t))*b(i,g)*[y(g,t) - \sum_{j=1}^{n} (p(j,g,t)*a(j,g))]$$

for i=1,...n; g=1,...H; t=0,...T,
with
$0 \le a(i,g) \le c(i,g,t)$ (all t)
$b(i,g) > 0$, $\Sigma_i\, b(i,g) = 1$ for all g, i=1,...n.

(2) consumer demand of group g for good i in period t:

$$C(i,g,t) = c(i,g,t)*pop(g,t)$$

for i=1,...n; g=1,...H; t=0,...T.

(3) total consumer demand for physical good i in period t:

$$CT(i,t) = \Sigma_g\, C(i,g,t) \quad \text{all i and t.}$$

(4) total physical demand for domestically produced good i in period t:

$$CTd(i,t) = CT(i,t) \quad \text{for } i=m+1,...,n$$

(5) total physical demand for imported good i in period t:

$$CTm(i,t) = CT(i,t) \quad \text{for } i=1,\dots,m$$

B) Consumer expenditures:

(6) per capita expenditures on commodities i=1,...,n of group g in period t:

$$y(g,t) = Y(g,t)/pop(g,t) \qquad \text{all } i,g, \text{ and } t.$$

(7) group expenditures on commodities i=1,...,n of group g in period t:

$$Y(g,t) = v(g,t)*CNT(g,t), \quad \text{all } g,t$$

(8) total consumer expenditures at current prices of group g in period t:

$$CNT(g,t) = r(g,t)*CNT(t), \quad \text{all } g,t$$

(9) total consumer expenditures at current prices in period t:

$$CNT(t) = CRT(t)*PCT(t)/100 =$$

(10) total consumer expenditures at constant prices in period t:

$$CRT(t) = a0 + a1*(YDT(t)/PCT(t)*100) + a2*Z(t)$$

C) Population equations:

(11) population in group g in period t:

$$pop(g,t) = pop(g,0)*(1+gr(g)) \quad \text{for } t=1,\dots,T$$

(12) total population in period t:

$$Tpop(t) = \Sigma_g \, pop(g,t)$$

D) Satisfaction of needs equations:

(13) actual per capita satisfaction level of need k for group g in period t:

$$Actual(k,g,t) = \Sigma_{i \epsilon S} \, c(i,g,t)*ncoef(k,i)$$

for index set $S = \{i;\ ncoef(k,i) > 0\}$ and $k=1,\dots,K$.

IF $DIF(i,t) > 0 : c(i,g,t) = c^*(i,g,t)$ for $i=1,\dots,n$.

(14) deficit in the satisfaction of need k of group g in period t:

$$DefSat(k,g,t) = Goal(k,g,t) - Actual(k,g,t) \quad \text{all } k,g,t.$$

(15) degree of goal satisfaction achievement of need k, group g in period t

$$DefSat\%(k,g,t) = 100-[(Goal(k,g,t)-Actual(k,g,t))/Goal(k,g,t)]*100$$

all k, g, t.

(16) actual average (per capita) satisfaction of need k in period t:

$$ACTUAL(k,t) = \Sigma_g(Actual(k,g,t)*pop(g,t))/(Tpop(t))$$

(17) degree of average (per capita) goal satisfaction of need k in period t:

$$DEF\%(k,t)=100-[(GOAL(k,t)-ACTUAL(k,t))/GOAL(k,t)]*100.$$

(18) satisfaction level of need k due to imports in period t:

$$ACTUALM(k,t) = \Sigma_g \sum_{i=1}^{m}{}_{i\epsilon S} (c(i,g,t)*ncoef(k,i))*pop(g,t)$$

IF $DIF(i,t) > 0 : c(i,g,t) = c^*(i,g,t)$ for $i=1,\ldots,m$.

(19) satisfaction level of need k due to domestic goods in period t:

$$ACTUALD(k,t) = \Sigma_g \sum_{i=m+1}^{n}{}_{i\epsilon S} (c(i,g,t)*ncoef(k,i))*pop(g,t)$$

IF $DIF(i,t) > 0 : c(i,g,t) = c^*(i,g,t)$ for $i=m+1,\ldots,n$.

(20) degree of average (per capita) goal satisfaction of need k due to imports in period t:

$$DEFM\%(k,t)=100-[(GOALM(k,t)-ACTUALM(k,t))/GOALM(k,t)]*100$$

(21) degree of average (per capita) goal satisfaction of need k due to domestic goods in period t:

$$DEFD\%(k,t)=100-[(GOALD(k,t)-ACTUALD(k,t))/GOALD(k,t)]*100.$$

E) Rationing equations:

(22) Excess demand for domestic good i in period t:

$$CEd(i,t) = CTd(i,t) - SUP(i,t) - Mf^*(i,t),$$
for $i=m+1,\ldots,n$

(23) Excess demand for imported good i in period t:

$$CEm(i,t) = CTm(i,t) - Mf^*(i,t) \quad \text{for } i=1,\ldots,m.$$

(24) Constrained quantity of good i in period t:

$$CT^*(i,t) = CTd(i,t) - CEd(i,t) \text{ for } i=m+1,\ldots,n \text{ and}$$
$$= CTm(i,t) - CEm(i,t) \text{ for } i=1,\ldots,m.$$

(25) rationing allocation coefficient for good i, group g in period t

$$u(i,g,t) = pop(g,t)/Tpop(t) \text{ all } i,t,g$$

or a given parameter with constraints:
$0 < u(i,g,t < 1$ and $\Sigma_g u(i,g,t) = 1$ all i,t.

(26) excess demand for good i in period t:

$$DIF(i,t) = CT(i,t) - CT^*(i,t)$$

(27) group excess demand for good i, group g in period t:

$$dif(i,g,t) = u(i,g,t)*DIF(i,t) \quad \text{all } i,t,g$$

(28) rationed per capita demand for good i ,group g in period t:

$$c^*(i,g\ t) = c(i,g,t) - [dif(i,g,t)/pop(g,t)].$$

F) Equations which may be used to establish an alternative link to macroeconomic disposable income:

(29) per capita consumption expenditure function for group g:

$$y(g,t) = b0(g) + b1(g)*yn(g,t) + b2(g)*A(g,t)), \quad \text{all } g,t$$

(30) aggregate nominal disposable income

$$\Sigma_g\ (yn(g,t)*pop(g,t)) = YDT(t) \qquad \text{all } t$$

Note: equations (29) and (30) can be used instead of equations (6) to (10) if the required information is available.

Appendix 2:

List of variables and parameters of the demand module.

Note: Exogenous variables and parameters are printed bold!

A(g,t) (not specified) variable of group attributes

a(i,g) constants in demand system (minimal quantities)

a0 constant in consumption function

a1 constant in consumption function

a2 constant in consumption function

Actual(k,g,t) actual per capita satisfaction level of need k for group g in period t

ACTUAL(k,t) actual average (per capita) satisfaction of need k in period t

ACTUALD(k,t) satisfaction level of need k due to domestic goods in period t

ACTUALM(k,t) satisfaction level of need k due to imports in period t

b(i,g) constants in demand system (marginal budget shares)

b0(g) constant in consumption expenditure function for group g

b1(g) constant in consumption expenditure function for group g

b2(g) constant in consumption expenditure function for group g

C(i,g,t) consumer demand of group g for good i in period t

c(i,g,t) per capita consumer demand for physical amount of good i, consumer group g, in period t

c^*(i,g,t) rationed per capita demand for good i ,group g in period t

CEd(i,t) excess demands for domestic good i in period t

CEm(i,t) excess demands for imported good i in period t

CNT(g,t) total consumer expenditures at current prices of group g in period t:

CNT(t) total consumer expenditures at current prices in period t

CRT(t) total consumer expenditures at constant prices in period t

CT(i,t) total aggregate consumer demand for physical good i in period t

CT^*(i) constrained quantities of good i in period t

CTd(i,t) total physical demand for domestically produced good i in period t

CTm(i,t) total physical demand for imported good i in period t

DEF%(k,t) degree of average (per capita) goal satisfaction of need k in period t

DEFD%(k,t) degree of average (per capita) goal satisfaction of need k due to domestic goods in period t

DEFM%(k,t) degree of average (per capita) goal satisfaction of need k due to imports in period t

DefSat%(k,g,t) degree of goal satisfaction achievement of need k, group g, in period t

DefSat(k,g,t) deficit in the satisfaction of need k of group g in period t

dif(i,g,t) group excess demand for good i, group g in period t

DIF(i,t) excess demand for good i in period t

Goal(k,g,t) desired per capita satisfaction level of need k for group g in period t

GOAL(k,t) desired average (per capita) satisfaction of need k in period t

GOALD(k,t) desired average (per capita) satisfaction of need k in period t
GOALM(k,t) desired average (per capita) satisfaction of need k in period t
gr(g) constant population growth rate for group g
Mf*(i,t) upper bound on imports of physical good i in period t
ncoef(k,i) conversion coefficient expressing the amount of the measure of satisfaction of need k per unit of commodity i
p(i,g,t) selling price of good i,in period t, (for group g)
PCT(t) consumer price index (or deflator)
pop(g,t) population of group g in period t
r(g,t) expenditure share of group g in period t, as percentage of total nominal consumer expenditures
SUP(i,t) domestic supply of physical good i in period t
Tpop(t) total population in period t
u(i,g,t) rationing allocation coefficient for good i, group g in period t
v(g,t) expenditure share of all goods i=1,...,n as percentage of total group expenditures for group g, in period t
y(g,t) total expenditure on consumer goods i=1,...,n
Y(g,t) total group expenditures on commodities i=1,...,n of group g, in period t
YDT(t) total nominal disposable income
yn(g,t) per capita nominal incomes of group g in period t
Z(t) (not specified) exogenous variable

Appendix 3:

Tables of input information and results of the demand module

1. Input tables

1.1. Population

population group names	people	rate
1 ... H	pop(g,0)	gr(g)

1.2. Demand system parameters

names of goods	group 1 ... H	group 1 ... H	need 1 ... K	prices 1 ... T
1 ... m m+1 ... n	a(i,g)	b(i,g)	ncoef(i,k)	p(i,t)

We assume the same prices to hold for all groups. If price discrimination exists the table must be expanded to permit price variation across groups.

1.3. Satisfaction goals

For each t=1,...,T

group	need 1 ... K
1 ... H	Goal(k,g,t)

1.4. Macroeconomic variables and parameters

variable	period 1 ... T
YDT PCT Z	

parameters	value
a0 a1 a2	

A corresponding table may be set up for the alternative link to the macro-level using equations (29) and (30).

1.5. Consumers expenditure distribution and shares

group	period 1 ... T	period 1 ... T
1 ... H	r(g,t)	v(g,t)

1.6. Rationing

goods	domestic 1 ... T	imported 1 ... T
1 ... m	no entry	$Mf^*(i,t)$
m+1 ... n	SUP(i,t)	$Mf^*(i,t)$

Group distribution of excess demand u(i,g,t) must be given in a separate table if equation (25) is not used.

2. Output tables

2.1 Quantities demanded and excess demand

good	demand period 1 ... T	excess demand period 1 ... T
1 ... n	CT(i,t)	DIF(i,t)

2.2. Satisfaction of needs

For each period t=1,...,T

group	need 1 ... K
1 ... H	DefSat%(k,g,t)
total	DEF%(k,t)
domestic imported	DEFD%(k,t) DEFM%(k,t)

Appendix 4:

Scheme of the current cost tables

I.
Product name and unit
Time period
Price computation type (price-maker or price-taker)
Output price in price-taker case
Total demand for the investigated product
(linkage with demand module and with the tables of products using the investigated product as input)
Exchange rate

II.
1. Material inputs

Domestically produced and imported goods
Fixed amounts and input coefficients in physical units
Total induced demand
Prices of input products
Total material cost

2. Labour
Employment of skilled and unskilled workers
Wages
Wage taxes and social security
Total labour cost

3. Inventories costs

4. Depreciation

5. Interests

Short and long term, domestic and foreign

6. Mark-up factor in the price-maker case

7. Taxes and subsidies

Possibilities:
Fixed taxes and subsidies
Taxes and subsidies proportionate to production value
Value added tax
Export taxes and subsidies
Sales tax

8. In price-maker case calculation of selling price

III.
Joint products
Total production value
In price-taker case calculation of profit

IV.
Summarizing foreign currency needs and government transfers

Appendix 5:

Scheme of the investment decision-making table

The upper heading of the table:

GESTATION PERIOD(years)					RUNNING-IN PERIOD			FULL-CAPACITY OPERATION
1st	2nd	3rd	4th	5th	6th	7th	8th	

The left side labels of the table:

Engineering data on linked major product

Product name
Capacity/year(in units)
Gestation period (months)
Estimated running-in time (months)

Expected life span (in years)
Major material inputs(in phisycal units/product)
a.
b.
c.
d.
e.
Number of employees needed, Total/year
out of which: White collars
Skilled workers
Unskilled workers

Economic data

1.Investment costs
1.1 Designing
1.2 Land costs
1.3 Land preparation
1.4 Building and construction
Material
Labour
Other(leasing,rent etc.)
Total
1.5 Machinary and equipment
Domestic origin
Imported
Total
1.6 Other investment costs
Domestic(taxes,etc.)
Foreign currency payments
Total (in national currency)

TOTAL INVESTMENT COSTS(1.1+1.2+1.3+1.4+1.5+1.6)

2.Operation costs
2.1 Material costs, domestic
2.1.1 Fixed cost/year
2.1.2 Variable costs/pr›duction unit
out of which, (see:A12 - A16) a.
b.
c.
d.
e.

2.2 Material costs, imported
2.2.1 Fixed costs total/year
2.2.1.1 out of which: Depreciation
2.2.2 Variable costs/production unit
out of which:(see (A12 -A16)) a.
b.
c.
d.
e.

2.3 Wages and salaries/production unit
2.3.1 Fixed costs total/year
2.3.1.1 White collars
2.3.1.2 Skilled
2.3.1.3 Unskilled
2.3.2 Variable wage costs total/units
2.3.2.1 White collars
2.3.2.2 Skilled
2.3.2.3 Unskilled
2.3.3 Social security contribution/units
2.4 Financial costs:
2.4.1 Long-term loan management domestic/year
2.4.2 Long-term loan management foreign/year
2.4.3 Total long-term/year
2.4.4 Short-term interests/year domestic
2.4.5 Short-term interests/year foreign
2.4.6.Short-term total/year
2.4.7 Taxes related to production,total/units
out of which:
2.4.7.1
2.4.7.2
2.4.7.3
2.4.8 Tariffs and duties,total/units
2.4.9 Subsidies
out of which:
2.4.9.1 Fixed
2.4.9.2 Variable/units