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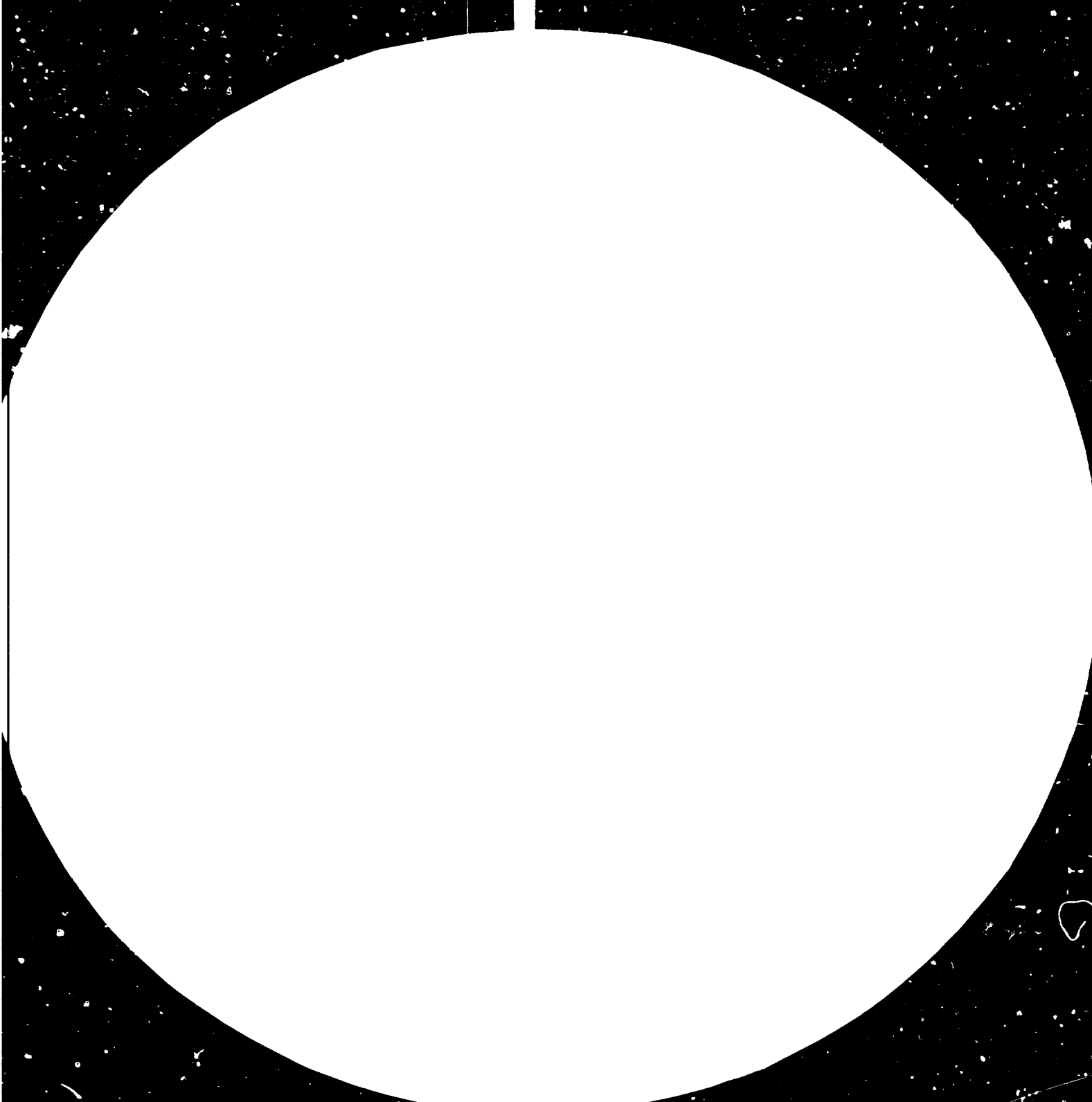

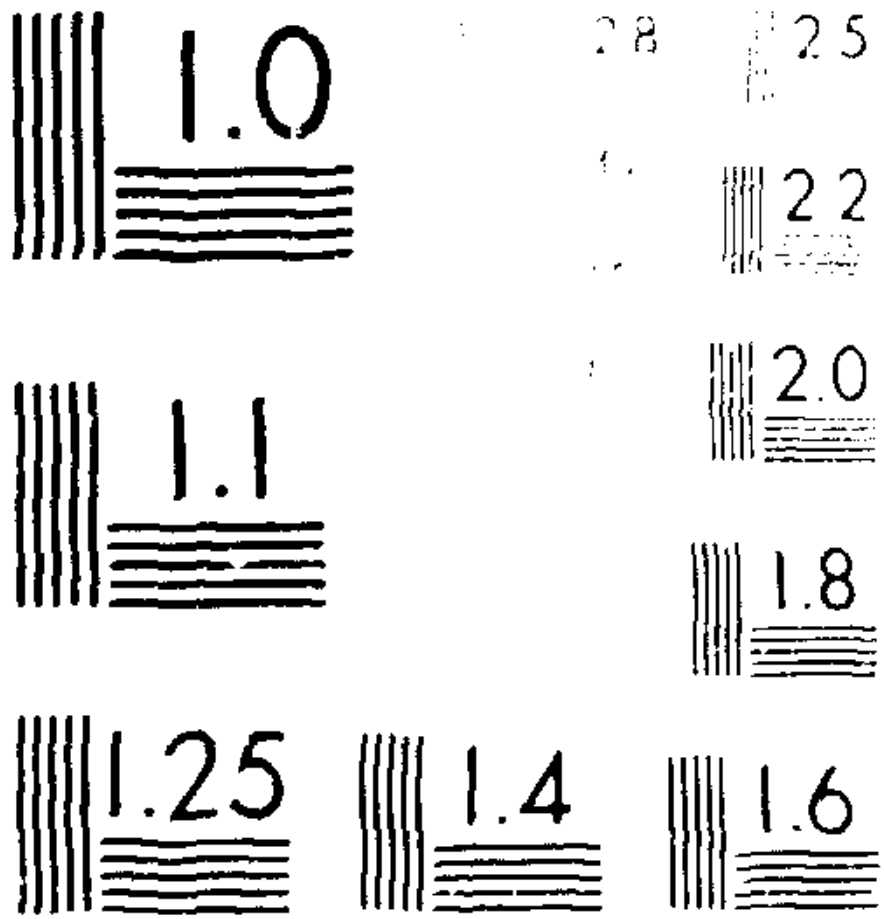
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THE UNITAD MODEL: MAIN METHODOLOGICAL FEATURES*.

Paper prepared for submission to the
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This paper has been prepared by the UNITAD team. The system and its various components were designed and estimated by G. A. Cornia, A. Duval and J. Royer who coordinated contributions from a number of sources. The Global and Conceptual Studies Branch of UNIDO contributed the Regional Input-Output Tables and the methodology of projecting matrices of technical coefficients, and is now operating the system.

1. The UNITAD Project was initiated in 1978, upon a request from the United Nations ACC Task Force on Long-Term Development Objectives. Financed by a group of donor countries (FUNDPAP) it has been jointly sponsored by UNCTAD, UNIDO and the Department of International Economic and Social Affairs, United Nations Headquarters. Its purpose is to build an analytical tool - the UNITAD system of models - for exploring the interrelationship between growth patterns, trade configuration and industrial structure within a broad development framework. The building phase of the project was completed at the end of 1980 and a report illustrating the use of the model for a 1990 trend scenario was issued early in 1981.

2. The present paper outlines the main methodological features of the system, which can be described as a set of eleven interrelated regional models, i.e. five models for developed regions[1/] and six for developing regions[2/]. The complex linkage among regional models is meant to picture the two-way relationship which exists between the broad industrial, commercial and development strategies at the regional level and a given international framework. More precisely, in the present version, the linkage (see Flowchart 1) consists of an International Trade Module and a World Financial Module. The former includes seven trade matrices, each of which corresponds to a specific commodity group[3/]. These trade matrices embody altogether 847 bilateral trade

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1/ North America, Western Europe, Eastern Europe, Japan and Other Developed (Australia, New Zealand and South Africa);

2/ Latin America, Tropical Africa, North Africa and West Asia, South Asia (Indian sub-continent), East and South-East Asia, Centrally Planned Asia;

3/ There are three groups for primary resources (agricultural raw material, other raw material, energy material) and four groups for manufactures (intermediary products, consumer non-durables, equipment goods, consumer durables); for precise definitions, see Annex A.

shares, which are exogenously defined in the present version[1]. Imports and Exports of Services are balanced in a pool of services. Regional models are also related through a series of financial pools which form the "World Financial Module". A system of international prices completes the picture of the "world economic structures" which are therefore meant to simulate the main rules of the game on trade, finance and international prices. The assumptions made on world economic structures can be combined in world scenarios with assumptions on domestic industrial, commercial and development policies at the regional level, so that the system can be said to investigate the overall impact of two broad families of assumptions at the world level and at the regional level respectively.

3. Three different types of regional models have been built up for market developing regions, market developed regions and Centrally Planned Economies, Europe, respectively. Plans were also made for a fourth category, i.e. Centrally Planned Economies, Asia (one of the eleven regions), but due to lack of available information this region plays a passive role in the system, in that it contributes trade and financial flows but there is no feedback of the world structure on the regional economy. The first section of this paper briefly describes the models for market economies, indicating the differences between developing and developed regions, and the second section refers to the model for Centrally Planned Economies, Europe. In a third section, the linkage mechanisms for the system as a whole, i.e. the International Trade and Financial Modules, are briefly described.

1/ Two alternative sets of 847 equations have been prepared to make these shares endogenously determined in another version.

Section 1: The Regional Models for Market Economies

4. Put in a simplified and condensed form, each regional model contains:

(a) an input-output table, 8 x 8 sectors, linking the output-mix with an endogenously generated final demand vector. The eight producing sectors are: agriculture, food processing, energy, basic products, light industry, equipment goods industry, construction and services;

(b) a technology mix, as embodied in the technical coefficients of the input-output tables and the variables of the production functions. The latter include the capital-labour coefficient as well as policy and other variables, such as the rate of technical progress and the market-size. A twelve sector classification is used in the production functions, i.e. the energy sector is decomposed into four components (oil extraction, coal mining, utilities and oil refineries) and the basic products sector into two (mining other than oil and coal, primary processing);

(c) the technology of the agricultural sector for developing regions is different according to the size of holdings (large, medium and small farms) and is based on policy and other variables including the land/labour ratio, the cropping intensity, the capital/labour ratio and the proportion of material inputs per worker;

(d) on the domestic final demand side, total private consumption is determined by the functional income distribution (exogenously given) while its structure is determined separately for rural and urban population for developing regions as a function of average income per capita and prices. Government consumption depends on the functional income distribution with an exogenous structure. Investment is demand-oriented and is a function of the technology-mix and the output-mix;

(e) the employment balance is obtained through the production functions which determine labour demand and through a demographic and labour supply sub-model;

(f) for developing regions, the land balance is obtained by subtracting the land demand, endogenously determined, from the land supply which includes a term for land extension. The extent to which land extension is required is determined by the model and the amount of land required influences the level of investment;

(g) trade has received an elaborate treatment. For each basket of goods (seven groups) and for services, the imports of each region are a function of the output-mix (in particular the industrial structure), and of two policy variables, i.e. the level of protection (tariff and non-tariff protection) and of the "average market size", i.e. an indicator sensitive to the establishment of economic groupings in the region. Exports are generated by the International Trade Module (see Section 3).

5. Balances for the input-output tables are obtained both in volume and value terms. The prices of the output vector are derived from the dual relations of the Input-Output matrices and should therefore be considered as costs. In these relations, the price of value added is based on exogenous values for the prices of two value-added components, wages and non-wages, which both include an exogenous inflation trend , and the two corresponding shares which are endogenously determined. The Domestic Final Demand price vector is computed as a weighted average of total output prices and import prices: The regional import prices for any commodity group are generated by the transposed trade share matrix, in the International Trade Module, on the basis of domestic export prices, supplied by each regional model, and an exogenous term, i.e. the "Incremental Export Prices". The latter, which is

used for primary resources in the present version[1/], is based on the assumption that exporting regions enjoy a rent which is not always positive and which adds up to the domestic export price when primary goods are sold on the world market. This makes it possible to simulate a wide range of prices for primary goods, and in particular to study the impact of growing energy prices on the world economy. The incremental export price, which differs from one regional model to another for each of the primary goods, generates an income which, in the present version, accrues to the government.

6. The model is solved by iteration. Initial values of value-added being given, the model generates final demand components. The aggregate final demand is adjusted to be equal to GDP through a loop affecting the shares of wages and non-wages in value-added. The new final demand vector, through the inverse Leontief matrix, then generates a new value-added vector which is used for the next regional interation. When all regional models converge an inter-regional loop generates new export values and new factor payments for each regional model and a new set of regional iterations begins. On the IBM system used in the Geneva International Computing Centre, three inter-regional loops and three times five regional loops for each regional model take approximately fourty seconds. Detailed information on regional models for market economies is given in Annex A, i.e. the analytical expression of the UNITAD system, as well as in Annex B which includes fourteen flowcharts on the various sub-systems.

7. The model clearly belongs to the family of gap models. It achieves equilibrium on the goods market but it does not contain equilibrating mechanisms for the markets of capital, labour and land or for the foreign

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1/ Incremental Export prices can also be used to simulate a monopolistic or oligopolistic export structure for specific manufactures, e.g. equipment goods.

accounts sector at the regional level. In the trend scenario, the growth of the GDP was exogenously determined, and the model generated three major gaps, i.e. the labour gap, the saving-investment gap and the land gap. Alternatively, in any region, one of the gaps could be exogenously given, so that the model would be used to generate the GDP growth rate and the other two gaps. More generally, an objective function of GDP and the three gaps could be maximized under the constraints of the equations of the model.

8. A distinction should be made between the formal structure of the model and its use for scenario building. In the latter case, the model should be used as a man-machine system. The feasibility, desirability and plausibility of the gaps are assessed for each solution in relation to the scenario assumptions as embodied in the values of the exogenous variables. For example, in a given scenario, the solution of some regional models may include saving-investment gaps which are found to be of a colossal negative magnitude, while other regions (e.g. West Asia) may accumulate large surpluses; in such a case, it may be interesting to change the exogenous GDP growth rate for specific regions, or to change some other exogenous variables, the only condition being that the new exogenous values should be compatible with the basic assumptions of the scenario.

Section 2: The Model for Centrally Planned Economies, Europe

9. The regional model for Centrally Planned Economies, Europe (in short, Eastern Europe), like the other regional models, is built around the A matrix of the input-output table for the region, but specific features of the economic system of the region are introduced into the model.

10. A first particular feature is that all aggregates are expressed in the Material Product Concept (MPS) of national income and product; this can be

justified not only on account of the available statistical data in national sources, but also in order to simulate in the model planning decisions expressed in the same conceptual framework, e.g. to adopt a growth target in terms of material product.

11. The model is a medium-term model and is expressed in real terms (constant prices). Another difference, therefore, refers to the fact that equations in value terms are restricted to those relations linking the region to the world economy. This is a recognition of the fact that the growth of Centrally Planned Economies is determined to a large extent by relations expressed in real terms and that the financial flows and price changes influence the economy to a much smaller extent than market economies.

12. Another feature which reflects the practice of Centrally Planned Economies is that full employment is always assured. As will be seen, this implies a different treatment of technology in the model.

13. One important simplification is introduced into the model. An assumption is made that all material activities are carried out as market activities (by enterprises and similar units) and all non-material activities as non-market activities. Thus the former are financed mainly through sales on the market and the latter are mainly financed via state budget. This assumption is not very far from the observed reality in Centrally Planned Economies (the value of non-material services purchased by households amounts to about 3 % of total expenditure of households).

14. The number of sectors used in the model is the same as for the other regions, except for the split of the services sector into two: material and non-material services. The sector frontiers, however, differ slightly (especially the capital goods services) to fit data available in national publications (see classifications in Annex A).

15. The target of the economy is assumed to be a selected growth rate for the Gross Material Product (GMP) over the medium-term period, but at the same time minimum growth rates of private and collective consumption are taken into consideration. The model is designed to trace up the impact on the economy (at the regional level) of decisions as taken at the central level. The main macro-economic planning decisions simulated in the model relate to:

(i) employment in agriculture, material and non-material services Sectorial employment in other sectors is endogenously determined;

(ii) desired technology (capital/labour retio);

(iii) amount of resources devoted to investment (gross fixed capital formation). The amount of fixed assets to be scrapped due to economic obsolescence, on top and above the scrapping due to physical deterioration, is endogenously determined;

(iv) ratio of growth of labour productivity to the growth of average real wage, which is the main factor influencing the level of private consumption (average real wages in non-material sphere and average social benefits are proportioned to the growth of real wages in the material sphere);

(v) amounts of resources devoted to the financing of the non-material sphere

(vi) the minimum growth rate of private consumption acceptable from the social point of view;

(vii) the minimum growth rate of collective consumption.

16. The treatment of employment and of withdrawal of obsolete capital deserves some explanation. Since full employment is to be achieved, it is necessary to secure capital to the whole labour force. It is assumed in the model that employment in services (material and non-material) and in agriculture is determined exogenously. The rationale for this is the following:

(a) employment in services is more independent from other factors of production than in another sector and is governed by central decision in planned economies;

(b) the labour force is in practice kept in the material sphere rather than moved to the non-material sphere when there is an excess of labour supply;

(c) no institutional changes within the agricultural sector are envisaged in the model.

17. In the non-agricultural material sectors full employment is achieved through a trade-off (computed by the model) between new technology, reflecting desired capital/labour ratios, and old technology which is more labour-intensive The rate of withdrawal of old technology is thus endogenously determined in the model as a compromise between decisions to introduce modern technology with a priority ranking of sectors, and the need to achieve full employment. As a consequence the average labour productivity determined by the model lies between the lower limit set by the old technology component and the upper limit set by the new technology component. This holds true for six "industrial" sectors, i.e. agri-food processing, oil refineries and coal product, primary processing of basic products, light industry, capital goods industry and construction.. For those six sectors, the model includes two different specifications for the old and the new technologies respectively. In the case of the old technology, the productivity equation is restricted to a trend of neutral technical progress, on the assumption that the equipment is more efficiently utilized at the end of the projection period than at the beginning; as to the new technology, the productivity is a function of neutral technical progress and of the capital/labour ratio, as in a "Cobb-Douglas" function.

18. There remain four sectors, i.e. the mining and utilities sectors, in which an average productivity function has been derived from past data.

19. The classifications and the analytical expression of the model are given in Annex A, and flowcharts illustrating those equations in Annex C.

Section 3: The Linkage Mechanisms for the System as a Whole

20. As can be seen in Flowchart I, regional models are linked with each other through the International Trade Module and the World Financial Module.

21. Regional models contribute import flows and export prices to the International Trade Module, and receive export flows and import prices (see paragraphs 5 and 6 above). Through this two-way process, each inter-regional loop influences all volume and value aggregates of regional models.

22. In the present version, import shares are exogenously determined in the seven trade matrices. Two different principles were applied in computing these shares[1/]. For the regional model of Centrally Planned Economies, Europe, an attempt was made to reflect recent policy decisions made by CMEA countries governing their mutual commercial strategies, as already reflected by their trade shares in the late 1970's. For all other regions, 1990 projections of trade shares were prepared with two sub-models, i.e. the semi-aggregated model for the three primary resources groups and the gravitational model for the four manufacture groups (see 1980 UNITAD Report).

1/ A computer programme has been designed to facilitate the manipulation of the 847 trade shares. New trade shares are entered for specific suppliers of any importing region, and the programme computes the remaining shares in proportion to initial values. Alternatively, blocks of shares (e.g. all DD suppliers) can be affected by the same coefficients.

23. All regional models contribute their trade balance (in value terms) to the World Financial Module and receive factor payments which are fed back to the Income Distribution, Saving and Consumption Module. This two-way process influences the regional equilibria, although to a lesser extent than the International Trade Module. In addition, the World Financial Module computes both the regional Balances of Payments, the Outstanding Debts and the Basic Balances (see Flowchart XI, Annex A). The former is based on endogenous values of the trade balances, the pool of migrant remittances, the ODA pool (related to GDP in current value) and interest payments (received from the Basic Balance). The Basic Balance requires the computation of the regional Outstanding Debts on the horizon year, which is made on the basis of exogenous data on the outstanding debt on base year, the import of long-term capital on base and current year (with an assumption of linear interpolation for intermediate years) and long-term loan maturity[1/]. The balancing of outstanding debts at the world level requires a proportional adjustment of loan maturities which is made in a special loop. Long-term interests paid are computed on the basis of Outstanding Debts. The gap of the Basic Balance (Payments Balance + net Imports of long-term Capital + change in currency reserves) is then financed by imports of short-term capital, with a loop to compute the resulting short-term capital interests.

24. It is worth noting that in the present version, there is no feedback of the basic balance (or the outstanding debt) on regional models. However, as was already observed, any scenario building requires an assessment of the gaps obtained in relation to the assumptions of the scenario, so that in practice a

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1/ Direct investments and loans on the international market are pooled together as imports of long-term capital, so that interest rates and maturity used in the model are computed as a weighted average of both sources.

number of solutions are rejected and adjustments are made in the operation of this "man-machine system". In future versions, the selection of solutions could be made through the use of an objective function.

ANNEX A

ANALYTICAL EXPRESSION

OF

THE UNITAD MODEL

Contents

GEOGRAPHICAL AND SECTORAL BREAKDOWNS

1. Geographical breakdown (R space)

Developed regions (DD)			Developing regions (DG)		
(1)	(NA)	North America	(6)	(LA)	Latin America
(2)	(WE)	Western Europe	(7)	(TA)	Africa (South Sahara)
(3)	(EE)	CPE, Europe	(8)	(NE)	North Africa and West Asia
(4)	(JP)	Japan	(9)	(IN)	Indian Subcontinent
(5)	(OD)	Other Developed	(10)	(AS)	East and Southeast Asia
			(11)	(OA)	CPE, Asia

2. Producing sectors (I^p space)

(1) Agriculture (ISIC 1, 3132)
(2) Agri-Food processing (ISIC 311/3/4)
(3) Energy (ISIC 210, 220, 353/4, 410/420)
(4) Basic products (ISIC 230, 290, 371/2, 341, 351/2, 361/2/9)
(5) Light industry (ISIC 321/2/3/4, 331/2, 342, 355/6, 381)
(6) Capital good industry (ISIC 382/3/4/5, 390)
(7) Construction (ISIC 5)
(8) Services (ISIC 6,7,8,9)

3. Utilizing sectors (I^u space)

(1) Agriculture (see $I^p(1)$)
(2) Agri-Food processing ($I^p(2)$)
(3) Oil extraction (ISIC 220)
(4) Utilities (ISIC 4)
(5) Coal mining (ISIC 210)
(6) Other mining (ISIC 230, 290)
(7) Oil refineries and coal products (ISIC 353/4)
(8) Primary processing (ISIC 371/2, 341, 351/2, 361/2/9)
(9) Light Industry (see $I^p(5)$)
(10) Capital good Industry (see $I^p(6)$)
(11) Construction (see $I^p(7)$)
(12) Services (see $I^p(8)$)

4. Manufacturing (I^{mu} space)

ISIC 311/3/4, 353/4, Primary processing, Light industry, Capital good industry

5. Trade sectors (I^t space)

	SITC Number (Rev.1)
1. Agricultural products	0, 1, 2 (excl. 251, 266, 27, 28), 4
2. Non-agricultural raw materials	27, 28 (excl. 286)
3. Energy	286, 3, 515, 688
4. Intermediate products	251, 266, 5 (excl. 515, 54, 55), 61, 621, 63, 541, 65, 66 (excl. 665, 666), 67, 68 (excl. 688), 691, 692, 693, 694, 698, 81
5. Consumer non-durables	54, 55, 62, (excl. 621), 642 665, 666, 696, 84, 85, 89 (excl. 891, 896, 897)
6. Equipment	695, 71, 72, (excl. 724, 725), 73 861
7. Consumer durables	667, 697, 724, 725, 82, 83, 86 (excl. 861), 891, 896, 897, 9

6. Private consumption categories (I^c space)

(for definition, see Yearbook of National Accounts)

(1) Food, Beverages, Tobacco
(2) Clothing and footwear
(3) Gross rent, fuel and power
(4) Furniture, furnishing and household equipment and operation
(5) Medical care and health
(6) Transport and Communication
(7) Recreation, entertainment, education and cultural services
(8) Miscellaneous goods and services

7. Specific classifications for Centrally Planned Economies (Europe)

Industry ($I^{indu} \subset I^u$)

- Agrifood processing (ISIC 311/3/4)
- Oil refineries and coal products (ISIC 353/4)
- Primary processing (ISIC 371/2, 341, 351/2, 355/6, 361/2/9, 390)
- Light Industry (ISIC 321/2/3/4, 331/2,342)
- Capital goods (ISIC 38, including 381)
- Construction (ISIC 5)

Mining and Utilities ($I^{min} \subset I^u$ space)

- Oil extraction (ISIC 220)
- Utilities (ISIC 4)
- Coal mining (ISIC 210)
- Other mining (ISIC 230, 290)

Private consumption categories

- Excludes non material services

NOTATIONS AND SYMBOLS

- Endogenous variables are designated by upper case letters;

- Pre-determined (exogenous and lagged endogenous) variables and parameters are designated by lower case letters;

- VA(i) indicates the i-th element of a vector, while [VA(i)] designates the whole column vector. [VA(i)]' represents the same vector written in line;

- If $CP^{kc}(i,j)$ is the element of the i-th line and j-th column of a matrix, $[CP^{kc}(i,j)]$ designates this matrix, and $[CP^{kc}(i,j)]'$ the transposed matrix;

- I and i designate respectively the unit matrix and vector, i.e.

$$I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \qquad i = \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}$$

- $[\hat{FD}(i)]$ designates the diagonal matrix which has on the diagonal the elements of vector $[FD(i)]$. For instance $\hat{I} = i$. $[a(i,j)]^{-1}$ designates the inverse matrix of $[a(i,j)]$;

- All the variables (unless specified) refer to the same time period. Only in few cases a time-lag (e.g. 15 years) is indicated by a subscript (e.g. -15);

- All the variables refer to the same region except in the linkage equations where the regions are denoted by the subscript r;

- The main control variables are denoted "cv" in the margin.

- General note:

Regional models can be closed either by fixing the growth rate of GDP (in which case the employment gap, the land gap and the saving gap are endogenously determined) or by fixing one of the gaps (and generating GDP and the other gaps). More generally, an objective function of the GDP growth rate and of the gaps can be build up, allowing the model to determine GDP and the gaps by minimizing the objective function. Equation (1) illustrates the first opportunity, which was used in the trend scenario, while Equation (2) illustrates the use of an objective function.

GENERAL MODEL

I. PRODUCTION AND LABOUR PRODUCTIVITY

(in constant prices)

Serial number	Number of equations	
(1)	1	$GDP = gdp_{-15}(1+gdpgr)^{15}$ (trend scenario)
or (2)	1	$W = w(GDPGR, LB, TAGA, NAREGA)$ (objective function)
(3)	8	$[VA(i)] = [\widehat{ivyco(i)}][I-A]^{-1}[FD(i)]$, $\forall i \in I^p$
(4)	11	$[VA^{\mu}(i)] = [\overline{bmu}][VA(i)]$, $\forall i \in I^{\mu}$
(5)	1	$VAM = \sum_i VA^{\mu}(i)$, $\forall i \in I^{mu}$
(6)	7	$LP^{\mu}(i) = f[tnp(i), ivyco(i), [le(i), caple(i), du]$, $i \in \{2,4 \text{ to } 9$
(7)	1	$LP^{\mu}(3) = lpoil$, $\mu = 3$
(8)	2	$LP^{\mu}(i) = lps(i)\left[1 - \frac{LS-LD}{LS}\right]LPM$, $i = 10,11$
(9)		i) <u>For developed regions</u>
	1	$LP^{\mu}(1) = VA^{\mu}(1) / LD^{\mu}(1)$
		ii) <u>For developing regions</u>
	3	$LP^{\mu}(1,i) = f\{lala(i) * cri(i), caple(i), [1-ivyco(i)]\}$, $\forall i \in I^a$
(10)	1	$LPM = \sum_i \frac{LD^{\mu}(i) * LP^{\mu}(i)}{\sum_i LD^{\mu}(i)}$, $\forall i \in I^{mu}$
(11)	1 av	$LIMA = \sum_{r \in R^{DG}} VAM(R) / \sum_{r \in R^{w}} VAM(R)$

II. Labour Demand, Labour Supply and Unemployment

(12) 1 $POP = pop_{-15}(1+popagr)^{15}$

(13) 1 $POPR = rur\ POP$ } for developing regions only

(14) 1 $POPU = (1-rur)\ POP$ } for developing regions only

(15)

For developed regions

1 $LD^{u}(1) = [f(VA^{u}(1)/GDP)] * LD$

ii) For developing regions

3 $LD^{u}(i) = VA^{u}(i) / LP^{u}(i)$, $\forall i \in I^{a}$ and $\forall i \in \{2 \text{ to } 11\}$

(16) 1 $VA^{u}(1) = \sum_{i} VA^{u}(i)$, $\forall i \in I^{a}$

(17) 1 $LD = z'[LD^{u}(i)]$, $\forall i \in I^{u}$

For developing regions

(18) 1 $LSMR = wapmr * prmr$

(19) 1 $LSFR = wapfr * prfr$

(20) 1 $LSMU = wapmu * prmu$

(21) 1 $LSFU = wapfu * prfu$

(22) 1 $LS = LSMR + LSFR + LSMU + LSFU$

(23) 1 cv $LBR = LSMR + LSFR - LD(1) * dwoty/dwtwoty - b \sum_{i=2}^{11} LD^{u}(i)$

Serial number	Number of equations	
(24)	1 cv	$LB^{u} = LSM^{u} + LSF^{u} - (1-b)\sum_{i=2}^{11} LD^{u}(i)$

For developed regions

(22bis)	1	$LS = wapm * prm + wapf * prf$
(23)	1	$LB = LS - LD$

III. Land Demand, Supply and Land Gap , for $r \in R^{DG}$ and

(24)	3	$TDA(i) = lala(i) * LD(1,i)$, $\forall i \in I^{a}$
(25)	1	$TSA = tsa_{-15} + tex$
(26)	1 cv	$TAGA = TSA - \sum_{i} TDA(i)$, $\forall i \in I^{a}$

IV. Investment Requirements

(in constant and current prices)

(27)	9	$IR^{u}(i) = ir^{u}_{-15}(i) * \exp[((capie(i) * LD^{u}(i)/15) - ir^{u}_{-15}(i)) * 2]$, $i = 1, 2, \ldots, 9$

Serial number	Number of equations	
(28)		i) For developed regions for $\forall i \in \{1,10,11\}$ and for developing regions for $i \in \{10,11$
	2/3	$IR^{u}(i) = ir^{u}_{-15}(i) * \exp[((capva(i) * VA^{u}(i)/15) - ir^{u}_{-15}(i)) * 2]$, $\forall i \in \{1,10,11\}$
		ii) For developing regions
	1	$IR^{u}(1) = ir^{u}_{-15}(1) * \exp[(\sum_{i \in I^{a}} capie(i) * LD(i) + tex * costex + \Delta cri * cosc.i)/15) - ir^{u}_{-15}(1)] * 2$
(29)	1	$IR = \sum_{i} IR^{u}(i)$, $\forall i \in I^{u}$
(30)	8	$[IR^{p}(i)] = [\overline{bmi}]\,[IR^{u}(i)]$, $\forall i \in I^{p}$
(31)	8	$IRCU(i) = IR(i) * PIR(i)$, $\forall i \in I^{p}$
(32)	1	$PIR = (\sum_{i} PIR(i) * IR(i))/IR$, $\forall i \in I^{p}$

V. Exogenous Income Distribution

(in current prices)

For developed regions

(33)	1	$GDPCU = \sum_{i} VA(i) * PVA(i)$, $\forall i \in I^{p}$
(34)	1	$GNPCU = GDPCU + XCU^{\sigma} + XCU^{ip} + XCU^{mr} - MCU^{\sigma} - MCU^{ip} - MCU^{mr}$, $\forall i \in$
(35)	1	$GNPCUC = GNPCU + \sum_{i} X^{p}(i)[PX^{p}(i) - PDD(i)]$, $\forall i \in I^{p}$
(36)	1	$LI = \sum_{i} VA(i) * PVA(i) * w\sigma(i) * pw/(w\sigma(i) * pw + nw\sigma(i) * p\ldots)$, $\forall i \in I^{p}$

Serial number	Number of equations	
(37)	1	$KI = GDPCu - LI - IT$
(38)	1	$KIH = \alpha_1 KI$
(39)	1	$KIE = \alpha_2 KI$ with $\sum_{k=1}^{3} \alpha_k = 1$
(40)	1	$KIG = \alpha_3 KI$
(41)	1	$DTH = t.r.h.(NDIH + DTH)$
(42)	1	$DTE = t.r.e.(GDIE + DTE)$
(43)	1	$IT = i.t.r.\ GDPCu$
(44)	1	$NDIH = LI + KIH - DTH + xcu^{mr} - mcu^{mr}$
(45)	1	$GDIE = KIE - DTE + xcu^{ip} - mcu^{ip}$
(46)	1	$NDIG = KIG + DTE + DTH + IT + \sum_{i \in I^p} x^p(i)[px^p(i) - PDD(i)] - xcu^{c} - mc$

For developing regions

(47)	1	$RURIN = VA(1) * PVA(1) + b \sum_{i=2}^{8} VA(i) * PVA(i)$
(48)	1	$URBIN = GDPCu - RURIN$

Serial number	Number of equations	
(49)	1	$LIR = VA(1) * PVA(1) * w\sigma(1) * pw / (w\sigma(1) * pw + nw\sigma(1) * pnw) + b \sum_{i=2}^{8} VA(i) * PVA(i) * w\sigma(i) * pw / (w\sigma(i) * pw + nw\sigma(i) * pnw)$
(50)	1	$KIR = RURIN - LIR - ITR$
(51)	1	$LIU = (1-b) \sum_{i=2}^{8} VA(i) * PVA(i) * w\sigma(i) * pw / (w\sigma(i) * pw + nw\sigma(i) * pnw$
(52)	1	$KIU = URBIN - LIU - ITU$
(53)	1	$KIRH = \alpha_1 KIR$
(54)	1	$KIUH = \alpha_1 KIU$ with $\sum_{k=1}^{3} \alpha_k = 1$
(55)	1	$KIE = \alpha_2 (KIR + KIU)$
(56)	1	$KIG = \alpha_3 (KIR + KIU)$
(57)	1	$DTHR = t.r.h. (NDIHR + DTHR)$
(58)	1	$DTHU = t.r.h. (NDIHU + DTHU)$
(59) (v.42)	1	$DTE = t.r.e. (GDIE + DTE)$
(60)	1	$ITR = i.t.r. RURIN$
(61)	1	$ITU = i.t.r. URBIN$

Serial number	Number of equations	
(62)	1	$NDIHR = LIR + KIHR - DTHR + \frac{1}{2}(XCU^{mr} - MCU^{mr})$
(63)	1	$NDIHU = LIU + KIHU - DTHU + \frac{1}{2}(XCU^{mr} - MCU^{mr})$
(64) (v.45)	1	$GDIE = KIE - DTE + XCU^{ip} - MCU^{ip}$
(65) (v.46)	1	$NDIG = KIG + DTE + DTHR + DTHU + ITR + ITU + \sum_{i \in I^p} X^p(i)\,[PX^p(i) - PDD(i)] + XCU^{\sigma} - MCU^{\sigma}$

VI. Savings, Saving Gap and Consumption

(in constant and current prices)

(66)	1	$GSE = GDIE$
(67)	1	$GCCU = f(NDIG)$
(68)	1	$NSG = NDIG - GCCU$
(69)		<u>For developed regions</u>
	1	$CPCU = f(NDIH/POP) * POP$
		<u>For developing regions</u>
(70)	1	$CPCUR = f(NDIH/POPR) * POPR$
(71)	1	$CPCUU = f(NDIU/POPU) * POPU$
(69 bis)	1	$CPCU = CPCUR + CPCUU$

Serial number	Number of equations	
		For developed regions
(72)	1	$NSH = NDIH - CPCU$
		For developing regions
(73)	1	$NSHR = NDIHR - CPCUR$
(74)	1	$NSHU = NDIHU - CPCUU$
(92bis)	1	$NSH = NSHR + NSHU$
		All regions
(75)	1	$GNPCUC^{*} = CPCU - GCCU + IRCU + XCU - MCU$
(76)	1 a/	$GNPCUC^{*} - GNPCUC = f(pola_{ij}, capl_{i}, \ldots ndig, dut_{i}, t_{nj}, we_{i}, pw, pc - pa_{i}, pz_{i}$
(77)	1	$GDP = CP + GC + IR + X - M$
		For developed regions
(78)	8	$CP^{f}(i) = POP * f(CP/POP, PCP^{f}(i)) \quad , \forall i \in I^{f}$
		For developing regions
(79)	8	$CPR^{f}(i) = POPR * f(CPR/POPR, PCP^{f}(i)) \quad , \forall i \in I^{f}$
(80)	8	$CPU^{f}(i) = POPU * f(CPU/POPU, PCP^{f}(i)) \quad , \forall i \in I^{f}$

a/ Slack variable to be minimized through an adequate combination of parameters and exogenous variables.

Serial number | Number of equations

All regions

(81) 1 $CP = \sum_i CP^{ac}(i)$, $\forall i \in I^{ac}$

(82) 8 $[GCCU(i)] = [gc(i)] * GCCU$, $\forall i \in I^{g}$

(83) 8 $GC(i) = GCCU(i) / PGC(i)$, $\forall i \in I^{g}$

(84) 1 $GC = \sum_i GC(i)$, $\forall i \in I^{g}$

(85) 1 cv NAREGA = GSE + NSG + NSH - IRCU

(86) 1 cv BACR = SOL * POP / (CP + GC)

VII. The Foreign Sector

(in constant and current prices)

(87) 7 $[AV(i)]'$: see Annex 1 , $\forall i \in I_7^t$

(88) 7 $M^t(i) = f[AV(i), PM(i)/PX(i), dut)$, $\forall i \in I_7^t$

(89) 7 $PM^t(i) = \sum_{r=1}^{11} t(r,j,i) * PX^t(i,r)$, $\forall i \in I_7^t$; $j = 1, 2, \ldots, 11$

(90) 7 $MCU^t(i) = M^t(i) * PM^t(i)$, $\forall i \in I_7^t$

Serial number	Number of equations	
(91)	1	$MCU^t(8) = f(GDPCU, \sum_{i=1}^{7} MCU^t(i))$
(92)	1	$M^t(8) = MCU^t(8) / PM(8)$
(93)	1	$PM^t(8) = \sum_{r=1}^{11} PX^t(8,r) * \Delta$
(94)	7	$X^t(i) = \sum_{r=1}^{11} t(r,j,i) * M^t(i,r)$, $\forall i \in I_7^t$; $j = 1, 2, \ldots, 11$
(95)	7	$XCU'(i) = X^t(i) * PX^t(i)$, $\forall i \in I_7^t$
(96)	1	$XCU^t(8) = \Delta \sum_{r=1}^{11} MCU^t(8,r)$
(97)	1	$X^t(8) = XCU^t(8) / PX^t(8)$
(98)	1 cv	$BAGOSE = \sum_{i=1}^{8} XCU^t(i) - \sum_{i=1}^{8} MCU^t(i)$
(99)	1 cv	$TOTOT = XCU * M / MCU * X$

VIII. The Capital Movement Module

(in current prices)

(100)	1	$MCU^{\sigma} = \sigma da * GDPCU$
(101)	1	$MCU^{lti} = ir^{it} * ODEB$

Serial number	Number of equations	
(102)	1	$MCU^{sti} = ir^{st} * STCAP * \frac{1}{2}$
(103)	1	$MCU^{ip} = MCU^{lti} + MCU^{sti}$
(104)	1	$MCU^{mr} = mcu^{mr}$
(105)	1	$XCU^{\sigma} = \sigma \sum_{r=1}^{11} MCU^{\sigma}(r)$
(106)	1	$XCU^{lti} = (ODEB / \sum_{r=1}^{11} ODEB(r)) \sum_{r=1}^{11} MCU^{lti}$, for $ODEB > 0$
(107)	1	$XCU^{sti} = (STCAP / \sum_{r=1}^{11} STCAP(r)) \sum_{r=1}^{11} MCU^{sti}$, for $STCAP > 0$
(108)	1	$XCU^{ip} = XCU^{lti} + XCU^{sti}$
(109)	1	$XCU^{mr} = mr \sum_{r=1}^{11} MCU^{mr}$
(110)	1cv	$CUBA = BAGOSE + XCU^{\sigma} + XCU^{ip} + XCU^{mr} - (MCU^{\sigma} + MCU^{ip} + MCU^{mr})$
(111)	1	$RES = \frac{1}{4} \sum_{i} MCU^{t}(i)$, $\forall i \in I_{7}^{t}$
(112)	1	$\Delta RES = (RES - res_{-15}) * \frac{1}{15}$, for all regions expect region 1
(113)	1	$MCAPLT = mcaplt$
(114)	1	$XCAPLT = \sum_{r=1}^{11} MCAPLT$
(115)	1	$ODEB = f(odeb_{-15}, xcap_{-15}, XCAPLT, n)$

Serial number | Number of equations

(116) 1 $RIMBA = ODEB/n$

(117) $REPA = [ODEB \quad / \sum_{r=1}^{11} ODEB(r)] * \sum_{r=1}^{11} RIMBA(r)$, for $ODEB < 0$

For all regions except NA (region 1)

(118) 1cv $STCAP = CUBA - \Delta RES + XCAP - MCAP - RIMBA + REPA$

For the NA (region 1)

(118bis) 1cv $STCAP = \sum_{r=2}^{11} STCAP(r)$

(112bis) 1cv $\Delta RES = CUBA - STCAP + XCAP - MCAP - RIMBA + REPA$

IX. Prices and the Definition of Final Demand by Producing Sector

(119) 5 $PVA^{*}(i) = wo(i) * pw + nwo(i) * pnw$, $\forall i \in I^{P}_{5}$ and with $wo(i) + nwo(i) = 1$

(120) 8 $[PVA(i)] = [pva(1), PVA^{*}(i), pva(3), pva(8)]$, $\forall i \in I^{P}$

(121) 8 $[PFD(i)] = [I - A^{1}]^{-1} \widehat{iuyco}\,[PVA(i)]$, $\forall i \in I^{P}$

(122) 8 $[PGC(i)] = [PDD(i)]$, $\forall i \in I^{P}$

(130) 8 $[FD(i)] = [CP^{p}(i)] + [GC^{p}(i)] + [IR^{p}(i)] + [X^{p}(i)] - [M^{p}(i)] \quad , \forall i \in I^{p}$

(131) 8 $[FDCU(i)] = [\widehat{PFD(i)}][FD(i)] \quad , \forall i \in I^{p}$

(132) 8 $PX^{p}(i) = [\overline{bmpt}]' \, PX^{t}(i) \quad , \forall i \in I^{p}$

(133) 8 $PM^{p}(i) = [\overline{bmpt}]' \, PM^{t}(i) \quad , \forall i \in I^{p}$

(134) 8 $XCU^{p}(i) = X^{p}(i) * PX^{p}(i) \quad , \forall i \in I^{p}$

(135) 8 $MCU^{p}(i) = M^{p}(i) * PM^{p}(i) \quad , \forall i \in I^{p}$

(136) 8 [a/] $FDCU(i) = [PDD(i)][CP^{p}(i) + IR^{p}(i)] + [GCCU(i)] + [XCU(i) - MCU(i)] \quad , \forall i \in I$

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a/ Drawing FDCU (i) from equation (131), this equation defines PDD(i).

Serial number	Number of equations	
(123)	8	$[PIR(i)] = [PDD(i)] \quad , \forall i \in I^p$
(124)	8	$[PCP^p(i)] = [PDD(i)] \quad , \forall i \in I^p$
(125)	8	$[PCP^c(i)] = [\overline{bmc}]' [PCP^p(i)] \quad , \forall i \in I^c$
(126)	7	$[PX^t(i)] = [\overline{bmt}]' [PDD(i)] + \Delta px^t(i) \quad , \forall i \in I_7^t$
(127)	8	$[CP^p(i)] = [\overline{bmc}] [CP^c(i)] \quad , \forall i \in I^c$
(128)	8	$[X^p(i)] = [\overline{bmt}] [X^t(i)] \quad , \forall i \in I^p$
(129)	8	$[M^p(i)] = [\overline{bmt}] [M^t(i)] \quad , \forall i \in I^p$

REGIONAL MODEL FOR CENTRALLY PL. ED ECONOMIES, EUROPE

(in constant 1970 prices, except section V.

Serial number	Number of equations	
		I. PRODUCTION
(1)	1	$GMP = gmp_{-15}\,(1+gmpgr)^{15}$
		II. CONSUMPTION AND FINAL DEMAND
(2)	1	$LPMP = GMP/LEMP$
(3)	1	$LENM = lenm$
(4)	1	$LD = ls$
(5)	1	$LEMP = LD - LEMN$
(6)	1	$LPMPGR = (LPMP/lpmp_{-15})^{-15} - 1$
(7)	1	$AWGR = \delta\, LPMPGR$
(8)	1	$WMP = wmp_{-15}\,(1+AWGR)^{15}$

Serial number	Number of equations	
(9)	1	$LI = WMP * LEMP$
(10)	1	$EI = GMP - LI$
(11)	1	$DEI = EI - EXNET + SAVING$
(12)	1	$EXNET = exch \sum_{i} (X^{t}(i) - M^{t}(i)) \quad , \forall i \in I^{t}$
(13)	1	$LINOM = LENM\,(1 + \% AWGR)^{15}\, wnm_{-15}$
(14)	1	$SOCI = (POP - LD)\,(1 + \% AWGR)^{15}\, Soci_{-15}$
(15)	1	$POPI = LI + LINOM + SOCI$
(16)	1	$SAVING = f(POPI, AWGR)$
(17)	1	$GFCFMP = i\ GFCF$
(18)	1	$GFCFNM = (1-i)\ GFCF$
(19)	1	$PC = POPI - SAVING$
(20)	8	$PC(i) = pc(i) * PC \quad , \forall i \in I^{P} \quad , \text{ with } \sum_{i \in I^{P}} pc(i) = 1$
(21)	8	$GFCF(i) = gfcf(i) * GFCF \quad , \forall i \in I^{P} \text{, where } \sum_{i \in I^{P}} gfcf(i) = 1$
(22)	1	$STOCK = \beta\ GMP$

Serial number	Number of equations	
(23)	8	$STOCK(i) = st(i) * STOCK \quad , \forall i \in I^P \text{ , with } \sum_{i \in I^P} st(i) = 1$
(24)	7	$M^t(i) = f[AV(i)] \quad , \forall i \in I^t$
(25)	7	$X^t(i) = \sum_{r=1}^{11} t(r,j,i) * M^t(i,r) \quad , \forall i \in I^t \quad , j = 1,2,\dots,11$
(26)	8	$[X^P(i)] = [\overline{bmt}][\widehat{exch}][X^t(i)] \quad , \forall i \in I^P$
(27)	8	$[M^P(i)] = [\overline{bmt}][\widehat{exch}][M^t(i)] \quad , \forall i \in I^P$
(28)	1	$CC = DEI - (LINOM + SOCI + GFCF + STOCK)$
(29)	8	$CC(i) = cc(i) * CC \quad , \forall i \in I^P \text{ , with } \sum_{i \in I^P} cc(i) = 1$
(30)	8	$FD(i) = CC(i) + PC(i) + GFCF(i) + STOCK(i) + X^P(i) - M^P(i) \quad , \forall i \in I^P$

III. Production Structure

(31)	8	$GO(i) = (I-A)^{-1} Fp(i) \quad , \forall i \in I^P$
(32)	8	$VA(i) = GO(i) * ivy(i) \quad , \forall i \in I^P$
(33)	11	$[VA^u(i)] = [\overline{bmu}][VA(i)] \quad , \forall i \in I^u$

Serial number	Number of equations	
		IV. INVESTMENT AND PRODUCTIVITY
(34)	6	$LP(i)_{new} = f_{new}[k(i)/l(i), t]$, $\forall i \in I^{indu}$
(35)	6	$LP(i)_{old} = lp(i)_{old}[1 + lpgt(i)]^{15}$, $\forall i \in I^{indu}$
(36)	4	$LP(i)_{min} = f_{min}[k(i)/l(i), t]$, $\forall i \in I^{min}$
(37)	1	$LEMIN = \sum_i GO(i)/LP(i)_{min}$, $\forall i \in I^{min}$
(38)	1	LEAGR = leagr
(39)	1	LESERV = leserv
(40)	1	LEINDU = LEMP - LEMIN - LEAGR - LESERV
(41)	1	$LEINDU = \sum_i LE_{new}(i) + LE_{old}(i)$, $\forall i \in I^{indu}$
(42)	1	$[LE_{new}(i)] = [\hat{\Gamma}][LE_{old}(i)]$, $\forall i \in I^{indu}$
(43)	6	$GO(i) = LP_{new}(i) * LE_{new}(i) + LP_{old}(i) * LE_{old}(i)$, $\forall i \in I^{indu}$
(44)	6	$KNEW(i) = [k(i)/l(i)] * LE_{new}(i)$, $\forall i \in I^{indu}$
(45)	6	$KOLD(i) = [k(i)/l(i)] * LE_{old}(i)$, $\forall i \in I^{indu}$

Serial number	Number of equations	
(46)	6	$GFCFINDU(i) = \lambda\ KOLD(i) + \frac{KNEW(i)}{10} \ln\left[\frac{KNEW(i)}{\alpha_i\ cap_{-10}(i)}\right] + + \lambda\left\{KNEW(i) - \frac{KNEW(i)}{10} \ln\left[\frac{KNEW(i)}{\alpha_i\ cap_{-10}(i)}\right]\right\}, \forall i \in I^{indu}$
(47)	6	$RET(i) = \frac{KOLD(i)}{10} \ln\left[\frac{(1-\alpha_i)\ cap_{-10}(i)}{KOLD(i)}\right], \forall i \in I^{indu}$
(48)	1	$GFCFAGR = gfcfagr_{-10} * \exp\left\{\left[(capvagr * VAGR/10) - gfcfagr_{-10}\right] * 2\right\}$
(49)	1	$GFCFSERV = gfcfserv_{-10} * \exp\left\{\left[(capvserv * VASERV/10) - gfcfserv_{-10}\right] * 2\right\}$
(50)	4	$GFCFMIN(i) = \frac{K(i)}{10} \ln\left(\frac{K(i)}{cap_{-10}(i)}\right) + \lambda\left[K(i) - \frac{K(i)}{10} \ln\left(\frac{K(i)}{cap_{-10}(i)}\right)\right], \forall i \in I$
(51)	1	$GFCFMP = GFCFAGR + GFCFSERV + \sum_{i \in I^{indu}} GFCFINDU + \sum_{i \in I^{min}} GFCFMIN$

V. FINANCIAL SUB-MODEL

(in current prices)

(52)	1	$STMCAP = CUBA - \Delta RES + XCAP - MCAP - RIMBA + REPA$

GENERAL MODEL (MARKET ECONOMIES)

ENDOGENOUS VARIABLES

AV(i)	7	Activity variable associated with trade sector i (see Annex 1) (I^T)
BACR	1	Basic consumption ratio
BAGOSE	1	Balance of goods and services
CP	1	Total private consumption at constant prices
$CP^C(i)$	8	Private consumption expenditures on the i^{th} consumption category (I^C
$CP^P(i)$	10	Private consumption demand for the i^{th} producing sector (constant)(I^P
CPCU	1	Total private consumption at current prices
$CPCU^C(i)$	8	Private consumption expenditures on the i^{th} consumption category (current)
$CPCU^P(i)$	8	Private consumption demand for the i^{th} producing sector (current)
CPCUR	1	Total private consumption at current prices rural, only for DG regions
CPCUU	1	Total private consumption at current prices urban, only for DG regions
CPR	1	Total private consumption at constant prices rural, only for DG regions
$CPR^C(i)$	8	Private consumption expenditures on the i^{th} consumption category (I^C rural, only for DG regions
CPU	1	Total private consumption at constant prices urban, only for DG regions
$CPU^C(i)$	8	Private consumption expenditures on the i^{th} consumption category (I^C) urban, only for DG regions
CUBA	1	Current payment balance
DTE	1	Direct taxes enterprises
DTH	1	Direct taxes households
DTHR	1	Direct taxes households rural
DTHU	1	Direct taxes households urban
FD(i)	8	Final demand for the i^{th} producing sector (constant) (I^P)
FDCU(i)	8	Final demand for the i^{th} producing sector (current) (I^P)

GC	1	Total public consumption expenditures at constant prices
GC(i)	8	Public consumption demand for the i^{th} producing sector (I^P) (constant prices)
$GC^P(i)$	4	Public consumption demand, by category (I^g)
GCCU	1	Total public consumption, current prices
GCCU(i)	8	Public consumption demand for the i^{th} producing sector (I^P) (current prices)
GDIE	1	Gross disposable income of enterprises
GDP	1	Gross domestic product at market prices (constant)
GDPCU	1	Gross domestic product at market prices (current), see also GNPCU
GNPCU	1	Gross national product (current)
"PCUC	1	Gross national product at market prices (current), adjusted by adding up income (positive or negative) accruing on account of exogenous export prices. This income is inputed to Government (see NDIG)
GSE	1	Gross saving of enterprises (including depreciation)
IR	1	Total investment requirement at constant prices
$IR^P(i)$	8	Investment demand addressed to the i^{th} producing sector (constant) (I^P)
$IR^u(i)$	11	Investment requirement of the i^{th} utilizing sector (constant) (I^u)
IRCU	1	Total investment requirement at current prices
IRCU(i)	8	Investment goods demand addressed to the i^{th} producing sector (current) (I^P)
IT	1	Indirect taxes
ITR	1	Indirect taxes, rural, only for DG regions
ITU	1	Indirect taxes, urban, only for DG regions
KI	1	Capital income
KIE	1	Capital income enterprises
KIG	1	Capital income government
KIH	1	Capital income households

KIR	1	Capital income, rural, only for DG regions
KIRH	1	Capital income, rural, households, only for DG regions
KIU	1	Capital income, urban, only for DG regions
KIUH	1	Capital income, rural, households, only for DG regions
LB	1	Total labour balance (man-years)
LBR	1	Labour balance in rural areas expressed in man-years
LBU	1	Labour balance in urban areas expressed in man-years
LD	1	Total labour demand (man-year)
$LD^u(i)$	11/3	Labour demand for i^{th} utilizing sector (man-year) (I^u), (I^a)
LI	1	Labour income
LIMA	1	Control variable indicating the relative share of developing countries in the world production of manufactures. Can be computed with or without China
LIR	1	Labour income, rural, only for DG regions
LIU	1	Labour income, urban, only for DG regions
$LP^u(i)$	11	Labour productivity per man-year in the i^{th} utilizing sector I^u
$LP^u(1,i)$	3	Labour productivity per man-year in agriculture, only for DG regions (I^a)
LPM	1	Labour productivity, manufacturing sector (I^{mu})
LS	1	Total labour supply (man-year)
LSFR	1	Labour supply, female, rural (man-years), only for DG regions
LSFU	1	Labour supply, female, urban (man-years), only for DG regions
LSMR	1	Labour supply, male, rural (man-years), only for DG regions
LSMU	1	Labour supply, male, urban (man-years), only for DG regions
M	1	Total imports of goods and services (constant prices)
$M^p(i)$	8	Imports of goods or services of the i^{th} producing sector (constant prices) (I^p)
$M^t(i)$	7	Imports related to the i^{th} trade category (constant prices) (I^t) (any one region)
$M^t(i,r)$	7x11	Same as $M^t(i)$, with regional suffix r (constant prices) (I^t)

MCAPLT	1	Long-term capital movement (outflow)
MCU	1	Total imports of goods and services (current)
MCU^{ip}	1	Total interests and property income paid to the rest of the world
MCU^{lti}	1	Interest and property income paid to the rest of the world (long-ter
MCU^{mr}	1	Migrant remittances paid to the rest of the world
MCU^{o}	1	Official Development Assistance provided by the region (only for DD regions)
MCU^{sti}	1	Interest and property income paid to the rest of the world (short-term)
$MCU^{p}(i)$	8	Imports of goods or services of the i^{th} producing sector (current)(I
$MCU^{t}(i)$	8	Imports related to the i^{th} trade category (current)
NAREGA	1	National resources gap
NDIG	1	Net disposable income of government, including additional income (positive or negative) originating from exogenous export prices
NDIH	1	Net disposable income of households
NDIHR	1	Net disposable income of households, rural, only for DG regions
NDIHU	1	Net disposable income of households, urban, only for DG regions
NSG	1	Net saving of government
NSH	1	Net saving of households
NSHR	1	Net saving of households, rural, only for DG regions
NSHU	1	Net saving of households, urban, only for DG regions
NWAR	1	Non-working age population, rural, only for DG regions
NWAU	1	Non-working age population, urban, only for DG regions
ODEB	1	Outstanding debt
$PCP^{c}(i)$	8	Price deflator for i^{th} private consumption category (I^{C})
$PCP^{p}(i)$	8	Price deflator of private consumption for producing sector i (I^{P})
PDD(i)	8	Price deflator of domestic demand for producing sector i (I^{P})
PFD(i)	8	Price deflator of final demand addressed to the i^{th} producing sector (IP)

PGC(i)	8	Price deflator of government consumption for the i^{th} producing sector (I^P)
PIR	1	Price deflator of total investment requirement
PIR(i)	8	Price deflator of investment required by the i^{th} producing sector (I^P)
POP	1	Total population
POPR	1	Population, rural, only for DG regions
POPU	1	Population, urban, only for DG regions
$PM^P(i)$	8	Price deflator of imports of goods (services) of the i^{th} producing sector (I^P)
$PM^t(i)$	8	Price deflator of imports of goods (services) of the i^{th} trade category (I^t)
PVA(i)	8	Price deflator of value added of the i^{th} producing sector (I^P)
$PX^P(i)$	8	Price deflator of exports of goods (services) of the i^{th} producing sector (I^P)
$PX^t(i)$	8	Price deflator of exports of goods (services) of the i^{th} trade category (I^t)
REPA	1	Repayments of outstanding credit received by creditor country
RES	1	Reserves
ΔRES	1	Change in reserve
RIMBA	1	Reimbursement of a fraction of outstanding debt by debtor country
RURIN	1	Gross rural income (total)
SOL	1	Standard of living (defined as per capita consumption expenditures on food, housing, health and education)
STCAP	1	Short-term capital movements
TAGA	1	Land gap, only for DG regions
TDA(i)	3	Land demand, only for DG regions
TOTOT	1	Total term of trade
TSA	1	Land supply, only for DG regions
URBIN	1	Gross urban income (total), only for DG regions
VA(i)	8	Value added of the i^{th} producing sector (I^P)
$VA^u(i)$	11	Value added, i^{th} utilizing sector (I^u)

VAGR(i)	8	Value added growth rate of the i^{th} producing sector
VAM	1	Value added of manufacturing (I^{mu})
VAS(i)	8	Value added share, i^{th} producing sector (I^{p})
X	1	Total exports of goods and services (constant)
$X^{p}(i)$	8	Exports of goods or services of the i^{th} producing sector (constant) (I^{p})
$X^{t}(i)$	8	Exports of the i^{th} trade category (constant) (I^{t})
XCAPLT	1	Long-term capital movement (inflow)
XCU	1	Total exports of goods and services (current)
XCU^{ip}	1	Total interest and property income received from the rest of the world
XCU^{lti}	1	Interest and property income received from the rest of the world (long-term)
XCU^{mr}	1	Migrant remittances received from the rest of the world
XCU^{o}	1	Official Development Assistance received by the region (only for DG regions)
XCU^{sti}	1	Interest and property income received from the rest of the world (short-term)
$XCU^{p}(i)$	8	Exports of goods or services of the i^{th} producing sector (I^{p})
$XCU^{t}(i)$	8	Exports of goods or services of the i^{th} trade category (current) (I^{t}

GENERAL MODEL (MARKET ECONOMIES)

PRE-DETERMINED VARIABLES AND PARAMETERS

α_i	3	Capital allocation parameter
a(i,j)	8x8	Input-output coefficient, i.e. intermediate consumption of products of the i^{th} sector by unit of production of the j^{th} producing sector
A		Matrix A = [a(i,j)] i,j = 1,2....., 8
b	1	Share of non-agricultural employment in the rural sector
$\overline{bmc}(i,j)$	8x12	Share of the j^{th} private consumption category supplied by the i^{th} producing sector in current prices; (a bar over the symbol indicates constant prices)
$\overline{bi}(i,j)$	8x8	Share of the j^{th} sector required investments supplied by the i^{th} producing sector (constant)
$\overline{bmt}(i,j)$	8x8	Share of the j^{th} traded goods (or services) category produced by the i^{th} producing sector (constant)
$\overline{bmtp}(i,j)$	8x8	Share of the j^{th} producing sector consisting in the i^{th} trade category (constant)
$\overline{bmu}(i,j)$	12x8	Share of the j^{th} producing sector supplied by the i^{th} utilizing sector (constant prices)
c	1	Share of the pooled capital outflow allocated to the region
caple(i)	9/3	Proxy for capital labour ratio, defined as the total gross investment over ten years divided by employed labour for the final year with a lag of two years (I^u), (I^a)
capva(i)	3	Proxy for capital value added ratio for 3 utilizing sectors (i=1 agriculture, i=10 construction, i=11 services) defined as the total gross investment over ten years divided by the value added of the final year with a lag of 2 years
coscri	1	Cost per hectare to increase cropping intensity
costex	1	Cost of the extension of a hectare of land
cri(i)	3	Cropping intensity
Δcri	1	Increase in cropping intensity
du	1	Dummy variable
dut(i)	7	Trade policy variable for i^{th} producing sector (I^t)
dwoty	1	Days worked over the year in rural areas
dwtwoty	1	Days wanted to work over the year in rural areas

gc(i)	8	Structure of government expenditure (current prices) (I^p)
gdp_{-15}	1	GDP of the previous horizon year
gdpgr	1	GDP growth rate
ir^{lt}	1	Interest rate on outstanding debt (long-term)
ir^{st}	1	Interest rate on outstanding debt (short-term)
$ir^u(i)_{-15}$	11	Investment requirement, utilizing sector i, for base year (I^u)
incaptl	1	Long-term capital movements (outflow)
ivyco(i)	8/10/3	Share of value added in gross output of producing sector i (constant prices) I^p, I^u and I^a
i.t.r.	1	Indirect tax rate
la(i)	3	Land per worker
lpoil	1	Labour productivity, oil extraction sector
lps(i)	2	Maximum ratio of labour productivity in utilizing sector i (i=10 construction, i=11 services) to labour productivity in the manufacturing sector
lti	1	Long-term interest (suffix)
mcaplt	1	Long-term capital movement (outflow)
$mcaplt_{-15}$	1	Long-term capital movement (outflow), base year
mcu^{mr}	1	Migrant remittances (outflow)
mr	1	Migrant remittances pool
n	1	Maturity of outstanding debt
nwo(i)	8	Share of non-wage into value added (I^p) (note: $wo(_i)$ + $nwo(_i)$ = 1) (constant prices)
o	1	Share of total pooled Official Development Assistance allocated to the region (for DC only)
oda	1	Official development assistance/GDP ratio (for DD only)
odeb	1	Outstanding debt of horizon year
$odeb_{-15}$	1	Outstanding debt, base year
pnw	1	Price of non-wage component of value added
$pola_{ij}$	8x8	Input-output coefficient used for policy purpose (can be any a(i,j))

pop_{-15}	1	Population of the previous horizon year
popagr	1	Population growth rate
popmoy	1	Average population per country (weights = population figures,
prf	1	Participation rate, female
prfr	1	Participation rate, female rural
prfu	1	Participation rate, female urban
prm	1	Participation rate, male
prmu	1	Participation rate, male urban
pva(i)	3	Exogenous price of value added for 3 producing sectors (agriculture, energy, services) I^p
pw	1	Price of wage component of value added
$\wedge$ x(i)	3	Exogenous part of the prices for the first three trade categories (agriculture, raw materials, energy) (I^t)
res_{-15}	1	Reserves, base year
rur	1	Proportion of rural population in total population, DG countries
s	1	Share of export of services in the world pool
sti	1	Short-term interest (suffix)
t(i,j,k)	11x11x7	Share of imports of the k^{th} traded goods category by the j^{th} region from the i^{th} region (evaluated at constant prices)
tex	1	Maximum land extension between 1975 and 1980
tle(i)	1	Labour size of plant, sector (i), I^u
tnp(i)	9	Technical neutral progress for i^{th} utilizing sector I^u
t.r.e.	1	Tax rate on enterprises
t.r.h.	1	Tax rate on households
tsa	1	Land supply for base year
$va(i)_{-15}$	8	Value added of the i^{th} producing sector of the previous horizon period
wapf	1	Working age population, female
wapm	1	Working age population, male
wapfr	1	Working age population, female, rural
wapmr	1	Working age population, male, rural

wapfu	1	Working age population, female, urban
wapmu	1	Working age population, male, urban
wo(i)	8	Share of wage and salaries into value added (I^p), constant prices
$xcap_{-15}$	1	Long-term capital movement, base year (inflow)

REGIONAL MODEL FOR CENTRALLY PLANNED ECONOMIES

SPECIFIC ENDOGENOUS VARIABLES*

AWGR	1	Growth rate of average wages in material production sectors
CC	1	Collective consumption
$CC_{(i)}$	8	Collective consumption, i^{th} supplying sector
DEI	1	Domestic entrepreneurial income
EI	1	Entrepreneurial income
EXNET	1	Net exports or (-) imports
GO	1	Gross output
$GO_{(i)}$	8	Gross output, i^{th} producing sector
$GFCF_{(i)}$	8	Gross fixed capital formation in i^{th} sector
GFCFAGR	1	Gross fixed capital formation in agriculture
GFCFINDU	1	Gross fixed capital formation in sectors I^{indu}
GFCFMIN	1	Gross fixed capital formation in sectors I^{min}
GFCFMP	1	Gross fixed capital formation in material production sectors
GFCFNM	1	Gross fixed capital formation in non-material production sectors
GFCFSERV	-	Gross fixed capital formation in material service sectors
GMP	1	Gross material product
Γ	6	Vector of proportions between employment in old versus new technologies (I^{indu})
LP(i)	12	Labour productivity (gross output per worker) I^{u}
LEAGR	1	Employment in agriculture
LEINDU	1	Employment in sectors I^{indu}
LEMIN	1	Employment in sectors I^{min}
LEMP	1	Employment in material production sectors
LENM	1	Employment in non-material production sectors

* For other variables, see General Model

LESERV	1	Employment in material services
LI	1	Total labour income
LINCM	1	Labour income in non-material service sectors
$LP_{min}^{(i)}$	4	Labour productivity, (I^{min})
$LP_{new}^{(i)}$	6	Labour productivity in new technology sector i, (I^{indu})
$LP_{old}^{(i)}$	6	Labour productivity in old technology sector i, (I^{indu})
LPMP	1	Labour productivity in material production sectors
LPMPGR	1	Growth rate of labour productivity in material production sectors
$KNEW_{(i)}$	6	New capital (with modern technology), 1st January of year t, (I^{indu})
$KOLD_{(i)}$	6	Old capital (with out-dated technology), 1st January of year t (I^{indu})
PC	1	Private consumption
$PC_{(i)}$	8	Private consumption, i^{th} supplying sector
POPI	1	Population's income
$RET_{(i)}$	6	Amount of old capital withdrawn on year t
SAVING	1	Total savings
SOCI	1	Social incomes
STOCK	1	Total stock increase
$STOCK_{(i)}$	8	Stock increase in sector i
STMCAP	1	Short-term capital flows
VAGR	1	Value added, agricultural sector
VASERV	1	Value added, services sector
WMP	1	Wages in material production sectors.

REGIONAL MODEL FOR CENTRALLY PLANNED ECONOMIES

SPECIFIC PRE-DETERMINED VARIABLES AND PARAMETERS*

α_i	6	Proportion of new capital, in total stock, base year (I^{indu})
β	1	Proportion of annual stock increase in GMP
$capvagr_{-10}$**	1	capva coefficient for agriculture, base year
$capvaserv_{-10}$**	1	capva coefficient for services, base year
$cap(i)_{-10}$	6/4	Total capital stock for i^{th} sector, base year (I^{indu}, I^{min})
cc(i)	8	Share of the i^{th} sector in collective consumption
δ	1	Ratio wage growth rate to labour productivity growth rate, material production sectors
exch	1	Ratio of internal to international prices
gmp_{-15}	1	Gross material product in base year
gmpgr	1	Rate of growth of gross material product
$gfcf_{(i)}$	8	Share of the i^{th} sector in gross fixed capital formation
$gfcf_{agr}$	1	Share of the agricultural sector in gross fixed capital formation in base year
$gfcf_{oser}$	1	Share of the material service sector in gross fixed capital formation in base year
i	1	Ratio of GFCF in material sphere to toal GFCF
k(i)/l(i)	1	Capital/labour coefficient (I^{indu}) (I^{min})
λ	1	Annual replacement rate of capital
leagr	1	Projected agricultural employment, 1975-1980
lenm	1	Projected non-material service employment, 1975-1990
leserv	1	Projected employment in material services, 1975-1990
lpgr(i)	6	Labour productivity growth rate of old technology sector i, $i \in I^{indu}$
$lpmp_{-15}$	1	Labour productivity in material production sectors in base year
$lp_{old}(i)$	6	Labour productivity of old technology sector i in base year, $i \in I^{indu}$
ls	1	Projected labour supply, 1975-1990

* Further variables, see General Model

** See definition of capva(i) in pre-determined variables for General Model

mcu^{mr}	1	Migrant remittances to the rest of the world
$pc_{(i)}$	8	Share of sector i in private consumption
$Soci_{-15}$	1	Social income per head of non-active population in base year
$St_{(i)}$	1	Share of stocks in NMP in base year
wmp_{-15}	1	Wages in material production sectors in base year
wnm_{-15}	1	Wages in non-material sectors in base year
χ	1	Elasticity of wages in non-material sphere to wages in material spheres

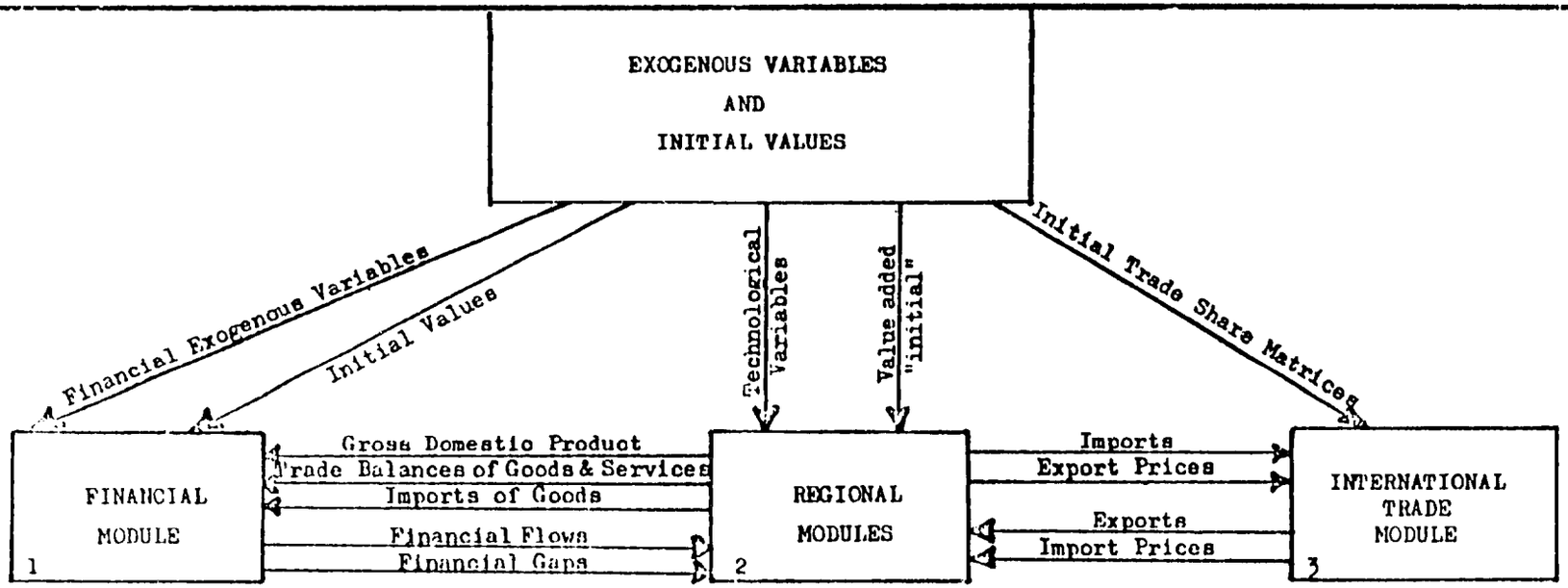
ANNEX B

FLOWCHART FOR THE REGIONAL MODELS

(MARKET ECONOMIES)

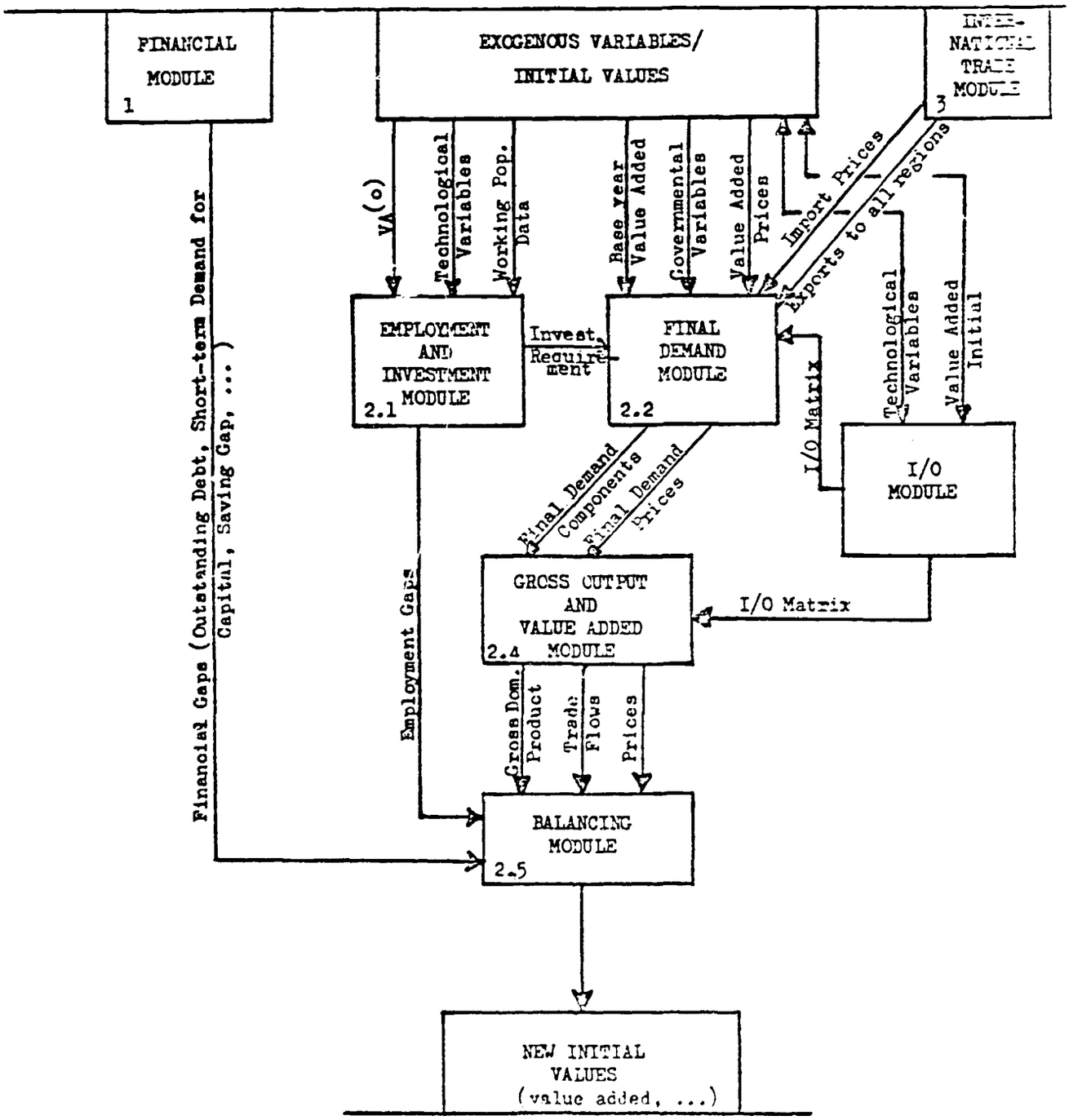
Contents

Flowchart I: THE GLOBAL MODEL

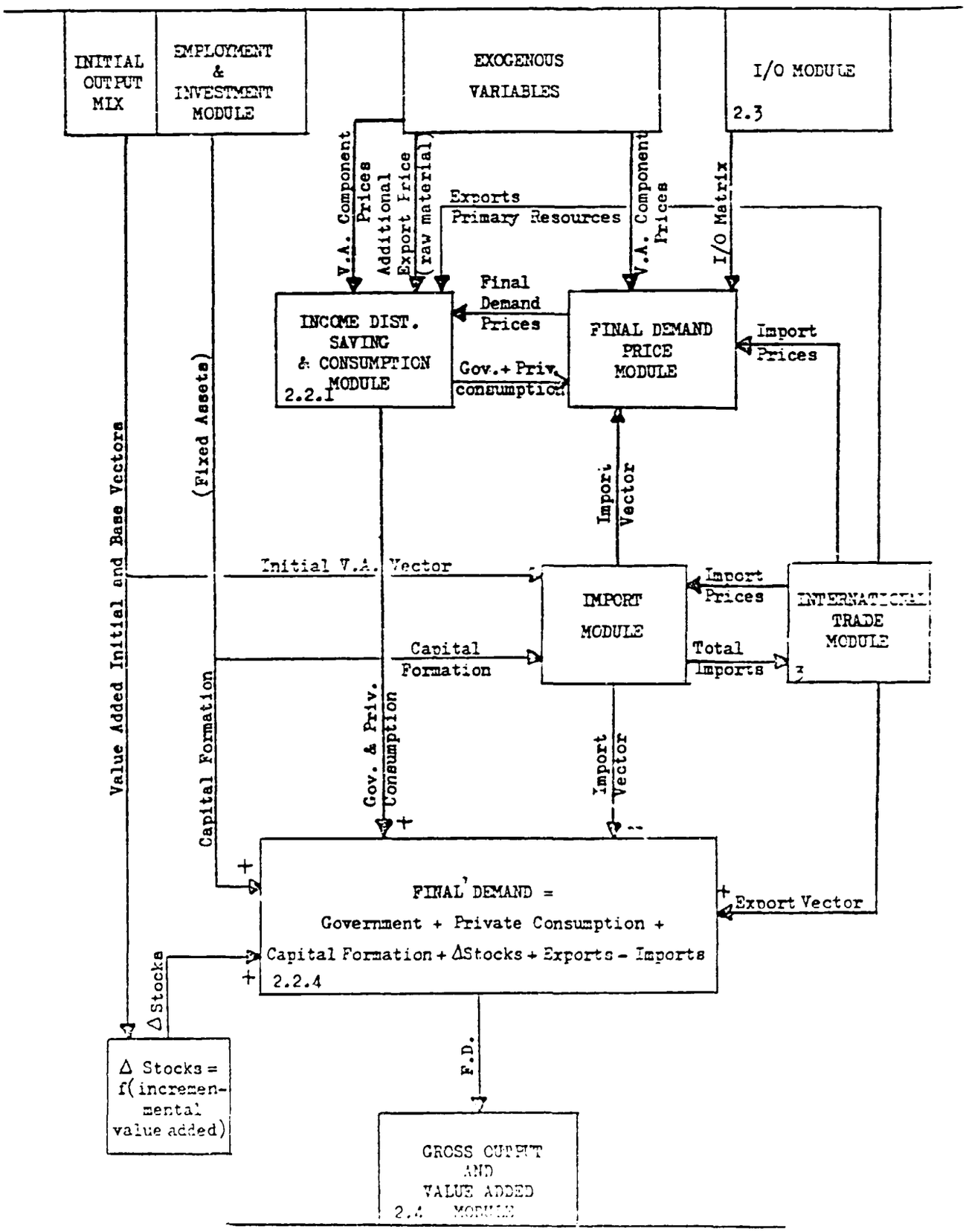


Flowchart I: THE GLOBAL MODEL

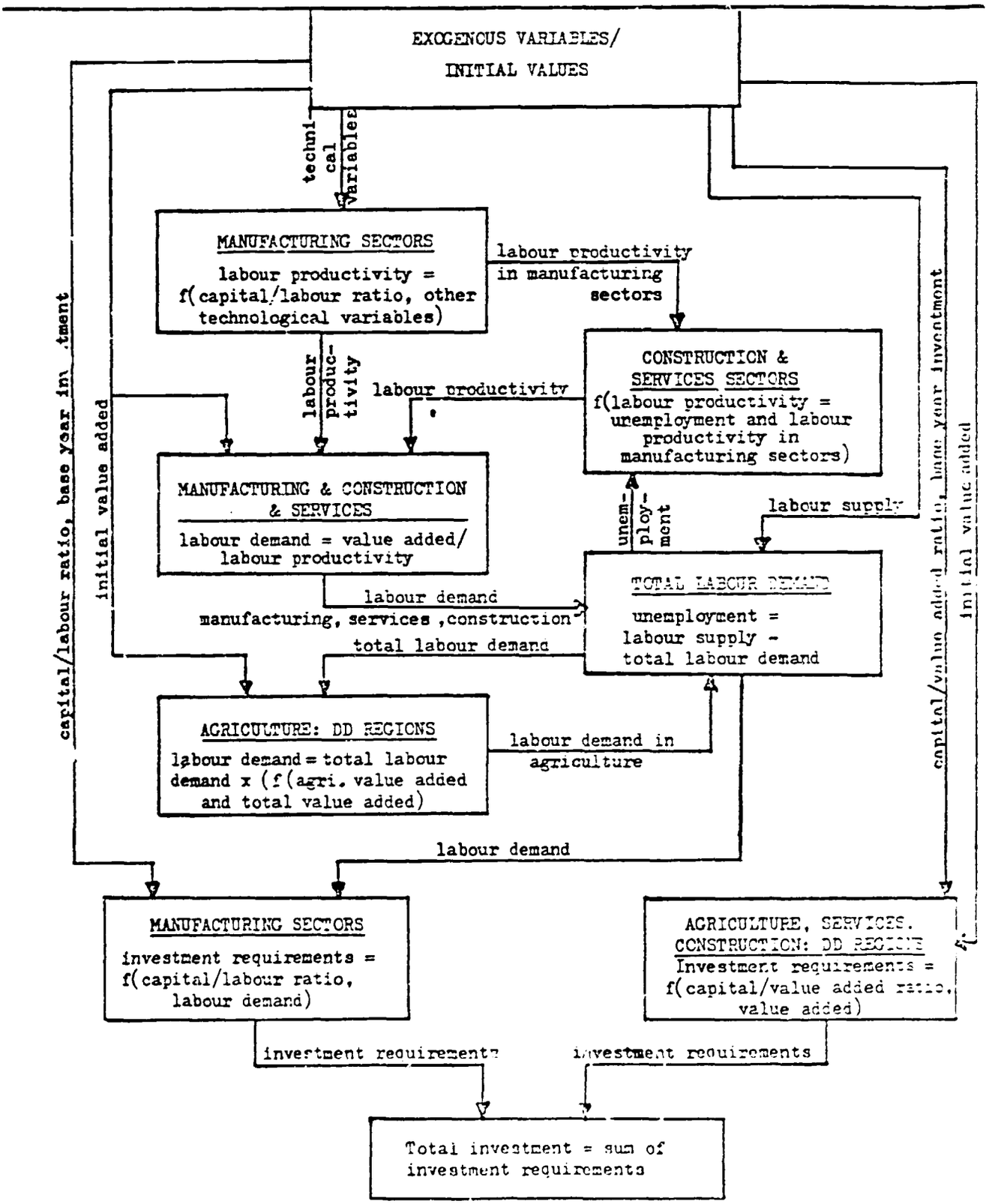
Flowchart II: REGIONAL MODEL



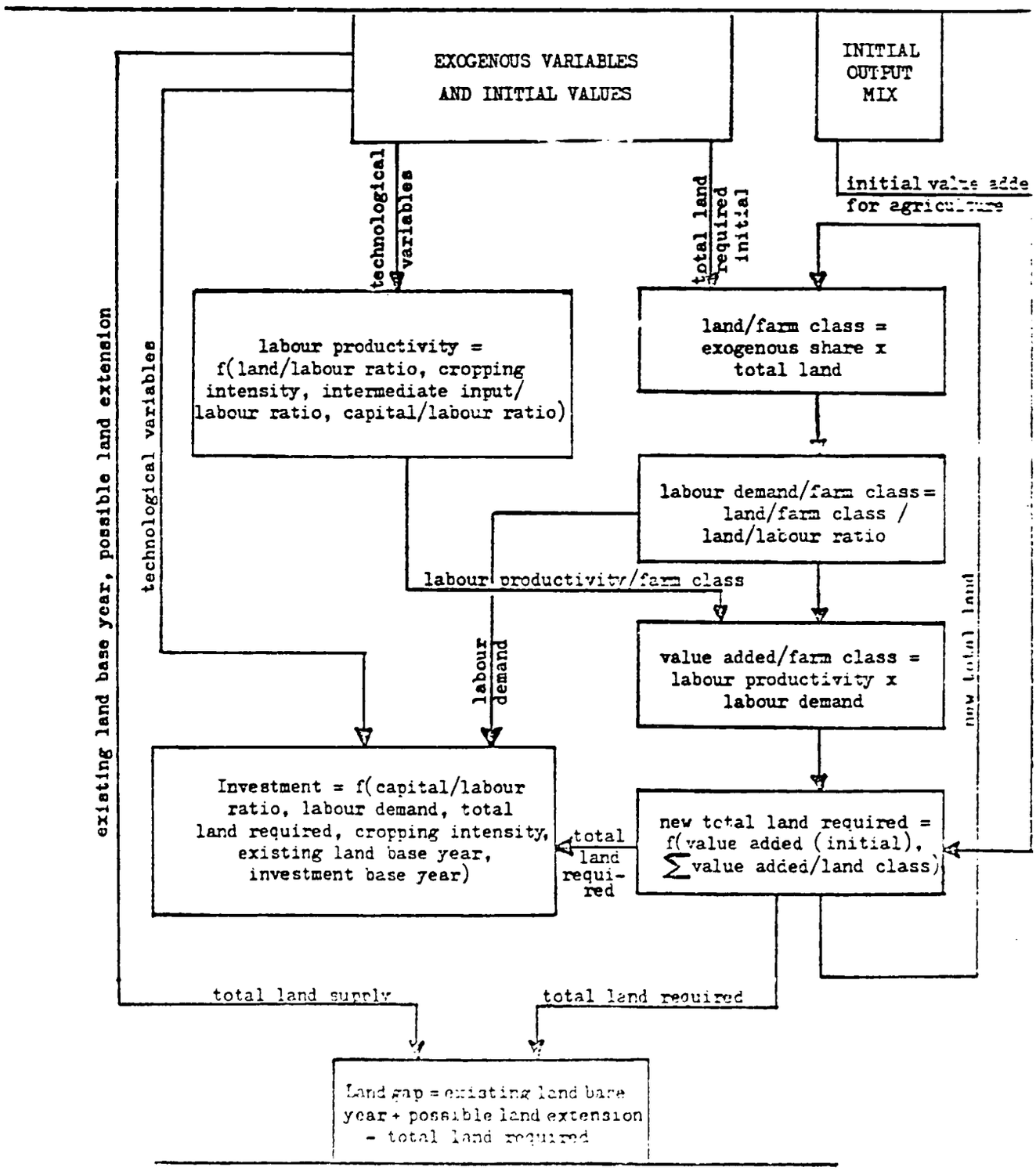
Flowchart III: FINAL DEMAND MODULE



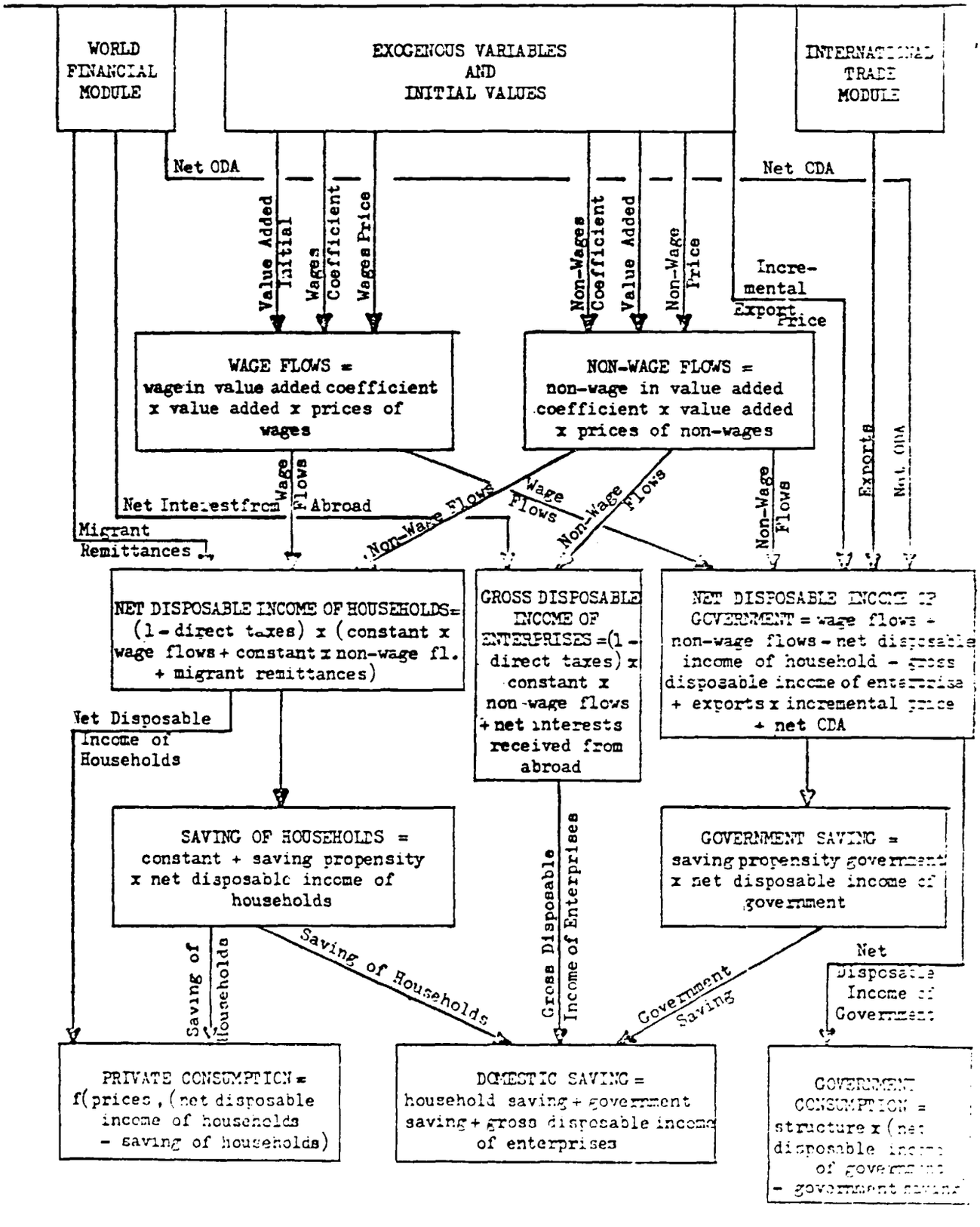
Flowchart IV: EMPLOYMENT AND INVESTMENT MODULE
(including AGRICULTURE for DD REGIONS only)



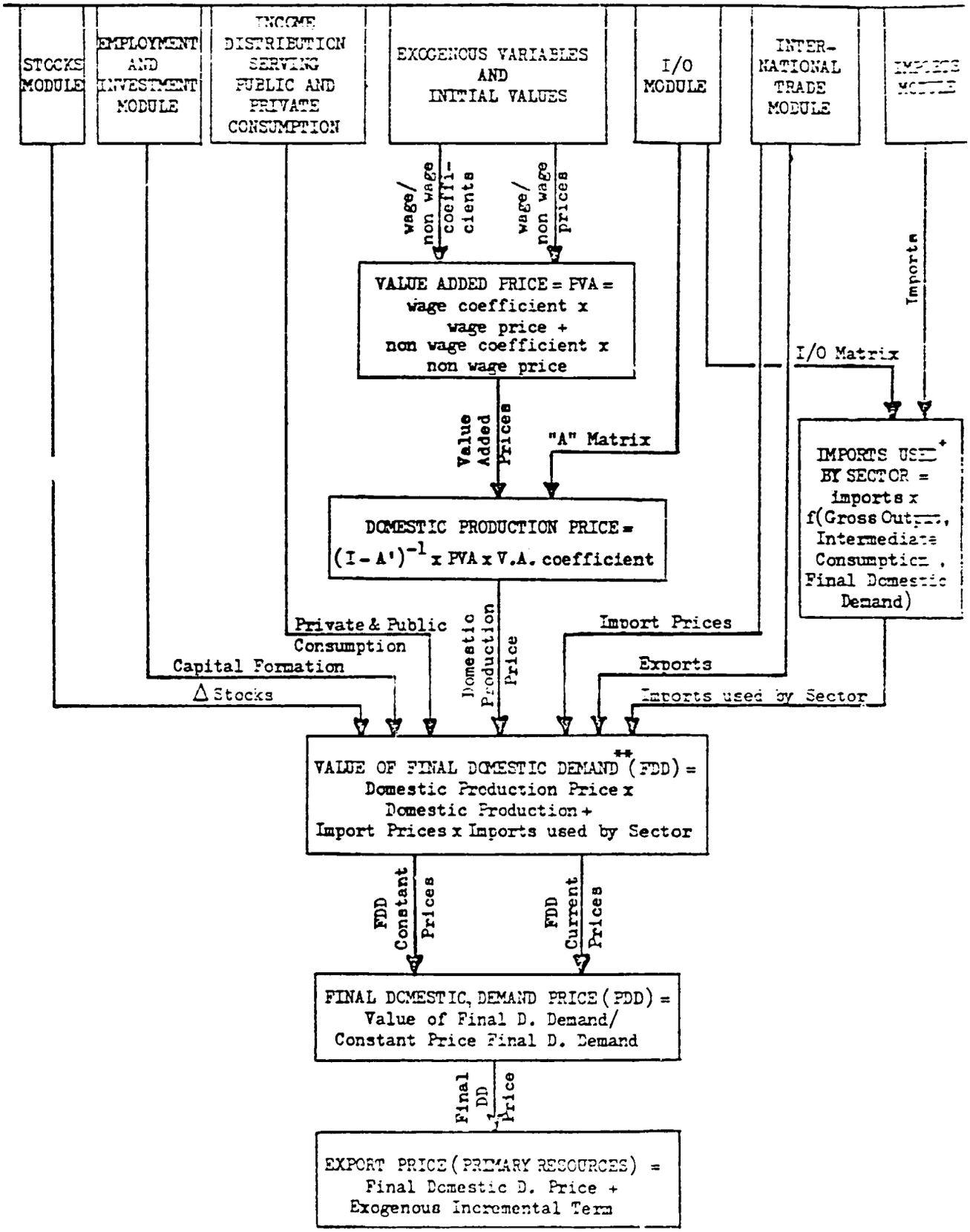
Flowchart V: AGRICULTURE MODULE: EC REGIONS



Flowchart VI: INCOME DISTRIBUTION, SAVING, PRIVATE AND PUBLIC CONSUMPTION MODULE



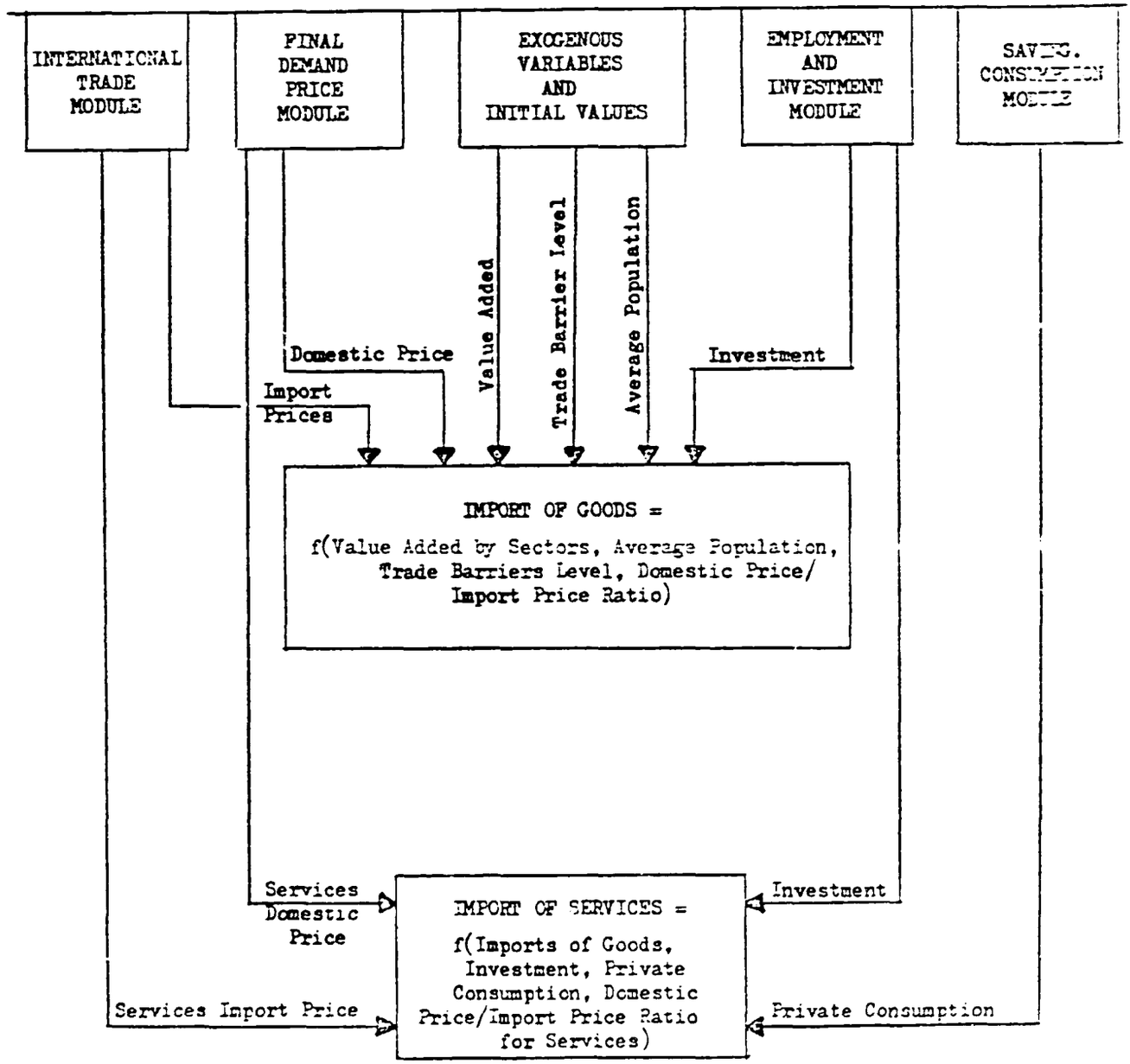
Flowchart VII: FINAL DEMAND PRICE MODULE



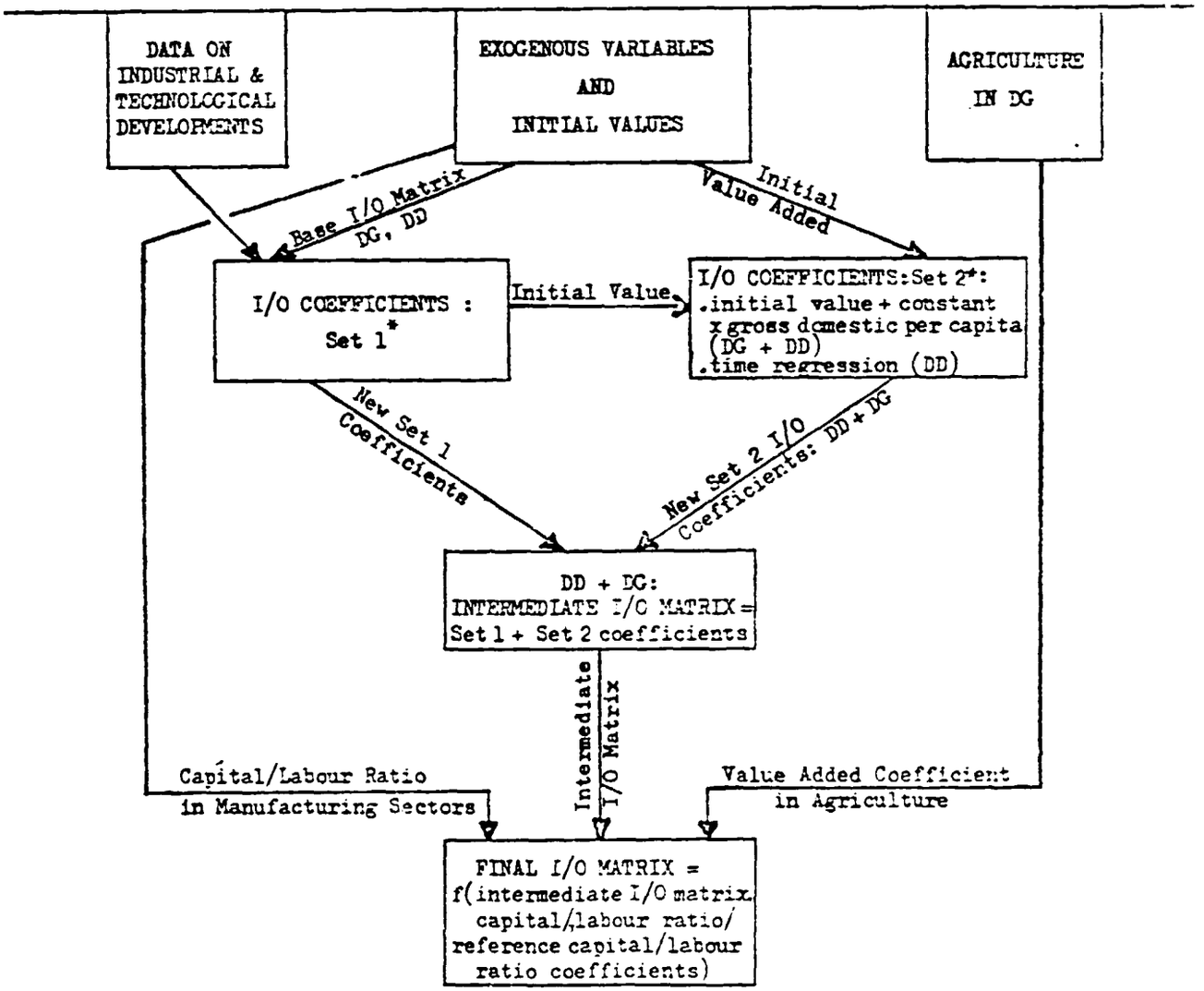
* 'Imports used by Sector' includes intermediate imported inputs of the corresponding column of the I/O matrix and excludes imported inputs of the corresponding row (except diagonal figure);

** 'Final Domestic Demand' (FDD) includes exports.

Flowchart VIII: IMPORT MODULE



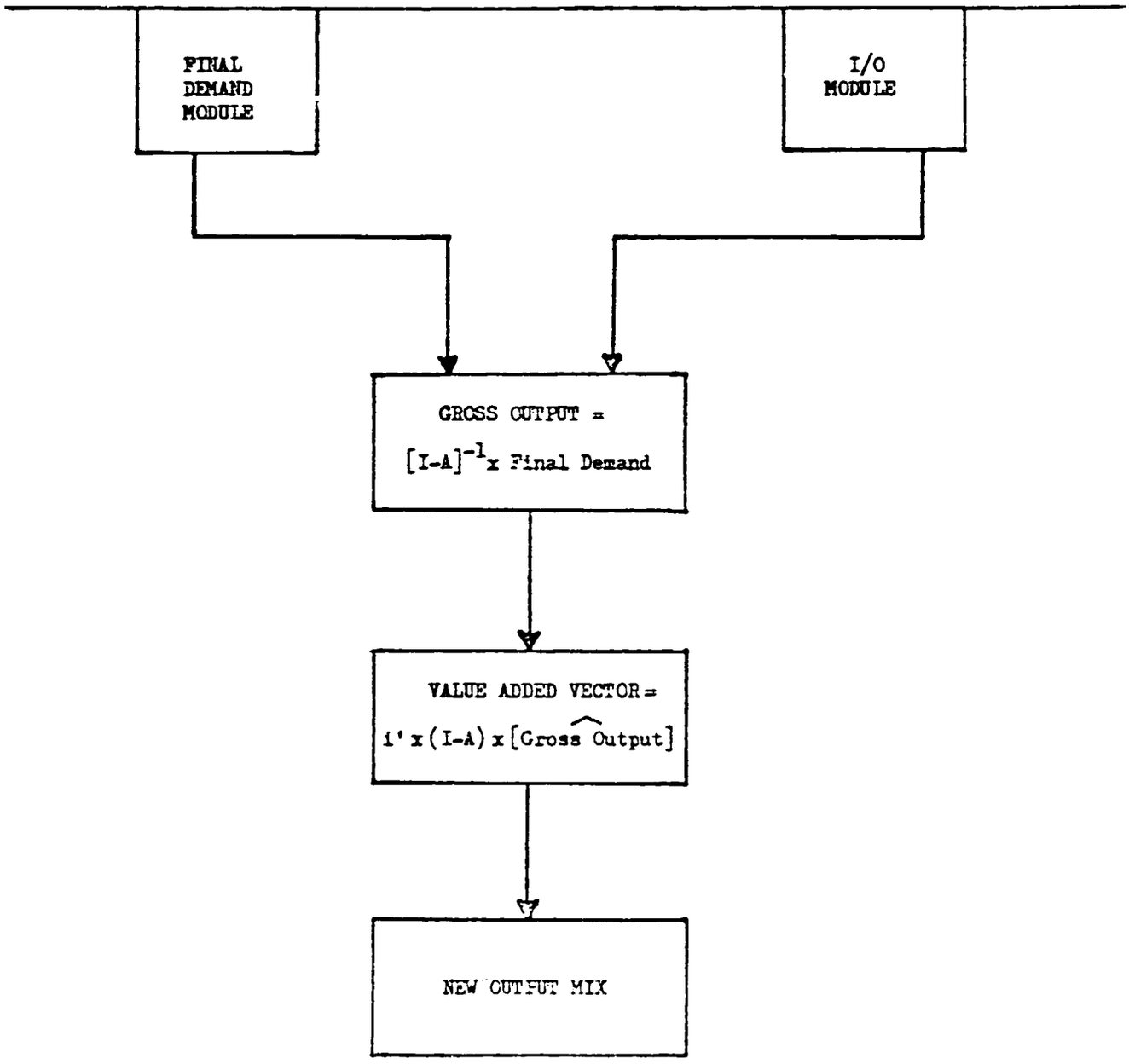
Flowchart IX: INPUT/OUTPUT MODULE (I/O MATRIX)



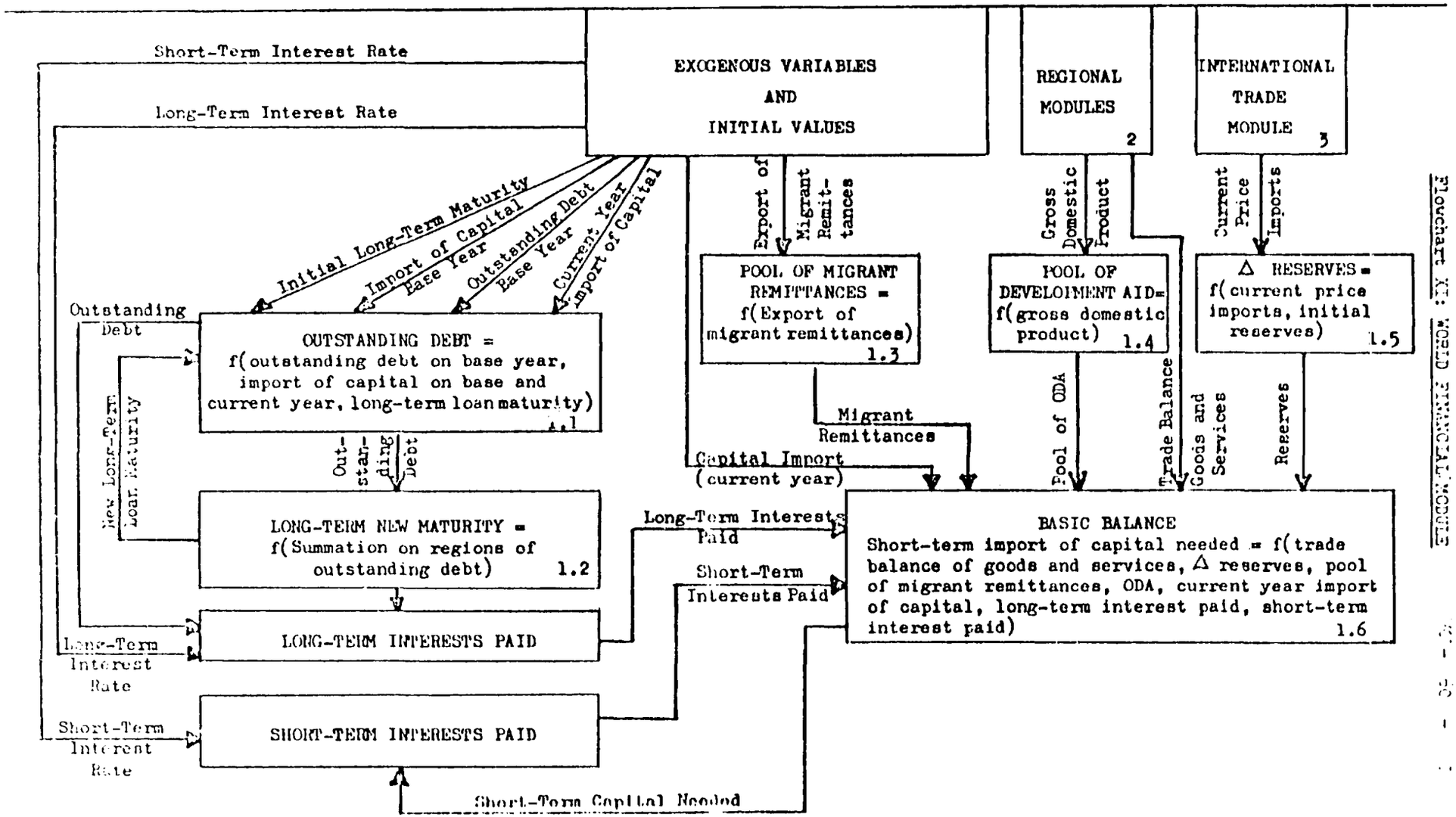
* set 1 of technological coefficients: no significant time or cross-country regressions are available;

* set 2 of technological coefficients: significant time or cross-country regressions are available.

Flowchart X: GROSS OUTPUT MODULE

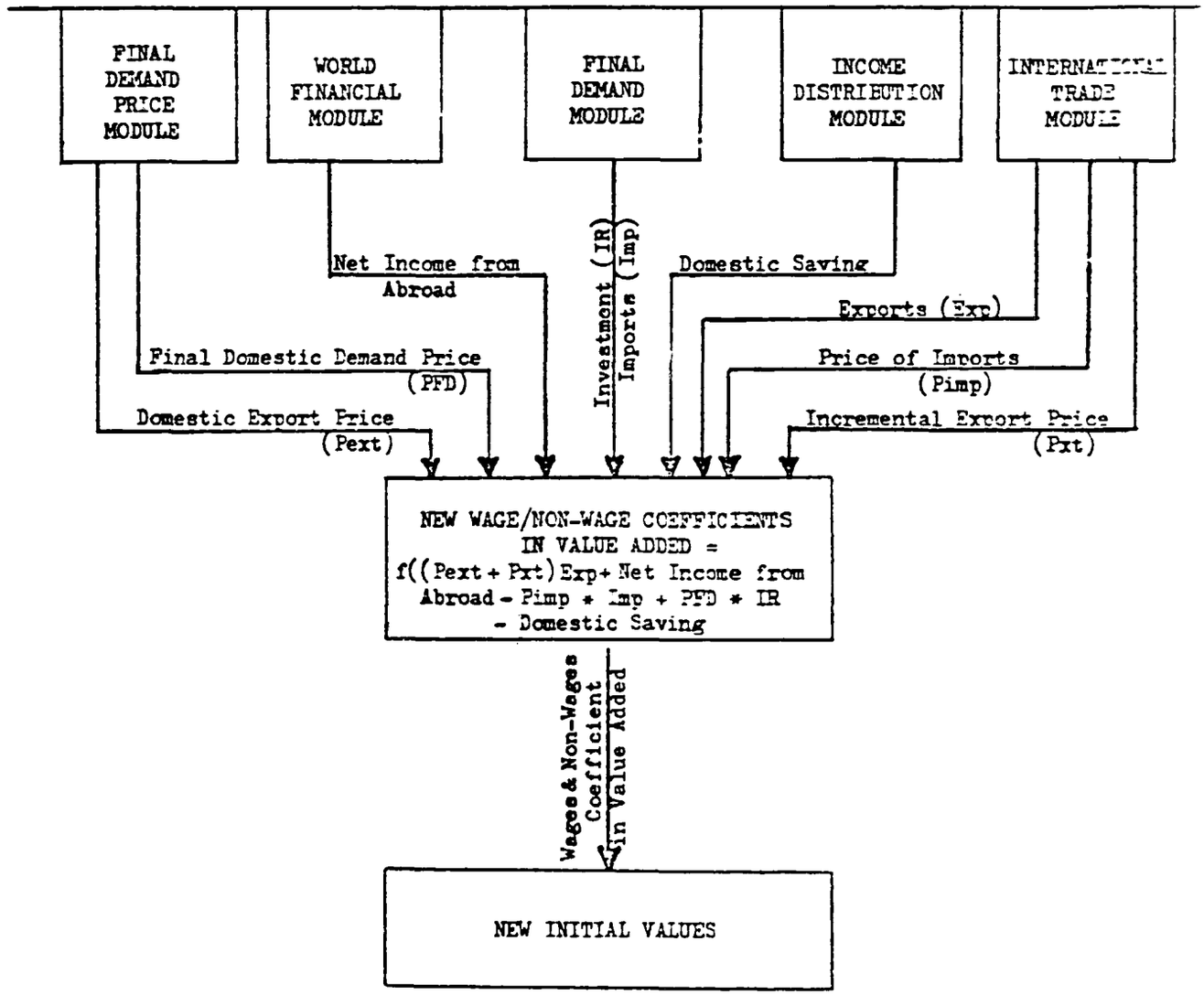


Flowchart XI: WORLD FINANCIAL MODULE



Flowchart XI: WORLD FINANCIAL MODULE

Flowchart XII: BALANCING MODULE



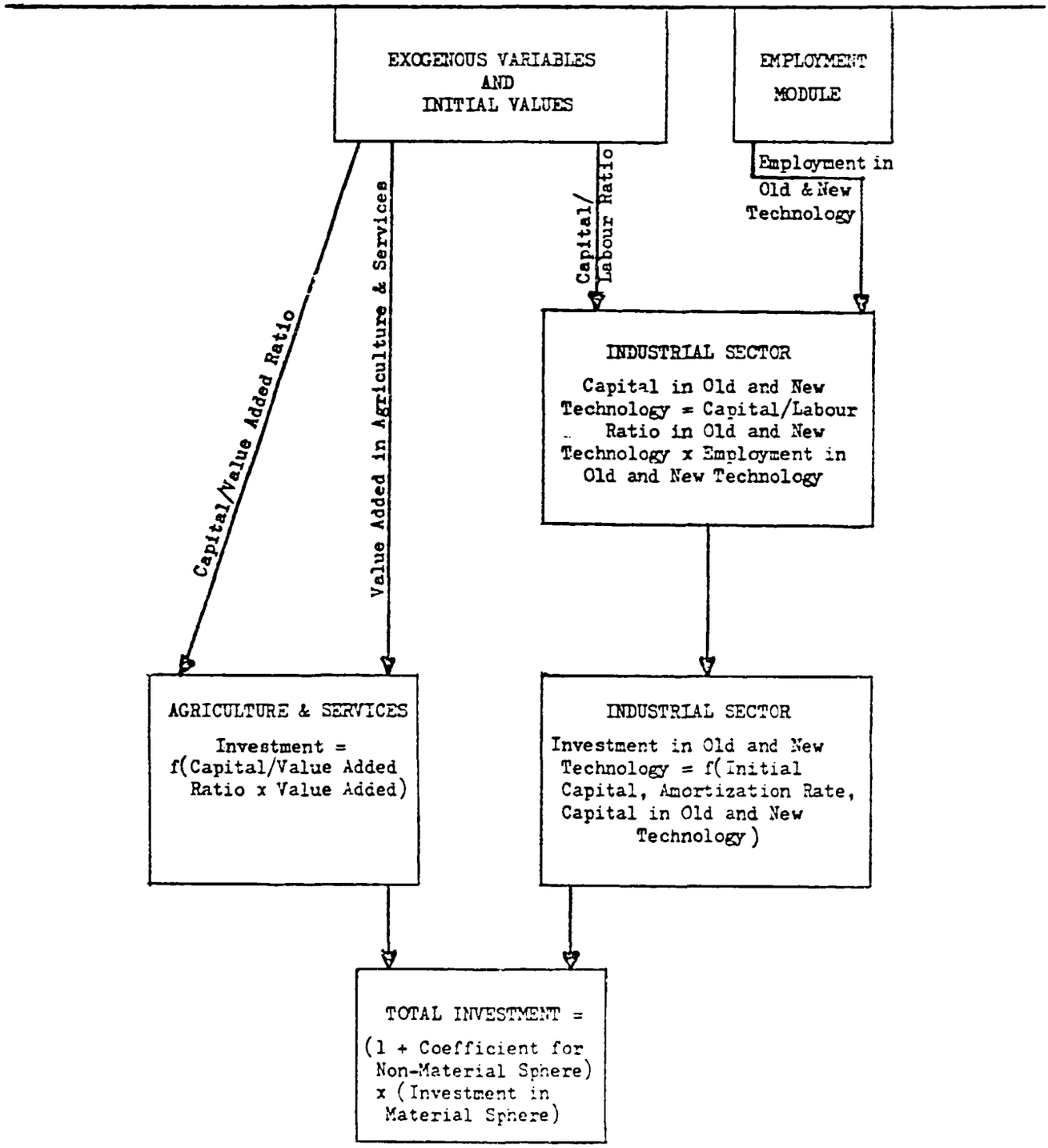
ANNEX C

FLOWCHARTS FOR THE REGIONAL MODELS

(CENTRALLY PLANNED ECONOMIES, EUROPE)

Contents

Flowchart XIII: INVESTMENT MODULE, EASTERN EUROPE



Flowchart XIV: EMPLOYMENT MODULE, EASTERN EUROPE