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**REPORT ON THE DEVELOPMENT AND IMPLEMENTATION OF  
SHORT-TERM FORECASTING SYSTEMS IN INDIVIDUAL AFRICAN COUNTRIES**

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## I. INTRODUCTION

1. The United Nations Economic Commission for Africa (ECA) has been engaged in a series of programmes involving the building of indicative planning models with the objective of mapping a future outlook of African economies. These models aimed at helping the African countries in formulating economic strategies and policies within a coherent and consistent national development plans by indicating the policy implications under various alternative development scenarios. In 1980, the ECA completed the econometric models which were presented at the first Joint Conference of African Planners, Statisticians and Demographers which made various recommendations regarding the extension of these models to cover multisectoral analysis and to supplement the macro and long-term models by short-term forecasting models.<sup>1</sup> Pursuant to this recommendation, the ECA secretariat made a second study on sectoral output and employment projections which was submitted to the second session of the Joint Conference of the African Planners, Statisticians and Demographers in 1982.<sup>2</sup> Among the various recommendations made by this Conference was the need to supplement the long-term macro-economic and sectoral models by short-term forecasting models for crisis management. These short-term forecasting models should enable African planners to devise appropriate adjustment measures to internal and external economic fluctuations while pursuing their long-term development objectives and strategies.

2. In this context, the ECA secretariat devised short-term forecasting models based on the Social Accounting Matrix (SAM). The approach underlying the construction of Social Accounting Matrix for Developing African countries was to devise and implement a framework of accounts which conforms to two principles, namely (a) the framework must be comprehensive and internally consistent in order to support and monitor development planning at the economy-wide level, and (b) the emphasis should be put on the distributional objectives of the development policy within the existing economic data system. The SAM whose format varies according to the socio-economic structure of each country and the availability of data involves in general two types of accounts: the current accounts of commodity production, labour and productive capital,

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<sup>1</sup> See UNECA, "Perspectives of the African Region in the 1980s and Policy Implications", March 1980 (E/CN.14/737); "Projections Results of some Individual African Countries" (E/CN.4/737/Add.1); "Quantitative Analysis of the Problems and Perspectives of the African LDCs and Perspectives of the African Least Developed Countries in the Framework of the Third United Nations Development Decade", (E/CN.14/748, March 1980).

<sup>2</sup> See UNECA, "Sectoral Projections: Some Basic Approaches", ST/EC/PSD.2/10, March 1982.

private and public sectors, workers abroad and the rest of world, and the capital account of the institutions and the rest of the world.<sup>3</sup>

3. In accordance with ECA Conference of Ministers resolution 500 (XIX) of 1984 and resolution 575 (XXXI) of 1986 which it called upon the ECA to assist individual African countries, on request, in the establishment of short-term forecasting systems, the ECA secretariat assisted the Republic of Congo in developing a SAM-Based short-term forecasting system within the context of medium- and long-term indicative development plans. This report particularly draws on the experience of the Congo in this area and attempts to give a methodology that can ensure the complementarity between short-term crisis solving and the requirements of medium- and long-term structural transformation.

## II. SAM-BASED SHORT-TERM FORECASTING MODEL: CASE OF THE CONGO

### 2.1 Data Availability: Social Accounting Matrix (SAM)

4. This part of the report reviews the methodology of a SAM-based short-term prototype model that ECA has developed for the Congo as a device that would enable African planners to improve on sound short-term forecasts of their respective economies within the framework of their medium or long-term development objectives. The model operationalization exercise attempts to reconcile both short-term financial concerns and medium or long-term structural concerns. The model attempts to quantify the short-term consequences of the external or exogenous shock perturbation as well as the changes in domestic economic policies, particularly those related to government budget or monetary policy (for example, devaluation of a currency). At the same time, the model is based on a sufficiently fine data disaggregation that takes into account the structural characteristics of the economy involved, using a social accounting matrix (SAM). This is consistent with the United Nations New Revised System of National Accounts which put emphasis on the distributional aspect of the economic growth rather than on the growth alone, since poverty alleviation and development in Africa can only be tackled through redistribution of the national income (sustainable growth) rather than through its high increase.

5. Rather than engaging in new theories on modelling options, the present report presents a set of short-term and medium-term models in the case of a specific economy, namely that of the Congo. It is important, in fact, to use a specific case in order to demonstrate what can be really done using the available data. Depending on the availability of statistical information, one can envisage various macro-economic schemes involving saving-investment equality. Three levels of modelling can be envisaged:

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<sup>3</sup> See UNECA-SERPD, "Note on Social Accounting Matrices and Their Adaptation in the African Context", November 1982.

Table 1: Levels of Modelling and Information Required

Level	Information required	Macro-economic closure
Level 1	- Input/output tables - Resource supply/demand balances	Supply/Keynesian
Level 2	- Operating accounts plus - Balance of Payments	Debt constraints
Level 3	- Income flows (complete Social Accounting Matrix -SAM)	Kaldorian: Income distribution adjusted for saving/investment equality

6. Of the three levels of modelling possible, it is the first and the third type that have mainly been used in the case of the Congo given the information constraints encountered for balance of payments and external debt for the second type.

7. The social accounting matrix of the Congo initially includes five types of data: (a) the input-output table describing an interindustrial exchange; (b) operating accounts by branch of activity; (c) demand-supply balance expressed in value terms; (d) various goods and services the saving-investment balance at the aggregate level; and (e) the income flows of various institutions. The social accounting matrix analyses the Congolese economy in 1984 in 13 branches and 8 institutions which are:

### 13 Branches

- b1 - agriculture, livestock, and fishing
- b2 - forestry extraction
- b3 - crude petroleum extraction
- b4 - food, beverages, and tobacco
- b5 - timber industry and woodworking
- b6 - Chemicals and petroleum derivatives
- b7 - other manufactured products
- b8 - electricity, gas, and water supply
- b9 - building and public works
- b10 - restaurants, hotels, and wholesale trade
- b11 - transport, warehousing, and communications
- b12 - retail trade services
- b13 - other services

### 8 Institutions

- 1 - households and household run enterprises
- 2 - non-financial non-petroleum companies
- 3 - non-financial public companies
- 4 - petroleum companies
- 5 - financial establishments
- 6 - public administration
- 7 - non-project private organizations
- 8 - rental income from property ownership

8. At this stage, the Congo SAM is in fact a complete input-output table and it could be extended to take account of the external constraints and income flows. Only two of the three initial levels of information has been used in the present phase, since detailed data is not available for the balance of payments and public finance. On the one hand, the input-output table and the demand-supply balances have been used to describe the closure in terms of volume. The input-output matrix thus built distributes the branches intermediate consumption into local and import products. Similarly the various headings under final demand are accounted for by product origin.

### 2.2 Choice of Computer Software

9. At the beginning of the operationalisation of the Congo model, the GAMS language was used to simulate all input data regarding production input-output; income, saving and consumption, and cash flow balances by institutions; import expenditures and export revenues; transfers to and from the rest of the world. However, because of the difficulties in acquiring the new revised version of GAMS developed in the USA and the less acquaintance of this tool by the national experts, it was found that of the five software packages available in ECA-SERPD: SIMECA, SORITEC, QUATTRO and GAMS, MICRO-TSP, the QUATTRO Programme spreadsheet could be advised as an alternative.

### 2.3 The Installation of the Model

10. A brief analysis of such a structure of the Congolese economy in 1984 makes it advisable to use a Keynesian type closure for all branches, except the petroleum sector (b3) whose production is fixed in the short-term by available capacity, the demand-supply balance will, in turn, determine the level of exports. However, the substantial weight of intermediate consumption or imported investment in food industries (b4) and wood manufacturing (b5) would have led to a debt closure in the two branches had the information on the balance of payments and external trade been available. In other words, the trade gap or the external balance that determine the level of new borrowing required to close the gap will determine the intermediate imports in branch 4 or investment needed in branch 4, which in turn will generate the production of branches 4. Only the petroleum sector is not modelled by a Keynesian closure; but production in the agricultural branch is constrained by the demand level (Keynesian closure) meaning that production is obtained as the sum of intermediate and final consumption.

11. The Congo short-term model is a simulation model where the components of demand and supply, income and revenues are iteratively resolved, and where the supply side takes into account the petroleum or oil endowments of the country, the forestry extraction resources and the informal sector; and where the demand side incorporates *inter-alia* the national and external financial resource flows. Hence, the Congo model obtains, by means of an iterative procedure, an equilibrium solution to a system of equations consisting of modules for demand and supply, income, public finance and balance of payments and what happens to these variables when there is an exogenous shock in the economy, for instance the rise or fall in the price of oil or a change in the government short-term fiscal or monetary policy. For more details of the model, see Annex A1. The model using the General Algebraic Modelling System (GAMS) programming language was installed on IBM compatible PC-TOOLS of the Ministry of Finance, Planning and Economic Affairs of the Republic of the Congo, for use by government officials.

#### 2.4 Training in Short-term Forecasting systems

12. Training is a fundamental dimension and activity of short-term forecasting systems since most African countries do not have a substantial number of well developed cadre of officials, experts and national consultants capable of handling all the many aspects of economic forecasting process and the implications of alternative economic strategies.

13. After Rwanda, ECA has provided training in short-term forecasting to the Congo and Cameroon. In the Congo, the government officials of the Division of Economic Forecasting were trained on how to install and to run the simulation packages of the short-term systems in their IBM compatible PC-Tools, using the General Algebraic Modelling System (GAMS). It was agreed that the staff of the Division will familiarize themselves with the working of the installed forecasting programmes on the previous estimated empirical parameters of the model, and that they would exercise themselves by introducing new data. The Department of Planning of the Ministry of Finance, Planning and Economic Affairs indicated it would consult the UNDP assistance to enhance further the training programmes of the staff in computerized model building and execution.

14. Likewise, the Cameroonian government in collaboration with the UNDP has sent a high-level delegation from the Ministry of Development Planning to ECA to be briefed on economic forecasting systems within the context of improving short-term and medium-term planning for crisis management. The delegation was briefed on how to tackle the issues of dynamic development planning and methodology, in particular the modelling of the African economies, structural adjustment programmes within the framework of the long-term structural transformation, external finance management and subregional dimension of structural adjustment and integration, with a view to reorient the Cameroon economic models towards an integrated system that takes into consideration short-term and long-term concerns. It must be recalled that after the first ECA mission to Cameroon in 1984 on short-term forecasting, the Cameroonian experts have succeeded in building a social accounting matrix (SAM) and an input-output table and this had made it easier to build a SAM-based short-term forecasting model in Cameroon.

### III. THE LINK BETWEEN SHORT-TERM FORECASTING MODEL AND MEDIUM/LONG TERM PLANNING MODEL

#### 3.1 The Medium-Term Model Assumptions

15. During the ECA team mission to Congo, the Congolese officials showed interest to develop, conjointly to the short-term model a medium-term planning model which will serve as a framework for the formulation of its five-year development plan (1990-1995). The general characteristics of the planning model that was suggested include: (a) the supply generates its own demand instead of the usual Say's law of markets applied in the previous short-term forecasting model that "demand calls its own supply"; (b) the supply is determined through the marginal efficiency of capital (ICORs) or through the planned growth rate objectives; (c) the structure of the GDP is susceptible to changes in medium-term.

16. The medium term planning model provides a macro-economic framework for programming the investment projects (both public and private) of the country within a medium-term period. It is the usual two gap model that shows what levels of investment, imports and external borrowing will be necessary in order to achieve the growth objective set by the government in the plan. On the one hand, for some countries the model can be used to show that the level of imports necessary to reach the growth objectives depends on the GDP, investment and consumption, the latter being determined residually.<sup>4</sup>

17. On the other hand, as a two gap model, it can be used under the constraints of savings in which case imports and not consumption are determined residually. However, if it is politically acceptable to maintain consumption at a given level, the constraints on imports can be reflected in a noticeable increase in external borrowing which is incompatible with the financial constraints that often prevail in Africa. As exports are exogenous in both cases, the difference between exports and imports determines the need for recourse to external financing. This reflects the "needs" approach that is favoured by the Bank's revised minimum standard model, in contrast with the "availabilities" approach of our model which determines possible growth based on the foreign capital available. In any case, it is absolutely vital that the coherence of the underlying macro-economic framework should be maintained and that the values of the principal variables should be realistic.

#### 3.2 Structure of the Medium/long-term Model

18. As supply is a constraining factor, the starting point is to estimate first the overall and sectoral production in the conformity of the objectives that the country intends to pursue during the medium-term plan period. In this case, the investment plays an important role in the determinative of supply. The investment (public and private) can be estimated either on the bases

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<sup>4</sup> Most of the World Bank's Revised Standard Minimum Models (RSMM) applied in several African countries use this approach where consumption is determined residually by successive iterations.

of structural trends of sector marginal incremental capital-output ratios reflecting the utilisation capacity of the economy or on the basis of the cost-benefit analysis of sectoral projects that are retained to be included and realized during the Plan period.

19. Annex II gives the structure of the model. Let here summarize that the overall GDP is obtained by the summation of sectoral value added which, in turn, are estimated as follows. The agricultural value added is derived from three subsectors: the food and cash crop production is assumed to depend on acreage under permanent cultivation and labour force in agriculture; whereas the acreage is assumed to depend on investment made in modern agriculture (purchase of tractors, fertilizers, irrigation, etc.).<sup>5</sup> The growth rate of the fishery, livestock and hunting is based on the growth objective of the Plan; whereas that of forestry is obtained through the ICOR. The manufacturing industry and mining sectors were based on the growth rates envisaged by the government in its five year development plan (1987-1992). The building and public works were function of the direct investment programming whereas the services sectors were estimated from the envisaged growth rate of the plan's growth objectives. Hence, the total GDP was obtained as the sum of sectoral value added. To obtain the GDP at market prices, indirect taxes net of subsidies were added to GDP at the factor costs. Hence, from the estimation of the supply, the demand is derived (from the assumption that supply calls its own demand in an open economy).

$$(13) \quad \begin{aligned} \text{GDP} &= C + I + X - M \\ \text{GDP} - C &= I + X - M \end{aligned}$$

$$S = I + X - M$$

Therefore the necessary equality of the two gaps can be derived:

$$(14) \quad I + S = M - X$$

where GDP gross domestic product; C: Total final consumption; I: fixed investment; x: exports; M: imports; and S: savings.

20. This means that savings shortfall relative to investment requirements of the Plan will have to be financed externally in the form of extra-imports which, in turn, necessitate an increase in the foreign debt. Exports are considered as exogenous and are introduced by product from the point of view of sales rather than production, by volume and prices without any explicit linkage with the growth performance of GDP. In the case of Congo, the exports of petroleum and woods are obtained as a proportion of the production in volume times the respective export prices.

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<sup>5</sup> The difference between this medium-term macroeconomic model and the World Bank's Revised Minimum Standard Model (RMSM) is that the latter is basically export-oriented model designed for the public investment programme (PIP) to promote export sector.

21. The consumption of the public administration is constrained to increase at an exogenous growth rate, whereas the private consumption is estimated by the growth rate of per capita consumption times the growth rate of the population. The investment is obtained through the incremental capital output ratio (ICOR) and the targeted growth rate of GDP, without taking account of increased production capacity, for example, or the availability of the labour factor. The imports of goods and services are taken as a residual between total consumption, investment and exports, minus GDP at the market prices. Hence, the trade gap and resource gap can be derived. These endogenous variables are adjusted to reflect variations in the terms of trade.

22. The calculation of the external debt, needed to complement the domestic financing of the Plan investment projects is made through the balance of payments accounts, with the classical principle that the current balance plus the net movement of capital plus the changes in reserves should equal zero. However, in the African case, the flows already "in the pipeline" or already planned can be distinguished from those fresh flows resulting from additional financing needs revealed by the projection exercise and will, in their turn, lead to new changes which will affect the balance of trade with the outside world. The linkage with the national account block is provided by external trade flows, reduced to current value in US dollars, the difference representing the balance of non-factor goods and services. An assessment must be made of net movements of capital, both private and public (linked to the previous debt and planned drawings), while additional financing needs (or gap filling) will depend on the planned level of reserves. However, the detailed balance-of-payments block and the public finance block have been introduced in the short-term SAM based forecasting model in order to monitor yearly the fluctuations within the Plan period so that they do not deviate substantially from the growth objectives of the Plan.

### 3.3 Link between Short-term and Medium-term Models

23. What has been devised in Congo is a methodological framework for integrating the short-term SAM-based forecasting model described earlier with the country's five year development plan (1990-1995)<sup>6</sup>. The model based on the social accounting matrix (SAM) was installed in the

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<sup>6</sup>Another technique which is being attempted in order to integrate short-term forecasting into the medium/long-term indicative planning is the **planning-programming budgeting system (PPBS)** approach, which is an efficient programming system with the following characteristics: (i) the integration of all forms of operational and development programmes or projects into one planning process; (ii) the integration of the short-term budgetary process into the medium/long-term planning process; (iii) planning and budgeting for more than one year budgetary period; (iv) planning and budgeting within a framework which seeks socially determined goals (for example, distributional goals through the use of SAM); and, (v) the continual updating overtime of planning and budgeting. This amounts to the integration of the Ministry of Finance and the Ministry of Planning into one Ministry of Planning and Finance, as is the case in some African countries.

PH 3000 main-frame computer of the Ministry of Planning and Economic Affairs to simulate the various government short-run policies that intend to implement the objectives of the five year plan, so that short-term growth achievements do not deviate substantially from the medium-term plan's growth objectives. The scenarios of economic policies included, in general, the following:

(1) Historical trends scenario

If the government perpetuate the past policies without any changes, what will be the consequences on the endogenous variables of the model and the possibility of achieving the five year plan growth targets.

(2) Policy of the petroleum sector, the driving force of the Congolese economy

As the petroleum sector represents about 50 per cent of GDP, what would be the consequence of an exogenous shock (like oil price increase or reduction, production volume quota increase or reduction) on the economy?

(3) Conjunctural structural adjustment programme

What would be the consequences of SAP fiscal policies (such as government expenditure cuts, tax increases, etc.) or SAP monetary policy (such as credit crunch, currency devaluation, interest rate increases, etc.) on the economy in general and its prospects in achieving the medium-term plan targets?

(4) The follow-up and monitoring of the Five Year Plan Targets

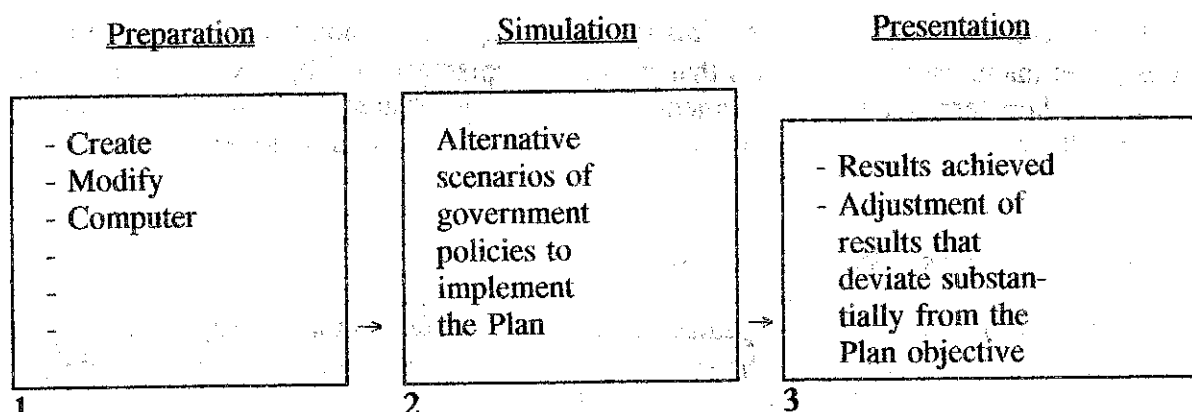
The short-term forecasting model will have the benefit of following up year by year the implementation of the medium-term or long-term perspective plans and to make the appropriate adjustments should the short-term growth results substantially deviate from the medium-term or long-term growth objectives.

(5) Equilibrium resources and its use

This is reflected and monitored by the proper characteristics of the model based on the social accounting model (SAM) to ensure the achievement of growth with equity, sustainability and alleviation of poverty.

(6) Other exogenous shocks to the economy

24. In general, the computer programme that has been elaborated on the base of model coefficients has the following phases (menu).



25. The scenarios 2 to 6 require the analysis of the model variables and coefficients so as to see whether there is need for changes in the short-run in order to realize the medium/long-term development objectives. In some cases, one will be compelled to exogenize the endogenous variables, so as to effect:

- (1) changes in the structure of production
- (2) the efficiency of investments (coefficients)
- (3) changes in the structure of investments (behaviour)
- (4) changes in the structure of demand (exports, imports)
- (5) changes in the savings, etc.

26. The link between the short-term model and medium/long-term model just described above can be explained as follows. At the beginning of the Plan period, the country (government and private sectors) selects and finalizes the sectoral projects that should be implemented during the Plan period. On the basis of their cost-benefit analysis, the sectoral investments are determined on basis of which the sectoral value added are estimated through the historical sectoral ICORs. The overall GDP at factor cost is then obtained as summation of sectoral value added and the GDP at market price is obtained through conversion factors. The Social Accounting Matrix can also be brought in to determine the sectoral distribution of projects. The demand components are estimated accordingly and the saving gap and the trade gap are derived. These gaps allow to determine the estimated growth rates of sectoral value added and of the GDP as a whole are feasible and can be included in the medium-term indicative Plan as the country's growth objectives, given the domestic and external financial resources constraints for financing the development projects during the Plan period. Once the Plan objectives and projects have been accepted by the country's legislative body, the task remains now on how to implement yearly Plans. Then, the short-term forecasting model is brought into the picture.

27. As in the short-term model, the demand calls its own supply, the estimated macroeconomic components of the demand are plugged into the structure of the final demand matrix which, with the input/output structure of the economy (its multipliers) will signal the level of sectoral gross output and value added that would be achieved in a particular year. The planned or estimated figures can be compared with the actual figures and signal the kind of adjustments in government policies that are needed to be made in order to achieve the sectoral growth targets.

Table 7: MEDIUM-TERM PLANNING MODEL OF THE CONGO

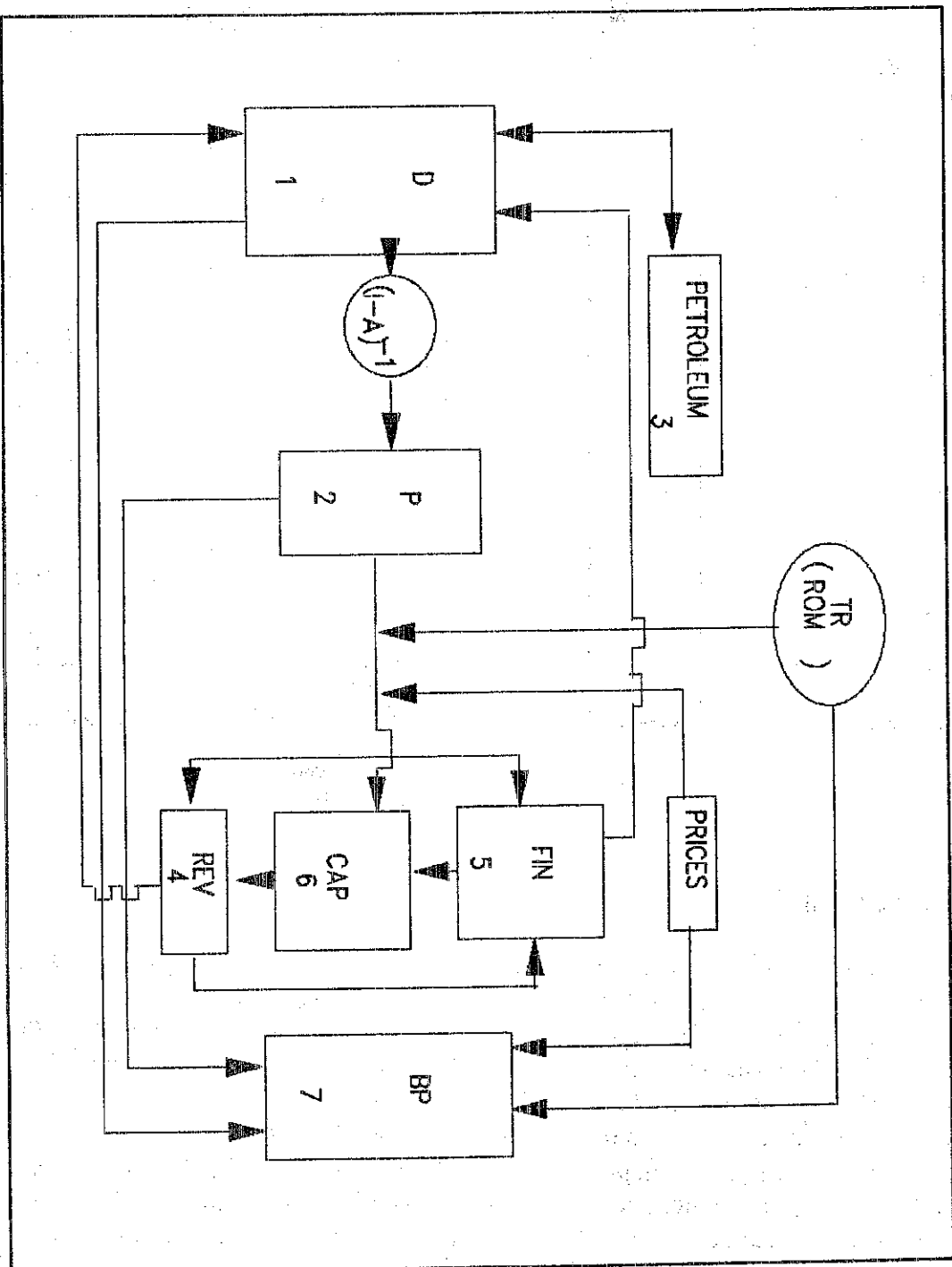
	SUPPLY			DEMAND		
	Actual	Estimate		Actual	Estimate	
Agriculture			SUPA G TAG			Consumpt
Mining			$r_5$			- Public
Industry			$r_6$			- Private
Building & Public Works			$k_4$			Investmen
Services			$r_7$			-INV AG
GDP <sub>g</sub>						-INV MIN
						-INV IND
						-INV BTP
IND						Exports
GDP <sub>mp</sub>						Imports
			BC, BR			

BC = Trade Gap  
BR = Savings Gap

#### IV. CONCLUSION

28. Indicative planning still remains an effective instrument for African decision-makers in marshalling forces involved in the socio-economic evolution and for managing coherent development programmes. This report, using an example of the Congo economy, gave a series of methodological frameworks for the operationalization of the short-term forecasting models within the framework of the medium/long-term plan. There is now a broad consensus by African countries and the international community that short-term economic management (structural adjustment programmes), although necessary, should be complemented by a transformatory programme that triggers resumption of growth and sustainable development in the long-run. A dynamic indicative planning process (as opposed to the traditional centralized plan formulation) is essential for bringing together the socio-economic actors as well as the institutions responsible for steering the economy (Ministries of Planning and Finances and sectoral ministries) and for providing the policy decision-makers with solid options of alternative policy actions for analysing development change as well as for managing such change.

DIAGRAM OF CONGO'S SHORT-TERM FORECASTING MODEL



Note : D = Demand block  
P = Production block  
PET = Petroleum block  
REV = Income block

FIN = Public finance block  
CAP = Capital block  
BP = Balance of payments block

## ANNEX I: SHORT-TERM MODEL FOR THE CONGO

NOTATION	MODEL EQUATIONS	EXPLANATION OF VARIABLES
<b>1. THE DEMAND MODULE</b>		
Consumption		Consumption by households
CM	$CM_T = A_0 + A_1 * RND_{t-1}$	Disposable income
$CM_i$	$CM_i = b_i * CM_t$	Sectoral consumption by household
$b_i$		Share of sector i in total household consumption
$c_i$	$CM_{li}^l = c_i * CM_{li}$	Share of local products from sector i in total household consumption
$1 - c_i$	$CM_{li}^m = (1 - c_i) * CM_{li}$	Share of imported products of type i in total household consumption
CIPSBL	$CIPSBL_t = (1 + r_1) * CIPSBL_{t-1}$	Consumption by private non-profit establishments
CG	$CG_t = d * (RBO + RBP + RBA)$	Consumption of public administration
RBO		Receipts within the ordinary budget
RBP		Receipts from petroleum
RBA		Other budgetary receipts
$CG_i$	$CG_i = e_{1i} * CG$	Sectoral government consumption
$CG_i^l$	$CG_i^l = e_{2i} * CG_i$	Public consumption of local products
$CG_i^m$	$CG_i^m = (1 - e_{2i}) * CG_i$	Public consumption of imported products
Investment		
INV	$INV = (INV_G + INV_{SP})$	Total investment
INV <sub>G</sub>	$INV_G = INV_{G0}$ : Exogenous	Investment of public administration
INV <sub>SP</sub>	$INV_{SP} = INV_{SP0}$ : Exogenous	Private investment of petroleum
$INV_j^j$	$INV_j = l_j * INV$ ; $j \neq 3, 6$	
$INV_{ji}$	$INV_{ji} = f_j * INV$ ; $i=1,2,...,13$	
$INV_i^l$	$INV_i^l = g * INV_i$	
$INV_i^m$	$INV_i^m = (1 - g_i) * INV_i$	

$VS_i^l$	$VS_i^l = V_{io}^l$ : exogenous	Variations in local stock per product
$VS_i^m$	$VS_i^m = VS_{io}^m$ : exogenous	variations in imported stock per product
$VS_i$	$VS_i = VS_i^l + VS_i^m$	Total stock of petroleum

NOTATION	MODEL EQUATIONS	EXPLANATION OF VARIABLES
<b>EXPORTS</b>		
$XPETR$	$XPETR = Q_p^{-a_{3,6}} * Q_6 - VS_3$	Export of petroleum
$Q_p$		Petroleum
$XBOIS$	$XBOIS = (1 + r_2) * XBOIS_{t-1}$	Wood exports
$XAUTR$	$XAUTR_t = (1 + r_3) * XAUTR_{t-1}$	Other exports
$X$	$X = XPETR + XBOIS + XAUTR$	Total exports
$X_i$	$k_i * X$	Sectoral exports
$k_i$		Share of product exports in total exports
<b>IMPORTS</b>		
$MC_i$	$MC_i = CM_i^m + CG_i^m$	Imports of consumer goods in sector i
$CM_i^m$		See consumption equations
$CG_i^m$		See consumption equations
$MI_i$	$MI_i = n_i * Q_i$	Imports of intermediate goods in sector i
$Q_i$		Economic output of sector i
$MINV_i$	$MINV_i = INV_i^m$	Sectoral investment goods
$MAUTR$	$MAUTR = (1 + r_4) * MAUTR_{t-1}$	Other imports
$M$	$M = \Sigma(MC_i + MI_i + MINV_i) + MAUTR$	Total imports

## 2. THE PRODUCTION MODULE

NOTATION	MODEL EQUATIONS	EXPLANATION OF VARIABLES
$Q_i$	$Q_i = \sum_{j=1}^n a_{ij} * Q_j + DF_i^1$	Sectoral domestic production

$a_{ij}$		Input output technical coefficients
$DF_i^1$	$DF_i^1 = CM_i^1 + CISBL_i^1 + CG_i^1 + I$	Final demand for imports by sector
$Q$	$Q = A * Q + DF$ $Q = (I - A)^{-1} * DF$	Production in matrix form Production solution
$Q_p$	$Q_{p,0}$ : exogenous	Petroleum production

3. THE PETROLEUM SECTOR MODULE		
NOTATION	MODEL EQUATIONS	EXPLANATION OF VARIABLES
$Q_p$	$Q_p = Q_{p,0}$ : exogenous	Production of crude petroleum
XPETR	$XPETR = Q_p - a_{3,6} * Q_6 - VS_3$	Demand for crude petroleum
RPETR	$RPETR = k_n * RBEL_3$	Revenue from petroleum and its distribution
DRPETR	$DRPETR = INVSP + RBP + \Sigma TRI_{k,3}$	
4. THE REVENUES MODULE		
<u>Value added</u>		
$VA_i$	$VA_i = q_i * Q_i$	Sectoral value added
PIB	$PIB = \Sigma VA_i$	GDP at factor costs
$MSINF_i$	$MSINF_i = v_i * VA_i$	Wages in the informal/traditional sector of production sector i
MSINF	$MSINF = \sum_{i=1}^n MSINF_i$	Total informal wage
$V_i$		The share of value given to wages in the informal or traditional sector
$MSFOR_i$	$MSFOR_i = w_i * VA_i$	Wages in the formal (Modern) sector of the production sector i
MSFOR	$MSFOR = \Sigma MSFOR_i$	Total formal wages
$w_i$		The share of value added given to wages in the formal/modern sector
MS	$MS = MSINF + MSFOR$	Total wages and salaries
$RBEL_i$	$RBEL_i = X_i * VA_i$	Gross profit revenue from sector i production
RBEI	$RBEI = \Sigma RBEL_i$	Total profit revenue

$x_i$		The share of sectoral value added given to profit
$IND_i$	$IND_i = y_i * VA_i$	Indirect taxes net of subsidies per sector
IND	$IND = \sum_{i=1}^n IND_i$	Total indirect taxes (nets)
	<u>condition</u> $v_i + w_i + x_i + y_i = 1$	
RND	$RND = MS + RBEI + IND + TCC - TCD - AMORT$	Disposable income
TCC	$TCC = TCC_0$ : exogenous	Current credit transfers as defined with the BOP module
TCD	$TCD = TCD_0$ : exogenous	Current debit transfers as defined in the BOP module
AMORT	$AMORT = Z * RBEI$	Amortization payments
Z		Amortisation share or the consumption of fixed capital

NOTATION	MODEL EQUATIONS	EXPLANATION OF VARIBALES
<u>Revenue of institutions</u>		
RM	$RM = \sum_{i=1}^n + \sum_k TRI_{k,i} + h_m * TCC - k_{p_m} * TCD$	Households' income
$TRI_{k,i}$	$TRI_{k,i} = TRI_{k,i}^0$ : exogenous	Transfers from other institutions (K=2, ..., n)
RG	$RG = RBO + RBP + RBA + H_g * TCC$	Government revenues
RBO	$RBO = ID + IND + DTI$	Ordinary budget receipts
ID	$ID = \sum TR_{k,6}$ : excluding petroleum	Direct taxes excluding the petroleum sector
DTI	$DTI = d_i * M$	Duties and taxes on imports
IND	$IND = \sum_{j=1}^n IND_j$ for all $j \neq p$	Total indirect taxes, except petroleum
RPB	$RPB = \sum_p TR_{p,6}$	Receipts from petroleum

$TR_{1,6}$	$TR_{4,6} = d_2 * Q_p + d_3 * (RBEI_p - AMORT_p)$ where $d_2 = 0.175$ $0.70 \leq d_3 \leq 0.75$	Transfers from the petroleum sector to the public government administration
RBA	$RBA = RBA_0$ : exogenous	Other receipts
$RE_j$	$RE_j = \sum TR_{kj} + d_4 * (RBEI_j - AMORT_j) + (1 - h_m - h_j) * TCC - (1 - k_{pm} - k_{pj}) * TCD$	Revenue of enterprise j $j \neq 1, 2, 5$
$TRI_{kj}$		Transfers from institution k to enterprises j

## 5. THE PUBLIC FINANCES MODULE

<u>Ordinary Budget</u>		
RG	$RG = RBO + RBA + kg + TCC$	Ordinary Budget revenues
DG	$DG = MS_{13} + CG + CONI + DS + TRI_{5,k} + kg + TCD$	Public expenditures from the ordinary budget
$MS_{13}$		Total bill of wages and salaries
CG		Government consumption of goods & services
CONI	$CONI = CONI_0$ : exogenous	Contribution of ordinary budget to investment budget
DS	$DS = DS_0$ : exogenous	Public debt service charges
$TRI_{5,k}$	$TRI_{5,k} = TRI_0$ : exogenous	Financial institutions to other institutions
RDS	$RDS \geq DS/X$	The public debt service ratio
kgTCD		Proportion of government debt transfers to abroad
DGAUT	$DGAUT_t = (1 - r_3) * DGAUT_{t-1}$	Other public expenditures
SBF	$SBF = RG - DG$	The ordinary Budget surplus or deficit
<u>Investment Budget</u>		
RBI	$RBI = CONI + BE + DON + TBEAC + RAUT$	Receipts of the investment Budget excluding external borrowing
CONI	$CONI = CONI_0$ : exogenous	Contribution of ordinary budget public
BE	$TBEAC_t = 0.2 * RG_{t-1}$	Equipments bonds
DON	$DON = DON_0$ : exogenous	Received grants or gifts

TBEAC	$TBEAC_t = 0.2 * RG_{t-1}$	Drawing from the Bank of Central African States
RAUT	$RAUT = RAUT_0$ : exogenous	Other revenues (taxes on fuels, on tourism, returns from the State's securities portfolio, etc.)
EMPEX TG	$INV G - RBI - SBF$	Government external borrowing
INV G		Public investment
SGBG	$SGBG = EMPEXTG$	The overall balance of the government budget

## 6. THE CAPITAL MODULE

NOTATION	MODEL EQUATIONS	EXPLANATION OF VARIABLES
<u>Savings</u>		
$S_1$	$S_1 = RM - TRI_{1j} - CM$	Savings of households and individual enterprises
$S_j$	$S_j = RE_j - \Sigma TR_{kj} \quad j \neq 1, 4, 6$	Savings of non-petroleum corporate and non-corporate companies
$S_4$	$S_4 = RPETR - TRI_{k4}$	Saving of petroleum companies
$S_6$	$S_6 = SBF$	Government savings
$S_j$	$S_j = RBEL_j + \Sigma TRI_{kj} - AMORT_j \quad j \neq 4, 6$	Overall total savings of households and non-petroleum industrial enterprises
<u>Investment</u>		
	See above on the demand module	
SOLM	$SOLM = INVM - S_1$	Capital resources balance of households and individual enterprises
SOLE <sub>j</sub>	$SOLE_j = INVE_j - S_j$	Capital reserve balance of non-petroleum corporate and non-corporate
SOLG	$SOLG = EMPEXTG - INV G - RBI - SBF$	Capital resources balance of government
SOLIP	$SOLIP = INVP - S_1 - S_j$	Capital resource balance of corporate and non-corporate companies outside the petroleum sector

7. THE BALANCE OF PAYMENT MODULE		
<b>XB</b>	$XB = XPETR + XBOIS + \sum XAUT_i$ $i \neq 3, 5, 9 \dots 13$	the value of exports of goods
<b>MB</b>	$MB = k_1 * (M - DTI - MARGI)$	The FoB value of imports of goods
<b>M</b>		The CIF value of imports of goods & services
$XS_i$	$XS_i = \sum X_i \quad i=9 \dots 13$	The value of exports of non-factor services
<b>MS</b>	$MS = M - MB$	The value of imports of non-factor services
<b>BCOM</b>	$BCOM = XB + XS - MB - MS$	The balance for the trade account
<b>TCC</b>	$TCC = TCC_0$ : exogenous	Current transfers (credit)
<b>TCD</b>	$TCD = TCD_0$ : exogenous	Current transfers (debit)
<b>TCN</b>	$TCN = TCC - TCD$	Net current transfers of factor services and grants
<b>BPC</b>	$BCOM + TCN$	Balance on the current account of balance of payments
$EMPEXT_{LT}$	$EMPEXT_{LT} = EMPEXT_{LT} + EMPEXT_{LT}$	Long-term borrowing (capital)
<b>EMPEXTG</b>	$EMPEXTG = INVG - RBI - SBF$	Government external borrowing
<b>EMPEXTP</b>	$EMPEXTP = SOLIP + SOLSP$	Private sector external borrowing
$EMPEXT_{CT}$	$EMPEXT_{CT} = EMPEXT_0$ : exogenous	Short-term capital
<b>BPCA</b>	$BPCA = EMPEXT_{LT} + EMPEXT_{CT}$	Capital account balance
<b>EOM</b>	$EOM_0$ : exogenous $EOM = 0$ during forecast periods	Errors and omissions
<b>SGBP</b>	$SGBP = BPC + BPCA + EOM$	Overall balance of payments

ANNEX II: MEDIUM/LONG-TERM PLANING MODEL FOR THE CONGO

NOTATION	MODEL EQUATIONS	EXPLANATION OF VARIABLES
<b>Supply Equations Agriculture</b>		
$PIB_{ct}$	$PIB_{ct} = \sum VA_i \quad i=1,2,\dots,5 \text{ sectors}$	GDP at factor costs
$VAG$	$VAG = VAG_1 + VAG_2 + VAG_3$	Value added of the agricultural sector
$VAG_1$	$\log VAG_1 = a_0 + a_1 \log TAC_1 + a_2 \log SUPAG_1$	Value added of agriculture (food & cash crops)
$TAG_{1t}$	$TAG_{1t} = (1+r_1)TAG_{10}$	Labour force in agriculture
$SUPAG_1$	$b_0 + b_1 INVAG_{10}$	Acreage under cultivation
$INVAG_1$	$INVAG_1 = C + INV \quad \text{or}$	Investment in agriculture
$SUPAG$	$SUPAG_{1t} = (1+r_2)SUPAG_{10}$	
$VAG_2$	$VAG_2 = (1+r_3)VAG_{20}$	Value added in fishery livestock & hunting with the growth rate $r_3$ retained in the five year plan as objective
$VAG_3$	$VAG_3 = 1/k_3 INVAG_3$	Value added in forestry based on the marginal efficiency of capital (ICOR), $k_3$
$INVAG_3$	$INVAG_3 = d*INV \quad \text{or}$	Investment in forestry
$VAG_3$	$VAG_{3t} = (1+r_4)VAG_{30}$	Based on the Plan's growth rate for the forestry sector, $r_4$
<b>Mining &amp; Petroleum</b>		
$VAMPET$	$VAMPET_t = (1+r_5)VAMPET_{10}$	Value added in the mining and petroleum sector obtained on the basis of growth rate $r_5$ retained in the five year plan
<b>Industry</b>		
$VAIND_t$	$VAIND_t = (1+r_6)VAIND_{10}$	Value added in industry based on the growth rate $r_6$ retained as objective of the five year plan
<b>Building &amp; public works</b>		
$VABTP$	$VABTP = c/k_4 INV$	Value added in building & public works based on direct programming of investment $ICOR = k_4$

NOTATION	MODEL EQUATIONS	EXPLANATION OF VARIABLES
<u>Services</u>		
VASERV <sub>t</sub>	$VASREV_t = (1+r_7)VASREV_{t0}$	Value added in services (transfer communications, commerce, other services) based on the growth rate retained in the plan $r_7$
<u>Conversion factors</u>		
IND	$IND = c * PIB_0$	Indirect taxes net of subsidies GDP at market prices
PIB <sub>pm</sub>	$PIB_{pm} = PIB_0 + IND$	GDP t market prices
<u>Demand Equations</u>		
C	$C = CG + CP$	Total consumption
CG	$CG_t = (1+r_8)CG_{t0}$	Consumption of public administration
CP	$CP_t = CP(1+r_{ch})^t * (1+r_N)^t$	Private consumption based on per capita consumption $r_{ch}$ growth rate times the population growth rate $r_N$
INV	$INV = k * PIB$	Total investment based on the economy's ICOR = k
XPETR	$XPETR = h * VAMPET * PPETR_0$	Exports of petroleum
PPETR <sub>0</sub>		Petroleum price at the base year
XBOIS	$XBOIS = g * VABOIS * PBOIS_0$	Exports of woods
PBOIS		Wood prices at base year
XAUT	$XAUT = (1+r_2)^t XAUT_{t0}$	Other exports
X	$X = XPETR + XBOIS + XAUT$	Total exports of goods & services
M	$M = C + INV + X - PIB_{pm}$	Total imports of goods & services
BC	$BC = X - M$	Trade balance (trade gap)
BF	$BF = INV - S$	Resources balance (saving gap)
S	$S = PIB_{pm} - C$	Savings