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A MACRO-MICRO FRAMEWORK FOR ANALYSIS OF THE IMPACT OF STRUCTURAL ADJUSTMENT ON THE POOR IN SUB-SAHARAN AFRICA

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PROLOGUE

This monograph represents an attempt to design a comprehensive empirical model linking the household with the macroeconomy, for the purpose of investigating the impact of stabilization and adjustment policies on the poor.

The subject has achieved prominence in recent years as many extensive reform programs were adopted in countries of Sub-Saharan Africa, and concern arose among policy makers about impact on the disadvantaged. Despite the urgency of reforms, however, and the need to be informed of potentially adverse impacts, no comprehensive empirical framework for analysis has as yet been suggested or utilized. The reasons are that given the complexity of the various links between the household and the macroeconomy, and especially those pertaining to dynamic adjustment, compromises must inevitably be made between detail of analysis, data availability and policy relevance. The monograph presents a model that has arisen out of a compromise, between these diverse objectives. The framework which hopefully can be applied to several country analyses, emphasizes the general structure of the model rather than country specific issues.

The idea for this monograph first arose in June 1987 during a workshop held at Cornell University under the auspices of the Cornell Nutritional Survey Program. That meeting brought together researchers working on adjustment at the macro level

and experts on the microeconomics of households. The ideas and inspirations from that meeting resulted in my undertaking the design of an empirical macro-micro framework in the course of 1988 under the auspices of the Cornell Food and Nutrition Policy Program (CFNPP) in the context of their economic policy analysis program for Africa. A first draft of the monograph was presented and discussed at meetings first in Arusha, Tanzania and then in Cornell both in December 1988. The extensive comments and suggestions received from participants in these meetings and particularly by the CFNPP staff subsequently in the first few months of 1989, led me to undertake a major revision in the course of the summer of 1989.

There are several people who have contributed in various ways towards the completion of this monograph. Per Pinstrup-Andersen must be credited for his early insistence that macro-micro links can indeed be modeled, and for his skill in organizing the workshop and subsequent project that supported this work. David Sahn has provided continuous support and stimulation throughout the project. I owe him a special acknowledgement. Several colleagues at the CFNPP have contributed with helpful comments and suggestions. While I can identify Harold Alderman, Eric Thorbecke, David Blandford, and Paul Dorosh, I am sure there are others whose suggestions have been passed to me anonymously. Apostolos Condos of the Food and Agriculture Organization of the United Nations was the first to stimulate my work on stabilization and structural adjustment programs as early as 1984, and has kept motivating a lot of my

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Needless to say, responsibility for the contents of the monograph resides solely with the author.

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EXECUTIVE SUMMARY

A MACRO-MICRO FRAMEWORK FOR ANALYSIS OF THE IMPACT OF STRUCTURAL ADJUSTMENT ON THE POOR IN SUB-SAHARAN AFRICA

The advent of Stabilization and Structural Adjustment Programs (SSAP's) in Sub-Saharan Africa (SSA) has given rise to many debates about their merits, effectiveness and more recently about their impact on the poor. Given the complexity of interactions at the micro, sectoral, and macro levels, it is nearly impossible to have intuition and make evaluations of impacts of policy changes without recourse for comparison, to states of the economy that would prevail under different alternative scenarios. These latter "counterfactual" pictures of the economy, however, can only be viewed with the help of descriptive empirical models.

The monograph presents an empirically implementable modeling methodology suitable for the analysis of the impact of macro and sectoral economic policies on households. While the methodology is general enough to be used for analysis of impacts on all types of households, it is particularly focused on the poorer types, namely those about which much recent concern has arisen.

The link between macro policies that are the objects of reform, and household level welfare necessarily passes through sectoral variables. This implies that the appropriate framework for analysis must exhibit sectoral specificity, as well as

simultaneous determination of micro and macro variables. Structural adjustment, furthermore, is an inherently medium term dynamic process of economic transformation, namely change of economic institutions and modes of behavior. These considerations imply that the appropriate framework for empirical analysis is a model of the recursive dynamic computable general equilibrium (CGE) variety.

While several models of this type with income distribution detail, have been estimated and applied in developed and developing countries, the one proposed here emphasizes and differs in three specific aspects that are deemed crucial in the context of SSA as well as for the analysis of SSAPs. First, it advocates a bottom-up approach to modeling, namely from the micro to the macro rather than vice versa. This is done so that those economic features that are characteristic of the poor are readily reflected in the upper level macro-modeling structure. Second, substantially more emphasis is placed on economic structure and behavior, rather than sectoral detail. This is done because on the one hand adjustment in various markets which determine model behavior, depend strongly on economic structure, and because structural features such as various types of duality are prevalent in SSA. This emphasis on structure implies that smaller models with the appropriate features can be as useful as larger more data intensive ones.

The third distinctive feature of the methodology is its emphasis on "stock-flow consistency". At any moment in time an economy is characterized by the state of its stock variables

such as amounts of physical and human capital, physical resources and financial assets. Changes in these stocks, within a time period are reflected in the familiar flow identities of national accounts, or in more detail in a Social Accounting Matrix (SAM). To depict dynamic changes, modeling of stock variables as well as their changes is necessary. Flow equilibrium within a period determines the stock changes that update the stocks for the next period in a recursive manner. The implications of this approach are that the economy is represented on the flow side by a SAM, while on the stock side by asset liability balance sheets for the major institutions. The stock flow consistent conceptual framework at both micro and macro levels, is shown to be quite helpful in the organization of micro-level household survey data, as well as macro information.

A review of the salient features of CGE models reveals that they have many capabilities that are desirable from the viewpoint of macro-micro interactions, such as product and factor substitution, factor mobility, market structure, possibiilty for incorporating money and other assets, as well as dynamics. While CGE models are the most comprehensive empirical tool currently available for medium term macro policy analysis, they nevertheless have limitations which reflect the very limitations of economic science. The so-called closure rule debate is examined and shown to involve none else but fundamental disagreements among economists of different persuasions regarding the way economies work. These

disagreements do not subtract from the value and potential of CGE models, but rather point out that special care should be taken in specifying model structure and modes of market adjustment.

The specification of the within-period or "static" part of the model starts with an outline of the types of households and stock variables that ought to be considered. These are in essence what determines the state of the economy. Macro flow constraints are then discussed. These delineate the overall macro "boundaries" within which the model must operate. A subsequent discussion of activities suggests about ten types of activities that should be considered as a "minimum" for a realistic model in the context of SSA. The discussion of production shows how a given activity column within a SAM can be split into a modern or formal part and an informal unincorporated part, the basic reasoning being that the technology of production for the similar products of the activity is different in the formal and informal sectors. Production in a given activity depends, apart from intermediate inputs and primary factors, on productivity enhancing availability of public infrastructure and capital.

Labor demanded by a given activity is postulated to be a mixture of labor of different skills. Availability of labor of a given skill is fixed within the period, and apart from self-employment, determines labor supply. Within certain skill classes labor markets operate more like fix-price markets, namely with fixed wages and potential unemployment. Within

other skill classes, the labor markets clear with endogenous nominal wages. Fixity of sectoral capital as well as the number of self-employed in the short-run, provides a mechanism for generating profits, which along with labor returns constitute value added.

The value added generated at the production block is distributed to various household types according to their ownership of the various types of capital as well as labor skills. Self-employed labor is treated like capital receiving part of the generated profits. Assuming appropriate distributions for wages and profits can generate the distribution of income among households within a given household class, and hence the number of absolutely poor households.

Private consumption is postulated to follow a permanent income type of specification, with allocation of consumption expenditures among different commodities, following standard expenditure systems. Government consumption is viewed as intermediate input to the production of a "public good", the output of which, namely the total demand for public services, is bought by private consumers as well as by the government itself. Demand for exports, as well as demand for competitive imports are treated in a conventional differentiated product mode.

One of the key components of the model is the determination of investment and the financing of capital expenditures. The desired sectoral capital stocks are first determined as

functions of realized profit rates, as well as the costs of capital and labor. These, when compared to existing capital, determine desired investment, to which desired stock changes are added. The cost of these investments as well as the cost of working capital determine the financing requirements of firms. The sources of finance are both internal to the firm through retained earnings or external through loans from households and banks.

Portfolio decisions of households are analyzed in order to determine the availability of funds to firms, as well as the portion of household savings out of full income devoted to human capital formation and other types of asset formation. Aggregation across household types yields the total availability of household funds for various types of firms and activities. The availability of commercial bank loans, is a function of the domestic money creation mechanism which, of course, depends on the domestic public deficit.

Once the various sources of finance are determined, firms are postulated to realize or not their investment plans according to whether their internal savings plus external finance is greater or not than their financing requirements. Firms that exhibit excess supply of funds realize all their desired investments, while those with excess demand for funds are rationed, and realize only a fraction of their desired investment. In this fashion the model combines the forced savings Keynesian type of investment behavior with the more classical savings driven investment determination.

The dynamic part of the model basically updates all stock variables as a function of the equilibrium flow variables of the one period model. It also updates all variables which are held nominally fixed within a period. Labor skill availabilities are updated as a function of education and training. Household numbers in the various classes are then determined by reference to the skill composition of households. Households determine the proportion of their labor that will be self-employed on the basis of past returns to self-employment. Sectoral capital stocks are updated in a standard way by reference to realized sectoral investments. New ownership of sector capital stocks by different household types is determined as a function of each household's contribution of investible funds, and each sector's use of such funds. Financial asset variables are updated trivially by reference to the changes in the various types of assets, which are determined endogenously in the static equilibrium part of the model.

Apart from the basic model structure, summarized above, the monograph outlines several extensions that are deemed particularly relevant for SSA. Given the importance of the agricultural sector in SSA, and the frequent need for product specific detail within an overall macro system, it is shown how product disaggregation can be done only by splitting the rows of a SAM for a given aggregate agriculture subsector, following supply-utilization accounts, without having to generate the same number of respective SAM columns. Then it is shown how to

empirically model import rationing and the subsequent emergence of parallel foreign markets for goods and foreign exchange. This aspect is particularly relevant for SSA where such markets are not only prevalent, but among the chief objects of reform. Finally, the model is extended to incorporate the simultaneous existence of official marketing parastatals and free domestic markets. This structural aspect is particularly relevant in Africa in the context of staple food marketing and again is the object of reforms.

In a final chapter, a schematic and very simplified two sector model, that incorporates several of the structural features of the overall suggested model, is analyzed in order to gain some intuition about the properties of the overall model. It is shown there that SSAPs present the adopting governments with painful short-run dilemmas, among which the choice is not always clear, and the danger of adverse unintented short and medium term impacts quite severe. It is for this reason that ultimately the use of empirical planning models of the type suggested in the monograph are necessary and useful.

1. INTRODUCTION

The purpose of this monograph is to present an empirically implementable framework for analyzing the short and medium term impact of stabilization and structural adjustment programs (SSAP) on the poor segments of the population in Sub-Saharan Africa (SSA). Almost all countries in SSA have adopted SSAPs in recent years, either willingly or more frequently at the recommendation of the International Financial Institutions (IFIs), namely the International Monetary Fund (IMF) and the World Bank (WB). The adoption of these programs has been inevitable given the substantial internal and external imbalances of most SSA countries that developed during the decade of 1970-80 and reached crisis proportions in many countries in the early eighties. The origins of the crises in turn and the similarity of responses of many SSA countries, are probably not unrelated to the post-independence pattern of political economic structures that were crucial for the path of African development. The largely western ideals of growth through industrialization, the formation of an urban based middle class, the principle of agricultural taxation in order to generate surplus for growth, and in many countries beliefs in socialism and state intervention, were very influential in shaping African institutions and policies during the post-independence period. It is largely these institutions and policies that have been held accountable for the growing crisis in Africa in response to external shocks, and that have been

the object of reforms under the SSAPs (World Bank (1981, 1984)). Given the political alliances behind the policies, and the power of the classes that benefitted in one way or another from the functioning of the various institutions it is not surprising that the adoption of SSAPs has been controversial in all countries, and that their implementation in many cases has been strongly resisted. The issues of the origins of the crises and the SSAPs, as well as resistance or not to implementation, however, will not concern the discussion to follow. While important in understanding the functioning of the economic system in any country, and in explaining the past pattern of growth, these political economic features have to be considered as exogenous in a largely empirical economic analysis.

The basic objective of stabilization policies is to achieve sustainable reductions in the current account of the balance of payments and the fiscal deficit, as well as the inflation rates. Structural adjustment in turn refers to reforms of policies and institutions, microeconomic (such as taxes), macro-economic (such as fiscal measures) and institutional (public sector reforms), (World Bank (1988)). Stabilization policies are supposed to operate in the short run (one-two years), while structural adjustment policies are designed to be effective in the medium run (typically three-five years).

While the necessity of some sort of SSAP for most countries in SSA has not been much in doubt, given the seriously deteriorating internal and external conditions during

the seventies and early eighties, the particular nature of the programs that were implemented quickly raised the concern of both recipient governments as well as external donors about the possible adverse consequences for certain and in many cases already disadvantaged groups. UNICEF (see Cornia et.al (1987)), IMF (see IMF (1986) and Heller et.al 1988)), and the World Bank (see Huang and Nicholas (1987)) have all recognized the possibility and importance of these adverse impacts. However, very little of empirical importance has as yet been done to assess in a meaningful fashion the magnitude and the type of the relevant impacts. The consequence is that many of the recent country specific programs designed to mitigate the social costs of adjustment, resemble more traditional poverty alleviation programs rather than ones designed to facilitate a transition of the poor to a new more sustainable economic level without the adverse consequences of the alleged shocks induced by SSAPs.

In a general sense adjustment entails the realignment of domestic demand with available resources, and changing supply and the production structure so as to eliminate the external deficit. Since demand can be curtailed more easily and faster, through for instance changes in public expenditures and money supply, it tends to be the focus of the first attempts at correcting disequilibria. Hence the association of short-run stabilization efforts with demand reductions. Changes on the supply side, however, are more difficult and slower to implement and hence tend to be associated with medium-run

structural adjustment efforts.

As the elimination of the external disequilibrium is the primary focus of adjustment, trade policies figure prominently in all adjustment programs. Apart from these there are two other general classes of policies that are usually instituted. These come under the headings "resource mobilization", and "efficiency of resource use".

Trade policies usually comprise two sets of measures, one aimed at export promotion, the other at import liberalization. Under export promotion, which is one of the major objectives of SAPs, come;

a) Financial incentives such as: exchange rate reforms, reduction of export duties or taxes, relaxation of export quotas or regulations, introduction of export subsidies and other financial incentives, improvement of credit arrangements for exporters, allowance of duty free imports for exporters.

b) Institutional reforms such as: the establishment or enhancement of export development funds and/or export promotion agencies, and the establishment of free trade or export processing zones.

Import liberalization policies usually comprise removal of quotas or licensing restrictions, rationalization of tariffs and protection, and changes in import regulations and procedures.

Domestic resource mobilization usually comprises three classes of measures under the general headings "fiscal

policies", "Monetary and credit policies", and "external borrowing policies". Fiscal policies are divided among revenue and expenditure policies. Revenue policies include revenue targets, improvement of tax collection and compliance, general tax increases, shifts to ad-valorem from specific taxes, indexing specific taxes, and tax incentives for businesses. Expenditure policies include specific expenditure targets, rationalization of public investments, current expenditure cuts and in particular subsidy reductions and wage/hiring reductions in the public sector, limits on transfers to public enterprises, and improved monitoring and control of public expenditures.

Monetary and credit policies comprise limits in public sector and private sector credit, decontrol or higher ceilings on interest rates and specific deficit targets. Policies with respect to external borrowing usually include limits on new foreign borrowing and improved monitoring or control.

Policies related to greater efficiency of resource use come under the general headings "public investment", "pricing", and "institutional reforms". Public investment policies usually concern improved rules for project choice such as payback or benefit-cost ratios, more detailed preparation of investment plans, and privatization. Pricing policies involve changes in agricultural producer and consumer prices, changes in input prices, raises in controlled industrial good prices, changes in energy prices, increases in prices charged by state enterprises, and decontrol of consumer prices. Finally under

institutional reform come policies aimed at restructuring or privatization of public sector enterprises, reductions of rules and regulations, changes in agricultural institutions such as marketing boards and extension services, and various studies aimed at improving performance.

Many of these policies are common to IMF and World Bank sponsored programs. The specific measures prescribed under each type of policy differ from country to country, and every program does not include all of the above measures.

Adjustment programs in many countries have become the source of considerable internal controversy. The reason is that they provide a visible and easily identifiable scapegoat upon which to blame all ills that befall the economy. On the other hand advocates of reforms tend to overstate their case by pointing at any good outcomes as due to the program. This situation brings out the importance of counterfactual analysis, namely, investigation comparing the actual path of the economy, to other trends that would have taken place under different policies. It is only through this type of analysis that rational discussion about the impacts of adjustment can take place. The importance of conducting empirical counterfactual analysis in turn, highlights the necessity of constructing empirical simulation, models that can capture the major links between policy variables and the welfare of individuals and in particular the poor households. It is to the design of such an empirical simulation model that this monograph is devoted.

There are several difficulties inherent in designing an

empirical framework to analyze the impact of SSAP and the types of macro policies on the poor in SSA. First since the objectives of most reform programs are monitored and designed at the macro or sectoral level, the model must be able to clearly describe the interconnections between welfare indicators of the poor and those macro variables. Second, since reforms have impacts that affect several sectors which are interrelated, a partial equilibrium framework that keeps exogenous key macro variables, is not appropriate. Third, and perhaps most difficult, since adjustment programs are designed to affect the economy in the medium run, a dynamic framework is necessary. While economists disagree about the nature and size of micro-macro links, as well as the dynamic effects of economic policies, one cannot escape the fact that the modeling of simultaneous static and dynamic interaction of several effects is a necessary albeit imperfect must in the investigation of policy reforms.

The study of impacts of policies on growth and income distribution is, of course, not a new subject, and during the last decade there have been several theoretical and empirical studies applied to various countries. This study will build upon these earlier methodological frameworks and extend them where necessary. Despite the apparent interest, however, in poverty and growth in SSA, not much empirical analysis at the macro-micro nexus has been undertaken. One of the major reasons has been the absence of detailed statistics for many countries in SSA, since the general deterioration of the economic

environment in many cases also led to a neglect of statistical gathering and analysis capabilities.

There are three general features of the proposed framework that distinguishes it from many previous attempts at empirical modeling of macro-micro interactions. First, since the objective is to understand the behavior and economic well being of the poor as they change under adjustment, primary emphasis is placed on a bottom-up approach to modeling. In other words, modeling of linkages, dynamic processes, etc., will be done starting from the behavior of micro-units. This approach is necessary in the context of SSA since micro survey information is more readily available, and also makes sense if one is to focus on the poor. Second, the methodology outlined in the sequel places strong emphasis on economic structure. Much of the theoretical and applied literature on adjustment, is based on a structure-free model of a "typical economy". Since, however, structural change is one of the main objects of reform, it cannot be neglected. Furthermore, different structural features in an economic system often dictate its behavior. Finally, the structure of many SSA economies in many ways is quite distinct from that of other developing countries, necessitating a structural perspective.

The final distinct feature of the methodology proposed here is its attempt to provide a stock-flow consistent view of the economy. Most sectoral, multisectoral, or econometric models are flow consistent only, meaning that they provide a complete accounting of economic flows within a given time

period. However, the necessity of examining dynamic adjustment in the medium run, necessitates an explicit recognition and incorporation of stock variables such as capital (human as well as non-human), money, etc.

The discussion will proceed in stages. In Chapter 2 a discussion of adjustment and the poor in previous modeling exercises is given and the special characteristics of poor in SSA are brought forth. Chapter 3 outlines the advantages of computable general equilibrium models in examining adjustment. Chapter 4 presents the general structure of the flow consistent equilibrium part of the model. In Chapter 5 the dynamic updating in the context of stock consistency is discussed. Chapter 6 presents some extensions of the model to capture special features relevant to SSA. Chapter 7 gives an analytical presentation of a two-sector stripped down version of the model, in order to highlight some of the general properties. Finally Chapter 8 summarizes the analysis and stresses the special features of the proposed model.

2. THE POOR IN THE CONTEXT OF ADJUSTMENT

The purpose of this chapter is to outline the nature and typology of poverty that is prevalent in SSA, and to indicate the types of linkages with the rest of the economy as well as the key variables that must be modeled in the empirical framework. In most previous empirical studies of income distribution in a macroeconomic context, poverty was the end result of a process by which all major macro and sectoral variables were modeled first, and then incomes of various groups including those of the poor, were derived. This essentially top-down approach to poverty neglects several aspects that are crucial in the context of adjustment. The approach to investigating the impact of macroeconomic adjustment on the poor advocated here, reverses this logic by starting with an analysis of poverty at the household level in order to uncover those aspects nd activities that are likely to be influenced by adjustment and other types of macroeconomic policies. It is those variables that will be included in the proposed framework, and it is the above logic that dictates a chapter on the characterization of the poor before the outline of the empirical model.

It must be noted that the object of inquiry is not income distribution or relative poverty, but rather absolute poverty. In other words what is of concern is first whether the numbers of the poor increase or not during a phase of structural change in the economy, and second whether the welfare of those already

below the poverty line become better or worse. In other words the concern is not with income or welfare inequality. This is the approach also suggested by Scobie (1989).

In section 2.1 a review of how the poor have been analyzed in previous empirical macro contexts is given. Section 2.2 highlights some of the features of poverty that seem prevalent in the context of SSA and are likely to be influenced by macro policies. Section 2.3 gives a conceptual presentation of the profile of the poor as it should be modeled and section 2.4 discusses the measurement of welfare and poverty levels.

2.1. The Poor in Previous Models of Adjustment

The major emphasis in previous empirical work on macroeconomic adjustment and the poor in developing countries has been on income distribution and not on absolute real incomes of a given class. Starting with the pioneering work of Adelman and Robinson (1978) and Taylor et.al (1980) who used computable general equilibrium (CGE) models to investigate the distributional impact of alternative adjustment and development policies, there has been a series of such models, e.g., deMelo (1982) for Sri-Lanka, Ahluwalia and Lysy (1979) for Malaysia, deMelo and Robinson (1980) for Colombia, Bourgignon et.al (1983) for Venezuela, Eckaus and Mohie-Eldin (1984) for Egypt, etc. (for a review see Devarajan et.al (1986)). Dervis, deMelo and Robinson (1982) give a complete account on how to construct and implement such models while Addison and Demery (1985) present a thorough review of what is currently known about

stabilization and income distribution.

The way in which income distribution is modeled in all of these models is basically the same. Starting from a representation of an economy given by a Social Accounting Matrix (SAM), the value added created in the process of production by each sector is apportioned to accrue to various classes or groups. For instance value added in a given agricultural sector (say rice) could be modeled to accrue to owner operators (of different size classes), to labor (again by skill or class categories), and to owners of capital (such as for instance large commercial farmers). This breakdown can be made very refined. For instance, in the Adelman-Robinson (AR) model of Korea there are 15 functional income groups while in the Lysy-Taylor (LT) model of Brazil there are 8 such functional groups. The possibilities are obviously limited by the availability of data.

The empirical model is usually built so as to provide a way to determine the incomes of these various functional groups. The size distribution of income is subsequently built by making some assumption about the size distribution within each functional group. Since the real income of any particular group depends on nominal flows of current income as well as the prices and amounts of goods that they consume, it is clear that in order to assess the evolution of the welfare of any class, a framework is needed that determines incomes as well as the relevant prices of a multitude of commodities.

The only currently known way to do this empirically is

with empirical multisectoral CGE models. Most of these models, however, provide a static flow profile of poverty. In other words they give an account of incomes of various classes including the poor within a consistent one period framework. Simulations then are of the comparative statics type, that illustrate changes in these essentially flow variables under different policy experiments. The interesting things, however, from an adjustment perspective are not only the short or medium run changes in the flows of income. They involve changes in the various stock variables such as numbers of people below poverty, changes in human and physical capital ownership, etc. These essentially dynamic processes have not been incorporated in most empirical models. Notable exceptions are the models of Adelman and Robinson (1978), for South Korea and the model of Kuwenaar (1988) for Equador. These models include dynamics of household formation and asset accumulation, and they are more firmly based on micro household level information than any of the other CGEs. It is the ideas of these two models, appropriately modified and extended to reflect the social and economic context of SSA, that will provide the background on which the methodology proposed here is built.

2.2. Structural Features of the Poor in a Sub-Sahara African Context

In this section the inquiry focuses upon some structural elements of the poor in SSA that are important from an adjustment viewpoint and must be built in an empirical

framework. It is quite difficult to generalize across all of SSA but the evidence to date points to certain features that the poor are characterized by in all of SSA.

It must be emphasized at the outset that the characteristics one is interested in from the adjustment perspective are functional ones. In other words one is not interested so much whether the poor are of this or that tribe (albeit this in some cases might explain the origins of poverty), or their religious beliefs. Instead one is mostly interested in things such as their occupational characteristics, their sources of income, their patterns of expenditure, the types of product and factor markets in which they operate, the types of access to public goods, their financial and asset structure, etc.

The single most widespread characteristic of the poor in SSA appears to be that they are concentrated in rural areas and have agriculture as their main occupation, chiefly as owner cultivators. In their study of the Ivory Coast, Glewwe and deTray (1988) revealed that about 92 percent of the poorest 10 percent of the population, and about 88 percent of the poorest 30 percent of the population have agriculture as their main occupation. Of the poorest 30 percent of the population, over 95 percent were self employed, supporting the view above that most of the rural poor are small owner operators.

That rural poverty is widespread in SSA is not news to those that have had some experience there. For instance a recent International Fund for Agricultural Development Report

(IFAD (1988)) estimated that in Ghana in 1986 about 67 percent of rural smallholder households had total income below what was estimated as basic needs income (BNI). In some predominantly rural areas this proportion was as high as 97 percent.

The conclusion certainly is that agriculture has to be given special attention in the analysis of adjustment. However, agriculture and the rural poor have been only marginally mentioned in recent analyses of the social costs of adjustment (Huang and Nicholas (1987), Heller et.al (1988). The reason is basically that most of those analyses take the top-down approach. They start by examining programs and specific measures and then ask in a general way the possible impact of reforms. The bottom-up approach advocated here, the functional identification of the poor as a first step will help center the debate on the impact of adjustment on only those aspects that are important from the perspective of the poor.

The second feature that appears to be important in SSA is that the majority of the poor in urban SSA, appear to be either self-employed or employed by private employers. In terms of occupation, the majority of the urban poor appear to be in sales or service jobs, albeit a significant amount is still agricultural (could be those residing in urban areas but employed in agriculture).

A final very interesting feature apparent from detailed household surveys such as those of the Ivory Coast (Glewwe (1987), Glewwe and deTray (1988), but most likely true elsewhere in SSA, is that the proportion of people that declare

no occupation or unemployed is nearly zero. Apparently then the bulk of the poor appear to be either in agriculture, as small owner operators or as agricultural workers, or in low level urban occupations (informal sales, or service activities). Focusing on these groups will most probably capture the overwhelming majority of the poor in SSA. There probably is substantial flux between rural small holders and urban low level labor. Also the fact that unemployment does not appear to be very high could be explained by the hypothesis that people that become unemployed in the higher echelons of the labor market (construction, industrial, etc.) join the lower level labor market.

The next set of characteristics that is important in SSA is the extent of participation of the poor in informal parallel product markets both as sellers (especially in the agricultural sector) and as buyers (of both inputs of production as well as consumer goods). A widespread feature in most SSA countries is the pervasive presence of parastatals in the markets of important agricultural products, as well as in the sale of staple foods. Also the widespread influence of the government agencies in providing agricultural inputs as well as urban and rural credit, is well known. However, it has become increasingly known that there is a large asymmetry in the participation of rural and urban poor in the functions of these institutions (see for instance Bates (1981)), with the poor conducting most of their functions outside this formal system. This feature suggests that it is important to model the

interaction between these formal and informal markets, as changes in the former, which are almost always a part of SSAPs, will influence the latter and hence those who participate in them. Parallel markets have not been formally incorporated in any empirical macro-sectoral model (for an exception in a sectoral context see Singh et.al (1985)) and this is an example of why the top-down approach is not appropriate for analyzing poverty under adjustment in an African contest.

Finally, but certainly not least, one must deal with the issue of credit and money markets and especially the interaction between formal and informal ones. A very crucial aspect of this is the parallel market for foreign exchange. Since one of the major objectives of SSAPs is to unify the formal and informal credit and foreign exchange markets, one cannot assume these issues away. Of course the problem remains as to how to meaningfully incorporate all this in an empirical model, but one cannot avoid it since it is well known that informal credit markets are pervasive in SSA and especially among the poor and that parallel foreign exchange markets are also quite active and give important signals for policy.

The brief review of characteristics of the poor in SSA above reveals that the interactions are many and complex. Nevertheless, it ought to convince the reader that the important issue from a welfare and adjustment perspective is how do individuals or households interact with the rest of the economy. Hence the basic focus ought to be the micro units in the economy, and it is to this that the discussion now turns.

2.3. A Schematic Conceptual Model of the Household

In this section a schematic discussion is presented of the determinants of household behavior and welfare with the purpose to identify the key processes and variables that ought to be modeled empirically. The ultimate objective, of course, is to be able to analyze individuals' welfare and hence one might question whether the individual rather than the household ought to be the focus of the inquiry. Since the focus of the methdology is more on interactions between macro and micro variables, rather than between micro variables themselves, the key micro unit on which analysis will be based is the household. This implies that issues of intrahousehold allocation for goods and tasks, gender and age specific task specialization and nutrition, etc., will not be emphasized. The household is a complex socio-economic nuclear unit whose internal dynamics are not yet clearly understood (see Singh et.al (1986)). Furthermore, the data necessary to analyze intrahousehold issues is quite extensive (see Grootaert (1982)) and difficult and expensive to collect. Nevertheless, whether poverty can best be measured by he individual or household level is a debatable issue (Kanbur (1987)).

Figure 2.1 presents a schematic model of the determinants of household welfare in a time sequence. In the beginning of a given period a household starts with a given stock of physical and financial assets. These are both productive such as labor, human capital of labor and physical capital, as well as non-productive such as financial assets (money, equity, stocks,

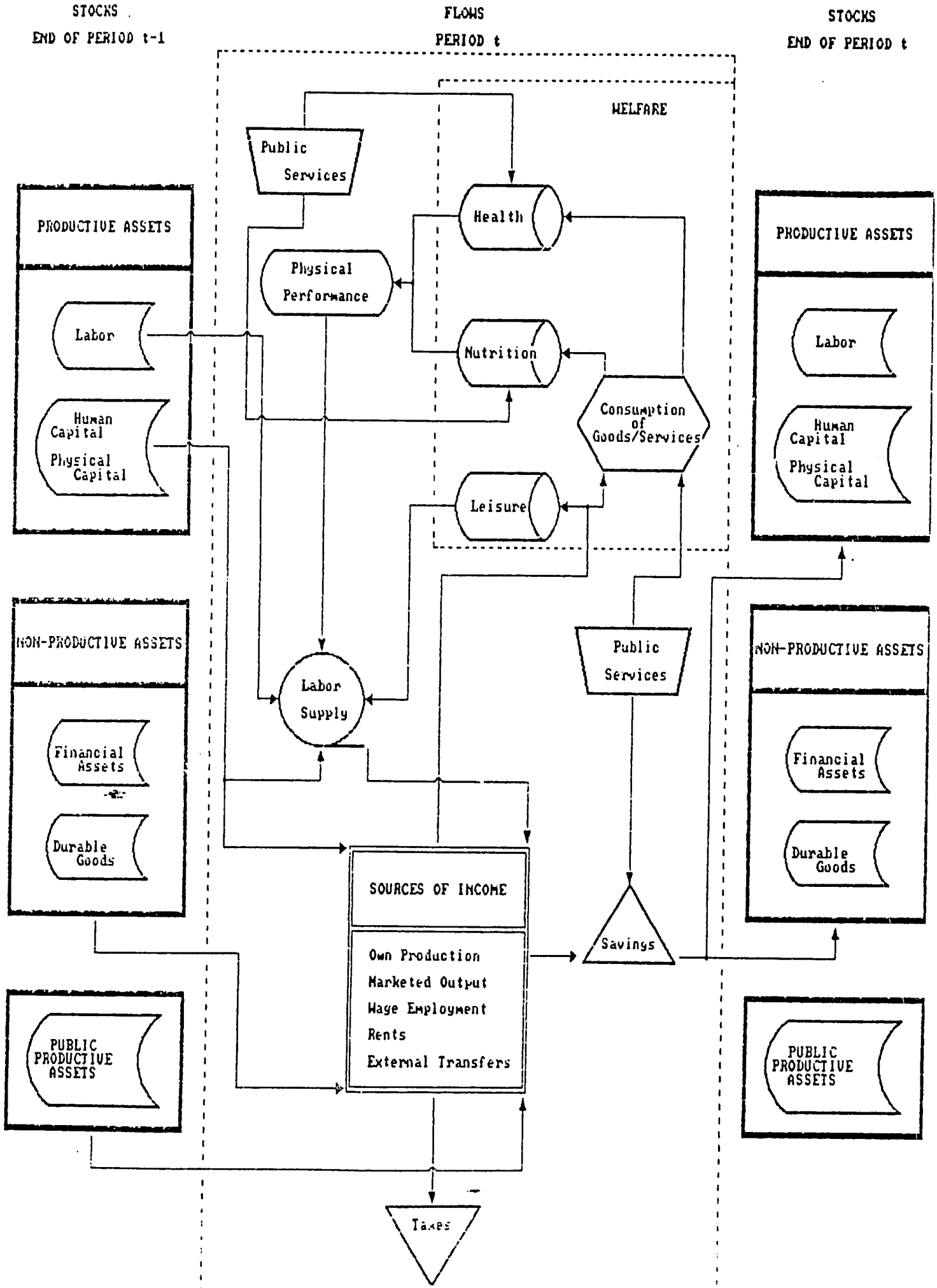

FIGURE 2.1 : The Determinants of Household Welfare

etc.) and durable non-productive goods (houses, cars, jewels, etc.). These assets are used to produce income within period t, with productivity dependent on the stock of public assets (roads, communications, irrigation, etc.). The income generated from the productive behavior of the household is split between savings, consumption, and taxes. Savings (including savings of household labor) are used to augment the household assets. Consumption expenditures are allocated among purchases of goods and services. Consumption of goods and services, supplemented by publicly provided services, determine health and nutrition, which in turn determine physical performance and labor supply.

From a household perspective welfare depends on the consumption of various goods and services, the state of health and nutrition and leisure. An ideal empirical framework would quantify all the elements of household behavior and welfare and would derive an index of welfare based on a concept of "full income", namely income derived from all productive assets including imputed income from leisure and a concept of utility derived from non-income generating states such as health. Such an approach, albeit desirable, will most likely not be feasible in practice because of the difficulty of modeling many of the household specific links, such as for instance the feedback from nutrition and health to physical performance and labor supply, and the inability to derive empirical welfare indicators based on full income concepts.

A more practical approach, and the one adopted here, is to neglect the feedback link from consumption to health and

nutrition, and then labor supply, and concentrate instead only on consumption as the main indicator of household welfare. This has the advantage that consumption can be derived from income, prices, and stocks of assets, all variables that can be endogenized in a macro-micro model. Furthermore, indicators of welfare based on consumption have a firm grounding in theory and can be easily computed from well accepted empirical systems of consumer behavior (see Deaton (1980)). While the feedback from current welfare to current productive activities are neglected and hence are not endogenized, nevertheless, a supplementary module that derives these indicators on the basis of endogenously generated flow variables, such as consumption of various types of items, public health expenditures, etc., is possible. In fact one could envision that a model of intrahousehold decisions could be separately constructed that accepts as exogenous, variables that are generated endogenously in a "higher level" model, and produces as outputs various state micro-indicators of welfare of different types of household members. This is something that will not be done here, but is suggested as an extension of the methodology outlined in the sequel.

Notice that the conceptual schema presented above is not restricted to poor households only, but is general. What differentiates the poor from the better-off households is both the pattern of asset ownership as well as the economic institutions and structures within which the variables that define current "flows" are determined.

2.4. Links Between Households and the Rest of the Economy

From the discussion of the previous section it becomes clear that the key determinants of household welfare are the processes determining incomes, consumption and savings of households. These in turn are determined by assets or stocks of resources owned by households; the technological processes by which productive assets produce commodities and in the process generate income, by prices of goods and factors of production, and by institutions that directly or indirectly affect the flows of income and commodities. Macroeconomic policies are the responses of one institution, the public sector, to internal and external stimuli and shocks. Hence to adequately model the impact of these policies on the poor households one needs a framework that includes the distribution of assets, the determination of prices, incomes and consumption, and the behavior of institutions.

Figure 2.2 indicates in a schematic form the key links between these classes of variables. The key actors in the system, namely, those that make the economic decisions are the institutions, namely households, enterprises and the government. Of course enterprises and the government are ultimately owned or managed by members of households. However, the structure of ownership of enterprise assets (and hence the power for decision making), or the power structure within a government, are usually quite different than those of the households. In fact one of the objectives of the field of political economy is to relate the functioning of these

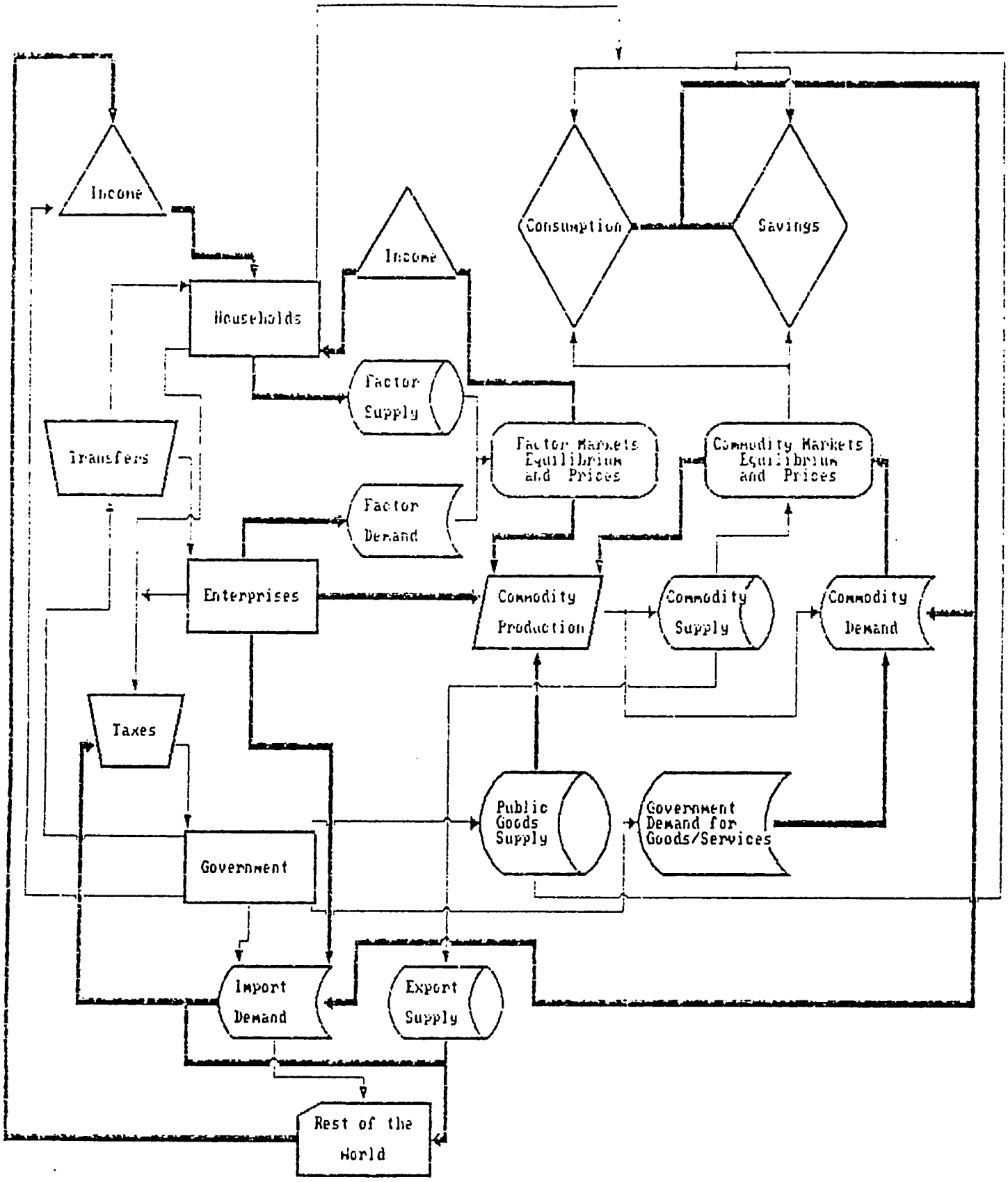

FIGURE 2.2 : The Household and the Macroeconomy

institutions to the functioning of households. This is something that for the framework presented here will be kept exogenous and constant. In other words the behavior of enterprises and the government will not be related in any way to the behavior of households albeit, of course, the consequences of government and enterprise behavior on households will be modeled.

As indicated earlier, households make decisions about factor supply in response to economic signals. Enterprises demand factors in order to produce goods and services. The functioning of the factor markets determine quantities and prices of factors utilized and hence the income flows to their owners, the households. The decisions about factor demand and commodity supply are made by enterprises. The domestic supply of commodities is used in both the domestic economy and for exports. The demand for goods and services comes from households, via their consumption and savings decisions, the government, and the enterprises as intermediate inputs to production. The functioning of the commodity markets determines domestic prices and quantities of commodities which feedback into the consumption decisions of the various institutions, as well as the production decisions of enterprises.

The government is a key actor in the system raising revenues through taxes, providing income through transfers and employment, supplying goods and especially services, and also demanding goods and services. The government has an important redistributive role in addition to its role as provider of

services and public goods.

The rest of the world will be assured passive and exogenous. It demands exports, and supplies imports. Furthermore, it supplies private and public transfers in terms of foreign exchange.

The relationships indicated in Figure 2.2 exclude two key aspects of the economy. One is the flow of funds and capital accounts of the economy. Savings take many forms, and are channeled to various types of investments via public and private intermediating institutions such as banks, money lenders, informal credit associations, etc. These links are quite important because they determine the availability of funds that finance investment expenditures by both enterprises, government and households. Hence they are key determinants of the growth pattern of the economy. The second excluded link in the figure is the one that determines the updating of stock variables such as population and labor force, capital stocks and distribution, etc. This is again a crucial link in the dynamic evolution of the economy. Both of these links are included in the framework and a separate discussion of them will be presented later.

The illustration in Figure 2.2 indicates that it is not possible to determine the impact of macro variables on the poor households unless one models all the parts of the system that influence the variables that link poor households to the economy. From Figure 2.1 it was seen that the household economy links consist of the prices for goods and services, the prices

of factors supplied by households, and the structure of taxes, transfers and public services. However, to endogenize for instance prices of goods, one must model all the supply demand components in the good markets. This in turn from Figure 2.2 implies that one must analyze the behavior of non-poor households because they also demand goods, as well as the behavior of firms and government. It is clear therefore, that one has to examine the functioning of the whole economy and not only the environment surrounding the poor. Furthermore, the framework chosen must be able to disaggregate household types, other institutions and provide commodity and factor market detail. The only class of empirical models currently known to be able to include such comprehensive links are the SAM based Computable General Equilibrium (CGE) models as already mentioned, and it is the above reasoning that dictates their choice.

2.5. Profile of Poverty in the Context of Adjustment

From the above discussion it must have become clear that the description of the poor or other households that is appropriate in order to trace the impact of macro policies on their welfare, is a functional one. In other words and based on the illustration of Figure 2.1 the households and especially the poorest must be described by the structure of their income and consumption, the structure of their assets, and the structure of their access to various publicly provided services.

The experience accumulated at the World Bank within the Living Standards Measurement Study (LSMS) has been quite helpful in identifying data needs, developing and adapting questionnaires and performing household surveys related to living standards and welfare (see e.g. Glewwe (1987) and Glewwe and deTray (1988)). Much of the data analyzed by each massive survey albeit very illustrative, is not designed to be used in macro-micro analyses. Nevertheless, it provides a lot of background information for constructing models such as the one proposed here.

Table 2.1 provides a checklist of information that is necessary for describing the linkages of households with the rest of the economy, within the schematic framework of Figure 2.1. It is information that could be collected via a survey. The types of variables that are needed are tabulated so as to conform to the stock-flow approach described earlier. Stock variables include demographic data, human capital data, productive and non-productive capital, and financial assets. Of these the most difficult ones to obtain are likely to be information on financial assets. The flow variables are the ones usually available from household expenditure and from management surveys. Data on asset changes are not normally collected, while they form an important part of flow information. Notice that education is considered as increasing human capital and is therefore classified as a flow variable that amounts to a stock change namely the change in the stock of household human capital. If exact prices for the household

Table 2.1

Information Needed at Household Level for Analysis of Impact of Adjustment

1. Stock Variables

i) Household demographic variables (size, composition, age, sex, working members, etc.)

ii) Human capital variables (education of household members, work experience, skills, etc.)

iii) Productive capital variables (ownership of agricultural land, perennial trees, tools, implements, work animals, storage bins, etc. for farm activities, ownership of machinery, shops, trucks, etc., for non-farm activities).

iv) Non productive capital variables (ownership of housing, radio-TV, bicycles, automobiles, jewels, etc.). Some of these can be considered as consumer durables, and be treated as part of the flow of consumption.

v) Financial stock variables (amount of credit received or given for personal or productive uses, debts outstanding, bank deposits, stock and equity ownership, etc.).

Table 2.1 (continued)

2. Flow Variables

2A) Income

i) Activities engaged in and quantities produced. Amounts sold and amounts used for own consumption. Includes provision of services as well as commodity production.

ii) Amounts received from ownership of stocks of capital such as house rents, interest income, royalties, dividends, etc.

iii) Transfers (public, private, domestic, foreign, gifts, remittances, etc.).

iv) Amounts and types of inputs purchased for productive uses (fertilizer, repairs, fuel, etc.).

v) Quantities of labor used for production. Amounts of labor hired out.

2B) Expenditure

Expenditures by commodity (quantities and prices).

2C) Changes in Assets

i) Types and quantities of productive assets purchased or sold during the period.

ii) Types and quantities of non-productive capital bought, sold or given as gifts.

iii) Number of births, deaths during given period.

Table 2.1 (continued)

iv) Types of education obtained during period (schooling, vocational training, other training).

v) Financial asset changes (sales purchases of stocks, bonds, payment of debts, etc.).

2D) Market Variables

i) Prices of commodities produced and consumed by household. Prices of services rendered.

ii) Wages for various types of labor.

iii) Market prices of capital items (land, animals, tools, machinery, etc.).

3. Access Variables

i) Access to public and private health and sanitary facilities. Usage of those.

ii) Access to public and private educational facilities. Usage.

iii) Access to and types of drinking water facilities.

iv) Types of roads servicing household.

v) Access to major public infrastructure such as electricity, telephones, paved roads, irrigation schemes, ports, public markets, etc.).

transactions are not available or are difficult to get then market data should be substituted. Market data is also bound to be quite important for capital items. Since it will be impossible to value capital stocks from direct observations, the relevant needed information in order to be able to assess household wealth is the ownership of a given type of capital item, the number of periods for which it is owned, and the current market price for a similar new item. Ownership type of data can be obtained from households by recall and price data can be observed from the markets. Since only a small number of types of capital items are bound to be widely owned by households in a given developing country, it might not be too difficult to classify the most common types of capital items and then inquire about their ownership.

Access variables are like stock variables in the sense that they indicate whether a particular type of public service is available. What is more interesting from the adjustment perspective is the kind and quality of service provided. Some information on that could be obtained by asking households some qualitative information about the services such as state of road, water system, irrigation services, etc.

Existing household information from surveys or other sources should be organized so as to conform to the same pattern as in Table 2.1. It is understandable that many items in the checklist of the table will be missing. However, having the stock-flow conceptual basis of Figure 2.1 as a background, whatever information is available can be used to fill different

slots.

2.6. Poverty Line and the Measurement of Poverty

As suggested by Scobie (1989), as well as the earlier discussion, when one deals with the impact of adjustment on the poor the concern is with absolute poverty and not relative poverty.

The measurement of poverty is a subject that has occupied development economists and agencies for a long time. The definition of what constitutes a poverty line has undergone criticism and changes but the currently most widely accepted method of defining it consists of first calculating the minimum expenditure necessary to purchase at current prices food commodities that will attain minimum nutritional intake, and then "blow up" this expenditure by a factor to take account of minimum non-food requirements. Neither of the above two steps is without its controversies, since the basket of foods to include, the definition of a minimum diet, and the blow-up factor cannot be precisely defined. Nevertheless, it appears from empirical studies that computation of a poverty level can be done reasonably well given information on household diets as well as other expenditure patterns, and prices.

Once a poverty level has been defined one must decide on a measure to use to summarize the degree of poverty. The two most widely used measures are the headcount ratio (the number of people below the poverty line), and the income gap ratio (the amount of income that will bring all the poor up to the poverty

line relative to the poverty line itself).

Let there be n income receiving units each with income y_i $(i=1,\ldots,n)$ and let their incomes y_i be arranged by ascending order.

$$y_1 \leq y_2 \leq \ldots \leq y_n \tag{2.6.1}$$

Alternatively for a continuous y let the density and cumulative density functions be denoted by f(y) and F(y). Let the poverty line be defined by z. Then if

$$y_q \leq z \leq y_{q+1} \tag{2.6.2}$$

in other words if there are q units with income below the poverty line, the above two measures of poverty are defined as follows in discreet or continuous terms (denoted by a superscript)

$$H^d = \frac{q}{n} \quad (2.6.3a), \qquad H^c = F(z) \tag{2.6.3b}$$

$$I^d = \frac{1}{zq} \sum_{i=1}^{q} (z-y_i) \quad (2.6.4a), \quad I^c = \frac{1}{zF(z)} \int_0^z (z-y)\, f(y)dy \quad (2.6.4b)$$

Kanbur (1987), has suggested that the product of these two measures, namely the number HI is a preferable poverty indicator. Furthermore, he has shown that both H and HI belong to the class of additively decomposable poverty measures proposed by Foster, Greer and Thorbecke (1984), that have many desirable properties.

$$P^d_\alpha (y;\ z) = \frac{1}{n} \sum_{i=1}^{q} \left(\frac{z-y_i}{z}\right)^\alpha \tag{2.6.5}$$

$$P^c_\alpha (y;\ z) = \int_0^z \left(\frac{z-y}{z}\right)^\alpha f(y)\ dy \tag{2.6.6}$$

For $\alpha=0$ the above measures reduce to H^d and H^c respectively. For $\alpha=1$ they reduce to $H^d I^d$ and $H^c\ I^c$ respectively.

The most desirable property of these measures from an empirical perspective is their additive decomposability. In other words suppose that the population of income units is divided into m mutually exclusive and exhaustive groups, with group k having a fraction s_k of the population ($\sum_{k=1}^{m} s_k = 1$). Then if the measure $P_{\alpha,k}$, either of the discreet or continuous type, is computed for each subgroup, for some α, then the aggregate poverty index can be written as

$$P_\alpha = \sum_{k=1}^{m} s_k\ P_{\alpha,k} \tag{2.6.7}$$

In other words the economy wide poverty index can be computed by a weighted average of the group specific poverty indices.

In the context of adjustment both incomes of individuals and households, as well as the poverty line will be changing. Furthermore, it might be that the poverty line will be different for different groups of households as for instance between rural and urban. When prices and hence the poverty line are changing, the appropriate thing to do empirically is to define the poverty line as a function of endogenous variables

and compute it simultaneously with all the variables of the model. When the definition of the poverty line is different for different groups of individuals or households, then the poverty index must be computed and updated separately for each group.

Changing prices complicate the measurement of poverty because with different prices a different bundle of goods can be bought by the household and hence utility and welfare might change through substitution and not only income effects. Using, however, a concept of welfare based on money metric utility (Deaton (1980)), it is easy to update poverty lines.

Suppose that for a given group of individuals or households a complete demand system has been specified based on maximization of some underlying utility function (such as e.g. the Linear Expenditure System (LES), see Brown and Deaton (1972) for a survey). Suppose that the resulting indirect utility function of a typical unit in that class is denoted by $V(y,p)$ where y is the income and p is a vector of prices facing the consumer. With initial prices equal to p_0 and income equal to the poverty line z_0, the typical unit of that class would achieve utility equal to $U_0 = V(z_0, p_0)$. Let the expenditure function corresponding to the same utility and demand system be denoted by $E(U,p)$. In other words E is the minimum expenditure needed by the consumer to achieve a level of utility U when he faces prices p. By definition

$$E(U_0, p_0) = E(V(z_0, p_0), p_0) = z_0 \qquad (2.6.8)$$

Suppose now that prices change to a new vector p. What is

the new poverty line? It can be defined as that level of expenditure at the new prices that will achieve the same utility U_0 as achieved at the old level of poverty and prices. Given the above definition, this is equal to

$$z = E\ (U_0,\ p) = E\ (V\ (z_0,\ p_0),\ p) \qquad (2.6.9)$$

Notice that the new level of poverty is consistent with the underlying demand system. Furthermore, note that the expression in (2.6.9) depends only on the original poverty line and the vectors of old and new prices. Notice that the function $E(\cdot)$ in (2.6.8) is homogeneous of degree one in prices, while the function V is homogeneous of degree zero in expenditure and prices. This implies for instance that when all prices are doubled the poverty line defined by (2.6.9) will automatically double as well. Given the updating of the poverty line provided by (2.6.9), computations of poverty indices such as P_0 or P_1 can be performed if the distributions of income within each group are specified.

3. COMPUTABLE GENERAL EQUILIBRIUM MODELS AND MACROECONOMIC ADJUSTMENT

In this chapter a brief sketch of the nature and debates surrounding CGE models in given as a background to the model presented later.

CGE's have their origin in the original work of Johansen (1960) but they did not really flourish until much later, when practical computer algorithms for solving walrasian general equilibrium systems were available. The pioneering modern works on CGE's are the model of Korea by Adelman and Robinson (1978) and the model of Brazil by Taylor et.al. (1980). Since then there have been several models built for various countries and even a book (Dervis et.al. (1982)) outlining the theoretical and practical steps in building such a model. Shoven and Whalley (1984), Devarajan et.al. (1986), Scarf and Shoven(1984), and Kuwenaar (1988), have provided useful surveys of models and the state of the art.

3.1 Basic Structure of CGE Models

A CGE is supposed to present a sequential picture of an economy. In each period the economy is driven to a static general equilibrium. For the next period the stock variables of the model, which are assumed constant for the within period equilibrium, are updated and a new general equilibrium is projected. The process therefore is akin to recursive comparative statics rather than true dynamics, involving

endogenous generation of expectations, intertemporal decision making, etc. While this is a limitation, there has been no empirical model to date endogenizing the dynamic features in a non-recursive manner. The discussion will first comment on the within period "static" equilibrium and then on the recursive updating of variables.

The static general equilibrium model of economic theory is well known (Arrow and Hahn (1971)). It is comprised of agents that are endowed with factors of production (capital, labor, land etc.) which generate income. This income in turn is spent on the goods produced within the economy. The balance between the amounts produced and consumed is traded. The government is a crucial part of any CGE model and it enters both as a producer (e.g. public enterprises) but mainly as a purchaser of goods and a redistributor of income via taxes and transfers.

All CGE models start with an empirically consistent description of the economy for one year along the lines of a so-called Social Accounting Matrix (SAM). The SAM is an extension of the more traditional inter-industry flow model that gave rise to the Leontieff type models. It includes a complete accounting of the circular flow of income - spending by the actors of an economy, so that sources of income and patterns of spending are clearly delineated. Consistency is assured by the fact that the sum of all payments by one of the identified sectors (namely the sum of the elements in a column of a SAM) is equal to the sum of all receipts (namely the sum of all elements of the corresponding row of the nxn SAM), (for

more details see Pyatt and Thorbecke (1976), or Pyatt and Round (1979)).

Table 3.1 shows the typical aggregate structure of a SAM. The major aspects of the economy shown, the so-called accounts involve productive activities, commodities (an activity can produce more than one commodity that is why there are conceptually separate accounts), primary factors of production typically divided into labor and capital, institutions which consist of households, enterprises and the government, the capital account which indicates the sources and uses of funds, and the rest of the world. Each one of these major accounts can be subdivided into many sub-accounts. For instance activities are typically disaggregated along the lines of an input-output matrix, labor is disaggregated into various classes, and similarly for households, etc. When numbers are attached to all the entries, then one has a complete picture of the flows of commodities, expenditures and receipts for the economy for one period, typically a year. Income distribution can be dealt with by specifying how different types of income flows accrue to various classes of households.

Constructing a SAM is not a trivial matter even if an I-O table is available, because one usually has to patch up disparate sources of information. Furthermore, the way one identifies sectors dictates the range of problems one can deal with. For instance if all income, irrespective of source is assumed accruing to either "Labor" or "Capital", then the only income distribution issues that the model can deal with are

Table 3.1. Typical structure of a social accounting matrix

		Expenditures									
				Factors		Institutions					
		Activities (1)	Commodities (2)	Labor (3)	Capital (4)	Households (5)	Enterprises (6)	Government (7)	Capital Account (8)	Rest of world (9)	Totals (10)
Activities	(1)		Domestic sales								
Commodities	(2)	Intermediate inputs				Private consumption		Export subsidy Government consumption	Investment	Exports	Total Receipts Total Uses
Factors:											
Labor	(3)	Wages									Wages
Capital	(4)	Rentals									Rentals
Institutions:											
Households	(5)			Labor income		Transfers	Distributed profits	Transfers		Net factor income	Household income
Enterprises	(6)				Capital income			Transfers		Net private flows	Enterprise income
Government	(7)	Indirect taxes	Tariffs			Direct taxes	Direct taxes			Net public flows	Government income
Capital account	(8)					Private saving	Retained earnings	Government saving		Reserve decumulation	Total savings
Rest of world	(9)		Imports								
Totals	(10)	Total costs	Total absorption	Wages	Rentals	Household Expenditures	Enterprise Expenditures	Government Expenditures	Investment	Total Net Foreign Exchange Inflows	Total Foreign Exchange Outflows

Source: Adapted from Dervis et.al (1982).

those between owners of labor and owners of capital. Similarly if only one sector is labeled "Agriculture", then the model that will be based on the SAM cannot deal for instance with relative prices among, say, subsistence food crops and cash crops. Hence choice of the appropriate sectors to include in a SAM is crucially dependent on the use to which the subsequent model is intended. The detail to which one can disaggregate productive sectors, income groups etc. is limited only by the availability of data and time by the researchers. However, the art of efficient model building is to construct a model that is large enough to capture the features of an economy one is interested in studying, but not too large so as to waste resources in unnecessary data manipulations. This part of model building, namely what to include and what to exclude is basically an empirical art.

The SAM presents only a snapshot of an economy in short run equilibrium. This is usually expressed by the ex-post identity.

Total Investment Flows = Total Savings Flows.

This identity in turn is derived by the commodity balance equations in the model. In other words if for every commodity or market included in the model, it holds that supply equals demand, a condition that will hold ex-post in equilibrium, then the savings investment identify necessarily must hold. It must be noted, and this is one of the aspects of CGEs that can lead to confusion. Supply-demand balance does not necessarily mean equality of flow supply and flow demand. Stock changes are part

of the supply demand balance as well, and they are a necessary part of "equilibrium." More on this, however, will be discussed below.

The second major part of the model-building exercise is to postulate a set of "equations of motion" of the system, namely a set of equations that describe how the various sectors behave. For instance producing sectors could be postulated to be characterized by full factor employment and profit maximization under some production function and perfect competition, or they could be postulated to have excess capacity so that production would be dictated by demand for the products under monopolistically set profit margins and prices. Consumers could be postulated to save a fixed or variable proportion of their income and could spend their disposable income according to a complete demand system such as the Linear Expenditure System (LES). Factors could be assumed freely mobile among sectors or fixed in the short run, or something in between. The government could be assumed passive in the sense that it sets policy parameters such as tax and subsidy rates, traded quantities, the level of domestic and foreign deficits, etc., and lets the system adjust to these; or it could be assumed active, in the sense that it employs feedback rules to achieve certain objectives within the period. Such a rule, for instance, would be a policy to vary food imports in a year so as to keep domestic consumer food prices fixed, or to vary domestic agricultural producer prices within a year so as to achieve a given level of domestic procurement.

The set of all these equations determines the structure of the model. The structure is the most important part of the model and by and large determines the properties of the model. The appropriate choice of structure is usually dictated by various considerations such as the kinds of behavior one wants to allow in the economy, the institutional set-up of the economy, the generality of the system of equations, their parsimony in terms of the numbers of parameters one has to specify to complete the model, etc.

3.2. Features that Distinguish CGE from Other Policy Models

CGE models are complex since they try to simulate the behavior of the whole economy. Nevertheless, they can incorporate a variety of features that are in many cases necessary to analyze particular cases

i) Substitution. In most traditional economy wide planning models (such as for instance of the I-O variety), very little or no substitution was allowed in production activities among factors, among domestic and foreign goods, and among commodities in production and consumption. The consequence was that simulating a smooth transition was quite difficult. In CGE models substitution at various levels can be introduced so that smooth transitions from one state to the other can be simulated. Of course, the more complicated the structure of substitution specified the more parameters have to be specified.

ii) Factor Mobility. Mobility of labor and capital among

activities is something that can be easily simulated in CGEs. Whether factor mobility exists or not in the real economy, and especially when short run versus long run mobility exists, is a difficult empirical issue that has troubled economists for a long time. However, this has nothing to do with CGEs. This type of model allows for some factors to be mobile and others not, for factors to be fixed in the short run and mobile in the long run, etc. It therefore, gives a lot of flexibility to the analyst in describing factor markets. In fact it gives him the possibility to simulate changes in the structure of factor markets a feature that no other type of empirical model can do. Whether the analyst chooses the right description, however, is another issue.

iii) Market Structure. Most of the early CGEs assumed perfectly competitive commodity and factor markets, with prices being the variables equilibrating flow supply and demand. However, rationing and quantity adjustments with rigid prices have been characteristics of markets in some recent CGE models (e.g. Bourgignon et.al.(1983)). While in the former type of model prices are determined in the market by competitive agents, in the latter prices in some markets are typically fixed or of the mark-up type and demand determines the supply. Explicit oligopolistic behavior in applied CGEs has only recently started being incorporated ee Harris (1984)) but is certainly feasible.

iv) Money and Assets. Most CGEs have been real barter models in the sense that they determine relative but not

absolute prices. Money demand and supply, the structure of public and private portfolios, investment and deficit financing are usually ignored. Since money markets are ignored, a numeraire must be chosen which typically is either one of the model prices (the nominal wage and the exchange rate, are typical examples), or a price index.

The absence of money has limited the applicability of CGE in past exercises, because it can be shown that money can be quite important in affecting real variables in both the short as well as the long run (see Taylor (1983) for a review of the issues). In developing countries this is particularly important because the typical way governments finance their deficits is via money creation and the "inflation tax" that this entails. The issues of monetary real interactions are quite involved and have occupied economists especially in developed countries extensively (re. the Keynesian-monetarist debate). Recently some interesting attempts have been made to incorporate interactions between monetary and real variables in CGE models (Bourgignon et.al (1989), deMelo et.al (1989), Akin-Karasapan et.al (1989)). The difficulties again are not that CGEs cannot incorporate the relevant interactions. They rather center on the one hand in economic theory and the relevant structure of equations that have been shown to be relevant, and most importantly with the unavailability of financial data especially at the level of households and enterprises, two of the key institutions in the economy.

v) Dynamics. As mentioned earlier, the type of dynamics

that can be currently incorporated in CGEs is that of recursively updating stock variables given current flows. In other words current variables are not simultaneously solved with future variables to give intertemporally consistent time paths or expectations. While in theory models of this type have appeared for some time, no attempt at empirical simulation with CGEs has been made to date. However, within the currently accepted recursive sphere there is a wide variety of features that can be simulated. For instance household formation, capital accumulation, wealth redistribution, etc., can all be simulated if, of course, relevant data is available. The empirical capabilities of current CGEs are much wider than the current availability of data.

In general the current structure of empirical dynamic CGE models can incorporate almost any type of special "realistic" feature about the functioning of particular markets one is interested in incorporating, except, as mentioned earlier, intertemporally consistent nonrecursive decision making and endogenous determination of expectations.

There are no set procedures about how one arrives at a proper CGE model structure. Economic theory, knowledge of the economy, personal biases etc. all contribute in the specification of the structure. This is not, however, a detriment of the models but simply a statement about the state of economic theory, and the criticism is applicable to all empirical economic models.

Given, however, the structure of the CGE model there are

two general key questions that must be answered before one is ready to proceed in empirical policy analysis. One has to do with the choice of the way in which the economy achieves short run equilibrium, the so called closure-rule. The second question, has to do with the choice of the values of parameters that are needed to make the structure complete.

3.3 Equilibrium and Model Closure

To comprehend the nature of the closure rule question consider a CGE model of an economy that is described by n excess demand equations of the type

$$f_i\ (x_1, \ldots, x_m;\ p_1, \ldots, p_r;\ a_1, \ldots, a_k) = 0 \qquad (3.3.1)$$

where $m+r > n$ $\qquad i=1, \ldots, n$

The symbols x_j, $j=1, \ldots, m$ denote quantity variables such as quantities of products or factors supplied or demanded, quantities of products traded internationally, etc. The symbols p_j, $j=1, \ldots, r$ denote prices of products or factors in various markets and a_j, $j=1, \ldots, k$, denote parameters that are necessary to completely specify the structure of the model, such as income and price elasticities of quantities demanded, elasticities of factor substitution in production, etc. Implicit, of course, in equation (3.3.1) are the structural specifications of the behavior of various agents included in the model. Notice that in general $m \leq n$ and $r \leq n$. This is because certain quantity or price variables depend on other quantity or price variables, and have thus been substituted

away. In that sense the excess demand equations in (3.3.1) are "reduced form excess demand equations".

Notice that as is indicated $m+r > n$. This, basically means that to achieve equilibrium, namely the satisfaction of the n excess demand functions, one usually has more variables available than equations (for given values of the parameters a_i of course). Hence one has a choice as to how to <u>close</u> the model. In other words one must choose certain of the variables as exogenous or must assume that they depend on the others in order to have exactly n variables to adjust in order to solve the n equation. This choice dictates how the model variables adjust to achieve the equilibrium.

As an example, consider a closed economy composed of only two sectors producing one commodity each, and two factors of production. There are thus four "flow" excess demand equations, two for the commodities and two for the factors. If the allocation of the quantities of factors and the supply and demand for goods depend only on the respective prices then the four excess demand equations depend only on the four prices of the goods and factors. However, Walras law dictates that only three of those four equations are independent. Suppose that one of the four equations is dropped, say, one of the commodity excess demands. This leaves three equations with four unknowns, namely the four prices. The normalization rule in this case consists of choosing the equation to be dropped and the price rule that in essence adds a fourth independent equation in the system. Such a rule for instance could be that one of the

prices is fixed (e.g. the wage), or that a combination of prices is fixed. Notice that in this system all quantities vary as functions of prices. It is this assumption that some analysts call the rule of closure, while the choice of the redundant equation and the exogenous price rule they call normalization.

To understand the distinction that has led to some confusion, consider another way in which the same system can achieve equilibrium. Assume that the allocation of one of the factors (say capital) to the two sectors is fixed, and fully utilized, while the other factor is mobile. Assume as before that product supplies and demands as well as the allocation of the other factor depend on prices of the two goods and the price of the mobile factor as before. Since the supply and allocation of one of the factors is defined a-priori, there is no excess demand equation for this factor but only for the two commodities and the mobile factor. There are now three excess demand equations dependent on three prices (two commodity prices plus the price of the mobile factor). However, this system again is not fully determined as Walras law still holds. Again one of the equations has to be dropped and a normalization rule for prices specified. Suppose that the same commodity equation as before is dropped and that the same normalization rule is specified. The new determinant system will behave in a very different way than the earlier one.

Clearly what makes the difference is not which equation is dropped or which normalization rule is imposed but instead what

behavioral assumptions are made about the adjustment of variables to achieve equilibrium, and it is this that must be considered as the model closure.

Of course the whole debate would be much more clear if money was explicitly introduced in the model because then there could be stock flow consistency. The closure rule debate has arisen because any assumption about how to balance the system entails underneath an implicit monetary rule. Dewatripont and Michel (1987) have clearly pointed this out, while Bourgignon et.al (1983) among others have shown how different closure rules correspond to different monetary behavior. Nevertheless, the choice of adjustment modes would still remain a problem and it is this that is considered here as the major one since money will be explicitly introduced in the model.

Obviously there are many different ways to close a model, namely to choose the adjustment behavior of the various markets. The choice is difficult because it depends by and large on one's intimate knowledge and/or intuition of the economy. The problem is that models behave quite differently according to the way one chooses the <u>closure rule</u>. This point has been substantiated, both theoretically and empirically through extensive research (Taylor and Lysy (1979), Rattso (1982), Ahluwalia and Lysy (179), Dewatripont and Michel (1987). Bell and Srivinvasan (1984) in their cogent assessment of CGE's conclude on closure rules (p. 460).

"The upshot of all this is that the qualitative behavior of the economy (as a static system) stems not so much from the

extent of disaggregation or the possibilities of substitution as from the manner in which investment and savings (more generally supplies and demands) are brought into equality. No doubt the specific magnitudes of the economy's responses to changes in the exogenous variables depend on how many goods and households there are and whether there is easy substitution in production and consumption. Yet, while the detail afforded should be valuable in examining resource pulls, it is the choice of the closing rule that seems to matter for aggregate output and the factoral distribution of income."

The choice of a closure rule is at the center of much of the debate in macroeconomics about short and long run adjustments. Keynesian economists for instance are more likely to side with the view that in the short run, if there is excess capacity in many industries and factor unemployment, the prices are rather rigid, and it is quantities supplied that adjust to aggregate demand. Economists with a neo-classical or classical bend on the other hand tend to believe that even in the short run there is full factor employment and hence factor and product prices are the equilibrating variables in the system. The choice is not a-priori easy, especially if one operates in a many sector world where some sectors could be in excess capacity while other in excess demand at any given period, and must be corroborated by empirical evidence.

It must be noted that the closure rule debate is not only a debate about whether investment adjusts to savings or vice versa. It is rather a wider debate about how the various

commodity and factor markets adjust whether by price or quantity variations, rationing, etc. For instance markets characterized by many small participants are expected to operate in a "flex-price" mode, namely to exhibit quick changes in prices in response to shocks. Agricultural product markets are usually of that type. Markets characterized by a monopoly firm or few large firms are expected to exhibit less price fluctuation and more quantity adjustment in response to changes. The closure rule debate is thus intimately related to product and factor market structure and behavior, a field that does not always offer clear cut guidelines as to the mode of adjustment.

It should be reemphasized that the closure rule debate has nothing to do with the principle of empirical CGE construction but rather with the state of economics and economic theory in general as well as the empirical knowledge about how different economies function. It nevertheless, should caution the analyst that it is not large sectoral detail that will provide the clues about the way an economy behaves and adjusts but rather the way in which the various markets are brought in equilibrium within a period. This in turn is largely an empirical and also subjective matter.

3.4. Parametrizing CGE Models

Given the choice of structure and the closure rule, there still remains the problem of the specification of the parameters that identify quantitatively the model. The first

thing to note is that there is an infinite set of parameters that is consistent with a SAM and a given structure with a closure rule. To see this rewrite the system represented by equation (3.3.1) as follows

$$f_i\ (y_1, \ldots, y_n;\ a_1, \ldots, a_k) = 0,\ i=1, \ldots, n \qquad (3.4.1)$$

Here y_i, i=1, ..., n represents the n endogenous variables (equal to the number of equations chosen among the x and p of equation (3.3.1) that have been postulated to adjust to bring the system in short run equilibrium.

A SAM is basically the empirical representation of one such equilibrium where the values of all the x_j and p_j (and consequently the y_i) is observed. In principle the system (3.4.1) can be solved for the n endogenous variables y_i in terms of the parameters (and of course the exogenous variables which are suppressed for clarity)

$$y_i = y_i\ (a_1, \ldots, a_k) \quad i=1, \ldots, n \qquad (3.4.2)$$

In general the number of parameters k is much larger than n - the number of excess demand equations. Hence there is no one-to-one correspondence between the y_i and the a_i. This means that there is basically an infinite set of parameter vectors $(a_1, \ldots, a_k)$ consistent with the observed values of y_i, much like there is an infinite set of partial equilibrium supply and demand curves consistent with one observed equilibrium price-quantity pair for a commodity market as illustrated in Figure 3.1.

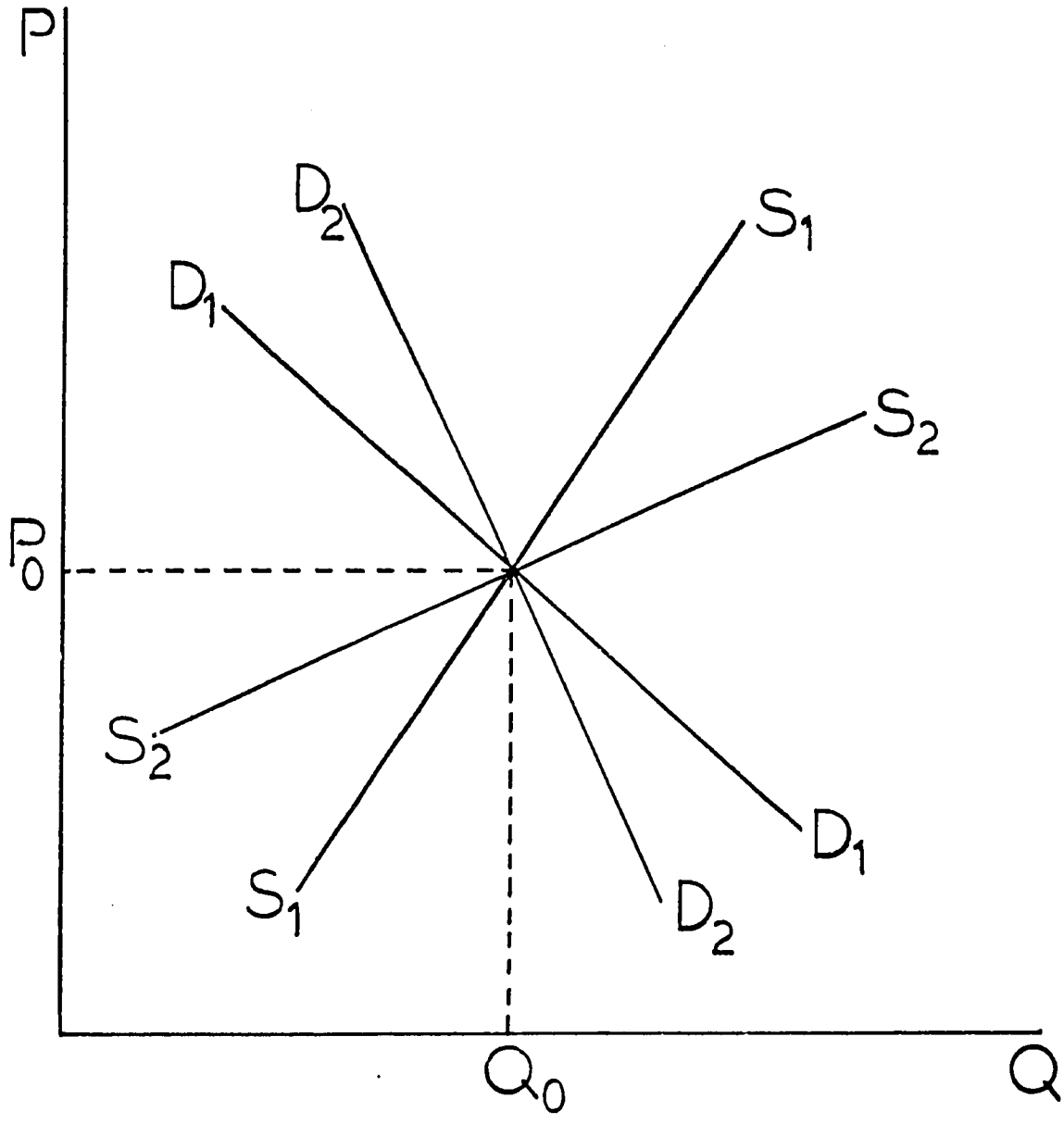

FIGURE 3.1 : The Indeterminacy of Supply and Demand Curves

In Figure 3.1 it can be observed that the sets of curves (S_1S_1, D_1D_1) and (S_2S_2, D_2D_2) give the same equilibrium price quantity pair P_0Q_0, yet they have different slopes.

In practice the way this indeterminancy is resolved is either by direct empirical (econometric or other) estimation and by assuming some of the parameters a_i, ex-ante by refering to independent econometric studies or "stylized facts" about the economy. The few remaining parameters are "tuned" so that the model equations (3.4.1) when solved for the y_i's in terms of the a_i's they reproduce the observed SAM flows in the base year.

3.5. Stock Flow Consistency, Equilibrium and CGEs

It has already been mentioned that most empirical CGE mdels are flow consistent in the sense that they explain the circular flow of production income-expenditure-consumption in an economy as represented by a SAM. The SAM, as explained, represents a snap-shot of our economy in a particular period.

In designing the one period CGE model structure, all underlying stock variables are kept constant (population, production capacities, amount of land, etc.) and they are updated in the next period in order to simulate a new period equilibrium. Most of the emphasis to-date has been placed in the appropriate design of the static one-period part of the model. However, when one is inherently interested in the five to ten year medium run, which is the horizon of most planning exercises, the mode of updating and the interaction between

stock and flow variables becomes important.

Before one considers the dynamic updating procedures and rules, it must be emphasized that a consistent stock-flow picture of the economy is needed. Thus the discussion on SAMs which concerned flow accounting must be complemented by a discussion of stock accounting. In other words the interest is in picturing at any given moment the magnitude of all stock variables which can be considered as the state variables of the economy. Consistent stock-flow accounting has recently become more widely emphasized even in developed countries (see Patterson and Stephenson (1988)).

Stocks of various assets are held by the institutions in an economy (government, firms, households, and the rest of the world) except for financial stocks which are also held by the financial intermediaries (Commercial banks, money lenders, etc.). The difference between total assets and liabilities of any institution constitutes his/her wealth or net worth in accounting terms. The sum of the wealth of all country institutions is the country's total wealth.

Table 3.2 presents in a schematic form the balance sheets of the varius institutions relevant in a developing economy context, such as those of SSA. For every domestic institution the column sum of all assets is equal to the column sum of all liabilities except for the government whose total liabilities normally exceed total assets by the value of the domestic government debt. Domestic and foreign assets are separately treated. The row sums for all domestic institutions basically

Table 3.2. Aggregate Balance Sheets of All Relevant Institutions in a Developing Economy

	Government and Central Bank		Commercial Banks		Domestic Enterprises		Domestic Households		Aggregate Domestic Economy (Net Assets)	Rest of World Accounts with the Domestic Economy	
Domestic Assets	A	L	A	L	A	L	A	L		A	L
Base Money	-	High Powered Money	Bank Reserves and Vault Cash	-	Cash	-	Cash	-	0	-	-
Domestic Money	-	-	-	Deposits	Bank Deposits	-	Bank Deposits	-	0	-	-
Productive Capital	Public Capital	-	-	-	Private Productive Capital	-	Productive Capital	-	Physical Productive Capital	-	-
Non-Productive Capital	-	-	-	-	-	-	Houses, Non-productive Durables	-	Physical Non-Productive Capital	-	-
Human Capital	-	-	-	-	-	-	Stock of Human Capital	-	Human Capital	-	-
Equity	-	-	-	-	-	Loans from Households (Equity)	Loans to Enterprises (Equity)	-	0	-	-
Bank Loans	-	-	Loans to Firms and Households	-	-	Loans from Banks	-	Loans from Banks	0	-	-
Net Worth	-	-	-	-	-	-	-	$K_h - K_h$	Total Domestic Wealth	-	-
Foreign Assets											
Foreign Money	Foreign Reserves	-	-	-	-	-	Foreign Money Holdings	-	Total Foreign Money Held by Domestic Institutions	Foreign Money of Domestic Institutions Held Abroad	Total Foreign Money Held by Domestic Institutions
Foreign Capital	-	Foreign Debt	-	-	-	Direct Loans from Foreign Firms (Foreign Equity)	-	-	Net Foreign Debt	Foreign Ownership of Domestic Firms (Equity) plus Foreign Loans to Government	-
Column Sums	Total Public Assets	Total Public Liabilities	Total Commercial Bank Assets	Total Commercial Bank Liabilities	Total Firm Assets	Total Firm Liabilities	Household Assets	Household Liabilities	0	-	-

A - Assets

L - Liabilities

give the structure of domestic wealth (not its ownership). So total domestic wealth is composed of physical production capital (roads, land, ports, machines, buildings, etc.), human capital (however measured), physical non-productive capital (houses, jewelry, plus other consumer durables, etc.), and foreign assets held by domestic residents. Notice that human capital is treated like an asset much like any other physical capital good. Also, notice that the row sum of the domestic monetary variables are all zero since whatever money is held as an asset by one institution is a liability of somebody else.

As far as the institutional accounts are concerned, the public sector is basically modeled as issuing domestic base money, through creating domestic debt by selling bonds to the central bank), and the only other asset it creates is public capital (roads, ports, etc.). The government through the central bank owns foreign reserves and owes to the foreigners foreign debt. Notice that the government is assumed not to issue bonds to the public. This is realistic in a SSA context where stock markets and public stock offerings are largely absent. Public enterprises could be pictured in the scheme in several ways. If their equity capital comes directly from the central bank then there would be an entry for equity under the government asset column. If they are financed by commercial banks but with deposits from the central bank then there is nothing that changes since essentially the deposits created by the government to the commercial banks act like high powered money or money base. In the way the balance sheet for the

government is set out, an increase in the total public debt (net liabilities) basically corresponds to creating more high powered money (in essence printing more money) or an increase in the foreign debt.

The commercial banks accept deposits (from households, firms and the public sector) and, apart from reserves, hold as assets the various types of loans they make to firms and households. It is assumed that commercial banks hold no foreign exchange deposits, albeit this is easy to incorporate. The domestic firms hold cash and bank deposits (mainly for working capital needs), and the productive capital they utilize. Their domestic liabilities are to households, who hold the equity of firms through "loans" and to banks. Furthermore, if there is foreign direct investment, the equities held by foreigners are part of the domestic firm liabilities.

Households ultimately hold most of the wealth in the economy. Their assets include both financial assets such as cash, deposits and foreign money, physical nonproductive assets, such as houses, jewelry, etc., productive capital both directly owned (livestock, farm tools, etc.) as well as indirectly owned through loans, namely equity participation in firms, and finally human capital assets (years of schooling, skills, etc.).

The rest of the world account just summarizes the net position of the rest of the world only vis-a-vis the economy at hand. It does not include all the foreign assets and liabilities.

The importance and utility of writing the assets of an economy in a tabular form such as indicated in Table 3.2 are great. The entries in Table 3.2 can be tabulated from bank, government and from balance sheets, and from a variety of sources (household surveys, bank aggregate figures, etc.) for the households. They indicate the state of the economy at any instant of time. The important thing to realize is that the <u>changes</u> in the various entries of the aggregate economy wide balance sheet over a given period are nothing but the entries in the flow of funds capital account of the SAM as far as the financial and capital variables are concerned, and the entries in the flow updates of all the human capital stock variables. In other words given an initial state of the economy at the end of period t-1 pictured by an asset-liability stock table such as the one in Table 3.2, the SAM for year t is sufficient to derive the asset-liability table for the economy at the end of period t. Hence the evolution of the economy can be viewed as a sequence of asset liability tables with the yearly SAMs just giving the data for updating the various stocks. An empirical model in order to be able to adequately portray the medium term evolution of an economy must be stock-flow consistent in the sense outlined above. As already noted, to date most CGE models have only concentrated on flow consistency and hence could not really be used to analyze the medium run.

Now that stock-flow consistency has been clarified, it is important to discuss the notion of equilibrium inherent in the medium term dynamic CGE that has been described above. For most

economists equilibrium means the equality of flow supply and flow demand. Stock changes are part of flow demand so they always appear as part of the supply demand balance, but traditionally theorists have considered the long run equilibrium to be one where stock changes are zero. If, however, all stock changes are zero, then the economy is not growing, and this does not appear to be a reasonable notion of dynamic equilibrium.

One can then think of dynamic equilibrium as one in which all stock variables are growing at the same rate (the notion of balanced growth). However, no economy ever finds itself in such a felicitous state of affairs. Usually the various stocks in the economy grow at different rates under the influence of various exogenous and policy shocks. However, we can still think of the economy evolving in the absence of any shocks. Then the economy should autonomously tend towards a stable balanced growth path, which could be thought of as a steady dynamic state. In any given year the economy, even in the absence of shocks, would be in a transition towards this dynamic steady state. The presence of shocks would make the situation even further away from the dynamic steady state.

Since an empirical CGE is supposed to simulate a dynamic time path of an economy starting from a given period, in which the economy will almost surely not be in a state consistent with dynamic steady state, what is the notion of "equilibrium" inherent in a CGE model? The answer lies not in arguing about equilibrium terminology, namely what constitutes a temporary

versus true equilibrium, or about short run versus long run equilibrium. The answer instead lies in noting that in whatever state the economy finds itself at the beginning of a period, the state that it will find itself at the beginning of the next period must be determined by what happens to various flows from the beginning of one period to the beginning of the next. In other words a description of the economy that is stock-flow consistent in the sense discussed earlier does not have to be in any kind of dynamic steady state. The particular ways in which flows are determined within a period is determined by the structure of the economy, or in the case of the CGE by what is known as the closure rules. These, as discussed earlier, can be of various types, price or quantity adjusting, neoclassical, Keynesian, structuralist, Marxian, Kaldorian, etc. (these are some terms used in the literature). As long as the empirical economic model is stock-flow consistent, it can accommodate any notion of "equilibrium" one cares to impose. Equilibrium should not be associated with any particular school of thought, and in fact it is a term fraught with ambiguity and should rather not be used in the description of an economy. The term market balance, or stock-flow consistency would be much better and less ambiguous. Nevertheless, the term equilibrium will undoubtedly continue being used. In this monograph wherever necessary reference will be made to the state of the economy and changes from that state.

3.6. Evaluation

While CGE models are undoubtedly the best currently known empirical tools with which to trace impact of macro economic policies on households, they frequently raise two types of criticism. First it is said that they take a lot of effort and resources to build them and they are very data intensive. Second it is said that because of their complexity they are not easy to comprehend and hence many of the simulated results cannot easily be traced or explained.

In answer to the first criticism it must be said that in any type of empirical model building exercise there is a tradeoff between resources expended and expected results. No empirical economic model, irrespective of size and complexity, can ever capture all the intricacies and details of a real economy. Hence investments in model building must be sufficient to deal with the problem at hand and not be wasted to capture effects in which the analyst or "investors" are not interested in. In the case of the impact of macro adjustment policies on the poor, that is the objective of the methodology outlined here, investments in effort should not be made in describing in detail sectors and activities where the poor have small participation. They should rather concentrate on describing in detail the elements of the economy that loom large in terms of affecting poverty. It is for this reason that a profile of poverty is a necessary prerequisite to any model building exercise. It is also for this reason that it is thought that a large model (in terms of number of sectors) will not be

necessary to analyze poverty and macro adjustment in SSA.

In terms of data needs, these are indeed considerable. However, the CGEs through the consistency framework that they impose, offer the possibility for adapting parameters and even some data in order to balance the various accounts. This is a great advantage in countries like those in SSA where data availability and quality are limited.

In answer to the second criticism of CGE models, it must be recognized that all empirical models are necessarily complex, some more than others. The process of model building, however, is as important as the model itself, in the sense that it forces the team of analysts to think consistently about the economy and hence be able to trace the various effects through their linkages. Ultimately what counts is not whether a model is complex or not, but rather how well it can analyze the questions at hand. For the type of questions in need of analysis in the context of adjustment and the poor, there is no other known consistent empirical methodology that can be applied to the task. Hence the issue is not whether one should use CGE models versus some other type of model, but rather what type of model within the CGE class is the simplest, most economical and most reasonable one to use given resources, data and time constraints.

4. STRUCTURE OF THE ONE PERIOD MODEL

In this chapter the one period balance part of the proposed model is presented in a general form in order to give the reader an overall idea about the structure and logic of the macro-micro framework.

Figure 4.1 presents in a diagrammatic form the main blocks of the model. The flow of information starts by assuming values for a set of stock variables such as population, numbers and types of households, wealth in its various forms and its distribution etc. The values of these variables, the "starting conditions" or "initial values" for the economy, along with exogenous variables determine the "flows" in year t. These flows in turn are determined as follows.

First the production decisions are made assuming a set of initial prices or other market equilibrium signals. Production decisions determine the employment of factors such as labor and capital, and determine the total value added produced. The value added is subsequently distributed to the various institutions such as households, firms and the government, which in turn make consumption, and savings-investment decisions. All these decisions, along with export demand, sum up to the total demand for domestic goods and factors. Comparing this with domestic supplies of goods and factors, one arrives at excess demands for commodities and factors. Import demand is determined by production as well as consumption and investment decisions. Along with demand for exports, these determine the

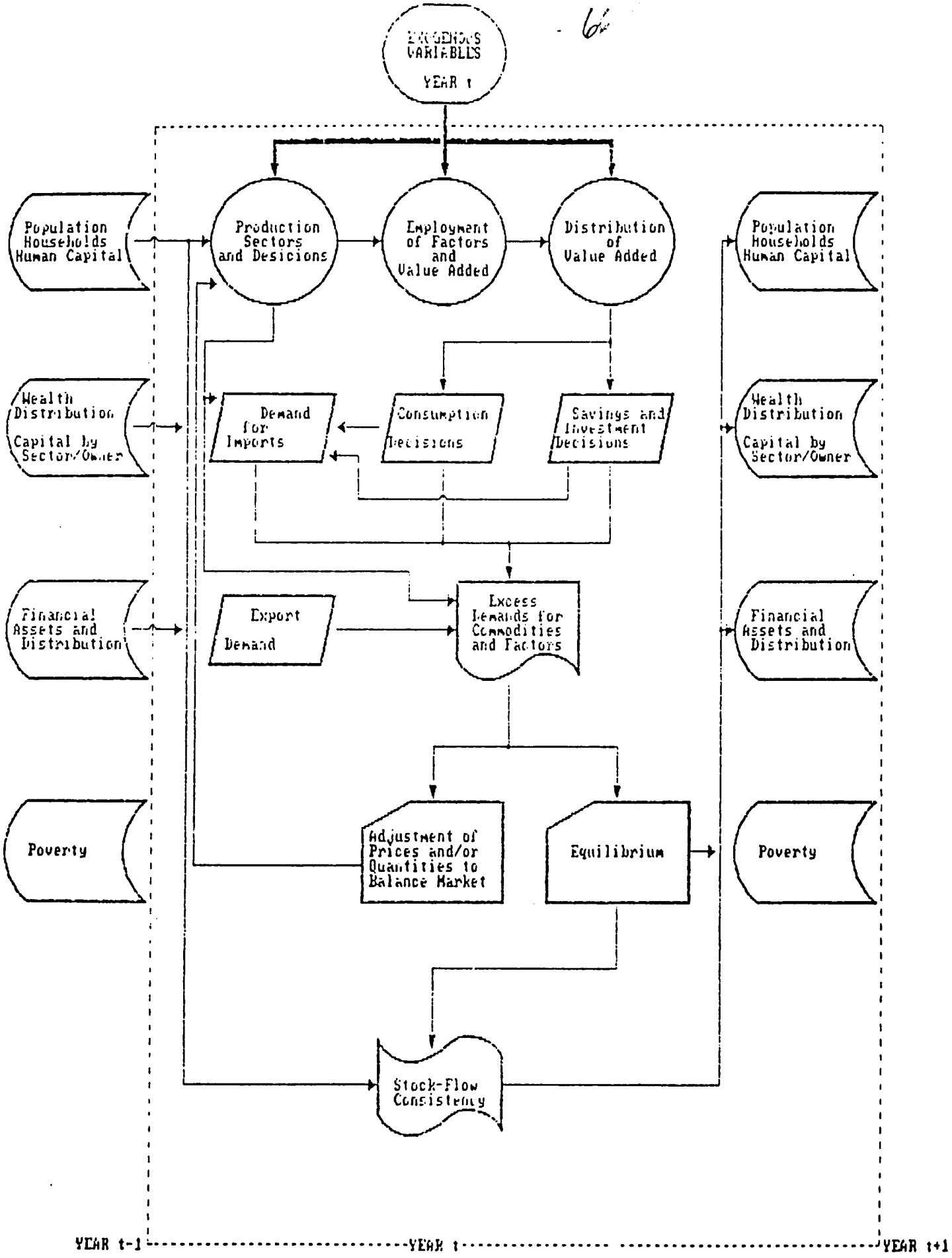

FIGURE 4.1 : The Model in Block Form

excess demand for foreign exchange. The excess demands are brought to zero and the various markets are balanced by a series of market adjustment rules, the closure rules of the model. Once equilibrium is achieved, the stock variables can be updated in order to start another simulation of the next period. Macro as well as micro stock-flow consistency is achieved at this stage. The equilibrating variables do not have to be prices. They could be quantities as well. It is the structure of the various markets and their behavior that is the heart of the model. A description of the various blocks is given in this chapter.

4.1. Stock Variables

Stock variables are those that are kept constant during any period but change from period to period. They are of three major types, namely demographic ones, those related to physical capital and wealth, and those related to financial assets. Each one of these is taken up in turn.

4.1.1. Demographic Variables

Since the basic focus of the analysis is the household, one of the most important aspects of modeling is to adequately classify households so that on the one hand, they are as homogeneous as possible, but on the other they can adequately correspond to classes where some descriptive data can be obtained.

In previous CGE models (e.g. Adelman and Robinson (1978),

Ahluwalia and Lysy (1979), Taylor et.al (1980), Kuwenaar (1988)), there has been considerable disaggregation of the data to reflect many classes of households. This was justified in those models since their main concern was income distribution. However, as Kuwenaar (1988) illustrates, in a recursive dynamic CGE the number of households in each class has to be updated from period to period, and this involves complicated modeling of several hXh transition matrices, where h is the number of the classes of households, for wealth ownership, household size, composition, education etc. Clearly if h is large the job of updating becomes extremely data demanding, and hence h should be kept at the lowest possible level.

The next problem in household model specification is to decide the basis on which to classify households. In most CGE models with detailed distribution of income, households have been classified by the occupational category of the head of the household. However, occupations of household heads change dynamically, and it is more appropriate to use a classiffication that is based on something inherently more permanent such as level of education. For the rural areas the size of landholding is probably a better classifier. In any case the criteria of classification should be at a minimum homogeneity with respect to household income, and consumption behavior. In the context of SSA a minimum household classification should include at least three rural classes (small land operators, medium and large land operators, and non-agricultural rural households). For the urban areas a

minimum of two types of households are needed (those with head of household illiterate or low education (primary school or less), and those with medium and upper education head of household). Of course if data allows, this classification could be expanded.

Once households are classified, the next set of variables that must be specified is the endowment of each household class with workers of different types. The types must be such as to reflect skill and educational level. As a minimum four classes of labor must be specified: Highly skilled and professional labor (managers, teachers, professionals etc.), medium skilled labor (technicians, skilled blue collar, etc.), low skilled labor (artisans, construction workers, tailors, carpenters, traders etc.), and unskilled labor (most agricultural operators, agriculture workers, unskilled urban labor, street hawkers etc.). The classification should be such that a worker of one type needs education or training to move to another class. Hence movement of labor within a class is not difficult but from class to class is nearly impossible in the short run. Notice that the way household types and labor categories are specified reflects the human capital endowment of households and the country as a whole.

4.1.2. Capital and Wealth Distribution

There are three types of physical productive capital in the model. First there is capital specific to each activity that is used for production, such as machines, buildings, work

animals etc. The value of this type of capital constitutes the equity of enterprises which in turn is owned by households, after the amount owed to financial institutions is netted out.

The second type of capital is owned directly by households and is non-productive such as houses, jewels, consumer durables, non-work animals etc. While information on this type of capital ownership can probably only be had in a qualitative manner, it is quite important from a household viewpoint since it constitutes the most important part of most households' wealth. This type of capital in a developing country inflationery context, is probably more important as a user of household savings than any other type.

The third type of capital that is important for production as well as investment is productive and social infrastructure capital. The existence of roads, irrigation, experiment stations etc. for instance, enhances agricultural production. The existence of electricity, communications etc. enhances industrial production. The existence of education facilities improves human capital, while health facilities increase the availability of productive labor. These types of capital have in almost all cases deteriorated substantially before the onset of adjustment programs in SSA, and they are one of the key objectives of reform. Their linkages with production and human capital development are quite important in the medium run.

4.1.3. Financial Assets

Table 3.2 in the previous chapter indicated the main types

of assets for each type of institution in the economy. The main types of financial assets of households are domestic money (cash and deposits), and foreign money. Firms also hold money basically for working capital needs. The total amount of money in the economy is, of course, generated by the government through public deficits and external borrowing. Thus, the public deficit is the main avenue through which the money stock changes in the economy.

4.2. Macro Constraints and Stock-Flow Consistency

Stock-flow consistency implies that the change in the various stock variables within a period is equal to the flows that are generated in the balanced accounts of the economy within the period the so-called "equilibrium". This consistency is basically what links the flow of funds and monetary accounts to the real part of the economy. The nature of the relevant identities is explored below.

The national income identity in domestic currency can be written ex-post, namely after equilibrium in period t has been achieved, as follows (all flows are indexed by t, a period index, while a stock variable indexed by t denotes its value at the end of period t.

$$C_t + I_t + G_t + (VEX_t - VM_t - TR_t) = C_t + S_t + T_t \qquad (4.2.1)$$

where C_t - aggregate private consumption expenditures

I_t - aggregate gross private domestic investment

G_t - total government spending (current consumption plus investment)

VEX_t - domestic value of all exports

VM_t - domestic spending for imports

TR_t - domestic value of net transfer payments abroad

S_t - private savings

T_t - aggregate domestic tax receipts

The left hand side is GNP at market prices, and reflects the pattern of expenditures on domestic output while the right hand side shows the sources of expenditures.

The above identity can also be written as follows.

$$G_t - T_t = (S_t - I_t) + (VM_t + TR_t - VEX_t) \qquad (4.2.2)$$

This form is the familiar aggregate savings-identity balance equation. The parenthesis in the left hand side of (4.2.2) denotes the current government total deficit (on current plus capital account), while the first parenthesis on the left hand side is the excess of domestic private savings over investment, and the second denotes the domestic value of the current balance of payments deficit. Equation (4.2.2) illustrates that the domestic fiscal deficit must be balanced by an excess of domestic private savings over investment and "foreign net savings" namely foreign capital inflows.

Turning to the sources of finance of the various elements of (4.2.2), and keeping in mind the balance sheets of the various institutions in the economy in Table 3.2, the following can be noted. First the external deficit can be financed by running down net foreign exchange reserves and by an increase in the foreign debt, namely by increasing total foreign liabilities.

$$VM_t + TR_t - VEX_t = e_t\ (\Delta FD_t^* + \Delta FDI_t^* - \Delta R_t^* - \Delta F_t^*) \qquad (4.2.3)$$

where e_t - exchange rate in period t

Δ - difference operator ($\Delta X_t = X_t - X_{t-1}$)

FD_t^* - end of period t stock of external debt

FDI_t^* - stock of outstanding total foreign direct investment at the end of period t

R_t^* - end of period t stock of official foreign exchange reserves

F_t^* - end of period t stock of foreign money holdings of domestic institutions except government

(all variables that are starred denoted that they are valued in foreign currency).

In most SSA countries holdings of foreign money by domestic residents is not formally allowed so that F^* would be equal to zero. Similarly, if official foreign exchange reserve holdings and foreign direct investment are small, the terms R_t^* and FDI_t^* would also be zero. In the sequel R_t^* and F_t^* will be set to zero for simplicity. This implies that equation (4.2.3) reduces to

$$VM_t + TR_t - VEX_t = e_t\ (\Delta FD_t^* + \Delta FDI_t^*) \qquad (4.2.4)$$

Under these conditions the only source of financing a balance of payments deficit would be by increasing the official external debt (public and private).

Notice that if there is an unofficial parallel market for foreign exchange, then the stock-flow balance identity in that

market would be consistent with the balance equation (4.2.3) but of the form

$$VM_t^p + VTR_t^p - VEX_t^p = - e_t^p \, \Delta F_t^* \qquad (4.2.5)$$

where the superscript p denotes parallel market transactions by domestic residents. A positive value for ΔF_t^* in this case means that domestic residents are accumulating foreign currency (deposits in foreign accounts) by conducting parallel exports, or receiving other foreign exchange transfers and using the proceeds on the one hand to bring in parallel imports or to keep more money abroad.

The public deficit in an economy of the SSA type, without direct sales of bonds to the public, can be financed either by creating high powered money or by net external borrowing.

$$G_t - T_t = \Delta H_t + e_t \Delta FD_t^* \qquad (4.2.6)$$

where H_t - stock of high powered money (currency in circulation plus commercial bank reserves)

To obtain a better picture of the way the private sector finances its excess of savings over investment, Table 4.1 presents in a tabular form the balance sheets of commercial banks, domestic firms, and households as outlined earlier in Table 3.2. The total savings and investment expenditures of the economy can be split into firms' savings-investment expenditures and household savings-investment expenditures.

$$S_t - I_t = (S_{ft} - I_{ft}) + (S_{ht} - I_{ht}) \qquad (4.2.7)$$

where the subscripts f and h denote firm and household specific

Table 4.1

Balance Sheets of Non-Government Institutions

Assets	Liabilities
Commercial Banks	
Bank Reserves BR	Deposits from Firms D_f
Loans to Firms L_b	Deposits from Households D_h
Loans to Households L_h	
Firms	
Physical Capital p_K K	Loans from Banks L_b
Deposits with Banks D_f	Loans from Households (Equity) E_h
Cash C_f	Loans from Abroad (Foreign Equity) E^*
Households	
Loans to Firms (Equity) E_h	Loans from Banks L_h
Deposits with Banks D_h	Household Wealth W
Durable Assets p_A A	
Cash C_h	

variables respectively. From the balance sheets of Table 4.1 it follows that the excess of firm and private household savings over their investment are equal to the following expressions

$$S_{ft} - I_{ft} = \Delta C_{ft} + \Delta D_{ft} - \Delta L_{bt} - \Delta E_{ht} - e_t \, \Delta E_t^* \qquad (4.2.8)$$

$$S_{ht} - I_{ht} = \Delta C_{ht} + \Delta D_{ht} + \Delta E_{ht} \qquad (4.2.8)$$

Equation (4.2.8) indicates that if firms invest more than they save, they must finance it by borrowing from banks, households and abroad, after allowing for an increase in their liquid capital (cash and deposits). Equation (4.9) in turn indicates that excess savings of households (over their investment in durable non-productive capital) must go to cash, bank deposits and to increase firm equity.

Summing (4.2.8) and (4.2.9) yields

$$S_t - I_t = (\Delta C_t + \Delta D_t - \Delta L_t) - e_t \, \Delta E_t^* \qquad (4.2.10)$$

where C_t - the outstanding stock of currency in the economy at the end of period t

D_t - the stock of end of period t private banks deposits

L_t - the stock of outstanding bank loans to firms and households at the end of period t

In other words the excess of private savings over investment must equal the sum of the two terms on the right hand side of equation (4.2.9). However, the balance sheets of Table 4.1 yield that the parenthesis on the right hand side of (4.3.10) is nothing but the change in the stock of high powered money.

$$\Delta C_t + \Delta D_t - \Delta L_t = \Delta BR_t + \Delta C_t = \Delta H_t \qquad (4.2.11)$$

The last identity in (4.2.11) is just the definition of high-powered money or money base.

If one substitutes equation (4.2.10) and (4.2.4) in the savings-investment identity (4.2.2), one obtains equation (4.2.6). In other words equations (4.2.4), (4.2.6) and (4.2.10) are consistent with the flow equilibrium national accounts identity (4.2.1) or (4.2.2). This gives a direct linkage between the real flows and the changes in the financial stocks.

The changes in the value of the stocks of firm and household capital (including depreciation), of course, must be equal to the flows of firm and household gross investment expenditures.

$$p_K \, \Delta K_t + DEPR_{Kt} = I_{ft} \qquad (4.2.12)$$

$$p_A \, \Delta A_t + DEPR_{At} = I_{ht} \qquad (4.2.13)$$

where p_K and p_A are the prices of new capital of type K and A, and $DEPR_{it}$ $i = K, A$ is the value of depreciation in firm and household capital stock in period t. A similar equation will hold for public sector capital.

$$p_G \, \Delta K_{Gt} + DEPR_{Gt} = I_{gt} \qquad (4.2.14)$$

where K_{Gt} - outstanding stock of public sector capital at the end of period t

$DEPR_{Gt}$ - value of depreciation of public sector capital

I_{gt} - public capital investment expenditures in year t.

The equations written up to now are just accounting and consistency identities. They provide the overall macro constraints to the economy that have to hold ex-post. The whole point about macroeconomic management and adjustment is exactly how this balance is brought about, in other words what are the rules that bring about the national income identity (4.2.1) or equivalently the national savings-investment identity (4.2.2). This, however, is where the real side of the model must be brought in.

4.3. Activities and Production

The types of activities assumed in a model must reflect the important features of the economy from a poverty perspective as well as from a stabilization and adjustment one. A feature, however, tha will be emphasized here and which is relatively novel to CGE adjustment type of models is the duality inherent in most producing sectors in SSA. For example the small farmers usually produce with a technology substantially different from that of larger "modern" farmers. Similarly food processing can be done in small informal sector units utilizing very simple technology as well as large factories. It is suggested that this duality of production is a more crucial feature of an economy in the context of SSA, than the det led breakdown into many sectors. Hence the emphasis in building a model should not be placed upon achieving a very detailed breakdown of the economy, but rather on understanding the duality within each sector. This will be illustrated

shortly.

The types of activities that seem appropriate to distinguish in a "minimum" adjustment model for a SSA are the following:

1. Major traded staple foods (rice, maize, etc.).
2. Other major staple food crops (cassava, yams, plantains, etc.).
3. Major other traded agricultural products (coffee, cocoa, cotton, sugar, palm oil, etc.).
4. Other agriculture (fruits and vegetables, livestock and dairy production, etc. possibly including fishing).
5. Extractive industries and forestry.
6. Food processing.
7. Manufacturing.
8. Utilities.
9. Construction.
10. Public services.
11. Other services.

Obviously these could be expanded or contracted depending on available data. Assume that there are n activities of which m produce agricultural products. Activity n+1 will denote the non-competitively imported good.

Consider now a given production activity denoted by j. Table 4.2 indicates the type of SAM column accounting that is envisioned in the model proposed here for this activity. The first column in the table is a standard expenditure column for an activity j with the total value of production $p_j x_j$ split

Table 4.2

Desired SAM Accounting for Production Activity j

Receipts	Expenditures: Total	Modern (Formal)	Unincorporated (Informal)
Intermediate Input i (i=1, ..., n+1)	$p_{ij}\ X_{ij}$	$p^m_{ij}\ X^m_{ij}$	$p^u_{ij}\ X^u_{ij}$
Indirect taxes	$t_j\ p_j\ X_j$	$t^m_j\ p^m_j\ X^m_j$	$t^u_j\ p^u_j\ X^u_j$
Returns to Wage Labor of Skill Level s (s=1, ..., S)	$w_s\ L_{sj}$	$w_s\ L^m_{sj}$	$w_s\ L^u_{sj}$
Returns to Self Employment of skill level s (s=1, ..., S)	$w_s\ LS_{sj}$		$w_s\ LS_{sj}$
Returns to Unincorporated Capital	Π^u_j		Π^u_j
Returns to Corporate Capital	Π^m_j	Π^m_j	
Total	$p_j\ X_j$	$p^m_j\ X^m_j$	$p^u_j\ X^u_j$

Notation

p_{ij} - price for intermediate product i paid by activity j

X_{ij} - quantity of intermediate input i purchased by sector j

t_j - indirect tax rate for sector j

w_s - wage rate for labor of skill level s

L_{sj} - employment of labor of skill level s in activity j

LS_{sj} - self employment of skill level s in activity j

Π_j - gross profits of activity j

m, u - superscripts denoting variables relevant to the modern and unincorporated sectors respectively.

among payments for intermediate inputs $p_{ij} x_{ij}$ (i=1, ..., n+1) (these payments are net of subsidies and this is why the price p_{ij} is not just p_i), indirect taxes, and valued added, which in turn is broken down into returns to wage (by skill type), returns to self employment (by skill type), labor, as well as gross operating surplus of unincorporated and corporate capital.

The next two columns in the table break the aggregate column into two columns corresponding to production by incorporated business units or what will be termed the "formal" or "modern" sector, and production by unincorporated units or the "informal" sector. While this classification might at first glance appear difficult to implement (and no doubt some judgement in the breakdown of the numbers will be needed), it might be thought of as the distinction between the "traditional" and the "modern" segments of an industry or between "small" and "larger" units (this might be relevant for agriculture). All public sector corporations would be classified in the formal sector.

Notice that while the column corresponding to a given activity in the SAM can be disaggregated to reflect the different technology and production behavior of the informal and modern sectors, the corresponding row of the SAM, that denotes uses of the commodity produced does not have to be disaggregataed. For instance a crop like cocoa could be produced by estates using purchased input intensive technology and by smallholders using traditional technology. While in

their production behavior the two modes of activity are different, they probably do not differ much in terms of the final product market characteristics.

The interaction between the unincorporated and the modern sectors is probably one of the most interesting but most understudied phenomena in the context of SSA economies. This is not only because the informal sector, including agriculture, constitutes usually more than half of the economic activity in SSA, but also because fluctuations in the activity of one segment could lead to similar or compensating fluctuations in the other. Kuwenaar (1988) in his model for Equador, for instance, assumed that self employment and the surplus of the informal sector were proportional to the overall level of the sector's activity. In other words the informal and formal sectors fluctuate together, or are perfect complements. However, it could be that informal and formal sector activity levels are substitutes in the sense that growth in the activity of one part of the sector implies relative decline in the share of the other. In order to analyze this, however, a mechanism must be specified that apportions the overall activity level.

Notice that in the accounting of Table 4.2, one can allow for different producer prices in the two parts of the sector. This is done because the modern part of a sector could operate with a different price, for instance a fixed or a mark-up price, while the informal sector could be operating under free market conditions with flexible price. In fact this is most likely to be the typical structure of most "mixed" sectors

(namely having both formal and informal segments) in SSA.

Production of an activity (the superscripts will be dropped for simplicity) will be given by a production function of the form

$$X_j = PR_j\ (GS_{jt},\ t)\ f_j\ (N_j,\ L_j,\ K_j) \qquad (4.3.1)$$

where N_j - index of intermediate inputs to activity j

L_j - index of labor utilized by activity j

K_j - index of capital utilized by activity j

$PR_j\ (\cdot)$ - productivity parameter

GS_{jt} - flow of public productive services relevant for production of sector j.

Of the three inputs outlined in (4.3.1) the capital input is considered fixed in the short-run. In other words the putty-clay assumption on capital is made. The flow of public productive services, depends on the existing stock of public capital relevant for sector j, as well as the level of current government expenditures for sector j.

$$GS_{jt} = f\ (KG_{j(t-1)},\ GCE_{jt}) \qquad (4.3.2)$$

where $KG_{j(t-1)}$ - stock of infrastructure and other public capital relevant for production of sector j

GCE_{jt} - current public expenditures for production activities related to sector j.

By a specification such as (4.3.2) productivity in a sector does not only change exogenously, and this is the purpose of the existence of t in the expression for $PR_j\ (\cdot)$, but also as a function of the past capital investment of the

government, as well as the level of maintainance and operation of this investment, expressed by the variable GCE_{jt}. It might not be easy to implement the above specification empirically but it appears that it is worthwhile to attempt.

The notation (4.3.1) is quite general and can accomodate neoclassical as well as fixed coefficient production functions. At this point it is not necessary to be more specific as only a general overview is being presented.

The intermediate inputs will be assumed to depend on the level of production of the activity.

$$N_j = f\ (X_j) \tag{4.3.3}$$

Equation (4.3.3) implies that in the short run the level of activity depends entirely on the labor input. Under an assumption of short-run profit maximization and full capacity utilization, the labor demanded is determined by a function of the wage rate for sector j and the price for the product

$$L_j = f\ (w_j,\ p_j) \tag{4.3.4}$$

where w_j - wage index corresponding to the skill mix employed by sector j

p_j - producer price of activity j

If, on the other hand, the level of activity for the sector is demand determined under excess capacity, then the derived short-run demand for labor will depend only on the level of activity

$$L_j = f\ (X_j) \tag{4.3.5}$$

In practice there will be some sectors behaving according to (4.3.4) and some that will behave according to (4.3.5).

The interaction between the formal and informal part of a "mixed" activity j will be modeled as follows. Assume that the output of the activity can be written as an index of the activity levels of the two constituent subsectors

$$X_j = f\ (X_j^m,\ X_j^u) \tag{4.3.6}$$

To this output index there corresponds a price index

$$p_j = g\ (p_j^m,\ p_j^u) \tag{4.3.7}$$

such that

$$p_j\ X_j = p_j^m\ X_j^m + p_j^u\ X_j^u \tag{4.3.8}$$

The index in (4.3.6) includes as special case the simple additive form,

$$X_j = X_j^m + X_j^u \tag{4.3.6a}$$

in case the products of the two subsectors are perfect substitutes, or functional specifications such as CES (constant elasticity of substitution) or CET (constant elasticity of transformation) where the modern and formal subsectors are substitutes or complements, their outputs being considered as differentiated ones.

The specification (4.3.6)-(4.3.7) implies that the output of each subsector can be written as a function of the total output and both prices

$$X_j^k = f\ (X_j,\ p_j^m,\ p_j^u) \qquad k = m,\ u \qquad (4.3.9)$$

Suppose that the modern part of the sector is governed by mark-up pricing and output adjustment according to (4. .5), namely output adjusts to demand, while the informal part is governed by short run profit maximization a-la (4.3.4). In other words the formal part of the sector is a fix-price subsector, while the informal part is a flex-price one. Assume that equilibrium in the supply-demand balance for commodity j has determined the price index p_j as well as the aggregate quantity demanded X_j (the type of balancing mechanism does not matter at this point). Since p_j^m is known from the mark-up formula, the knowledge of p_j from the equilibrium solution, allows the determination of the flexible p_j^u from equation (4.3.7). Then equation (4.3.9) allows the determination of the output levels of both the formal as well as the informal part. The advantage of such a formulation compared with one where the formal as well as the informal parts are treated as producing two distinct commodities, is first that one saves rows in the SAM. In other words one does not have to specify separately the uses of the output of each subsector, a task that would be empirically quite difficult. Secondly, one can model explicitly the substitution or complementarity between the two subsectors, and hence could experiment with alternative assumptions.

If a sector j produces more than one commodity then the output of that sector X_j will be written as an index of the outputs of the various commodities.

$$X_j = f\ (x_{j1}, \ldots, x_{jk_j}) \qquad (4.3.10)$$

where x_{jk} - output of the k'th commodity produced by the j'th sector.

Since X_j is assumed to be produced directly by the production factors (re. 4.3.1) the multi-product formulation above is akin to an assumption of separability between inputs and outputs in production.

4.4. Labor Markets, Employment of Labor and Value Added

The functioning of the labor markets in the short run (namely within the one period equilibrium) is one of the most important features in any economy, and one of the crucial aspects of macro-economic adjustment. There are basically two ways in which labor markets have been modeled in previous CGE exercices. The first one involves setting the nominal wages for various occupational classes at fixed values and deriving the short run demands for labor by quantity adjustment, in a fashion similar to equation (4.3.5). The early work of Taylor et.al (1980), as well as the recent model of Kuwenaar are samples of that approach. The other approach to labor market adjustment involves equilibrium clearing of the labor market separately for each occupational category by varying the nominal wages so as to equate labor demands with labor supplies.

In a model where commodity prices are free to clear their markets, the former approach implies that real wages vary a lot

since commodity prices vary in the face of rigid nominal wages, while the other approach entails relatively stable real wages. This difference in labor market behavior leads to considerable difference in model behavior and has been the object of extensive discussion under the rubric of closure rules (see Taylor and Lysy (1979), and the accompanying papers in the same issue of the Journal of Development Economics). The underlying issues have to do with short-run ease of labor mobility across sectors. If labor can easily shift to fill in shortages, then the flexible wage labor market equilibrium is more realistic. If not, then the rigid nominal wage hypothesis is a better description of reality.

The view taken in the model proposed here is a mixed and eclectic one. For formal sectors and for labor classes that are in the upper echelons of skills it could be hypothesized that they are not easily shiftable, and hence fixed short-run nominal wages prevail with attendant quantity adjustment and possibly labor unemployment. For labor classes on the other hand in the lower skill levels, it seems more reasonable to postulate that there is a continuous and easy flux between sectors, so that in essence in such markets the nominal wage is flexible and dictated by supply and demand for labor.

Labor utilized in each sector will be defined by an aggregation function of different skill levels.

$$L_j = f\ (L_{1j}, L_{2j}, \ldots, L_{Sj}) \qquad (4.4.1)$$

where L_{sj} - labor employment of skill class s by sector j

This function will imply an index function for the sectoral wage level

$$w_j = f\ (w_1,\ \ldots,\ w_S) \tag{4.4.2}$$

where w_j - wage index for sector j

w_s - nominal wage for labor with skill s (s=1,...,S)

The total demand for labor by each sector will be determined by either a function like (4.3.4) for flex price sectors or a function like (4.3.5) for fix price ones. Given sectoral labor demand, the demands for individual skill categories can be derived as follows

$$L_{sj} = f\ (L_j,\ w_1,\ \ldots,\ w_S) \tag{4.4.3}$$

In deriving (4.4.3) the following aggregation condition will be observed

$$w_j\ L_j = \sum_{s=1}^{S} w_s\ L_{sj} \tag{4.4.4}$$

The numbers of self-employed by skill category will be assumed fixed for each sector within each period. These workers will receive, in addition to the market wage w_s for their skill class, which is their opportunity cost of labor, all the unincorporated profits generated in the flex price informal sectors. For sectors that have self-employed workers, if the labor demand for one skill category in equation (4.4.3) turns out to be smaller than the availability of self-employed workers there, then the number of self-employed becomes the labor demanded, and hence there is no excess supply of self-

employed labor. In other words it is assumed that if at the market wage there is excess supply of self-employed labor, this does not spill into other sectors.

With these assumptions the total labor demanded from occupational class s is equal to

$$L_s^d = \sum_{j=1}^{n} L_{sj}^m + \sum_{j=1}^{n} \max (L_{sj}^u, LS_{sj}^u) \qquad (4.4.5)$$

where L_s^d - total economy-wide demand for labor of skill class s

L_{sj}^m - demand for labor class s by modern sector j

L_{sj}^u - demand for labor type s by unicorporated sector j

LS_{sj}^u - fixed supply of self-employed of skill class s in unincorporated sector j.

For labor categories that are assumed to have flexible wages the labor market equilibrium condition is

$$L_s^d = \bar{L}_s - LE_s \qquad (4.4.6)$$

where $\bar{L}_s$ - fixed quantity of economy wide labor supply of skill level s at the beginning of period t

LE_s - amount of labor withdrawn from the labor market for education and training (see section 4.9 below).

For sectors that are assumed to exhibit unemployment, equation (4.4.5) yields the demand for labor of skill class s. Equations such as (4.4.6) lead to equilibrium nominal wages for as many skill classes as there are equations.

Up to now the discussion has not considered any kind of variability of wages and was done as if the wage received by a given labor type was the same in each activity. However, it is frequently observed that wages for the same skill class have substantial variability across sectors. In other words not all unskilled workers in different activities for instance get the same wage. Traditionally the way this effect has been handled is to postulate wage differentials for a given skill class specific to each sector. This can easily be handled in the framework above if specific constant wage differentials are postulated for the same skill class in different sectors, and the equilibrium conditions are solved for only the "base" wages. This, however, will not be pursued further here.

Equilibrium in the labor markets yields the wage employment of all types of labor. The total returns to wage labor are simply the sum of all wage payments (explicit or implicit for self-employed) in the economy.

$$VA_L = \sum_{j=1}^{n} VA_{Lj} = \sum_{j=1}^{n} \sum_{s=1}^{S} w_s L^d_{sj} = \sum_{s=1}^{S} w_s L^d_s \qquad (4.4.7)$$

where VA_L - aggregate value added due to returns to labor

VA_{Lj} - returns to labor in sector j

The gross profit of firms is equal to the gross value added minus the returns to labor.

$$\Pi_j = p_j x_j - VA_{Lj} = p_j x_j - \sum_{s=1}^{S} w_j L^d_{sj} \qquad (4.4.8)$$

where L^d_{sj} - demand for wage labor of skill class s by sector j

The gross profit is basically the returns to fixed factors and accrues to the producing enterprises which must decide how to dispose of it. Enterprises, however, are owned by the various institutions in the economy. Since the financial decisions are taken at the institutional level, an allocation of the gross profit to the various institutions must be done.

There are basically three types of institutions that share in the gross profits of activities, namely modern sector enterprises through ownership of corporate capital, the public sector, again through ownership of capital, and households through "ownership" of self-employed workers. The allocation will be done as follows

$$GOS_G = \sum_{j=1}^{n} \mu_{jG} (\Pi_j^m - INT_{Ej}) (1 - TDE_j^m) \qquad (4.4.9)$$

$$GOS_E = \sum_{j=1}^{n} GOS_{Ej} = \sum_{j=1}^{n} (1-\mu_{jG})(\Pi_j^m - INT_{Ej})(1-TDE_j^m) \qquad (4.4.10)$$

$$GOS_U = \sum_{j=1}^{n} GOS_{Uj} = \sum_{j=1}^{n} (\Pi_j^u - INT_{Uj}) (1-TDE_j^u) \qquad (4.4.11)$$

where GOS_i - Gross operating surplus of institution i where i= G, E, U for government, enterprises, and unincorporated self-employed individuals respectively

GOS_{Ej} - Gross operating surplus of modern sector enterprises of sector j

TDE_j^k - direct taxes on gross profits of modern sector j enterprises (k=m) or unincorporated firms (k=u)

μ_{jG} - share of modern sector j capital that is owned by the government (see below)

INT_{ij} - net interest and amortization payments of firms of type i (i=E,U) in sector j.

Notice that the factor "self-employed" in effect acts as though it is some type of productive capital, fixed in the short-run and owned by households. It receives the "profits" of all unincorporated sectors.

The reason for which the allocation of profits to institutions is aggregated as above, is that financial decisions are usually taken at the level of institutions, and furthermore financial data relevant for examining allocation decisions is most likely not bound to be available except at an aggregated institutional level.

Gross operating surplus accruing to the government and enterprises will be used for either retained earnings (namely gross savings of institutions), or distributed profits.

$$GOS_G = \sum_{j=1}^{n} GOS_{Gj} = RE_G \qquad (4.4.12)$$

$$GOS_i = \sum_{j=1}^{n} GOS_{ij} = \sum_{j=1}^{n} (RE_{ij} + DP_{Ej}) = RE_i + DP_i \qquad (4.4.13)$$

where

$$RE_i = \sum_{j=1}^{n} RE_{ij} \qquad (4.4.14)$$

$$DP_i = \sum_{j=1}^{n} DP_{ij} \qquad (4.4.15)$$

and GOS_{ij} - gross operating surplus of institution i (i=G,E,U) in sector j (these numbers are defined as the terms in the summations in (4.4.9)-(4.4.11))

RE_i - retained earnings of institution i (i=G,E,U)

RE_{ij} - retained earnings of institution i (i=E,U) in sector j

DP_i - total distributed profits of institution i (i=E,U)

DP_{ij} - distributed profits of institution i (i=E,U) in sector j

Notice that public enterprises profits are either all given to the government in which case the direct tax rates of (4.4.9) are equal to one, or are used as savings. In other words no distribution to households is done out of this surplus.

It is not clear that the full disaggregation indicated in equation (4.4.13) will be possible if data is not available at the sectoral level. Of the terms indicated above, distributed profits accrue as income to households while retained earnings are the enterprises' gross financial savings and, along with bank loans can be used for building up cash balances or investment. This is taken up below in the flow of funds section.

The division of gross operating surplus into retained earnings and distributed profits is a decision at the heart of any enterprise, but also at the heart of the closure rule debate in model building. Retained earnings will finance new

investment. Hence if a rule is specified that splits the gross operating surplus of firms into retained earnings and distributed profits which is independent of any other variable, for instance if RE_i is a fixed share of GOS_i, then savings are specified independently of desired investment decisions. The consequence is that actual realized investment will have to be such as to accomodate whatever savings are made available (by firms as well as the banks). If on the other hand desired and realized investment are specified without regard to availability of funds to finance it, then somehow savings and retained earnings must be flexible to accomodate it. The former view is typically regarded as neoclassical, while the latter as Keynesian in the closure rule debate. The approach that will be taken here is an intermediate one and will be described later.

4.5. Distribution of Value Added

The income that is distributed to households comes from the remuneration of wage labor, including the imputed wages of those self-employed, and the distributed profits of modern sector firms as well as unincorporated enterprises.

Consider Table 4.3 that presents in a tabular form the ownership matrix of various types of labor and capital by households. Each household class of type h (h=1,...,H) is endowed with given amounts of labor of skill s, of which an amount determined endogenously in the beginning of each period, is self-employed labor. As noted earlier capital is specific to each sector and the ownership matrix shows the ownership

Table 4.3

Household Ownership Matrix of Labor and Capital Assets

	Type of Asset											
	Wage Labor by Skill Class				Self-Employed Labor by Skill Class				Productive Capital by sector			
Household Type	1	2	...	S	1	2	...	S	1	2	...	n
1	L_{11}	L_{12}	...	L_{1S}	LS_1^1	LS_2^1	...	LS_S^1	K_{11}	K_{12}	...	K_{1n}
2	L_{21}	L_{22}	...	L_{2S}	LS_1^2	LS_2^2	...	LS_S^2	K_{21}	K_{22}	...	K_{2n}
.	.	.		.	.	.		.	.	.		.
.	.	.		.	.	.		.	.	.		.
.	.	.		.	.	.		.	.	.		.
H	L_{H1}	L_{H2}	...	L_{HS}	LS_1^H	LS_2^H	...	LS_S^H	K_{H1}	K_{H2}	...	K_{Hn}
Total Household Assets	L_1	L_2	...	L_S	LS_1^H	LS_2^H	...	LS_S^H	K_1^H	K_2^H	...	K_n^H
Government									K_1^G	K_2^G	...	K_n^G
Total	L_1	L_2	...	L_S	LS_1^H	LS_2^H	...	LS_S^H	K_1	K_2	...	K_n

pattern of each sector specific capital by household groups and by government for capital of the modern sector.

In most countries, and certainly in almost all countries in SSA, there is not enough statistical information to permit construction of a full detailed wealth ownership matrix of the type indicated in Table 4.3. Apart from some information on labor ownership by occupational categories based on household surveys, and some information on land ownership patterns based on agricultural census data, not much else is likely to be known. This is then one of the main reasons for keeping the number of household types, labor types, and sectors to the minimum possible so as to be able to allocate capital ownership on the basis of indirect information.

Table 4.4 indicates the type and amount of value added that is to be distributed to the various factor owners. Distribution of wage labor income presents no problem as households of a given type share in proportion to their availability of that type of labor.

$$YW_h = \sum_{s=1}^{S} w_s \, (L^d_{hs} + LS^h_s) \qquad (4.5.1)$$

where YW_h - wage income (realized and imputed), of household type h (h=1,...,H)

L^d_{hs} - amount of labor of skill s that is employed (demanded), and belongs to household type h (s=1,...,S), (h=1,...,H)

LS^h_s - amount of self-employed labor of skill type s that

belongs to household type h (s=1,...,S), (h=1,...,H).

Table 4.4

Value Added to be Distributed to Factor Owners

Value Added to be Distributed		Factors whose Owners will Receive Value Added	
$w_s L_s^d$	(s=1,...,S)	L_s, LS_s	(s=1,...,S)
DP_{Ej}	(j=1,...,n)	K_h^H	(j=1,...,n)
DP_{Uj}	(j=1,...,n)	LS_s	(s=1,...,S)

Households will receive income only from the portion of their labor that is actually employed. This in turn will be determined by the overall employment rate of labor of that skill class.

$$L_{hs}^d = \frac{L_s^d}{L_s^a} \cdot L_{hs} \qquad (4.5.2)$$

where L_s^d - was defined in (4.4.5) and is the amoung of labor of skill class s that is demanded in the current period. L_s^a is the total labor of skill s that is available for wage employment in the given period. By reference to Table 4.3 this is equal to

$$L_s^a = L_s - L_{sE} = \sum_{h=1}^{H} (L_{hs} - LE_{hs}) \qquad (4.5.3)$$

where L_{hs} is the amount of labor of skill s owned by household type h, and LE_{hs} is the amount of labor of skill s from household type h that is being withdrawn from the labor market for education and training.

The allocation of modern sector distributed profits of enterprises to the households can be done in a way similar to the one done above for labor income.

$$YDP_{Eh} = \sum_{j=1}^{n} \frac{K_{hj}}{K_j^H} DP_{Ej} \qquad (4.5.4)$$

where YDP_{Eh} - income form distributed profits of enterprises received by household type h

K_j^H - amount of sector j's capital owned by households (= $(1-\mu_{jG})\ K_j$ re. equations (4.4.9)-(4.4.10)).

The allocation of distributed profits of the unincorporated sector will can done in a more involved fashion. First the distributed profits of each unincorporated sector will be distributed to the various categories of labor skills according to their contribution to the "value" of skilled labor utilized in that sector

$$DP_{Ujs} = \frac{w_s LS_{sj}}{\sum_{s=1}^{S} w_s LS_{sj}} DP_{Uj} \qquad (4.5.5)$$

where DP_{Ujs} - distributed profits to skill class s out of unincorporated distributed profits of informal

sector j

LS_{sj} - amount of labor of skill type s self-employed in unincorporated sector j.

The self-employed of skill type s will receive the following total distributed profits from all informal sectors

$$DP_s^U = \sum_{j=1}^{n} DP_{Ujs} \tag{4.5.6}$$

where DP_s^U - total amount of distributed profits from informal sector activities received by self-employed of skill class s.

Household income from unincorporated profits will be determined as follows

$$YDP_{Uh} = \sum_{s=1}^{S} \frac{LS_s^h}{LS_s} DP_s^U \tag{4.5.7}$$

where YDP_{Uh} - income of household type h, from all unincorporated distributed profits

LS_s^h - supply of self-employed individuals of skill level s from household type h

LS_s - total supply of self-employed of skill class s.

Total current income received by all households of type h in the given period will be given by the following simple formula

$$Y_h = YW_h + YDP_{Eh} + YDP_{Uh} + TR_h + INT_h \tag{4.5.8}$$

where TR_h - direct transfers to household type h from the government, from abroad, and possibly from other

types of households

INT_h - net interest income from deposits with banks or loans to other households.

The last type of income, namely income from ownership of financial assets will be discussed later.

Apart from the current income flows summarized in (4.5.8) there are two major imputed income flows that conceptually form part of household income. The first concerns imputed rent on owner occupied housing and services of other durables and wealth items (automobiles etc.). The second involves the foregone income of those in the family that are being educated. In countries in SSA both income streams are bound to be important especially for low income people. The imputed income from rents is all consumed since it represents the value of rendered services. The second type of income must be treated as part of investment in human capital and be counted as part of total savings. With these conventions a concept of "full income" could be defined as follows

$$YF_h = Y_h + HR_h + YE_h \qquad (4.5.9)$$

where YF_h - full income of households in class h. It is equal to the potential income that all assets in the household human and non-human can earn

HR_h - value of "housing" rental services

YE_h - foregone income of those being educated.

If for instance a certain amount LE_{hs} of potentially employable labor of skill s belonging to household class h is

being educated or trained, then the foregone income YE_h would be equal to

$$YE_h = \sum_{s=1}^{S} w_s \, LE_{hs} \tag{4.5.10}$$

Notice that the larger is YE_h, the smaller is Y_h, but YF_h depends only on total assets. As far as the value of services obtained by non-productive household assets is concerned, it could be determined as follows. Let the beginning of period outstanding stock of such assets be $A_{h(t-1)}$ and their current market price be PA_t. Assume that the asset lasts T periods, and that there is a discount rate i inherent in valueing the services of these assets. Then

$$HR_{ht} = \frac{PA_t \, A_{h(t-1)}}{h(i)} \tag{4.5.11}$$

where

$$h(i) = 1 + \frac{1}{1+i} + \ldots + \frac{1}{(1+i)^{T-1}} \tag{4.5.12}$$

and PA_t is the current price of asset A. Notice that since PA_t will depend on current year prices, the flow of rental services will be endogenous in period t.

The price of new assets A will depend on commodity prices in the following manner.

$$PA_t = \sum_{j=1}^{n+1} BA_j \, p_{jt} \tag{4.5.13}$$

where BA_j are coefficients like the capital coefficients. Notice that since all non-productive capital of households is assumed to be of the same type there is only one "column" of these coefficients. If the non-productive physical asset holdings of different household classes are vastly different, then different columns of BA_j for each household class will be necessary.

4.6. Generating the Number of Households with Income below the Poverty Line

There are several ways to generate the distribution of household incomes and the numbers of households below poverty. Two of these will be outlined below.

The first procedure is based on assuming that the wages received for each skill class are not the same but they follow a wage distribution, and that the distributed profits also follow some distribution.

Assume that the wages received by labor of skill class s are random drawings from a distribution with density function $f_s(w)$. Similarly assume that the distributed profits from formal sector enterprises in sector j are random drawings from a distribution with density $f_{Ej}(DP_{Ej})$, and that the distributed profits from informal sector enterprises are drawings from a distribution f_{Uj} (DP_{Uj}).

Assume that there are N_h households in class h and that the average size of household is M_h. Then the per household average wage income in household type h will be equal to

$$YWH_h = \frac{YW_h}{N_h} \qquad (4.6.1)$$

where YWH_h - per household wage income of household type h. The variable YW_h (total wage income of household type h) was defined in (4.5.1). The per household income from distributed profits to rural enterprises, unincorporated capital, and transfers can similarly be defined by dividing the variables YPD_{Eh} and YPD_{Uh} derived in (4.5.4) and (4.5.7) as well as the variable TR_h in (4.5.8) by the number of households N_h. For the poverty calculation the inclusion of the full income concept would have been more appropriate, but it is not clear whether it will be feasible in a given context. If it is, then it is that that could be used. In the remainder of this section only the more restricted apparent income is used.

Using the distributions mentioned above, which can be derived from independent studies and assumed constant, will yield with the help of the allocation formulas (4.5.1), (4.5.4) and (4.5.5)-(4.5.6) (where in (4.5.5) the average wages are utilized), a distribution of household income for household class h. Using a poverty line such as the one discussed in section 2.6 multiplied by the average household size M_h, will allow the determination of the number of households in class h below poverty. The same distributions of wages and distributed profits can be used to derive a different distribution of household income for each household class, thus allowing a calculation of the number of poor households in each household category.

A simpler and perhaps more practical way to do the same thing would be to compute for each household class an empirical distribution of per capita or per household consumption expenditures based on household budget data, and use it, translating only the average expenditure to correspond to the per household income computed above, to compute for each household class the number of poor households. The problem with such an approach is that unless the household survey has split households in the classes desired for the model, it might be necessary to go to the primary raw data to reconstruct distributions according to the desired household classifications.

4.7. Private Consumption

Once average household, and per capita incomes are determined, consumption follows a two stage process. In the first a consumption-savings decision must be made, and then the decided current consumption expenditures must be allocated to purchases of various commodities.

Denote the per capita full income in a given household class h by $YFPC_h$. Let total consumption expenditures be denoted by YC_h. Then following the permanent income hypothesis a reasonable type of consumption function to postulate is the following

$$YCPC_h = YCP_h + (1-s_h)\ (YFPC_h - YCP_h) \qquad (4.7.1)$$

where $YCPC_h$ - per capita consumption expenditures of a house-

hold of type h

YCP_h - per capita consumption out of "permanent income" of household class h

$YFPC_h$ - per capita full income of household class h

s_h - marginal savings rate of household class h.

The parameter YCP_h could be set constant for the empirical specification of the model. If one desires to become more sophisticated, permanent consumption YCP_h could be made a function of per capita household wealth (including perhaps the value of the stock of human capital in the income group). Since changes in wealth will be endogenous in the model this specification offers a natural way to update dynamically the parameter YCP_h. However, in many applications this specification will not be empirically feasible since wealth will not be possible to measure. Other consumption or savings equations are of course possible.

Since the consumption services of housing and other durables are rendered out of ownership of a particular asset, whose use can stop only by sale, it follows that imputed rents and other such services should be made part of permanent consumption. On the other hand the foregone income of those being educated should be counted as part of investment out of current savings. This for instance implies that if by some external shock, current income fell to a low level, some of those in the household who are being educated might have to stop and engage in productive activities in order to contribute to family income.

Once per capita consumption is determined via (4.7.1), the allocation to purchases of various commodities can be made using any of the standard demand systems such as for instance the Linear Expenditure System (LES) (for a review of appropriate systems see for instance Deaton and Muellbauer (1980)). Denote by p_{dk} the consumer price of the k'th commodity where

$$p_{dk} = p_{ck} (1 - s_{dk}) \qquad (4.7.2)$$

where p_{dk} - final consumer price of item k (k=1,...,K)

p_{ck} - price of "composite commodity" k (more on this below)

s_{dk} - ad-valorem consumption subsidy rate for commodity k

Then the private consumption demand for composite commodity k by household class h will be given by a function of the type

$$QCP_{hk} = N_h M_h QCPC_{hk} = f (YCPC_h, p_{d1}, \ldots, p_{dK}) \qquad (4.7.3)$$

where N_h - number of households in class h

M_h - average size of household in class h

QCP_{hk} - total private demand by households of type h for composite commodity k

$QCPC_{hk}$ - per capita consumption demand by households of type h, for composite commodity k.

A LES system, for instance, would give the following per capita demand functions

$$QCPC_{hk} = \bar{Q}\bar{C}\bar{P}\bar{C}_{hk} + \frac{m_{hk}}{p_{dk}} (YCPC_h - \sum_{k=1}^{K} p_{dk} \bar{Q}\bar{C}\bar{P}\bar{C}_{hk}) \qquad (4.7.4)$$

where m_{hk}, $\bar{Q}\bar{C}\bar{P}\bar{C}_{hk}$ are parameters.

Notice that the number of commodities K demanded for consumption by private consumers does not have to be the same as the number of sectors. This could be for instance because a particular sector could produce more than one commodity which the analyst wishes to include in final consumption. A typical example in SSA might involve the major traded staple foods sector, which for SAM accounting and production specification might be kept as one sector but for consumption purposes might have to be disaggregated. Similarly some sectors whose outputs that are kept separate for production, might combine at the final demand stage to form more aggregate products.

The prices p_{ck} of the composite final commodities are formed as follows. First, from the production block the producer price of the output of a given sector j was denoted earlier by p_j. If the sector produces more than one commodity then let p_k denote the price of one of these commodities. The price p_k must be adjusted by some trade or processing margin to translate it to a price that reflects the one that final consumers pay for this domestically produced commodity.

$$p_{cdk} = p_k (1 + trd_k) \qquad (4.7.5)$$

where p_{cdk} - consumer price of domestic commodity k

trd_k - trade margin as a proportion of producer price for commodity k.

The margin $trd_k \cdot p_k$, when multiplied by the amount of domestically produced commodity that is demanded by final consumers,

yields a flow which in the SAM would be accounted for by an item for final demand for the product of the sector "trade".

The commodity, however, the final consumer will demand will be a composite of the domestically produced commodity and a similar but differentiated commodity which is competitively imported. By now this "Armington" type of specification is fairly standard and convenient in CGE models (see Dervis et.al (1982)). It implies that the price p_{ck} defined in (4.7.2) can be written as follows

$$p_{ck} = f\ (p_{cdk},\ p_{cmk}) \qquad (4.7.6)$$

where p_{cmk} - domestic price of commodity k imported competitively and differentiated from the domestically produced commodity k.

Underlying (4.7.5) is an assumption that the composite commodity can be written as an index (traditionally a CES one) of the commodity that is domestically produced and imported.

$$QCP_k = f\ (QCPD_k,\ QCPM_k) \qquad (4.7.7)$$

where QCP_k - quantity index of composite commodity k

$QCPD_k$ - quantity of domestically produced commodity k

$QCPM_k$ - quantity of imported differentiated commodity of type k.

Given the differentiated product specification the demand for the domestically and imported products for final private demand can be derived by postulating that consumers minimize the cost of procuring a given amount of the composite

commodity. The result is functions of the following type

$$QCPD_{hk} = f\ (QCP_{hk},\ p_{cdk},\ p_{cmk}) \tag{4.7.8}$$

$$QCPM_{hk} = g\ (QCP_{hk},\ p_{cdk},\ p_{cmk}) \tag{4.7.9}$$

In the equations above the quantity variables are the same as above (defined below equation (4.7.7)) except that the household index h has been appended. By specifying the quantity index in (4.7.7) as a Constant Elasticity of Substitution (CES) index, the above specification can include as special cases, fixed import shares (zero substitution) or infinite substitution between domestic and imported product (no product differentiation).

While there are various prices that have been defined above it should be emphasized that the prices that will eventually vary so as to achieve equilibrium in the commodity markets are the producer prices for the domestically produced goods, namely the p_k according to the notation above.

While demand for most commodities can be satisfied from both domestic sources and differentiated imports, there are also commodities imported for consumption that are not produced domestically. In that case the quantity demanded for this non-competitively imported commodity will not be a composite index as there is no corresponding domestic production.

Given the demand system for the various consumer classes, consumer price indices could be computed for each class and for the economy as a whole.

4.8. Intermediate, Government and Export Demand

Demand for intermediate uses can be modeled in several ways, the simplest one of which is by fixed coefficients, and is the one suggested here.

$$X_{ij} = f(X_j) \tag{4.8.1}$$

where X_{ij} - demand of composite commodity i for intermediate use for production of sector j.

Current consumption demand by government is part of total government expenditures which include wage payments and transfers. The best way to treat government, is to model it as a sector producing a "service product", the public good or commodity. The output of this activity is just the total demand for government services, which is equal to demand for services by private consumers and by government. In the process of providing the service, government demands "intermediate" products, which are basically the current demands of the government for the products of the various sectors. Suppose that the activity level of the government sector is denoted by X_G, and the "producer" price by p_G, in conformity with earlier notation. Then the private demand for government consumer services can be found just like private demand for any other final product (re. equation (4.7.3)). It must be remembered that provision of free public services to given types of households could be modeled either as direct transfers, or as price subsidies in accordance to equation (4.7.2).

$$P_G\ QCP_{hG} = p_G\ (1-s_{Gh})\ QCP_{hG} + p_G\ s_{Gh}\ QCP_{hG} \tag{4.8.2}$$

where QCP_{hG} - demand for public service by private households of type h

s_{Gh} - subsidy rate on provision of public services to households of type h.

The second term in (4.8.2) denotes the public expenditures for provision of public services to households, which are essentially transfers. If all services are provided for free then $s_{Gh} = 1$. If data permits, the various type of services such as health, education, etc. could be disaggregated.

The activity level of the government can probably best be described by a production function with the only argument being the level of public employment. A given level of public employment thus determines X_G.

$$X_G = f(L_G) \tag{4.8.3}$$

where L_G - level of public employment.

The demand for current consumption expenditures by the government from the different sectors could easily be modeled by fixed coefficients or another function of aggregate government activity

$$QDG_i = f(X_G) \tag{4.8.4}$$

where QDG_i - demand for government consumption for composite product i.

Given private consumption demand for the public good, the residual that remains after subtracting it from X_G, the overall level of public activity, can be considered as government final demand for its own good.

$$QDG_G = X_G - \sum_{h=1}^{H} QCP_{hG} \qquad (4.8.5)$$

where QDG_G - government demand for its own output

QCP_{hG} - demand for public services by households of type h.

With the above conventions, government current consumption spending can be written either as the value of all public activity (production side definition) or as the sum of all expenditures for government provided services.

$$GE = p_G X_G = p_G QDG_G + \sum_{h=1}^{H} p_G QCP_{hG} \qquad (4.8.6)$$

where GE - total government current expenditures.

The first term on the right hand side of (4.8.6) denotes public expenditures for public services, (government consumption of own production) while the second term denotes private expenditures for public services including transfers.

Demand for exports will be modeled by assuming that the product of each sector can be considered as a differentiated product in the world market. Hence the domestic price when translated into an offer price in the international market must be compared with the price of the corresponding good of the other competing countries.

$$E_{dk} = f\ (p_k^f,\ p_k^*) \qquad (4.8.7)$$

where E_{dk} - demand for exports of domestic commodity k

p_k^f - price offered by domestic producers in the international markets

p_k^* - international price of the similar competing good

If for instance the export subsidy rate (negative if tax) for commodity k is denoted by se_k, and the official foreign exchange rate by e, then the international price for commodity k offered to foreigners by domestic producers is equal to $p_k\ (1-se_k)/e$.

4.9. Investment and Flow of Funds

In a developed country with efficient capital markets the cost of capital and investment decisions are theoretically independent of financial considerations, namely the nature of the sources of funds, (see, e.g. the classic paper by Modigliani and Miller (1958)). In a credit constrained economy of the SSA type with non-existent capital markets, however, this is not likely to be the case. The mechanism that will be proposed here is based on the notion that institutions first formulate their desired investment expenditures which they then seek to finance. However, credit constraints and rationing leads to different realized investment. In the remaining discussion foreign direct investment is not considered.

There are many theories of investment (see, e.g. Jorgenson (1971), Rowley and Trivedi (1975), Wai and Wong (1982)), formulated mostly for developed countries. The major variables that have been identified to influence investment are present and past profitability, the cost of capital, expectations, etc.

There is no clear agreement among analysts as to which theory offers the best explanation. An approach which is simple and feasible in the context of a CGE model is exhibited below. The approach distinguishes between investment in the formal modern enterprise sector and in the unincorporated informal one. In the latter more severe credit constraints will operate.

Desired level of capital stock in sector j (formal or informal) will be the product of a capital output ratio times a desired level of output. The capital output ratio will depend on the expected prices of new capital and labor which will be assumed to equal the current prices of these two factors. The desired level of output will depend on current and past levels of output, as well as current profitability. Given a matrix of capital coefficients, the price of new capital for sector j can be obtained. Desired investment will equal the difference between desired capital stock and present level of capital stock minus depreciation.

Analytically the model is the following

$$K^*_{jt} = \kappa_j \, (w_{jt}, PK_{jt}) \, X^*_{j(t+1)} \qquad (4.9.1)$$

where K^*_{jt} - desired level of capital stock in sector j (formal or informal) at the end of perio t

κ_j - capital output ratio

w_{jt} - current index of cost of labor for sector j (re. equation (4.4.2)

PK_{jt} - current cost of a unit of new capital for sector j

$X^*_{j(t+1)}$ - level of desired output in the next period in sector j.

If a matrix of capital coefficients is known then PK_{jt} can be written as follows

$$PK_{jt} = \sum_{i=1}^{n+1} B_{ij} \; P_{it} \qquad (4.9.2)$$

where PK_{jt} - price of a unit of new capital installed in sector j at time t

B_{ij} - amount of sector i output needed per unit of new capital installed in sector j (capital coefficient). These coefficients will be different for formal and unincorporated sector capital

p_{it} - price of sector i output in period t.

The summation in (4.9.2) goes up to n+1 since by convention the n+1'st good denotes the non-competively imported good.

The form of the function κ_j can easily be derived from cost minimization in order to achieve a givel level of output $X^*_{j(t+1)}$.

The next period level of desired output will be written as a function of current and past output, as well as the current profit rate.

$$X^*_{j(t+1)} = f\,(X_{jt}, X_{j(t-1)}, \pi_{jt}) \qquad (4.9.3)$$

where π_{jt} - current profit rate of sector j.

Under a partial adjustment mechanism for instance one could write

$$X^*_{j(t+1)} = \lambda X_{jt} + (1-\lambda) X_{jt-1} + f(\pi_{jt}) \qquad (4.9.4)$$

The after tax rate of profit after depreciation in sector j at time t can be written as follows

$$\pi_{jt} = \left(\frac{GOS_j - \delta_j PK_{j(t-1)} K_{j(t-1)} + (PK_{jt} - PK_{j(t-1)} K_{j(t-1)})}{PK_{j(t-1)} K_{j(t-1)}}\right) +$$

$$\left(\frac{(P_{jt} - P_{j(t-1)}) ST_{j(t-1)}}{PK_{j(t-1)} K_{j(t-1)}}\right) \qquad (4.9.5)$$

where GOS_j - gross operating surplus of firms in sector j (defined in (4.4.10)

δ_j - depreciation rate for capital stock of sector j

$ST_{j(t-1)}$ - stocks of commodities produced by sector j at end of period t-1.

Notice that the capital utilized in the current period is valued at last period's costs. Also notice that capital and stock appreciation is included in the definition of the sectoral profit rate. Finally notice that the mechanism specified does not exclude negative desired net investment, namely desired liquidation of existing capital.

Given desired capital in equation (4.9.1), the desired physical investment is equal to

$$ID_{jt} = \max (K^*_{jt} - K_{j(t-1)} (1-\delta_j), 0) \qquad (4.9.6)$$

where ID_{jt} - quantity of desired new productive capital.

The formulation in (4.9.6) allows for excess capacity, since

negative desired investment does not lead to actual liquidation or sale of existing capital stock. The cost of new investment will be the product of the cost of new capital and the expression in (4.9.6).

$$IDC_{jt} = PK_{jt} \cdot ID_{jt} \tag{4.9.7}$$

Notice that desired investment depends on current equilibrium variables and is not constant, or a function of past variables.

While the above derivation of desired investment is reasonable for the formal modern sector, it might not be easy to implement in the informal sector. The reason might be that there is not enough information to generate some of the variables. In this case probably a simpler specification of desired investment might be necessary.

Apart from demand for fixed investment there is demand for stock changes. This will be modeled in a very simple way. Desired level of end of period stock ST_t will be assumed to be a function (for instance a fixed proportion) of the level of current activity.

$$ST^*_{jt} = f\ (X_{jt}) \tag{4.9.8}$$

where ST^*_{jt} - desired end of period t stocks of activity j.

Based on a partial adjustment mechanism and on the idea of adaptive expectations the following specification for stock changes could be derived

$$\Delta ST_{jt} = ST_{jt} - ST_{jt-1} = f(X_{jt} - X_{j(t-1)},\ P_{jt} - P_{j(t-1)}) \tag{4.9.9}$$

where ST_{jt} - actual level of end of period t stocks in sector j

Given the demand for fixed investment a mechanism must be specified by which the purchases of new capital are financed. The mechanism will be based on the notion of excess demand for new funds by a sector or institution.

Firms of the formal or informal sector apart from demand for funds to finance new capital, demand funds for working capital namely to pay workers and buy raw materials. A relatively simple way to specify this demand is to postulate that the demand for working capital is equal to a fixed proportion of the total uses of intermediate inputs and hired wage labor.

$$WK_{jt} = \varphi_j \, (PN_{jt} \, N_{jt} + w_{jt} \, L^d_{jt}) \qquad (4.9.10)$$

where WK_{jt} - needs for funds to finance production.

Demand for short-term funds for working capital are then equal to

$$DWK_{jt} = \varphi_j \, (PN_{jt} \, N_{jt} + w_{jt} \, L^d_{jt}) \cdot (C_{j(t-1)} + D_{j(t-1)}) \qquad (4.9.11)$$

where

DWK_{jt} - desired new funds for working capital during period t

PN_{jt} - price index of intermediate inputs

φ_j - stock flow conversion parameter for sector j

$C_{j(t-1)} + D_{j(t-1)}$ - cash on hand and bank deposits by sector j at the beginning of period t.

Notice that DWK_{jt} could be positive or negative, depending

on whether the firm has less or more available cash and deposits in the beginning of the period than is needed to finance productive activities.

The total demand for new finance by the j'th sector of activity is equal to the sum of the demand for funds for new fixed investment, stock changes and working capital.

$$DF_{jt} = IDC_{jt} + p_{jt}\ \Delta ST_{jt} + DWK_{jt} \qquad (4.9.12)$$

where DF_{jt} - demand for new funds by sector j.
Notice that in (4.9.12) the value of stock changes has been explicitly included.

Given that each sector j (formal or informal) generates an amount of retained earnings equal to RE_j (which can be negative), it is assumed that this is utilized first to finance the sector's demand for new finance indicated in (4.9.12). The excess demand for funds by sector j is then equal to

$$EDF_{jt} = DF_{jt} - RE_{jt} \qquad (4.9.13)$$

where EDF_{jt} - excess demand for funds by sector j in period t.

The sum of all excess demand for productive firms in the various sectors yields the excess demand for new funds of the institution enterprises. At this level the demand for funds by formal and informal enterprises is aggregated separately.

$$EDF_{Et} = \sum_{j=1}^{n} EDF_{Ejt} \qquad (4.9.14)$$

$$EDF_{Ut} = \sum_{j=1}^{n} EDF_{Ujt} \qquad (4.9.15)$$

where EDF_{Et} - excess demand for new funds by all formal sector firms in period t

EDF_{Ut} - excess demand for new funds by all unincorporated sector firms in period t

EDF_{ijt} - these are the variables defined above in (4.9.13) except there, as well as in the earlier discussion, the additional index i (i=E,U) was suppressed for ease of notation.

Up to now only the institution enterprises has been analyzed. There are three other types of institutions that will influence the flow of funds, namely households, commercial banks, and the government. The discussion begins by examining households.

Table 4.3 presents a detailed balance sheet for a typical household of some class h at the beginning of some period t. Note the presence of foreign exchange holdings on the asset side, and the absence of direct personal loans from banks on the liabilities side. Both of these are likely to be very small in a developing SSA country's official accounts. However, the former might be important in the presence of parallel markets and will be maintained. Notice that they are valued at the parallel exchange rate e^P. The stock of human capital on the assets side can be thought of as the accumulated past foregone earnings of individuals in the household that have been educated or trained. It certainly forms part of the household wealth. Also note the distinction between equity participation in formal and informal firms. While data on the exact structure

Table 4.3

Balance Sheet of a Typical Household of some Type h at the Beginning of Period t

Assets	Liabilities
Cash $C_{h(t-1)}$	Net Loans from other Households $LH_{h(t-1)}$
Deposits with Banks $D_{h(t-1)}$	
Loans to Formal Sector Firms (Equity) $E_{Eh(t-1)}$	Household Wealth $W_{h(t-1)}$
Loans to Unincorporated Firms (Equity) $E_{Uh(t-1)}$	
Durable Assets $PA_{t-1}\ A_{h(t-1)}$	
Foreign Currency $e^{p}_{t-1}\ F^{*}_{t-1}$	
Stock of Human Capital $KH_{h(t-1)}$	

of the household balance sheets will be very difficult to obtain, descriptive information about household participation in various types of activities, will give some idea about the existence of either or both types of equity in the household wealth. It will probably be the case in SSA that most lower skill household classes will have no equity participation at all in formal sector firms, while extensive participation in informal activities. This will mean in the notation of Table 4.3 that only one of the two types of equity is likely to be part of the household balance sheet.

The interest income from deposits with banks minus the net payments from loans obtained by other households composed the term net interest income INT_h that was introduced in the determination of household income in equation (4.5.8). In a society of the SSA type where extended families and informal mutual assistance schemes are very strong, the loans from other households (which should sum to zero over all households) can be a very significant aspect of the household balance sheet. However, it will be very difficult to collect information on this item. One convenient assumption is to hypothesize that only households within the defined class h loan to each other. This would make the term $LH_{h(t-1)}$ vanish, and will be made in the sequel. The interest income of households would then come only from the outstanding bank deposits.

$$INT_{ht} = i_d D_{h(t-1)} \qquad (4.9.16)$$

where i_d - interest rate on personal bank deposits.

In countries of the SSA type personal bank deposits are bound to be small. It might even be hypothesized that most personal bank deposits belong to the highest skill household classes. Since it will be quite difficult, if not impossible, to ascertain bank deposit ownership, such assumptions might have to be made.

From the consumption function (4.7.1) household savings is determined as a residual.

$$SVH_{ht} = YF_{ht} - N_h M_h \cdot YCPC_{ht} =$$

$$= s_h (YF_{ht} - N_h M_h \cdot YCP_h) \qquad (4.9.17)$$

where the last expression is found by using (4.7.1) and where SVH_{ht} - total savings of household class h.
The other variables in (4.9.17) have been defined in (4.5.9), (4.7.1) and (4.7.3).

Households must now allocate these savings to the various types of assets that they are permitted to hold. The first item that is hypothesized to be allocated is investment in education by a rule that specifies that such investment will take place only if savings is positive.

$$YED_{ht} = \max (\rho_h^E SVH_{ht}, 0) \qquad (4.9.18)$$

where YED_{ht} - expenditures for investment in education by household class h. This is composed of the opportunity income of those being educated. YE_{ht} which is part of full income in equation

(4.5.9), and of cash expenditures for education $YEDC_{ht}$

ρ_t^E - share of total current household savings that go for investment in human capital.

A formulation such as (4.9.18) implicitly determines the amount of labor that is withdrawn from the labor force in order to be educated. To simplify matters assume that the household has members of only one type of labor skill say s, its aggregate supply of that type of labor being L_{st}, which command wage w_{st}. If the non-wage income of the household is denoted by YNW_{ht}, then the full income would be equal to

$$YF_{ht} = w_{st} L_{st} + YNW_{ht} \tag{4.9.19}$$

Denote by L^h_{sEt} the amount of household labor that is been withdrawn from the labor market in order to be educated. Let c_{sE}, be the total cost of educating (upgrading) a unit of labor of type s, of which a portion $c_{sE}\ s_{Gs}$ is born by the government. Then the household cash expenditures on education are equal to $c_{sE}\ (1-s_{Gs})\ L^h_{sEt}$. This plus the opportunity cost $w_{st}\ L_{st}$ constitute the household "expenditures on education" YED_{ht} above. Substituting these definitions in expression (4.9.18) one can solve for L_{sEt} as follows

$$L^h_{sEt} = \max\left(\frac{\rho^E_h\ s_h}{w_{st} + c_{sE}\ (1-s_{Gs})}\ SVH_{ht},\ 0\right) \tag{4.9.20}$$

Expression (4.9.20) shows first that if full income is below permanent income, then no education of potentially productive labor will be undertaken. It also shows that if public

subsidies for education s_{Gs} decline, then the cost of education rises for the household, and this via (4.9.20) implies that less labor will be withheld for education.

By making assumptions about the relative mix of labor skills that is being withdrawn from the labor market by each household, equations such as (4.9.20) can be solved for each household type to find the amount of labor withdrawn by skill type by each household. Adding up the labor withdrawals by households yields the total labor of skill type s that is withheld from the market, namely the variable L_{sE} in equation (4.4.6).

Once investment in human capital has been determined the remaining savings must be allocated to the physical and financial assets. Denote the savings available for such investments as follows

$$SVHF_{ht} = SVH_{ht} - YED_{ht} \tag{4.9.21}$$

where $SVHF_{ht}$ - household savings available for increasing financial and physical wealth.

The portfolio allocation of this available household savings to assets will be done by functions of the following type.

$$\Delta C_{ht} = \rho_{hC}\ SVHF_{ht} \tag{4.9.22}$$

$$\Delta D_{ht} = \rho_{hD}\ SVHF_{ht} \tag{4.9.23}$$

$$\Delta E_{Eht} = \rho_{hE}\ SVHF_{ht} \tag{4.9.24}$$

$$\Delta E_{Uht} = \rho_{hU}\ SVHF_{ht} \tag{4.9.25}$$

$$PA_t\ (\Delta A_{ht} + \delta_A\ A_{h(t-1)}) = \rho_{hA}\ SVHF_{ht} \tag{4.9.26}$$

$$e^p_t\ \Delta F^*_{ht} = \rho_{hF}\ SVHF_{ht} \tag{4.9.27}$$

$$\rho_{hC} + \rho_{hD} + \rho_{hE} + \rho_{hU} + \rho_{hA} + \rho_{hF} = 1 \tag{4.9.28}$$

δ_A - depreciation rate of physical non-productive capital.

The share parameters ρ_{hi} should depend on all the previous period stocks, as well as the following variables that will either be exogenous or endogenously generated in the model.

i_{dt} - nominal bank deposit rate in period t - exogenous

r_{hit} - current return on household h from equity ownership in the formal (i=E) or informal (i=U) sectors- endogenous.

$\hat{e}^p_t = \dfrac{e^p_t - e^p_{t-1}}{e^p_{t-1}}$ - rate of depreciation of the parallel exchange rate-endogenous when parallel markets are explicitly modeled.

$\hat{CPI}_t = \dfrac{CPI_t - CPI_{t-1}}{CPI_{t-1}}$ - rate of change in the consumer price index.

The current return to households from equity ownership of enterprises can be derived by a weighted average of the sectoral profit rates defined in (4.9.5), weighted by the household ownership shares in each sector's capital (in a fashion similar to that in equation (4.5.4)).

$$r_{hEt} = \sum_{j=1}^{n} \frac{K_{hj(t-1)}}{K^{H}_{j(t-1)}} \pi_{jEt} \qquad (4.9.29)$$

For the informal sector where the matrix of ownership of capital by household group is unlikely to be available, the weighting in computing r_{hUt} could be based on "ownership" of self-employed in a fashion similar to that used in equations (4.5.5) and (4.5.7).

$$r_{hUt} = \sum_{s=1}^{S} \frac{LS^{h}_{s(t-1)}}{LS_{s(t-1)}} \cdot \sum_{j=1}^{n} \frac{w_s \, LS_{sj(t-1)}}{\sum_{s=1}^{S} w_s \, LS_{sj(t-1)}} \pi_{jUt} \qquad (4.9.30)$$

Notice that the specification of household portfolio allocation above refers to allocation of current savings to new assets and does not refer to changes in the structure of the old portfolio. In other words it is assumed that portfolio decisions made in the past, which have determined the initial stocks of household assets are not affected. This in essence is like a "putty-clay" approach to portfolio allocation. Also notice that since rates of change of actual prices are specified as influencing portfolio decisions rather than changes in expected prices, a naive adaptive expectations mechanism has implicitly been postulated.

While the equations above indicate the variables that should influence the share allocation parameters ρ_{hi}, they leave the exact nature of the specification open.

If the portfolio decisions of various households are aggregated, one obtains the aggregate desired flow of funds

from households as well as their demand for new non-productive assets and foreign exchange.

$$\Delta CH_t = \sum_{h=1}^{H} \Delta C_{ht} \tag{4.9.31}$$

$$\Delta DH_t = \sum_{h=1}^{H} \Delta D_{ht} \tag{4.9.32}$$

$$\Delta EH_{Et} = \sum_{h=1}^{H} \Delta E_{Eht} \tag{4.9.33}$$

$$\Delta EH_{Ut} = \sum_{h=1}^{H} \Delta E_{Uht} \tag{4.9.34}$$

$$PA_t \ (\Delta A_t + \delta_A \ A_{t-1}) = PA_t \sum_{h=1}^{H} (\Delta A_{ht} + \delta_A \ A_{h(t-1)}) \tag{4.9.35}$$

$$e_t^p \ \Delta F_t^* = e_t^p \sum_{h=1}^{H} \Delta F_{ht}^* \tag{4.9.36}$$

The market for non-productive assets A presents the following special feature. As long as the aggregate sum in the left hand side of (4.9.35) is greater than zero, it represents the demand for "household" investment which is financed, of course, out of own household savings. The prices at which this new investment will be bought were defined earlier in equation (4.5.13). However, it is entirely possible that the sum total of all household demands for new A type of goods in (4.9.35) is negative at the prices PA_t determined by (4.5.13). This means that there is an excess supply of A goods in the market or that households are liquidating assets. A frequent case of such behavior in SSA is distress sales of cattle, jewels, etc. by

poor farmers in times of a drought. In such a case, no new investment in A will be taking place, but instead the existing stock of A will be changing ownership. The way this can be modeled is by letting PA_t be determined endogenously (in other words not using equation (4.5.13)) so as to clear the A market.

$$\sum_{h=1}^{H} (\Delta A_{ht} + \delta_A A_{h(t-1)}) = 0 \qquad (4.9.37)$$

Changing the price of asset A in such a fashion will, of course, have side effects on the demands for the other assets through portfolio reallocation. Depreciation is added in (4.9.37) because the assets changing hands this period, are not the same assets as in previous periods, but instead the depreciated ones.

The informal sector can be dealt with now. Since the informal sector does not have access to the formal banking system, its only source of finance apart from retained earnings is equity loans from households. Table 4.4 indicates the balance sheet of the informal unincorporated sector. Notice that all the assets of this sector are owned by the households, and no loans from banks are taken. Capital and stock appreciation will change the value of the equity of unincorporated firms and hence the value of household equity through household ownership of unincorporated capital.

Equilibrium in the market for funds for the informal sector implies that the supply of funds to this sector will equal its excess demand.

Table 4.4

Balance Sheet of the Unincorporated Firms of Sector j at the Start of Period t

Assets	Liabilities
Cash $C_{Uj(t-1)}$	Loans from Households (Equity) $EU_{j(t-1)}$
Deposits with Banks $D_{Uj(t-1)}$	
Physical Capital $PK_{U(t-1)}\ K_{jU(t-1)}$	
Stocks of Commodities $P_{j(t-1)}\ ST_{Uj(t-1)}$	

$$\Delta EH_{Ut} = EDF_{Ut} \tag{4.9.38}$$

There are no prices that could be used to balance this market which will normally exhibit more demand for funds than available supply. Instead, what will be assumed is that working capital needs are satisfied first and then the amounts of expenditures devoted to the remaining two purposes (re. equation (4.9.12)) namely fixed investment, and stock build-up), are all scaled down in proportion to their contribution in the total demand for funds DF_{jt} (re. equation (4.9.13)). This in turn is scaled down according to its contribution to the whole

excess demand for funds of the informal sector. Since working capital needs are satisfied first, a credit squeeze has the direct result to cut down investment.

However, it will be assumed that sectors with excess supply of funds always satisfy their financing requirements.

Define the following variable for total supply of funds to the unincorporated sector

$$TSFU_t = \Delta EH_{Ut} - \sum_j^{-} EDF_{Ujt} \qquad (4.9.39)$$

The negative sign over the summation denotes that it is done only over those j's for which the excess demand for funds (defined in (4.9.13) is negative. The total demand for funds can be defined analogously

$$TDFU_t = \sum_j^{+} EDF_{Ujt} \qquad (4.9.40)$$

For sectors with positive excess demands for funds their investment, and stock desired plans are all scaled down by a factor equal to

$$x_{Ut} = \frac{TSFU_t}{TDFU_t} \qquad (4.9.41)$$

In the rare case where x_{Ut} is larger than one then the same type of scaling could be done upwards.

Turning now to the formal firm sector, the commercial banks, and government, Table 4.5 illustrates their respective balance sheets. Notice that this type of firms borrow both from

the banking system as well as households. The supply of new equity to these firms by households was already analyzed above. The supply of new equity or loans by the public sector directly to state corporations can be taken as exogenous. What remains is to analyze the supply of new bank loans to complete the supply of funds to them. This is, however, what requires the interaction of banks with the public sector. As was mentioned in the beginning of this section foreign direct ownership of domestic assets is not considered, so, the only source of equity of firms is from domestic sources.

Turning to the macro constraint analysis of section (4.2), equation (4.2.11) with the notation of Table 4.5 can be solved to give the change in the supply of commercial bank loans

$$\Delta LE_t = \Delta C_t + \Delta (DH_t + DE_t) - \Delta H_t \qquad (4.9.42)$$

Notice that the creation of new high powered money ΔH_t is governed by equation (4.2.6) and assuming an exogenous value for change in foreign debt (and loans to state enterprises which is not included in (4.2.6) but can be seen from Table 4.5) is an endogenous variable. This is so since the level of government spending is largely exogenous but the level of revenues (denoted by T_t in (4.2.6)) is endogenously determined. The other term in (4.9.42) above besides the change in high powered money is the change in the demand for money.

$$\Delta MD_t = \Delta C_t + \Delta (DH_t + DE_t) \qquad (4.9.43)$$

The task therefore, is to determine the changes in the

Table 4.5

Balance Sheets for the Government (Central Bank), Commercial Banks, and Incorporated Enterprises at the end of period t-1

Assets	Liabilities
Government	
Public Infrastructure PG_{t-1} KG_{t-1}	Domestic Public Debt DD_{t-1}
Loans (Equity) to Public Firms $EP_{E(t-1)}$	Foreign Debt e_{t-1} FD^{*}_{t-1}
Central Bank	
Domestic Public Debt DD_{t-1}	Currency in Circulation C_{t-1}
	Commercial Bank Reserves BR_{t-1}
Commercial Banks	
Reserves BR_{t-1}	Deposits from Households DH_{t-1}
Loans to Firms LE_{t-1}	Deposits from Corporate and Unincorporated Firms (DE_{t-1} + DU_{t-1})
Incorporated Firms (sector j)	
Cash $C_{Ej(t-1)}$	Loans from Banks $LE_{j(t-1)}$
Deposits with Banks $D_{Ej(t-1)}$	Loans from Households (Equity) $E_{Ej(t-1)}$
Physical Capital $PK_{E(t-1)}$ $K_{jE(t-1)}$	Loans from Government (Equity of State Enterprises) $EP_{Ej(t-1)}$
Stocks of Commodities $P_{j(t-1)}$ $ST_{Ej(t-1)}$	

money demand in order to determine availability of new bank loans to firms.

The money available in the economy is held by households in the form of cash and bank deposits, by unincorporated firms in the form of working capital (cash and bank deposits), and by incorporated firms, again in the form of cash and bank deposits. Hence (4.9.43) can be written as follows

$$\Delta MD_t = \Delta CH_t + \Delta DH_t + \sum_{j=1}^{n} \Delta (C_{Ejt} + D_{Ejt}) +$$

$$+ \sum_{j=1}^{n} \Delta (C_{Ujt} + D_{Ujt}) \qquad (4.9.44)$$

All the components of the right hand side of (4.9.44) have been analyzed above, hence the demand for money is endogenously determined in the model. This implies that the model generates endogenously the availability of new loans to the incorporated firms. Notice that an increase in the stock of high powered money, through more public deficit has an unclear impact on bank loans to the private sector, as it also affects the domestic demand for money. Taylor (1983) has shown how this process can lead to surprising results in the short-run.

The total new supply of funds to the corporate private sector is the following

$$TSFE_t = \Delta EH_{Et} + \Delta LE_t + \Delta LEG_t - \sum_{j}^{\bar{}} EDF_{Et} \qquad (4.9.45)$$

where $TSFE_t$ - availability of new funds to the enterprise

sector from households banks and the government.

ΔLEG_t - new direct loans to state enterprises (financed through the general public budget).

The last term in (4.9.45) follows from a reasoning similar to that which led to equation (4.9.39). The determination of realized investment by incorporated firms can then be accomplished by a credit rationing scheme very much like it was outlined in the discussion of the unincorporated sector.

In the model the official intermediaries in the money markets, namely the commercial banks, could be assumed to be pure intermediaries or could be modeled separately as a service industry. In the former case the total costs for the deposits will exactly balance the total income from lending. In the latter case the value added of the commercial banking sector could be assumed to equal the difference between revenues from lending and cost of money.

From the balance sheet of Table 4.5, and assuming that the interest rate on deposits can be summarized by a single variable i_d, the cost of money to the banks in period t is equal to

$$CBCM_t = i_{dt} (DH_{t-1} + DE_{t-1} + DU_{t-1}) \qquad (4.9.46)$$

where $CBCM_t$ - commercial banks' cost of money

i_{dt} - average deposit interest rate in period t.

The various components of (4.9.46) appropriately allocated accrue as income to households and firms. They form part of the interest income variables.

INT_{ij} (i=E,U) in (4.4.9) - (4.4.11), and the variable INT_h in (4.5.8).

The revenues of the banks are obtained from interest on outstanding loans. Assuming an average interest rate i_t on bank loans.

$$RCB_t = i_t \, LE_{t-1} \tag{4.9.47}$$

where RCB_t - revenues of commercial banks

i_t - average interest rate on loans to enterprises during period t.

Since the government in a SSA setting is likely to control both official deposit and lending rates, it could be forcing profits or losses on the banking sector. It could be assumed that the state covers the losses of these intermediaries or reaps the profits. This is especially relevant when the state controls the banking sector directly or indirectly.

$$GRBL_t = RCB_t - CBCM_t \tag{4.9.48}$$

where $GRBL_t$ - government revenue (negative if loss) from the operations of the commercial banking sector.

The upshot of the above analysis is that the mechanism of savings-investment balance in the model is partly of the Keynesian type and partly of the neoclassical type. It is felt that this largely eclectic approach is more realistic in the context of SSA. Notice that the sectors where credit is rationed do not have to be the same in every period.

4.10. Excess Demands and Within Period Balance

Given the description of the various parts of the model above it is instructive to point out the types of markets that have to balance within each period. There are three types of markets in the model, those for commodities, labor, and domestic and foreign money.

Labor markets were described in section (4.4). It was pointed out there that there is a separate market for each labor skill, and that some of these markets can adjust by variations in the nominal wages (cf. equation (4.4.6)) while others could adjust by variations in the amount of labor demanded, with nominal wages fixed for the period.

Commodity markets will adjust mainly by variations in domestic prices so as to achieve supply demand balance in period t. The excess demand for commodity i can be written as follows, under the assumption that an activity produces only one commodity.

$$EDC_{it} = f_i\ (X^E_{it},\ X^U_{it}) - (\sum_{j=1}^{n} XD_{ijt} + \sum_{h=1}^{H} QCPD_{hit} -$$

$$+ QDGD_{it} + IDRD_{it} + IGRD_{it} + IAD_{it}) -$$

$$- \Delta ST_{it} - E_{dit} \qquad (4.10.1)$$

where EDC_{it} - excess demand for commodity i

X^k_{it} - total domestic production of commodity i by the formal (k=E), and unincorporated (k=U) sectors (cf. section 4.3)

XD_{ijt} - the domestic component of total intermediate demand for composite commodity i by activity j (cf. section 4.8)

$QCPD_{hit}$ - domestic component of consumption demand by household type h for composite commodity i (cf. section 4.7)

$QDGD_{it}$ - domestic component of government current demand for composite commodity i (cf. section 4.8)

$IDRD_{it}$ - domestic component of realized demand for fixed private investment for composite commodity i (cf. section 4.9)

$IGRD_{it}$ - domestic component of demand by government investment for composite commodity i

IAD_{it} - domestic component of the demand of households for non-productive capital increases by origin in sector i (cf. section 4.9)

ΔST_{it} - change in stocks held of commodity i (cf. section 4.9)

E_{dit} - demand for exports of commodity i (cf. section 4.8).

From the above variables the demand of the government for investment was not treated earlier, and will be regarded as exogenous. The total supply of commodity i is an index of the supplies of the commodity by the formal and informal sectors. The demands for investment by sector of origin indicated above can be obtained by applying the various capital coefficients

mentioned earlier to the demands for investment by sector of destination which were derived in section 4.9. Notice that the demands for intermediate uses, private consumption, current public consumption, and all fixed investment, are demands for the composite commodity, of which the domestic component is what enters the market balance relation (4.10.1).

There are two ways in the model outlined here in which commodity markets can balance. One involves variations in the domestic nominal prices of the commodities, so as to achieve zero excess demand. In the second mode, the domestic price can be set equal to the foreign price multiplied by the official exchange rate, and the term E_{dit} in (4.10.1) is computed as a residual.

Note that the domestic price of commodity i that is varied, is the index of the domestic price of the formal sector and informal sector goods (cf. equation (4.3.6)). When these two products are perfect substitutes then there is only one price for the product of both sectors. When, however, the products are not perfect substitutes, then the price of the formal sector will be assumed determined by a cost-plus markup rule, and it will be the price of the good of the informal sector that will adjust to achieve the variation in the overall price p_i, and the commodity balance. In this way albeit there are two differentiated products, only one market balance equation is needed and only one price per market needs to be varied to clear it. It is this reasoning that is behind the decomposition of a SAM column into two separate columns, one for the formal

and the other for the informal sector, without the corresponding decomposition of the same row.

The market for foreign currency in most SSA countries has two components, the official and the parallel market. At this point only the official market will be treated, the parallel one left for a subsequent chapter. Assuming away foreign direct investment, the balance of payments equilibrium condition can be written from (4.2.4) in the form outflows = inflows, as follows

$$VM_t + e_t i_t^* FD_{t-1}^* = VEX_t + e_t (\Delta FD_t^* + TRP_t^*) \qquad (4.10.2)$$

where i_t^* - average interest on outstanding foreign debt at end of period t-1

TRP_t^* - net private foreign transfers from abroad.

The values of imports and exports above, VM_t and VEX_t, are equal to the product of the exchange rate and the respective international values. Substituting in (4.10.2) and cancelling the common term e_t, one obtains the supply-demand external balance in foreign currency.

$$VM_t^* + (\rho + i_t^*) FD_{t-1}^* = VEX_t^* + \Delta FD_t^* + TRP_t^* \qquad (4.10.3)$$

where VM_t^* - foreign exchange cost of imports

VEX_t^* - foreign exchange receipts from exports

ρ - rate of amortization of foreign debt

i^* - foreign interest rate.

Given a predetermined value of interest payments, and exogenously determined values for the change in the outstanding amount of foreign debt, and private transfers, equation (4.10.3) is the equilibrium condition for the foreign exchange market. Under a regime where the foreign exchange rate is controlled, a rationing mechanism for imports must be postulated to balance this market, otherwise the exchange rate is the equilibrating variable.

There are n commodity markets, S labour markets, and one foreign exchange market, that must clear in the above structure. by variations in n+S+1 prices and or quantities. Since by Walras law these markets are not all independent, one needs an additional equation to normalize the system.

The final market namely the one for domestic money, is the one that provides the normalization, necessary to determine nominal prices. The various components of the domestic demand for money were analyzed in detail in the previous section. The balance equation in domestic money is equation (4.9.42) which determines the residual supply of bank loans. The domestic high power money creation ΔH_t, which is the other component of the domestic money market balance, is found residually from an equation such as (4.2.6), which gives the sources of finance of the public deficit.

The various components of government revenue and spending were highlighted in the earlier sections. Given the change in the amount of foreign debt outstanding, an exogenous variable in almost all SSA countries, the need for creation of new money

base can be derived endogenously, given the various nominal components of public spending. Money supply in this fashion is directly linked to the budget for current as well as capital expenditures. This part of the government can be considered exogenous and is undergoing reform under the various stabilization and structural adjustment loans.

By substituting ΔH_t from (4.2.6) in (4.9.42), one obtains an additional equation in the n+S+1 variables necessary to clear the commodity, factor and foreign exchange markets, and it is this equation that provides the normalization rule.

4.11. Solution Method

The model outlined in this chapter adjusts by both price and quantity variations. Hence a simple tatonnement type of price adjusting algorithm is not sufficient to balance the excess demand equations (for a discussion of these and other solution techniques for CGE's see Dervis et.al (1982), and Adelman and Robinson (1978)).

The problem of setting n+S+1 excess demands to zero can be solved, however, in several ways. One is to follow the circular flow of computations, as for instance is outlined in this chapter. Assuming an initial set of values for the balancing variables (this could be the previous period solution), and setting the exogenous variables at their new levels, derive the excess demand equations. Then one could set new values for the equilibrating variables on the basis of the magnitudes of the deviations of the computed excess demands from zero. There are

several ways of doing this and they will not be reviewed here as they are covered in the above mentioned references.

5. THE DYNAMIC MODEL

In this chapter the updating of the various stock variables is discussed. As mentioned in the previous chapter there are three classes of stock variables that must be updated, demographic and human capital ones, those related to quantities and ownership of physical capital, and financial ones. Furthermore, there are few nominal variables that must be updated such as for instance wages in labor classes that have fixed wages.

5.1. Updating Demographic and Human Capital Stock Variables

The major types of demographic variables that will need updating are the number of households in each class and the respective average household sizes as well as the supplies of labor of various types. The latter could probably be left exogenous (constant or exogenously specified functions of time), because otherwise one might have to analyze intrahousehold dynamics that are not modeled in the proposed framework.

Since households are classified by the skill class of the head of the household, it will be the availability of labor of various skill types that will determine the number of households. Since skills are acquired through education and training, it is education that will determine primarily the new distribution of skills.

From Table 4.3 the following SxH matrix AA can be defined

for the base year

$$\{AA\}_{hs} = a_{sh} = \frac{L_{sh}}{N_h \cdot M_h} = \frac{L_{sh}}{POP_h} \tag{5.1.1}$$

where POP_h - total population belonging to household class h. The element a_{sh} denotes the available labor (in man-years) of skill type s, per average person belonging to households of type h. Remember that N_h denotes the number of households of type h, and M_h, denotes the average size of this type of household.

Denote by a column vector LL_{t-1} the aggregate supply of labor of various skill categories at the end of period t-1, and by PH_{t-1} a column vector of population in each household class at the end of period t-1.

$$LL_{t-1} = \begin{bmatrix} L_{1(t-1)} \\ \bar{L}_{2(t-1)} \\ \cdot \\ \cdot \\ \cdot \\ \bar{L}_{S(t-1)} \end{bmatrix} \qquad PH_{t-1} = \begin{bmatrix} POP_{1(t-1)} \\ POP_{2(t-1)} \\ \cdot \\ \cdot \\ \cdot \\ POP_{H(t-1)} \end{bmatrix} \tag{5.1.2}$$

Given the above definitions the following holds.

$$LL_{t-1} = AA \cdot PH_{t-1} \tag{5.1.3}$$

The next step is to define two triangular SxS transition matrices Φ_E and Φ_N as follows. An element φ^E_{ij} of Φ_E denotes the proportion of labor of skill type i being educated or trained in some period, that becomes transformed into labor of type j.

Since all labor that is educated in some period must end up in some skill class it must hold that

$$\sum_{j=1}^{S} \varphi_{ij}^{E} = 1 \tag{5.1.4}$$

Notice that if skill classes are arranged from lower to higher, then $\varphi_{ij}^{E} = 0$ for $j < i$ in the indices of φ_{ij}^{E} above means that someone being educated cannot become a laborer of a lower skill class, and this is the reason that Φ_E is upper triangular.

The elements of the matrix Φ_N have similar meaning, except that the transitions occur autonomously or naturally. In other words, laborers of skill type i might be transformed to skill type j through on the job training and learning. Again the matrix Φ_N must be upper triangular.

Denote by LE_t the column vector of the labor force of various skill types that is being withdrawn from the labor market for education and training in period t (re. section (4.9) and the discussion following equations (4.9.19) and (4.9.20)).

$$LE_t = \begin{bmatrix} L_{1Et} \\ L_{2Et} \\ \vdots \\ L_{SEt} \end{bmatrix} \tag{5.1.5}$$

Then the redistribution of the labor that has been educated in period t to various skill classes can be represented by the

vector $(\Phi_E' - I_S)$. LE_t where a prime denotes the transpose of a matrix, and where I_S denotes a SxS identity matrix.

Clearly, the result of education is an upgrading of labor skills represented by the above term. The elements of the transition matrix Φ_E could be interpreted as probabilities. In other words φ_{ij}^E could be thought of as the probability of a laborer of type i, to turn into a laborer of type j if he is withdrawn from the labor force for a period and educated. If education takes some years then clearly φ_{ij}^E will be small for $j > i$ and will be larger for $i = j$. By analogy a vector of the form $(\Phi_N' - I_S)\ LL_{t-1}$ will represent the autonomous rearrangement of labor skills from period to period.

Assume that the natural population growth rate is g, and assume a fixed labor participation rate. Then if education does not take place, the only segment of the labor force that will be growing is the lowest skill class and it will be growing by the same growth rate g.

Denote by d_s the death rate of labor of skill type s for $s > 1$. Then define the following (SxS) diagonal matrix which will represent the natural decline of the skill mix of the labor force if there is no education or no autonomous rearrangement.

$$\Phi = \{\varphi_{ij}\} \tag{5.1.6}$$

where $\varphi_{ij} = \begin{cases} 1 + g & \text{if} \quad i = j = 1 \\ 1 - d_i & \text{if} \quad i = j > 1 \\ 0 & \text{if} \quad i \neq j \end{cases}$

With all the above definitions the new labor force skill vector LL_t can be written as follows

$$LL_t = \Phi\ LL_{t-1} + (\Phi'_N - I_S)\ LL_{t-1} + (\Phi'_E - I_S)\ LE_t \qquad (5.1.7)$$

If there is no education at all, namely if $LE_t=0$, and if Φ_N is close to being an identity matrix, namely if there is no natural upgrading of skills through working, then equation (5.1.7) yields a deterioration of the human capital of the country towards the lower skill. Out migration could be modeled in the above framework by adding additional parameters to the death rates d_s for given skill classes.

Suppose now that the number of household classes H is equal to the number of skill classes S. This is reasonable to assume since households will be classified by the skill level of the household head. Then by using equation (5.1.3) and LL_t derived in (5.1.7), the population in each household group at the end of period t can be found by inverting the matrix AA which could be assumed constant.

$$PH_t = AA^{-1}\ LL_t \qquad (5.1.8)$$

Dividing the elements of PH_t by the average household size, one obtains the new number of households in each class. Equation (5.1.8) is the implicit "household generator function" in the model.

The above analysis could be done separately for rural and urban households if data is available. This might make sense if provision of education services is vastly different in rural

and urban areas. Suppose in fact that there are H_r rural household types and H_u urban household types. Suppose that the number of household classes in each area is the same as the number of labor skills distinguished in the area, namely $S_r=H_r$ and $S_u=H_u$. Then the same type of analysis as above could be used to predict the new numbers of households at the end of period t. Migration of rural people to the urban areas could be modeled by using migration rates by skill class as outlined earlier, a procedure that will probably be easier to implement empirically.

Notice that if rural households are not classified by the skill class of the head of household, but by size of cultivated land, then as long as the number of rural skill classes is the same as the number of land classes, the procedure goes through. In fact a reasonable suggestion is to first decide on the number of national labor skill classes one wants to model, and hence the number of urban household types, and subsequently split rural households by land size so as to have exactly the same number of size classes as labor classes.

Once the labor supplies by skill category and household type are determined, a decision must be made by each household type about the amount of labor in each skill class that will be self-employed. This decision will be based on the "profits" made by self-employed labor of skill class s in the previous period. Recall from equation (4.5.6) that total unincorporated sector profits distributed to labor of type s in period t-1 are equal to $DP^U_{s(t-1)}$. If the total available self-employed labor

of type s in the same period is $LS_{s(t-1)}$, then the realized average return per self-employed person of skill class s is equal to

$$RUS_{s(t-1)} = \frac{DP^{U}_{s(t-1)}}{LS_{s(t-1)}} \tag{5.1.9}$$

In the next period t the amount of labor available by skill class for each household can be determined by multiplying the elements of the matrix AA, with the elements of the vector PH_t (cf. equation (5.1.8)). The household decision to allocate this labor (denoted in Table 4.3 by L_{hs}), to self-employed and for hire will be modeled as follows

$$\frac{LS^{h}_{st}}{L_{hst}} = f\ (RUS_{s(t-1)},\ h) \tag{5.1.10}$$

The functional form in (5.1.10) can take several simple expressions, and could be made to depend on household type.

5.2. Updating Physical Capital Quantities and Ownership

The productive capital of the various sectors can be updated by using the concept of realized investment derived in section 4.2.

$$K_{jt} = K_{j(t-1)}\ (1 - \delta_j) + ID_{jt}\ \chi_t \tag{5.2.1}$$

where δ_j - depreciation rate for capital of sector j

ID_{jt} - desired investment (cf. equation (4.9.6)

χ_t - scale down factor due to unavailability of in-

vestment funds (cf. equation (4.9.4)) and the discussion following (4.9.45)).

Remember that χ_t is equal to one in sectors that have excess supply of funds, and less than one in sectors that exhibit excess demand for funds. An equation such as the above will hold for each sector j and each portion of the sector, incorporated and informal.

The next item to update is the ownership pattern of enterprise capital by household category. The total new funds made available by households for new enterprise financing in period t are equal to ΔEH_{Et} (cf. equation (4.9.33)), while new government funds are represented by an exogenous variable ΔLEG_t (cf. equation (4.9.45)). If it is assumed that banks do not directly participate in the equity of firms, in other words do not exercise ownership, then the following pattern of ownership of formal enterprise capital in period t can be ascertained.

$$K_{hjt} = K_{hj(t-1)} (1-\delta_j) + \frac{\Delta E_{Eht}}{\sum_{h=1}^{H} \Delta E_{Eht} + \Delta LEG_t} ID_{jt} \chi_t \quad (5.2.2)$$

$$K^G_{jt} = K^G_{j(t-1)} (1-\delta_j) + \frac{\Delta LEG_t}{\sum_{h=1}^{H} \Delta E_{Eht} + \Delta LEG_t} ID_{jt} \chi_t \quad (5.2.3)$$

Notice that households and the government participate in new capital ownership according to the funds made available to the whole sector. In other words the decisions about how much to invest in each sector are made at the enterprise level, via

the desired investment equations. Households and government only supply the funds. The above assumption implies, for instance, that if some household class does not initially have any ownership in capital of a certain sector, but provides equity funds to the overall pool of funds, and if that sector decides to invest, then that household automatically gets ownership of a portion of the new capital. An alternative mechanism would have been to have each household make separate decisions about where to invest its money on the basis of household specific assessment of each sector's prospects. This, however, will necessitate information which is certain not to be available at the household level. The mechanism adopted here implicitly assumes that there is an intermediation mechanism by which household investment funds are delivered to the firms that need them.

Updating the stocks of non-productive capital owned by households is straightforward once the allocations represented in equation (4.9.26) are complete. The new ownerships are as follows

$$A_{ht} = A_{h(t-1)} (1-\delta_A) + \Delta A_{ht} \qquad (5.2.4)$$

Updating stocks of finished products of various sectors is also straightforward once the stock changes described in equation (4.9.9) are determined

$$ST_{jt} = ST_{j(t-1)} + \Delta ST_{jt} \qquad (5.2.5)$$

Finally the stock of public sector infrastructure capital

can be updated by adding to the existing stock after depreciation, the new exogenously determined level of public investment

$$KG_{jt} = KG_{j(t-1)} (1-\delta_G) + \Delta KG_{jt} \qquad (5.2.6)$$

where ΔKG_t - public investment in period t specific to sector j

Remember that cumulative public investment or the stock of outstanding infrastructure capital has been postulated to affect sector productivity (cf. equation (4.3.2).

5.3. Updating Financial Stock Variables

There are several types of financial variables which can be easily updated once the changes described in the previous chapter have been determined. The determination of their outstanding stock and ownership is needed because many of them yield interest payments which are part of current income of households or cost of firms. They will be considered in turn

i) Outstanding cash held by households. Since this stock does not yield interest, only the total outstanding amount is needed

$$CH_t = CH_{t-1} + \sum_{h=1}^{H} \Delta C_{ht} \qquad (5.3.1)$$

where ΔC_{ht}, the change in cash held by household type h is given in equation (4.9.22).

ii) Bank deposits by households. This stock ideally must be determined by household category as it yields interest

$$D_{ht} = D_{h(t-1)} + \Delta D_{ht} \qquad (5.3.2)$$

where ΔD_{ht} is given in equation (4.9.23).

iii) Cash and bank deposits of firms, namely working capital. Each sector in equilibrium has been assumed to satisfy its working capital needs first, and then all other financing needs. For the informal sector firms since they cannot obtain bank loans this implies that in equilibrium their end of period cash and demand deposits have to be equal to their working capital that they needed in the current period. By reference to equation (4.9.11)

$$C_{Ujt} + D_{Ujt} = \varphi_{Uj} \, (PN_{Uj} \, N_{Ujt} + w_{Ujt} \, L^{d}_{Ujt}) \qquad (5.3.3)$$

Formal sector firms can cover part of their working capital requirements from short-term loans by banks. If it is assumed that short-terms loans cover a certain proportion of all their working capital need, then the new cash and deposit position of formal sector forms would be as follows

$$C_{Ejt} + D_{Ejt} = (1-\alpha_j) \, \varphi_{Ej} \, (PN_{Ej} \, N_{Ejt} + w_{Ejt} \, L^{d}_{Ejt}) \qquad (5.3.4)$$

where α_j - proportion of firm j's working capital needs that are covered by loans.

The allocation of holdings of working capital by firms between cash and deposits could be made a function of the bank deposit rate.

iv) Outstanding bank loans. Given the changes in outstanding bank loans in (4.9.42) the stock of outstanding loans at

the end of period t can be found

$$LE_t = LE_{t-1} + \Delta LE_t \qquad (5.3.5)$$

v) Domestic and foreign public debt. As indicated in the previous chapter, new foreign debt in a SSA context is likely to be exogenous. Hence the new stock of foreign debt will be equal to

$$FD_t^* = FD_{t-1}^* (1-\rho) + \Delta FD_t^* \qquad (5.3.6)$$

Domestic outstanding public debt in turn can be readily found by adding to old debt, new money creation

$$DD_t = DD_{t-1} + \Delta H_t \qquad (5.3.7)$$

If there is no other way to accumulate domestic debt except by creating high powered money, then DD_t is nothing more than the outstanding stock of high powered money.

Finally notice that asset appreciation and depreciation, like capital revaluation, houses' price appreciation etc. are reflected in the updated balance sheets as increases in net-worth or wealth of firms and households. If wealth is assumed to feedback on permanent income and consumption, this revaluation will have real effects, otherwise it will not.

5.4. Updating Nominal Wages

For sectors where nominal wages are fixed within the period, a wage adjustment process must be formulated. It seems reasonable in view of the Phillips curve type of literature to

hypothesize that the nominal wage agreed to in the next period will be a function of the current unemployment rate and expected inflation, which under naive expectations can be approximated by the current inflation rate. This implies the following form for nominal wage adjustment for fix-wage labor market s.

$$\frac{\bar{w}_{s(t+1)} - \bar{w}_{s(t)}}{\bar{w}_{s(t)}} = f\left(\frac{L_{st} - L^{d}_{st}}{L_{st}}, \frac{CPI_{t} - CPI_{t-1}}{CPI_{t-1}}\right) \qquad (5.4.1)$$

Various speeds of adjustment can be estimated or specified within the above formulation.

6. EXTENSIONS AND FURTHER SPECIFACTION

In this chapter further details on some aspects of the model are presented, and extensions to cover specific issues are discussed.

6.1. Production in the Agricultural Sector

In all macrosectoral CGE models to date the agricultural sector or subsectors within, have been modeled just like any other sector, namely producing one type of product with quasi-fixed sector specific capital. This, however, creates several problems. First, there might be a desire to include more than one commodity per agricultural sector, on both the production as well as on the consumption side. While there is usually detailed information about the uses of a specific commodity, namely specification of a row in the SAM along lines of the so-called supply utilization account, there might not be enough information on the input and cost side in order to specify the corresponding column elements. Second, even if the columns and rows can be specified in a disaggregated manner, the factors capital and land are not usually specific to any given product. The same land can be used to produce cereals and export cash crops as well as vegetables. The tools used for production are the same in all products. Hence the assumption of quasi-fixed sector specific capital cannot be made. An appropriate specification under these circumstances is the following.

Denote the aggregate output indices of sectors producing

agricultural products by X_1, X_2, ..., X_m. The sectors should be aggregated so that the capital employed is quasi-fixed for that sector. For instance since tree crops use a specific capital factor, trees, they could all be aggregated together. Animal production could also be lumped together. Nevertheless, there might be aggregates which use the same capital factors, for instance X_1 could represent major traded staple foods (rice, maize, wheat), while X_2 might be the aggregate of all other staple food crops (cassava, yams, plantains, vegetables, etc.).

Each one of the sectors 1, ..., m is represented by a separate column in the SAM. However, suppose that there is desire to have more detailed product disaggregation, without adding further columns to the SAM. For instance one might want to disaggregate the traded cereals sector into rice and maize, the tree crop sector into cocoa, coffee, fruit trees, and others etc. It is suggested that for each agricultural sector j where product disaggregation is desired the output of that sector is written as a Constant Elasticity of Transformation (CET) index (see Powell and Gruen (1968)) of the outputs of the individual products.

$$X_j = CET\,(x_{j1}, \ldots, x_{jk}; \tau_j) = \left(\sum_{k=1}^{k_j} \alpha_{jk}\, x_{jk}^{\frac{\tau_j+1}{\tau_j}} \right)^{\frac{\tau_j}{1+\tau_j}} \qquad (6.1.1)$$

where x_{jk} - output of the k'th commodity within agricultural sector j

τ_j - constant elasticity of transformation parameter for agricultural sector j

α_{jk} - positive constant parameters.

The CET specification in (6.1.1) has been alluded to in a general sense in section 4.3 (cf. equation (4.3.10)) and could be used for other sectors producing multiple commodities. Suppose now that agricultural sectors 1 and 2 (it could be more sectors but consider only two for simplicity) producing k_1 and k_2 commodities each, share the same fixed factors, capital and labor. Then it is suggested that the following separable production transformation frontier is utilized.

$$CET\ (X_1,\ X_2;\ \tau_{12}) = PR_{12}\ (GS_{12t},\ t)\ CES\ (L_{12},\ K_{12};\ \sigma_{12}) \quad (6.1.2)$$

where

$CET\ (X_1,\ X_2;\ \tau_{12})$ - a CET function of the indices X_1 and X_2 with transformation parameters τ_{12}

$CES\ (L_{12},\ K_{12};\ \sigma_{12})$ - a constant elasticity of substitution (CES) function of total labor and capital L_{12} and K_{12} utilized jointly by sectors 1 and 2.

PR_{12} - the joint sector 1 and 2 productivity parameter (re. equations (4.3.1) and (4.3.2)).

Note in passing that the CES index function with parameter σ could be written as a CET index function with parameter $\tau = -\sigma$.

The specification above has already supposed that intermediate inputs are used in fixed proportions to output indices in sectors 1 and 2, and that is why they do not appear in the CES function in the right hand side of (6.1.2). The separable tree structure specified in (6.1.1) and (6.1.2) can

consistently disaggregate the agricultural sector into as many products as desired without creating more columns in the SAM. In other words the purchases of inputs by e.g. sector j are assumed to be used for production of all products and are not product specific. In this fashion, for instance, fertilizer input does not have to be specified as separately being used for each of the sub-products x_{jk}, but instead is used by the whole sector j, producing the k_j sub-products. This in essence implies that inputs such as fertilizer are freely mobile within sector j in the production of the subproducts x_{jk}.

The specifications (6.1.1) and (6.1.2) imply CET price indices for the aggregate goods 1, 2 and their combination which has been denoted as good 12, as follows

$$P_{12} = CET\ (P_1,\ P_2;\ \frac{1}{\tau_{12}}) \tag{6.1.3}$$

where

$$P_j = CET\ (p_{j1},\ p_{j2},\ \ldots,\ p_{jk_j};\ \frac{1}{\tau_j}) \qquad j = 1,\ 2 \tag{6.1.4}$$

where p_{ji} - is the price of commodity j that is part of aggregate sector i.

The price indices are such that the following relations hold

$$P_{12}\ X_{12} = P_1\ X_1 + P_2\ X_2 \tag{6.1.5}$$

$$P_j\ X_j = \sum_{k=1}^{k_j} p_{jk}\ x_{jk} \tag{6.1.6}$$

6.2. Supply Utilization Accounts for Commodities and SAM Row Disaggregation

Since some sectors are aggregates of several commodities, each with its own price, there is need for individual markets for each one of these commodities. This can be provided by disaggregating row j in the SAM, of the corresponding aggregate sector j, into k_j subrows along supply-utilization lines.

A supply utilization account, exemplified for instance, by those produced by the Food and Agriculture Organization (FAO) of the United Nations, for agricultural commodities, states the sources of supply (domestic production, imports and stock carryovers from the previous period), as well as the uses (intermediate uses, exports, other final demand components) for a relatively homogeneous commodity (e.g. shelled maize, or paddy rice). As such, a supply utilization account corresponds to a row in a SAM. As, however, mentioned already, while the components of the row might be easy to specify, the components of the respective columns might not be, as the example of the fertilizer input in the previous section made clear.

Table 6.1 indicates a SAM row disaggregation of a sector into the various supply utilization accounts for the k individual commodities that constitute the sector. The variables m_{ji} denote the competitive imports of product ji. Since this product is more or less homogeneous, these imports might not be determined by the Armington specification (cf. equations (4.7.5)-(4.7.8)) but instead by other rules. For instance imports of a key food commodity such as rice or maize

Table 6.1

Row Disaggregation of the SAM row for Aggregate Sector j

(Composed of k Commodities)

		Uses of Product						
Domestic Supply		Intermediate Demands				Final Demands		
Production	Imports	1	j	...	n	1	...	F
x_{j1}	m_{j1}	x_{j11}	x_{j1j}	...	x_{j1n}	x^1_{j1}	...	x^F_{j1}
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
x_{jk}	m_{jk}	x_{jk1}	x_{jkj}	...	x_{jkn}	x^1_{jk}	...	x^F_{jk}

might be exogenously determined by the government. Stock changes are subsumed as one of the components of final demand. The intermediate uses of the commodity as input to all other sectors besides j could be specified by fixed input coefficients. For instance total input of rice into the food processing industry might be made equal to a fixed proportion of the output of that industry.

Alternatively, and this might be more appropriate for a homogeneous commodity, the quantities of the commodity going for a particular intermediate use might be made equal to a fixed share of the quantity of the product supplied. For instance, the quantity of a commodity such as rice going as intermediate

to the food processing industry (which, of course includes the rice milling industry) might be specified as a fraction of the total domestic current supply (domestic production plus imports). This specification might be particularly appropriate for the intermediate input of one commodity, say the ji one, into industry j, namely the element x_{jij} in the notation of Table 6.1. This because, for instance, the use of rice as input into the cereals sector, will basically be composed of seed, and this can generally be well approximated by a fixed share of the output or supply of rice.

As far as the final demand components are concerned, the rows for the individual commodities can be treated in a standard SAM format, except that the notion of group separability might be used, for instance, to economize on parameters of the relevant private consumer demand system. In other words the demand for the set of commodities (j1, ..., jk) might be considered as demand for a separable group, and hence treated like demand for an individual product in the higher-echelon demand system. Demand for the individual sub-products within the group could then be derived via the aggregation rule for the group.

Each row within the row disaggregated SAM corresponds to a commodity balance equation. The single excess demand function for the grouped commodity j has thus been transformed into m excess demand functions for the individual commodities. These m excess-demand must be driven to zero along with the remaining n-1 other sector excess demands. Therefore, the disaggregation of a SAM sector into sub-sectors, increases the number of

excess demand equations and corresponding balancing variables.

The procedure outlined above, in essence brings together principles long used in building sectoral micro models (such as for instance those outlined in Singh et.al) with individual commodity detail, and techniques more appropriate for macro-sectoral SAM based models. In the latter the difficulty of introducing more commodities and markets (which is what the policy-makers want) has traditionally been bound by the inability to disaggregate the corresponding columns. The procedure outlined above indicates a way by which this column disaggregation is not necessary.

6.3. Import Rationing and the Parallel Market for Foreign Exchange

Probably the most serious distortion in most SSA countries has to do with overvalued exchange rates, and most SSAPs have as a central aim the devaluation of the currency. The reason overvaluation and foreign exchange rationing are so prevalent in these countries is that they act as invisible but powerful redistributive mechanisms. Those privileged to have access to goods purchased at the official rate essentially obtain a rent equal to the difference between the value of the good at the black market exchange rate and the official one. The existence of parallel markets for foreign exchange gives rise to various other distortions in the product markets. It is well known than in most SSA countries in the markets of the major export products, as well as the major staple food crops there exist

large parastatals that aim to control the prices and markets often in a coersive manner. This gives rise to parallel product markets that have significant and non-negligible macroeconomic impacts. In most analyses of adjustment, however, these important phenomena have been neglected, albeit there exist some scattered attempts to analyze them (May (1985) and Singh et.al (1985)).

The parallel market for foreign exchange will be analyzed in stages. First assume that the official exchange rate e is fixed. Denote the excess demand for foreign exchange at this rate as DFX_t^*. This is equal to the difference between the foreign exchange value of all imports demanded at this rate, and the value of exports supplied to the foreign market, minus the value of net private autonomous transfers to the country

$$DFX_t^* (e_t) = M_t^* (e_t) - EX_t^* (e_t) - PTR_t^* (e_t) \qquad (6.3.1)$$

where $DFX_t^* (e_t)$ - net demand for foreign exchange by domestic agents at exchange rate e_t

$M_t^* (e_t)$ - foreign exchange value of all imports demanded by domestic agents at exchange rate e_t

$EX_t^* (e_t)$ - foreign exchange value of all exports supplied by domestic agents at rate e_t

$PTR_t^* (e_t)$ - net private foreign exchange transfers at rate e_t (might be defined to include net private capital inflows, including foreign direct investment).

Assume that at the official rate e_t, the excess demand for foreign exchange DFX_t^* is larger than the accomodating supply of foreign exchange available from government, multi-lateral and other official sources, denoted by EF_t^*, namely external finance. Hence EF_t^*, becomes a constraint on the net demand for foreign exchange. Given this constraint, and if the exchange rate does not vary to clear the market, a rationing rule has to be specified for all categories of imports, so that the actual official foreign exchange expenditure on imports by all domestic agents matches the total supply of foreign exchange, which according to the above notation is equal to

$$SFX_t^* (e_t) = EX_t^* (e_t) + PTR_t^* (e_t) + EF_t^* \qquad (6.3.2)$$

where SFX_t^* - total supply of foreign exchange from all sources.

Denote the quantity of the k'th type of import (consumer good, intermediate good, investment good, etc.) demanded by domestic agents at the official rate e_t by $QM_{kt} (e_t)$, and the corresponding cif foreign price by PM_{kt}^*. Then the variable $M_t^* (e_t)$ defined in (6.3.1), that represents the foreign exchange value of all demanded imports, is equal to

$$M_t^* (e_t) = \sum_{k=1}^{M} QM_{kt} (e_t) \cdot PM_{kt}^* \qquad (6.3.3)$$

where M denotes the various types of imports.

A rationing rule could then be specified, for instance by a function of the following form

$$QM^r_{kt} = f\ (QM_{kt}\ (e_t),\ \ SFX^*_t\ (e_t)\ /\ M^*\ (e_t)) \qquad (6.3.4)$$

For instance the government might specify that priority is given to intermediate and investment type of imported inputs, which are rationed in proportion to their total demand at official rates, and that no other type of import is allowed. Such a rule would imply that for k belonging to the class of intermediate and investment goods, the rationed quantity of imports would be equal to

$$QM^r_{kt} = QM_{kt}\ (e_t)\ \cdot\ \frac{SFX^*_t\ (e_t)}{M^*\ (e_t)} \qquad (6.3.5)$$

Clearly, a variety of rationing rules can be specified. From the modeling perspective, the important thing is that the rules can be implemented in a simulation exercise. A rule like (6.3.5) for instance could easily be implemented by computing the variables QM_{kt}, SFX^*_t, and M^*_t when the model is run with a fixed exchange rate e_t, and a variable such as DFX^*_t in (6.3.1) is computed as a residual of all the demands and supplies of foreign exchange.

If there is no parallel market for foreign exchange, then the system would have to be solved with the amounts for the various variables such as QM_{kt} fixed at their rationed levels defined in (6.3.4). To illustrate the technique assume that a consumer class h (namely a class of households) is allocated (on a per-capita basis) an amount QM^r_{hk} of the non-competitive

import, indexed where K is the number of total consumed goods (cf. equation (4.7.4)), at price p_{dK} (which does not have to be equal to the exchange rate times the international price). Then the rationed consumer demand system of the LES type for this consumer class would be modified from the one outlined in equation (4.7.4) as follows

$$QCPC_{hk} = \bar{Q}\bar{C}\bar{P}\bar{C}_{hk} + \frac{m_{hk}}{p_{dk}(1-m_{hK})} (YCPC_h - p_{dK}\, QM^r_{hK} - \sum_{k=1}^{K-1} p_{dk}\, \bar{Q}\bar{C}\bar{P}\bar{C}_{hk}) \qquad k = 1, \ldots, K-1 \qquad (6.3.6)$$

This equation derives from the typical consumer of class h maximizing the same utility that gave rise to the LES of equation (4.7.4), except that now the price and quantity of the K'th good are fixed.

Assume that the rationed import is for a competitively imported but differentiated good i (for instance rice). This presents a slightly different problem because the consumer can substitute domestic for the foreign good. Differentiated imports were treated without specific functional definitions in equations (4.7.6)-(4.7.9). To illustrate the technique involved here, assume that the index aggregating the domestic and differentiated imported good is of the CES type

$$QCP_i = (\delta_1\, QCPD_i^{\frac{\sigma-1}{\sigma}} + \delta_2\, QCPM_i^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}} \qquad (6.3.7)$$

where the variables are all the same as in equation (4.7.7), δ_1, δ_2 are positive parameters, and σ is the elasticity of substitution. This "Armington" specification implies the following functional forms for the demand for the domestic and imported goods, as well as the price of the composite commodity i (notation corresponds to that of equations (4.7.6) and (4.7.7)-(4.7.8)).

$$QCPD_i = QCP_i \; \delta_1^{\sigma} \left(\frac{p_{cdi}}{p_{ci}}\right)^{-\sigma} \tag{6.3.8}$$

$$QCPM_i = QCP \; \delta_2^{\sigma} \left(\frac{p_{cmi}}{p_{ci}}\right)^{-\sigma} \tag{6.3.9}$$

$$p_{ci} = \left(\delta_1^{\sigma} \, p_{cdi}^{1-\sigma} + \delta_2^{\sigma} \, p_{cmi}^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{6.3.10}$$

It is now specified that under rationing the quantity of the imported intermediate $QCPM_i$ is fixed at some level $QCPM_i^r$, and the corresponding price is fixed at some level p_{cmi}^r. If this price and quantity are substituted in the four relations above, then the six variables present in the four equations (4.3.7)-(4.3.10) are reduced to four "free" variables, namely p_{cdi}, p_{ci}, $QCPD_i$, QCP_i. If the four equations were independent then they could be solved for these variables. However, they are not independent, as the following aggregation relation must hold

$$p_{ci} \; QCP_i = p_{cdi} \; QCPD_i + p_{cmi} \; QCPM_i \tag{6.3.11}$$

This, nevertheless, implies that only one of the four free variables can be independent, the rest being dependent through the system. This implies that the quantity $QCPD_i$ of the domestic commodity i demanded internally, is a function of the domestic price p_{cdi}, independently of the function implied by say the private LES demand system. In other words for every value assumed by price p_{cdi}, the quantity demanded internally can be solved from the system of four equations above and not by the LES demand system. This, in turn implies that, when the model is solved by iteration on commodity prices, namely when prices are assumed and quantities subsequently computed to yield the excess demands, in the LES consumer demand system, the i'th equation (namely for the composite good i) is not included, but the quantity QCP_i of the composite good demanded as well as its price p_{ci} are computed instead from equations such as (6.3.7)-(6.3.10). Once this is done the demand equations for the remaining composite commodities can be found by a "rationed LES system" of a type similar to (6.3.6). (In the following notation the household index h is dropped).

$$QCPC_k = \overline{QCPC}_k + \frac{m_{hk}}{p_{ck}(1-m_{hk})} (YCPC_k - p_{di}\ QCP_i - \sum_{\substack{k=1 \\ k\neq i}}^{K} p_{dk}\ \overline{QCPC}_k) \qquad (6.3.12)$$

where

$$p_{di} = p_{ci}\ (1-s_{di}) \qquad (6.3.13)$$

by reference to equation (4.7.2).

Once the system is "equilibrated", the equilibrium prices and quantities will be compatible with both (6.3.12), and the four equations (6.3.7)-(6.3.10), as well as the rationing rule. Similar reasoning can lead to "rationed profit maximizing" quantities of intermediates demanded, etc. The point is that under the assumption of effective rationing and absence of parallel imports, the whole model can be empirically solved subject to the rationing constraints, and the fixed official exchange rate. The so-obtained equilibrium prices and quantities would be the observed ones if there were no parallel markets.

Another way the system could be solved would be to hypothesize that there is no foreign exchange constraint but that the foreign exchange rate varies to clear the foreign exchange market. In other words the following equilibrium equation would be solved in addition to the others.

$$DFX_t^* (e_t) = EF_t^* \qquad (6.3.13)$$

Under such a system equation (6.3.13) would become an additional equilibrium condition of the system and the solution e_s would represent the <u>shadow price of foreign exchange</u>. The implicit rents in the system could then be computed by comparing the solution with rationing with this latter solution. All this of course under the assumption that the rationed solution represents the actual state of affairs.

In reality, of course, rationing of foreign exchange will

give rise to a parallel market for foreign exchange. The problem is how to describe such a market empirically. Since not much data is usually available on these markets, one must make several guesses and use his knowledge of the country. However, some general suggestions are possible and are outlined below.

The first question concerns the demand for parallel market foreign exchange. How does it arise? The answer is conceptually simple. From those participants in the system (firms and individual consumers) who at the prevailing parallel market foreign exchange rate, denoted by e^p, find it advantageous to buy foreign exchange from individuals who supply it, in order to import goods (possibly through clandestine routes) that cannot be obtained via the rationing scheme of the government.

To illustrate the problem and solution consider a typical consumer of household class h who is allocated a ration QM^r_{hK} of the non-competitive import (indexed by K) at a fixed price $p^r_{dK} = e\ p^*_K$, where e is the official exchange rate and p^*_K is the international price of good K (for simplicity tariffs or other taxes are ignored). Suppose that this consumer also has the option to obtain an amount QM^p_{hK} through parallel imports at a price $p^p_{dK} = e^p\ p^*_K$, where e^p is the parallel market exchange rate. Assuming that the consumer's demand is determined by a LES system as exemplified in section 4.7, then one can consider the problem of maximizing the underlying utility implied by the LES, subject to the rationing constraint, but with the possibility for the consumer to buy more of the same good at a different price. The result is the following demand system.

$$QCPC_{hk} = \bar{Q}\bar{C}\bar{P}\bar{C}_{hk} + \frac{m_{hk}}{p_{dk}} (YCPC_h - p^r_{dK}\ QM^r_{hK} -$$

$$- p^p_{dK}\ \bar{Q}\bar{C}\bar{P}\bar{C}_{hK} - \sum_{i=1}^{K-1} p_{di}\ \bar{Q}\bar{C}\bar{P}\bar{C}_{hi}) \qquad (6.3.14)$$

for $k = 1, \ldots, K-1$

$$QM^p_{hK} = \bar{Q}\bar{C}\bar{P}\bar{C}_{hK} + \frac{m_{hK}}{p^p_{dK}} (YCPC_h - p^r_{dK}\ QM^r_{hK} -$$

$$- p^p_{dK}\ \bar{Q}\bar{C}\bar{P}\bar{C}_{hK} - \sum_{i=1}^{K-1} p_{di}\ \bar{Q}\bar{C}\bar{P}\bar{C}_{hi}) \qquad (6.3.15)$$

In essence the consumer acts so as to allocate his uncommitted income $YCPC_h - p^r_{dK}\ QM^r_{hK}$ to the K commodities, where for the K'th commodity the relevant price is p^p_{dK}. The demand of this consumer for parallel market foreign exchange is equal to $p^*_K \cdot QM^p_{hK}$.

For competitive but differentiated imports the situation is analogous. Let QM_i, the total quantity of competitive imports in sector i for all uses, be the sum of rationed and parallel market imports.

$$QM_i = QM^r_i + QM^p_i \qquad (6.3.16)$$

Let agents be modeled as using a CES aggregation function between the domestic and imported good like equation (6.3.7), to allocate their total demand for composite commodity i between the domestic and the imported good. Then the demand for QM_i can be found in exactly the same way as illustrated in

equations (6.3.8)-(6.3.10) with the restriction that the relevant price for the imported good is the parallel price $p^p_{mi} = e^p\, p^*_{mi}$ where p^*_{mi} is the international price (again assuming no tariffs, taxes etc. for simplicity).

Agents in reality pay price $p_{mi} = e\, p^*_{mi}$ for the rationed amount QM^r_i and p^p_{mi} for the remaining parallel amount QM^p_i. Hence, while the problem solution is identical to the one outlined in section 4.7, it amounts to a situation where all agents using the composite commodity i for any use, consumption, intermediate, investment etc., in essence obtain a rent equal to $(p^p_{mi} - p_{mi})$ times the amount of the rationed import QM^r_i that they utilize.

Given the above system, the demand for parallel imports of the i'th competitive differentiated imported good is equal to

$$QM^p_i = QM_i - QM^r_i \tag{6.3.17}$$

A similar procedure can be used to derive demand by firms for parallel imports of non-competitive intermediate goods, investment goods etc. The total demand for foreign exchange for parallel market imports of goods will be the sum of the foreign values (foreign price times parallel import quantity) of all types of commodities thus demanded. Denote this demand by M^p_t.

Notice that the empirical calculation of the demand for the various parallel market imports is not too difficult. If one imposes for instance, the structure on consumer demand described by the mixed rationed system in (6.3.14) and (6.3.15), then consumer budget surveys will yield the total

quantity of QM_{hK} demanded. If one subtracts the officially recorded quantities of imports that are allocated for non-competitive consumption, the amount of total parallel market imports can be obtained. Hence calibration of the demand system in (6.3.14) and (6.3.15) can be achieved given the market prices which will inevitably be equal to parallel market prices.

The supply of foreign exchange comes from two basic sources. One is unofficial transfers of relatives or firm affiliates to local residents. The second is through parallel market exports of goods. The first source is quite difficult to pinpoint empirically, albeit rough estimates can probably be made from secondary data on immigration, job and family status of immigrants etc. Conceptually, however, once a number is derived it can be considered exogenous to the rest of the system.

The second source can be analyzed in the following manner. Consider a sector that produces an exportable product (the subscript i will be dropped for simplicity). Assume that foreign demand for this sector's exports is given by the following special form of equation (4.8.7).

$$E = \bar{E} \left(\frac{p_f}{p^*}\right)^{-\eta} \qquad (6.3.18)$$

where η is the elasticity of foreign demand.

Exports are channeled through two markets, the official one where the offer price to foreigners is

$$p_{fo} = \frac{p\ (1-s_e)}{e} \tag{6.3.19}$$

where p is the domestic producer price, and the parallel one where the offer price is

$$p_{fp} = p/e^p \tag{6.3.20}$$

Denote the exports channeled through the official market by E_o and those channeled through the parallel market by E_p. Define the composite commodity E bought by foreigners by a CES function of E_o and E_p as follows

$$E = (\zeta_o\ E_o^{\frac{\sigma-1}{\sigma}} + \zeta_p\ E_p^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}} \tag{6.3.21}$$

where the ζ_i and σ are parameters. Then minimization of

$$p_{fo}\ E_o + p_{fp}\ E_p \tag{6.3.22}$$

subject to (6.3.21) yields

$$E_o = E\ \zeta_o^{\sigma}\ (\frac{p_{fo}}{p_f})^{-\sigma} \tag{6.3.23}$$

$$E_p = E\ \zeta_p^{\sigma}\ (\frac{p_{fp}}{p_f})^{-\sigma} \tag{6.3.24}$$

where

$$p_f = (\zeta_o^{\sigma}\ p_{fo}^{1-\sigma} + \zeta_p^{\sigma}\ p_{fp}^{1-\sigma})^{\frac{1}{1-\sigma}} \tag{6.3.25}$$

The price p_f is the one entering the demand function (6.3.18). Domestic equilibrium in the market for commodity i is achieved by varying p so as to achieve the zero excess demand condition (cf. equation (4.10.1), where the quantity of exports is the simple sum of official and parallel exports $E_o + E_p$. Notice that $E_o + E_p$ is different than E in equation (6.3.18), and that p_f E is just a shorthand way of writing the total expenditure of foreigners which are given by (6.3.22).

The above specification can be empirically implemented as follows. Calibration of the system could be done by "guessing" at the ratio of E_o to E_p and via equations (6.3.23)-(6.3.24) and knowledge of the official imports, estimating the parameters ζ_o and ζ_p, given o as well as the magnitude of E_p. Once this is done the variable E could be constructed via (6.3.21) and the parameter $\bar{E}$ could be estimated from (6.3.18) given a value for η. This shows that not much more than one educated guess per market is necessary to implement the parallel export markets in the model.

The total supply of parallel market foreign exchange from transfers and parallel exports of goods will be denoted by

$$EX_t^p + PTR_t^p \tag{6.3.21}$$

where PTR_t^p denotes the private parallel transfers of foreign exchange to residents, and where EX_t^p is just the sum of the products of the prices paid by foreigners (cf. equation (6.3.20)) and the quantities exported in the parallel market.

The final component of the parallel market for foreign exchange is capital flight, namely the change in the foreign currency holdings of households. This was explicitly incorporated in the portfolio decisions of households in section 4.9 (cf. equation (4.9.27)). Hence if portfolio decisions regarding the other components of investments (equations (4.9.22)-(4.9.26)) have been estimated, then the demand for change in foreign currency hodlings will fall out as a residual via equation (4.9.28). The aggregation of the changes in the demand for foreign currency holdings by domestic residents across all households yields the total demand ΔF_t^* (cf. equation (4.9.36)).

Given the above analysis the excess demand for foreign exchange in the parallel market EDF_t^p is equal to the following

$$EDF_t^p = M_t^p - EX_t^p - PTR_t^p + \Delta F_t^*$$

The parallel market exchange rate e_t^p is the adjusting variable corresponding to this equation.

6.4. Marketing Parastatals and Parallel Product Markets

Consider a product i whose market includes a government parastatal. This product could be identified with a whole sector of the model or a sub-product along the exposition of section 6.2. Suppose that the parastatal offers the producers a fixed price p_f and sells the same product to consumers at a fixed price p_c which could be different than p_f (the subscript i is temporarily suppressed). Denote by x_f the amount of supply

procured by the parastatal, by x_p the amount of supply that producers sell in the parallel uncontrolled market at a price p_p and by x_s the amount they use for self consumption. To simplify the analysis for this discussion, intermediate sales, final sales apart from those used for private consumption, imports and exports will be neglected. They could easily be brought in the analysis.

Since quantities x_f, x_s and x_p are of the same good, they are essentially perfect substitutes. Denote by x the total quantity produced by the producer

$$x = x_f + x_p + x_s \tag{6.4.1}$$

This quantity should be a function of the average price received by the producer which is equal to

$$\bar{p} = \frac{x_f\, p_f + (x_p + x_s)\, p_p}{x} = p_p - \frac{x_f}{x}\,(p_p - p_f) \tag{6.4.2}$$

Notice that self-consumption is valued at the parallel market price. In (6.4.2) if a farmer sells nothing to the parastatal, his effective price is equal to p_p, while if he sells all his production to the parastatal ($x_f/x = 1$) his effective price is, of course, equal to p_f.

Suppose that the ratio x_f/x can be estimated as a function of the difference between the parallel and fixed official prices

$$\frac{x_f}{x} = f\left(\frac{p_p - p_f}{p_f}\right) \qquad f' < 0 \tag{6.4.3}$$

Such an estimation, will normally be econometrically feasible. The official market basically consists of the parastatal procuring a quantity x_f at p_f and reselling it to consumers at a price p_c (normally lower than p_f but this is of no analytical consequence). The basic market that must be balanced in the model is the parallel market. In that market the total supply of the product depends on the mixed price $\bar{p}$, while the private demand must be given by a rationed demand system like the one relevant for the demand for parallel imports (cf. equations (6.3.14)-(6.3.15)). In other words the distributions of the parastatal at low prices act as rations to households.

Given a rule such as (6.4.3) the total supply x of the commodity can be found in a straightforward way. For a given price p_p in the parallel market and for fixed p_f, equation (6.4.3) will determine the ratio of the amount sold to the parastatal and total production x_f/x. This ratio, in turn determines in (6.4.2) the price relevant for the producer. It is this price that will enter the production decision outlined in section 4.3. As far as the market balance in the parallel market is concerned, it will be of the following form (remember intermediate uses, imports and exports stock changes, investment demand etc. are not included, and only private consumer demand has been allowed).

$$x_p + x_a = (x_a + QDP) \tag{6.4.4}$$

where QDP is the demand in the parallel market by the non-producing consumers. The total quantity demanded in the right

hand side of (6.4.4) will be the sum of various household demands, each one of which will obey a rationed demand system of the type illustrated in equation (6.3.15).

7. ANALYTICS OF A SIMPLIFIED MODEL

The model outlined in the previous three sections is comprehensive but at the same time quite complex. It might help the reader to see how a simplified version, stripped down of many complications will behave under some changes common under adjustment. This chapter analyzes such a model, which albeit not too detailed, nevertheless preserves many of the essential features of the main model. Emphasis throughout will be placed on economic structure and adjustment behavior.

7.1. The Model

There are two key features of the model described earlier that stand out. The first is that in an economy of the SSA type there is simultaneous presence of certain sectors that behave with excess capacity and rigid prices in the short-run, while there are other sectors which behave in a more or less full capacity mode, and where prices are flexible in the short-run. Most of agriculture and the non-agricultural informal sectors would typically fall in the latter category, while larger scale manufacturing and public firms would typically constitute the former.

The second major structural feature of the model outlined earlier is that investment is constrained by the availability of funds, which in turn are influenced by public sector deficits as well as external loans.

In the simplified model two sectors are distinguished. The

first is a fix price sector, where prices in the short-run are fixed by a mark-up over prime cost, which in turn is constituted by formal wages and intermediate imported inputs. This sector is assumed to operate with excess capacity, and hence the quantity produced is what adjusts in the short-run.

The second sector is assumed to operate at full capacity. It is a sector where a lot of self-employment exists. For simplicity the quantity produced in this sector is assumed fixed in the short-run, and it is the price which adjusts to achieve supply-demand balance.

The first sector is assumed to be largely non-tradeable. This is justified if one considers that most manufacturing firms in SSA are producing import substituting light consumer goods. The public corporations certainly fit into this mold as well. On the other hand the flex-price sector is assumed to produce an exportable commodity. One can think of agriculture to justify this assumption.

With the above assumptions the following commodity balance equations summarize the model.

$$X_1 = C_1 + G \tag{7.1.1}$$

$$X_2 = C_2 + \lambda I + E_2 \tag{7.1.2}$$

where X_i - output of sector i (i=1 denotes the fix price sector, while i=2 denotes the flex price sector)

C_i - private domestic consumption of the output of sector i

G - both current and capital real public spending. The public sector is assumed to demand products mostly from sector 1

I - total real domestic investment, a fraction λ of which is demanded by sector 2 (think of construction), the remainder being imported

E_2 - exports of sector 2 good.

The price of output of the first sector is given by a mark-up relation

$$P_1 = (1+\tau)\ (wl_1 + a_1\ e\ p_m^*) \qquad (7.1.3)$$

where P_i - output price of sector i

τ - fixed mark-up factor

w - nominal wage of labor employed in sector 1 (fixed in the short-run)

l_1 - fixed labor output coefficient for sector 1

a_1 - fixed intermediate imported input coefficient

e - exchange rate (amount of local currency per unit of foreign currency)

P_m^* - foreign price of the non-competitively imported intermediate input.

The price P_2 of sector 2 is assumed flexible.

Income in this model consists of sector 1 wage income, sector 1 operating surplus (profits), and sector 2 income. This last item is equal to the value of all production of sector 2, since no intermediate inputs are assumed for this sector, and since because of self-employment, wage and profit income is not

distinguished.

$$Y = wl_1 X_1 + \tau (wl_1 + a_1 e p_m^*) X_1 + P_2 X_2 \qquad (7.1.4)$$

where Y - Nominal domestic value added or nominal gross domestic product (GDP).

For simplicity direct and indirect taxes are assumed away in this model. Income recipients are assumed to consume the wage portion of their income plus a fraction of the income of sector 2. Hence consumed income is

$$YC = wl_1 X_1 + (1 - s_2) P_2 X_2 \qquad (7.1.5)$$

where YC - total consumed income

s_2 - average saving propensity of sector 2 operators.

Note that no class distinctions are made in the simplified model. If the poor are concentrated among the wage recipients and the self-employed (a likely scenario), then increases in poverty are implied by a decline in real wage income, and income of sector 2. However, given that the wage is nominally fixed in the short-run, the nominal wage bill depends on production of sector 1, while both the nominal income of the self-employed, as well as the real income of wage labor depend on the other adjusting variable P_2.

Assuming that both classes consume both goods, then an increase in X_1 and P_2 benefits both classes on aggregate, albeit on an individual basis it favors those deriving income mostly from sector 2, and it hurts workers. This is because with a rise in X_1, employment and hence total wages rise, but with a

fixed nominal wage and an increase in P_2, per capita real income of workers is likely to fall. An increase in P_2 on the other hand, coupled with a fixed nominal price P_1, will increase the real income of those in sector 2. Of course, if some workers were formerly unemployed, an increase in X_1 will certainly benefit them. If then the poor are concentrated in sector 2, then an increase in P_2 will benefit them more than an increase in X_1.

Clearly, the movements in X_1 and P_2 tell a lot about the underlying income distribution. However, in this simplified analytical model these details are subsumed in order to focus on the macro-implications for X_1 and P_2, the key variables.

Given the above discussion, and the absence of many income classes, one private consumption system needs to be specified. The one chosen is a very simplified form of a Linear Expenditure System (LES).

$$P_1 C_1 = (1-m) YC - \theta P_2 \qquad (7.1.6)$$

$$P_2 C_2 = m YC + \theta P_2 \qquad (7.1.7)$$

where C_i - private consumption demand for the output of sector i

m - positive constant ($0<m<1$). It has the interpretation of a marginal budget share (above supernumerary income) spent on good 2.

θ - a positive constant.

The above assumptions imply that the expenditure elasticity of good one is larger than one, while that for the second good is

smaller than one. They also imply that there is a negative cross elasticity of demand of good one with respect to the price of good 2. These implications suggest that sector 2 can be thought of as the one that produces basic necessities (think of agriculture and food).

The exports of sector 2 are given by the following simple specification

$$E_2 = (\varepsilon_0 + \varepsilon_1 \frac{e\ P_2^*}{P_2}) X_2 \qquad (7.1.8)$$

where P_2^* - international price of good 2.

The above specification states that the exportable share of domestic output of sector 2, is a function of the relative prices in the world market, of the competing good exported by other countries, and the price P_2/e offered by domestic exporters to foreigners. The specification implies that exports are supply constrained, and they behave on the aggregate like a differentiated product in the world market. It is naturally assumed that $\varepsilon_1 > 0$. If $\varepsilon_0 > 0$ then the elasticity of the export share with respect to the relative price is smaller than one, while if $\varepsilon_0 < 0$, it is larger than one.

The external sector balance is given by the following relation

$$(1-\lambda)\ P_I^*\ I + a_1\ P_m^*\ X_1 - P_2^*\ E_2 = F^* \qquad (7.1.9)$$

where P_I^* - the international price of the imported portion of the investment good

F^* - total net availability of foreign exchange.

The term F^* summarizes in a simplified manner the official sources of external finance. It is the difference between the new external loans available and the payments on existing debt and arrears. In many SSA countries this term can be negative if external debt payments are larger than new loans. Competitive consumer or intermediate imports, and non-competitive consumer imports are assumed away for simplicity.

The domestic deficit of the public sector is given by the following equation

$$DF = P_1 G - (e P_2^* - P_2) E_2 \qquad (7.1.10)$$

Notice that the only source of public revenue in this simplified model is export taxes. No tariff or direct and other indirect taxation is assumed.

The savings-investment identity in this model can be written as follows

$$P_K I = (\tau (wl_1 + a_1 e P_m^*) X_1 + s_2 P_2 X_2) + e F^* - DF \qquad (7.1.11)$$

where P_K - is the cost of new capital.

$$P_K = \lambda P_2 + (1-\lambda) e P_I^* \qquad (7.1.12)$$

In equation (7.1.11) above the first term on the right hand side denotes private savings, the second foreign savings, and the third public savings.

7.2. Short-Run Equilibrium and Adjustment under Policy Changes

The basic constraint that has forced adoption of SAPs in SSA countries, is the external one. Because of it, governments are usually forced to cut down on imports and investment. In the simplified model under investigation, it shall be assumed that the result of fixed exchange rates and a limited supply of external loans is a reduction in investment expenditures. While a more realistic assumption is to postulate rationing, this would lead to parallel markets which would complicate the simple model. This assumption implies that the volume of investment can be derived by the foreign exchange "gap", equation (7.1.9).

$$I = \frac{1}{(1-\lambda)\ P_I^*} (F^* + P_2^* E_2 - a_1 P_m^* X_1) \qquad (7.2.1)$$

Substituting this relation in the commodity balance equation (7.1.2), and using the expressions for private consumption and export (equations (7.1.5)-(7.1.7) and (7.1.8)), in the two commodity balance relations (7.1.1)-(7.1.2), results in the following two equations in X_1 and P_2.

$$P_1 X_1 = (1-m)\ (w\ l_1 X_1 + (1-s_2) P_2 X_2) - \theta P_2 + P_1 G \qquad (7.2.2)$$

$$P_2 X_2 = m\ (w\ l_1 X_1 + (1-s_2) P_2 X_2) + \theta P_2 +$$

$$+ \frac{\lambda P_2}{(1-\lambda)\ P_I^*} (F^* + P_2^* (\varepsilon_0 + e_1 \frac{e P_2^*}{P_2} X_2 - a_1 P_m^* X_1) +$$

$$+ P_2 \left(\varepsilon_0 + \varepsilon_1 \frac{e\, P_2^*}{P_2}\right) X_2 \qquad (7.2.3)$$

These equations can be rewritten in a more suggestive form as follows

$$X_1 \left(P_1 - (1-m)\, w\, l_1\right) = \left((1-m)(1-s_2)\, X_2 - \theta\right) P_2 + P_1\, G \qquad (7.2.4)$$

$$X_1 \left(\frac{m\, w\, l_1}{P_2} - \frac{\lambda\, a_1\, P_m^*}{(1-\lambda)\, P_I^*}\right) = - \left(1 + \frac{\lambda\, P_2^*}{(1-\lambda)\, P_I^*}\right) \left(\varepsilon_0 + \varepsilon_1 \frac{e\, P_2^*}{P_2}\right) X_2 +$$

$$+ X_2 \left(1 - m\,(1-s_2)\right) - \theta - \frac{\lambda\, F^*}{(1-\lambda)\, P_I^*} \qquad (7.2.5)$$

Equation (7.2.4) is a positively sloped graph in the space of X_1-P_2 as illustrated in Figure 7.1 by the line labeled (1). Equation (7.2.5) is a non-linear relation in X_1 and P_2. To obtain an idea about its location consider the intercept of the locus in X_1-P_2 space that the equation represents, when P_2=0. If (7.2.5) is first multiplied by P_2 and then P_2 is set to zero, the resulting solution for X_1 is negative. This implies that the locus in X_1-P_2 space must intersect the equilibrium locus for good 1 from below as illustrated in Figure 7.1 by the curve labeled (2). Equilibrium in the short-run is achieved at the intersection of the two curves at point A. Denote the equilibrium values of X_1 and P_2 by $\bar{X}_1$ and $\bar{P}_2$ respectively.

Assuming that international prices are not affected by trade of the country under study (a small-country assumption), there are three domestic policy variables and one external

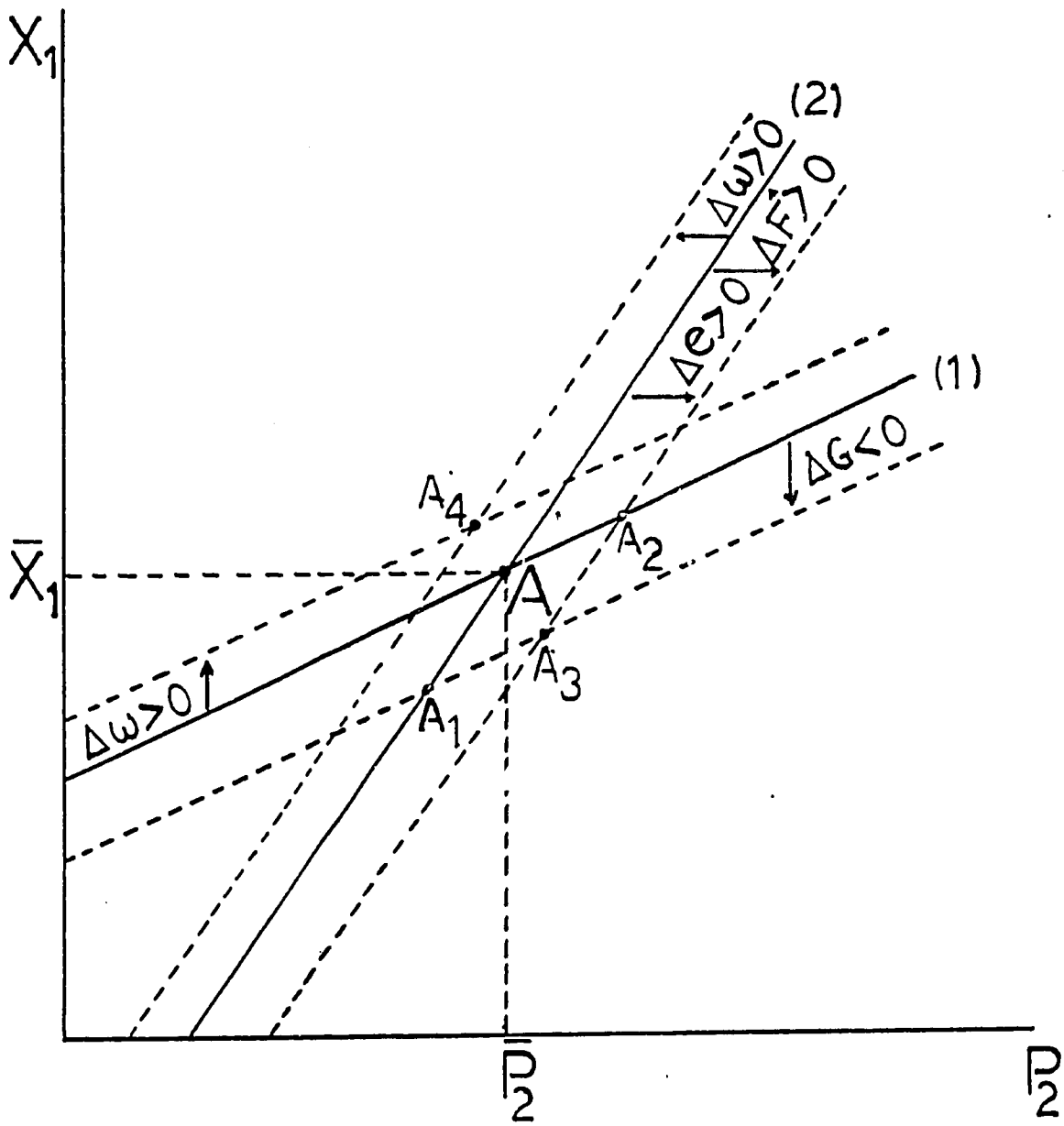

FIGURE 7.1 : Equilibrium and Adjustment in a Simplified Model

policy variable. The domestic policy variables are real government spending G, the exchange rate e, and the nominal wage w, which is assumed can be altered by the government through its wage policy for the public sector. The external policy variable is the flow of external finance F^*. Stabilization and structural adjustment programs typically impose in the short-run a reduction in G, a non-increasing w, an increase in e (devaluation), in return for an increase in F^*, namely more external finance.

Consider first the consequences of a decline in G. Since G does not appear in the commodity balance equation for sector 2, the corresponding locus in Figure 7.1 does not shift. However, it can be clearly seen from equation (7.2.4) that the locus representing equilibrium in sector 1 will shift downward. The reasoning is quite straightforward. A decrease in public spending will immediately affect negatively production of sector 1. The attendant decline in both total wage and profit income in sector 1 will have negative impact on aggregate demand, and a-fortiori on demand for sector 2 good. This drives the price for sector 2 down since supply there is fixed in the short-run. This despite the fact that exports rise as international competitiveness rises with the declining domestic price of good two. The new equilibrium is pictured in Figure 7.1 by point A_1. The consequences of a decline in public expenditure ceteris paribus is clearly deflationary, very much along Keynesian lines, despite the fact that investment is foreign savings driven, a more classical assumption, but one

that appears relevant for SSA. Notice from the investment determining equation (7.8.1) that since E_2 goes up and X_1 declines, investment goes up in the short-run as the balance of trade improves.

Consider now a devaluation. From perusal of equation (7.2.4) it can be seen that it is not affected. However, the locus describing equilibrium in sector 2 shifts to the right. This is because devaluation helps increase the share of sector 2 exported. This, ceteris paribus decreases the availability of good 2 in the domestic market, and increases its price in the face of fixed supply of good 2. The increased price in sector 2 boosts incomes in sector 2 and this in turn generates spillover demand for sector 1, which increases its output. In short-run equilibrium, illustrated by point A_2 in Figure 7.1, both the output of sector 1, as well as the price of sector 2 increase. The effect on investment from equation (7.2.1) is uncertain as the increase in exports is counteracted by an increased demand for intermediate imports to support increased production in sector 1.

A combination of reduced government spending, however, coupled with devaluation, could very well turn out to be stagflationary in the short-run. This is illustrated by point A_3 in Figure 7.1, which is at the intersection of the two shifted curves. At this point the output of sector 1 is lower than $\bar{X}_1$ while the price P_2 is above level $\bar{P}_2$. Since this policy package is almost always present in stabilization and structural adjustment programs, this short-run possibility is

something that appears quite possible. Notice that with the shifts in the curves predicted by the policy shifts, a situation of stable or declining prices and increase in the output of sector 1 cannot be achieved in the short-run. It rather appears that there is a trade-off between higher output (for sector 1) with inflation on the one hand, and lower output and stable or declining prices on the other. In other words if stagflation is to be avoided, the consequence is one of the above two outcomes. Of the two situations, however, the high output inflationary option will lead to decrease availability of excess foreign savings with which to finance investment, while the decreased output deflationary option will have the opposite effect.

These choices, of course, have strong implications for growth, as a painful short-run adjustment apparently leads to higher medium term investment and growth, while the opposite occurs with a short-run improvement in the economy. The options are for the government to make, but the simple analytics illustrate that a country might have to face a painful recession before the economy improves. Notice that the inflationary option will benefit those poor that operate in the flex price sector, while it will hurt those with fixed nominal wages. The deflationary option on the other hand will tend to favor the fixed wage earners (of course those that still have a job after the deflation) while it will hurt those in the flex price sector.

Consider an increase in the nominal wage w. From equations

(7.2.4)-(7.2.5) it can be seen that this shifts both curves (1) and (2) upwards and to the left. The consequence is an increase in X_1 as workers' improvement in income leads to higher demand for X_1 and an uncertain outcome on P_2 illustrated by point A_4 in Figure 7.1. This comes about because the increase in domestic demand for good 2 is counterbalanced by a decline in investment, which in turn comes about because the increased intermediate imports preempt foreign investment funds.

Finally, consider an increase in F^*, the availability of foreign funds. This will have a positive impact effect on investment, which will lead to a boost in domestic demand for commodity 2. This in turn leads to a rise in P_2 and hence inflation. However, the increased incomes induced by a higher P_2 lead to a spill-over increase in output of sector 1. Effects on the loci of Figure 7.1 are similar to the effects of a devaluation, since the locus of market one does not shift, while the locus for market two shifts to the right.

The conclusion of the analysis of the short-run under adjustment in an economy characterized by structural features relevant in a SSA context, is that there does not appear to be a recipee that will satisfy everyone. Some policies tend to have beneficial effects in the short-run and adverse in the medium-run, while others do the opposite. Clearly the design of the most appropriate policy is an empirical matter, and this is the reason that an empirical model is necessary for proper policy design.

8. SUMMARY AND CONCLUSIONS

The argument has been made in this monograph that in order to analyze the impact of macroeconomic and structural policies, such as those prescribed under stabilization and adjustment programs, on certain disadvantaged classes, one needs a framework that basically simulates in an empirically realistic way the entire economy. This is so because the crucial variables that affect the welfare of the poor, such as prices and quantities of goods and services they produce and purchase, and types of public amenities available to them, cannot be predicted in isolation from the rest of the economy. It was advocated that the most complete empirical technique to simulate the various effects, is through the construction of a multisectoral computable general equilibrium (CGE) model. The monograph then outlined the structure of such a model, designed to capture structural features important both for the poor as well as in countries of Sub-Saharan Africa.

The model suggested is a recursive dynamic CGE one. In other words starting from an initial period, where enough data is available to present a snapshot of the economy, the model updates the various stock variables and then recomputes an equilibrium solution for the next period. The so-called "equilibrium" solution for one period should be thought mostly in terms of supply-demand balance in the various markets for goods and factors rather than as a traditional general equilibrium where only prices vary to clear markets. In the

model presented here, both price as well as quantity adjustments are allowed, and hence equilibrium should be thought of in a wider sense.

The model presented here, advocated two major general areas for the analyst's attention. First, since the objective is to analyze the impact of macro-policies on the poor, a necessary prerequisite before one proceeds in constructing the CGE, is an understanding of the profile of poverty in the relevant country. This is a major element of what was termed the "bottom-up" approach to analysis of the impact of macro-policies on the poor, which contrasts and can lead to significantly different models than the more traditional "top-down" approach to macro-sectoral modeling.

The second area that requires special care is the assumptions the analyst will make about the structure of the economy, and even more importantly about the adjustment behavior of the various markets, the so-called closure rules. It was suggested throughout that it is not size and sectoral detail that will be important in determining the economy's development under macro policy changes, but rather the ways in which the various markets adjust. It was pointed out repeatedly that the fact that analysts differ on their assessment of the appropriate clusure rules, is due to the weakness of economic science itself in giving clear guidance as to which is the correct way an economy adjusts, and is not due to the weakness of the CGE modeling methodology. The necessity of empirically predicting the outcomes of envisioned policy shifts,

nevertheless, forces the analyst to make some definite choices and it is in those where he should be careful. The principle advocated here is to keep the model small from the perspective of number of sectors, so that the closure assumptions become clear and are not obscured in unnecessary detail.

Since the choice of the closure rule as well as the structure of the economy are empirical matters, the question arises about whether all these questions could be resolved by empirical estimation. However, it is well known that statistical techniques can give information about parameters etc., given the underlying structure of the economic system. Hypothesis testing has not reached the point yet where testing among alternative underlying structures of an economy can be performed. Perhaps this is due to the lack of good data, but it should not be forgotten, that there is a variety of structures that potentially could be consistent with a given body of data. It is for this reason that for some time to come judgement on the part of the analyst, as far as economic structure is concerned will continue playing an important role.

Notwithstanding the above caveat, which is common to all empirical macroeconomic model building, once a model structure is decided, perhaps along the lines of the model suggested here, there is a lot of empirical estimation that could be done to ascertain values of specific parameters of structural forms. The breadth with which this can be done is limited only by the availability of information. It is suggested, however, that after all the estimations, the best test for the empirical

validity of the model should be the ex-post simulation of a number of periods and the "tuning" of the model so that the simulated values of the variables are reasonably close to those observed. Given that the so-called benchmark data set, namely a complete consistent social accounting matrix of an economy will not be possible to construct for every period of the simulation, the process of tuning should be based on those time series that are indeed observable. This last procedure of ex-post validation of a model, while standard practice for macroeconometric forecasting models, has not been much utilized by CGE model builders. It is, however, quite necessary especially in the context of SSA where data is scarce, and hence the dynamic behavior of the model will need special attention.

The CGE model that was proposed in the main body of the paper has several features that are relatively unique, but are deemed important from the perspective of SSA. First, it emphasizes the co-existence of an organized incorporated sector which will be observable with the existing data, and a large unorganized informal sector. Information on this latter sector will not be easily forthcoming but it is a very important aspect of African economies and it is there where most of the poor operate. It is the belief of this author that it is better to have weak or "guesstimated" information about an important aspect of an economy, rather than neglect it altogether. Second, the framework places emphasis on stock-flow consistency. Most CGE models to date have been flow consistent.

However, a dynamic model that updates the stock variables, must be stock flow consistent in the sense that the period-to-period changes in the various stocks are equal to the equilibrium flows within the period. The organization of data along a stock-flow consistent manner also helps the analyst in constructing the specification of the equations.

Another relatively unique feature of the model is the consistent integration of the financial accounts with the real accountsl. While this has been attempted in some recent models, the level of integration has been at the macro level, without detailed specification of the household level financial decisions. The model here shows how these could be modeled. The empirical implementation of some of these features will be difficult, given the lack of information. However, several simplifications can be made based on what is available and known.

Wealth accumulation and redistribution is at the heart of the welfare effects of medium term adjustment. Earlier CGE models that emphasized distributional features, concentrated on distribution of the flows of income among households, and did not consider the accumulation of wealth. The model proposed here, indicated how wealth accumulation, and decumulation, as well as its redistribution, could be modeled consistently. The discussion emphasized both human as well as non-human capital accumulation, a feature that is very important from a growth perspective. With the incorporation of such features, dynamic processes of medium term improvement or marginalization of

various classes of households could be traced.

The monograph indicated how the model structure could be extended to include more detailed commodity specificity while not burdening much the SAM accounts. This was done by suggesting that row disaggregation of the SAM was the most empirically feasible way to deal with a nagging aspect of these models when faced with a policy maker. Invariably policy makers are interested in several commodity specific issues, while if an essentially macro model is to incorporate them, the detail required is more than the weak data base available. The proposed model shows how this could be done with a minimum of extra information.

Finally, another unique feature of the model presented here is the capability of simultaneously simulating the existence of official and parallel markets. The indicated structures point out the information necessary in order to simulate these markets, and in many cases it was seen that this information is not too excessive.

When all is put together, it still might appear that a model of the sort outlined here is too data demanding to be implemented. The view taken here is that it is best to start with a comprehensive framework, and compromise along the way, depending both on available information as well as the analyst's general impressions, rather than compromise from the start. It is reemphasized, nevertheless, that it is the structure and the adjustment behavior in the various markets that is the most crucial aspect of an economy under structural

transformation. A simulation model of the type outlined here can be built for almost any country with some existing information, as well as guesses at several other parameters. Once the behavior and predictions are checked, new information from detailed household surveys for instance could be used to update and refine the parameter values. It is nevertheless, believed that at the hands of a trained team of analysts, a model of the type described in this monograph will be an invaluable policy tool for short and medium term economic planning.

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