Macro-modeling of Poverty and the Dual-dual Model

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Introduction

The significance of linking macroeconomic modeling to poverty reduction analysis has been recognized for some time although actual economy-wide modeling efforts in this particular area are quite recent. From the policy perspective, the relevance of this type of modeling is almost immediate. For example, understanding the impacts of the macroeconomic structural adjustment programs on income (and wealth) distribution and poverty is important because of the vulnerability of the poor as a group in developing economies. There is much evidence that economic and financial crises often hurt the poor, who have few cushions to protect themselves when a downturn occurs. There is also growing evidence that particularly for poverty reduction objectives, there are dynamic trade-offs in the implementation of such reforms (Agenor 2002; Khan 1997, 1996). For instance, it is well known now that budgetary retrenchments associated in many cases with structural adjustment have fallen largely on various types of social expenditures leading to a short-run worsening of the poverty situation in the absence of countervailing programs. In the medium to long-run, however, the reforms are expected to bring down inflation, lessen credit rationing, and increase economic activities leading to sustained growth and to the extent that the poor are also beneficiaries of these outcomes, poverty is expected to decline.

Typically, program loans[1] finance this type of reform package. In one sense program lending provides countries with external resources to ease the adjustment process in a situation in which absorption exceeds income; this is the 'living beyond ones means' scenario and program lending in this context is described as providing 'general balance of payments support' (where funds remain as reserves with the central bank) or 'support for the budget' (where the funds are sold to the private sector). Here the positive role of program lending is to allow a smoother and less destabilizing adjustment of expenditure to income and in particular to protect the real value of government expenditure that benefits the poor and vulnerable. This has been seen as a particularly important goal in economies in transition, where the government's revenue base has been eroded substantially.

There is a second dimension to this lending, which is the reform scenario where program lending is designed to finance wide-ranging policy reform at the level of individual sectors or the economy as a whole. Reform can embrace both adjustments to monetary variables – liberalizing prices as part of 'first generation reforms' - as well as institutional change under 'second generation reforms'.[2] Program loans should in principle cover the costs of such reforms – both the costs of implementing change and of compensating those negatively affected. Insofar as a good policy package can be identified and implemented, program loans can have wide-ranging positive effects through acceleration in economic growth.

In practice this simple distinction between the two dimensions of program loans may be blurred. Since countries thinking of implementing major policy reforms are often suffering from macro imbalances and since government funds are fungible, it is possible for countries to accept a program loan, but implement its reform conditionality only partially using the program funds also to support government expenditure. This may be one of a

[1] More, broadly, aid funds as a general category that are non-project specific and can fund policy reform.
[2] See Rodrik (2002), and Naim (2002, 2000,1994) This institutional reform has become an integral part of the new aid orthodoxy (or Post-Washington Consensus).

number of reasons why, in terms of their impact, often in aid evaluations program loans have been found to be only partially successful.

On the macroeconomic side, the indirect effects of policy reform on poverty reduction mainly work through generating rapid growth. The growth-poverty elasticity is the crucial parameter here. As noted in chapter 1 the empirical relation between growth and poverty has been examined in numerous studies, however the typical the estimate in cross-sectional analysis that the poverty elasticity of growth is about -2, is not automatically applicable for every national case. Furthermore individual elements of a policy reform package may have complex and sometimes unexpected distributional consequences.

In this context policy makers and aid officials need information on how particular policy changes may impact on poverty and there is an urgent need to develop practical, operationally relevant, tools for this purpose.[2] Arguably the first-best approach is to develop a detailed country-specific model for the economy concerned and considerable progress has been made in recent years in developing macroeconomic computable general equilibrium (CGE) models for the purpose of integrating poverty analysis with the usual macroeconomic variables and relationships. However in this chapter we suggest a simpler approach based around the construction of 'generic models' that aim to capture some of the key features of different types of developing economy. Running a policy change as a shock to a generic model will allow some predictions of poverty effects even if the model is meant to be 'representative' of a cluster of countries in a certain geographic region rather than specific to the country concerned. This can be seen as a pragmatic intermediate approach between the use of large economy-wide CGE models and the existing practice in many instances of fairly vague statements regarding poverty reduction impacts of policies based on first principles or intuition (Bolt et. al. 2003). We set out a particular form of simple model based on the so-called 'dual-dual' characteristics of low-income economies. Chapter three follows this up by constructing such a model for a low-income labor surplus economy, for example reflecting conditions in much of South Asia. This model is used to assess the poverty impact of trade liberalization, as a specific aspect of policy reform.

The rest of the chapter is organized as follows. It begins with a survey of modeling efforts in developing countries drawing out different strands in the literature and the evolving focus on poverty impacts. It then sets out the dual-dual approach as a first step towards the construction of a simple generic model. Finally it gives a detailed illustration of the use of the dual-dual approach in assessing the poverty consequences of a reduction in import tariffs.

CGE Models for Developing Economies

In order to discuss how to incorporate poverty analysis in a CGE model, we need a clear understanding of the structure of CGE models as such[3]. As a first step in understanding CGE models, we can start with the Walrasian 'fundamentalist' approach

2 See the discussion in Bolt et al (2003) for example.

3 A related item is a consistent data set that can be used to implement such models. In the appendix the structure of a Social Accounting Matrix (SAM) as such a data set is discussed. A class of simple fixed price CGE models based on such SAMs is also discussed there.

to general equilibrium. Essentially, the problem here is to find a set of prices (a price vector) that will clear all markets.[4]

It is assumed that producers maximize profit and consumers maximize utility. All markets including futures markets must exist and all uncertainty must be subject to actuarial calculation of risk. It is clear that while theoretically elegant and analytically impressive, the conditions in many actual economies do not approximate this theoretical model.

In the Keynesian type macroeconomic models at any rate, there can also be underemployment equilibrium. There is thus a tension between such macroeconomic models and the Walrasian general equilibrium models where full price flexibility ensures full employment at a market clearing wage level.

> As Robinson (2003:1) observes:
>
> The literature on CGE models is replete with debates about the macro properties of these models, and a number of different schools of thought have emerged concerning how, or indeed whether, one should incorporate macro features into these SAM-based models. No clear consensus has emerged, which is hardly surprising since the debate really concerns the theoretical dividing line between Walras and Keynes, and the micro foundations of macro models--- or the lack thereof.

It is not relevant here to outline the contours of this debate, except to mention that there is at least one group of models, namely the class of fixed price multiplier models (discussed in the Appendix along with Social Accounting Matrices) which can, under a constraining set of conditions, particularly that of excess capacity, can capture unemployment equilibria. It is perhaps important to emphasize that the most significant aspect of the differences among various macro-models arises often from the choice of different closure rules. However, it is both intellectually honest and from a practical point of view a prudent policy to keep firmly in mind that a CGE model in its origin--- and initial historical development--- is Walrasian in spirit.

At the applied level, a CGE model incorporates all the flow variables that can be captured in a Social Accounting Matrices or SAM.[5] These include production activities, factorial income distribution and household income distribution among other variables. The importance of both the factorial income distribution and household income distribution for poverty analysis in a CGE model is intuitively obvious. However, proper modelling strategy for these distributions in a CGE model is far from obvious. Later, we deal with the issues that arise in this context for poverty analysis.

As implied before, the Walrasian spirit of a CGE model is shown in its determination of only relative prices, with some price index chosen as the numeraire. The model also incorporates the assumption of 'no money illusion'. So, if all prices are multiplied by a fixed number, the equilibrium quantities do not change. Money is also neutral in this

[4] Actually, it is necessary and sufficient for all but one of the markets to be in equilibrium. As is well known, by "Walras' law" when all but one market clears, the last one must clear also.

[5] For a succinct discussion of some of the relevant features of the applied models for policy analysis*, see* Yao and Liu (2000).

model so that at the end a change in the nominal stock of money can affect only the general price level. Changes in money supply will not lead to any corresponding changes in any other quantities in equilibrium.

As a matter of historical record, it has been a standard practice of CGE modelling to specify fixed supplies of factors of production such as various types of labor and capital, or aggregate indexes of these, and carry through the implications of the assumption that all markets must clear. These “classical” CGE models calibrate wage and rental rates to employ all of the exogenously specified labor and capital. In many “applications”, the guiding idea has been to introduce distortions to the ‘equilibrium price vector’ and calculate the resulting inefficiencies. In this sense, CGE models have been used as a normative check for distortions and for estimating their costs against the benchmark of a Walrasian market clearing price system.[6]

There is also much discussion in the CGE modelling literature about the various “closure rules” for the models. The discussion on macro-closures, initiated by Sen (1963), was revived by Taylor and Lysy (1979), who found that the choice of macro-closure affected to a large extent the policy simulation results obtained with a CGE model. As the previous discussion already indicates, macroeconomic modeling is forced to depart from the Walrasian assumptions embodied in a ‘fundamentalist’ CGE model. This also leads to the so-called ‘closure rule problem’ and because short-run macro CGE models do often deviate from the Walrasian closure, a separate literature has grown up around the various alternatives.

There are mainly two ways to interpret and define the closure rule problem. In mathematical terms, the problem boils down to the simple notion that the model should consist of an equal number of equations and endogenous variables. In the linear case, clearly the equations have to be linearly independent also. Thus, in a certain sense, the closure rule problem is the decision the model builder has to make on which variables are endogenous and which variables are exogenous. Alternatively, if the model is built in the Walrasian tradition and all decisions are based on optimizing behavior, the closure rule problem involves the introduction of macroeconomic constraints that impinge upon the microeconomic behavior of individual agents. One then needs to introduce additional balancing equations. (Ginsburgh and Keyzer 1997). In general, a closure rule is determined by the theoretical preferences of the model builders and, in their view, empirically the most plausible adjustment processes.

In the early works that used CGE models for development policy analysis, much time was spent in finding ways to model the various distortions in the foreign trade sector. Thus, modeling exports, imports, the balance of trade and the balance of payments became important items on the modeling agenda during the 1980s. After trying various approaches, a general consensus was reached. The consensus approach admits imperfect substitutability between imported goods and their domestic counterparts. The so-called Armington assumption is invoked by almost all modelers and has been extended to the modeling of exports also (Armington 1969). The most common approach now is to specify sectoral constant elasticity of substitution import demand functions, export transformation functions that assume constant elasticity of transformation and

[6] It should be noted, however, that the assumption of full employment means that the economy is at the wrong point on the (multidimensional) production possibilities frontier, not inside it.

aggregation functions based on these.

Typically, the trade balance is treated as exogenous with any imbalance matched by a domestic saving-investment imbalance. Looked at in this way, trade imbalances can be treated as foreign saving flowing in with a trade deficit, and of savings flowing abroad when the trade balance is positive. However, this does raise the question of why people at home or abroad would be willing to save and lend, a question that can only be answered in an explicitly intertemporal model. Thus, static CGE models, which treat the trade balance as exogenous are, in fact, compressions at a point in time of a more fully specified intertemporal equilibrium model.

There is also the related issue of how to bring in balance the traded with the nontraded sector, and the domestic economy with the rest of the world. This is done by making flexible another relative price. This is the relative price of traded and nontraded goods, or the real exchange rate. Naturally, modelers tend to specify an implicit functional relationship between the real exchange rate and the trade balance. Increased flow of foreign savings raises the relative price of nontraded goods, which is equivalent to an appreciation of the real exchange rate in these models. There is a shift of production away from export goods producing sectors to nontraded goods and services. Consumers shift demand to cheaper imports and the new trade balance equals the exogenous flow of higher foreign savings.[8]

This is perhaps a good place to shift our attention from foreign savings to domestic savings and investment, with the role of the government as a key macroeconomic entity. As explained in the Appendix in the SAM system the savings-investment account collects savings and spends money on investment goods. The flow equilibrium condition is that savings must equal investment. Some mechanism is needed to achieve this balance, as our previous discussion of the closure rules indicated.

The common strategy here is to specify savings parameters by household types. These fixed parameters map income to savings. A fairly common (neoclassical) assumption is also to assume that all savings are spent on investment. Thus under this closure rule there is no ‘paradox of thrift’. Either through loanable funds markets or a more direct allocation rule (this is often the case), savings are translated into investment. However, this is not the only way to relate savings and investment, and even here, as the reference to the loanable funds markets hints, the full specification of a ‘savings-driven’ model on the financial side is often missing. Important questions regarding the saving-investment links need to be raised. These include: why save at all? Why spend on investment rather than on consumption? Who owns the new capital stock? Do actors have and care about an asset portfolio? Introduction of proper dynamics is necessary to answer these and other similar questions.

The question of private savings is also related to that of public savings and dis-savings, as the case may be. But the government does more than generating savings or dis-savings. It collects taxes, makes transfer payments and purchases goods and services. Through all these activities it can affect the flow of income and consumption of all or some socioeconomic groups. Hence, an intuitive link between government’s

[8] Therefore, this is properly described as a comparative statics exercise with the chain of causality starting with the exogenous change in foreign savings and ending with a new trade balance.

actions and poverty is justified. Later, we will see how this link can be made more explicit in a causal sense. For the moment, let us simply observe that in most CGE models government is a rules-based (but not necessarily a utility maximizing) actor. What this means is that the government may be expected to behave consistently over time (for example by not deviating from certain targets by too much') but this may not necessarily be modeled as utility maximization.[8] Typically, the monetary side is absent or sketchy. Usually, there is a flow-of-funds specification[9], but no consideration of how the government finances its deficit. There is simply a crowding out of private investment.

Thus, the trade balance, private saving-investment balance and the public sector balance are all treated in a somewhat *ad hoc* fashion, but in a way this treatment broadly respects the relative price flexibility in the Walrasian spirit. However, the previous discussion also raises the question of including dynamic considerations explicitly. In particular asset endowments, markets and expectational dynamics may need to be included. Opening up the model in this way, also carries the danger of making it less tractable. This explains why dynamic CGE models to this day are not as well developed as a reasonable theoretical critique would demand. It would seem reasonable, for example, to expect that an 'ecumenical' approach could postulate the possibility of unemployment, informal labor markets, financial markets for various assets and their relation to the real sectors. Such a realistic model could better capture the location and dynamics of poverty among other things. However, at the present state of poverty modeling in a general equilibrium context even the simpler models can add a great deal and can lead to better policy analysis by avoiding some of the problems of sectoral or partial equilibrium analysis.

Income Distribution and Poverty in CGE Models

Since the publication of the pathbreaking book by Irma Adelman and ShermanRobinson on the Republic of Korea in 1978, the literature on applied general equilibrium modelling has exploded. In this section we focus narrowly on the strand of literature dealing with income distribution and poverty. The seminal contribution Adelman and Robinson (1978) already had used an implicit SAM to capture both factorial and household income distribution in a disaggregated manner. At about the same time the work of Taylor and Lysy (1980) focused on Brazil and made distributional aspects a part of the overall analysis. Dervis, et al (1982) also addressed distributional issues in the general equilibrium modeling context. However, real concern with distribution and poverty analysis started towards the end of 1980s, after a decade of structural adjustment policies. Under the aegis of the OECD, Thorbecke (1991) for Indonesia, de Janvry et. al (1991) for Ecuador and Morrison (1991) for Morocco are some modeling examples from this 'second generation' of CGE models for developing countries that addressed income distribution and welfare issues in greater detail than before. A number of papers by Bourguignon and others also contributed to this stream. (Bourguignon et al, 1991; 1989a,

[8] See Khan (2005) for a formal description of a policy maker who is not a utility maximizer but follows consistent rules (in this case formalized by a certain type of loss function which the government minimizes).
[9] Although details vary, generally the specification includes both the demand and supply side of money and financial flows in the economy. The institutional features may also vary from one economy to another, but generally, the central bank, private money markets and other relevant credit and financial markets plus the household sector are involved.

1989b).[10]

We can summarize the main analytical developments in modelling distribution up to this point by noting that these first and second generation models relied on a representative household assumption and fixed distributional coefficients for the household income distribution. Therefore, the analysis of poor households was necessarily coarse. No information about intra representative household income distribution and poverty was sought or used. The multiplier decomposition models of Thorbecke and Jung (1996) for poverty analysis in Indonesia and Khan (1999) for South Africa also share this weakness.

However, by utilizing the information in household income and expenditure surveys, it is now possible to generate an intra-household group distribution profile empirically for any particular household group for any given income distribution and poverty profile. It is also possible to use these profiles as part of the initial calibrating exercise in CGE models. A set of recent modeling efforts have been directed in precisely this direction. (Decaluwé at al 1999a, Dorosh and Sahn 2000), Here, the paper by Decaluwé at al (1999a), is a pioneering piece. The authors test the relevance of intra-household distributional information for poverty analysis. Based on an archetypal economy with four areas of activity (agriculture, industry, marketable and non-marketable services), three factors of production (capital, skilled and unskilled labor) and four types of agents (rest of the world, government, firms and households), their approach is to isolate the contribution of average income variations, poverty line changes, and income distributional changes and then to look at the effect of these variations on various poverty indicators. Their results are unambiguous. They clearly highlight the relevance and significance of intra-household group information. Of the three influences they discuss, the changes in the poverty line in a price-endogenous model account for most of the changes in poverty. Therefore, both intra-household group information and price endogeneity that allows us to compute a new nominal poverty line after each policy change are important. Azis (2002) is an example of the use of this approach for analyzing poverty after the Asian financial crisis. Another set of papers exemplified by Cogneau and Robillard (2000) and Cororaton (chapter 4 in this volume)) utilizes the household expenditure survey results to carry out micro-simulations. Here each household is treated effectively as an individual economic agent and its decisions are modeled directly. Among the papers cited above those that still use a representative household groups classification adopt the Beta distribution function because of the flexibility it provides in constructing a distribution that corresponds to the unique characteristics of each group.[12]

[10]For a concise review of recent issues in both macro and micro aspects of poverty analysis, see Bourguignon et al (2002).

[12] The Beta distribution function is defined over a random variable whose support is in the unit interval. The function shown here is just that of the transformed variable $\tilde{y} = \frac{y - \min}{\max - \min}$, whose support is the unit interval. The function for a given household group is:

$$f(y; p, q) = \frac{1}{B(p,q)} \frac{(y - \min)^{p-1} (\max - y)^{q-1}}{(\max - \min)^{p+q-2}}$$

As Decaluwe et al (1999a) point out, the Beta distribution function is much more flexible than the log normal function in that the shape of the densities can be either symmetric or asymmetric, and can be skewed to the right or to the left. For example, if $p > q > 1$, the distribution is skewed to the right (i.e. large tail to the right) and the mode is located to the left of the median income. Conversely if $q > p > 1$, the density is skewed to the left with the asymmetry increasing with the inequality between p and q. Finally, if $q = p > 1$, the distribution is symmetric.

Since one of the purposes of this chapter is to see if there are 'generic' models of poverty analysis within the CGE family of models, we now turn to a detailed discussion and evaluation of a generic model by Stifel and Thorbecke (2003) that offers an approach that we build on in chapter 3.

Poverty Analysis in a dual-dual Structure

It would indeed be very helpful to the applied policy analysis for poverty reduction if we could construct a generic model that could be applied to a number of different policy settings in different countries. While we must guard against an oversimplifying "one size model fits all" type blunder, the gain in being able to assess relatively quickly the impact of certain policies for poverty reduction justifies such a search.

Among the models mentioned in the previous section, the closest to being a generic model is the Stifel-Thorbecke (2003) model of an archetype African economy. They build a CGE model in order to simulate the welfare effects of trade liberalization. In particular, their effort is directed towards an analysis of the effects of trade liberalization on poverty. They use what can be called a 'dual-dual' framework.[13]

Briefly, the coexistence and distribution of modern and informal type of activities in both rural and urban areas are taken as basic structural features of the economy in question. According to the authors their modeling approach integrates poverty analysis with CGE proper "… by endogenizing both intra-group income distributions and the nominal poverty line". Following this line of work leads to their being able to assess policy repercussions on both poverty specific to particular socioeconomic groups and on overall national poverty.

The rationale for the dual-dual economy model is the need to capture the diversity of

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$$\text{where} \quad B(p,q) = \int_{\min}^{\max} \frac{(s-\min)^{p-1}(\max - s)^{q-1}}{(\max - \min)^{p+q-2}} ds \text{, and } \; y \in [\min, \max],$$

where y is per capita income, *min* and *max* are the minimum and maximum incomes within the group, respectively, and p and q are parameters. See the chapter on the Beta distribution in Balakrishnan and Nevzorov (2003) for further details.

[13] See also, Svejnar and Thorbecke (1982), and Khan (1982a, 1982,b, 1983, 1985, 1997). In these analyses, the particular country chosen was the Republic of Korea in the 1970s. Instead of CGE flex-price models, SAM-based models of fixed price variety were used. In the Appendix we summarize the fixed price multiplier approach used in the earlier prototypes of the dual-dual model.

technologies in productive activities, and the diversity of institutional networks and organizational features in developing economies. In analyzing poverty, the structure and institutional framework of labor markets are particularly important. The reason is that the poor households in particular operate frequently in the informal part of the economy where the labor markets are organized quite differently from those in the formal sectors. For example, the formal sectors often have labor unions and collective bargaining whereas the informal sectors contain numerous self-employed workers and non-cash wage workers. The workers who are paid in cash have relatively fewer worker rights compared to those who work in the formal sectors.

A second reason for taking the dual-dual approach seriously is that at least in the early to mid-level stages of development, labor migration is a significant feature of developing economies. Usually, the direction is from rural to urban areas and from the informal to the formal sectors. At least as a motivating factor it is the higher average wage expectations, partly because of the formal sector wage rate--, that propel the rural workers (or surplus labor) towards the cities. The famous Harris-Todaro (1970) model was an early formalization of this basic labor market feature. To the extent this is still an existing structural feature in a developing country, the dual-dual approach incorporating a Harris-Todaro component would appear to be promising as a tool for poverty analysis.

The starting point is the dual economy models of Lewis (1954) and Fei and Ranis (1964)[13]. These pioneering efforts, however, could not or did not take into account the co-presence of dualism within each sector of the two sector models of the dual economy. Erik Thorbecke first raised this issue in 1979 during the course of a National Science Foundation interdisciplinary project on technology and development and Svejnar and Thorbecke (1982) was the first published work on a prototypical of dual-dual technology classification scheme. Khan (1982a,b) and Khan (1983) were applications of this scheme to the energy and textiles sectors in the Republic of Korea[14]. Khan (1983) raised the issue of linking technological dualism to poverty theoretically, following an early observation of Pyatt and Thorbecke (1976). Khan and Thorbecke (1988,1989) were further applications of technological dualism to Indonesia. It should be mentioned that all these models were based on social accounting matrices that were divided into endogenous and exogenous accounts (see appendix for details). Fixed price multipliers were derived by incorporating expenditure elasticities. These gave the total impact of any unit of injection along an exogenous account. For example, an increase in final demand for the products of one of the dualistic sectors would lead to both direct and indirect effects on household incomes. This has been studied in great detail with some attention to various decompositions of the effects as well.[15]

In Thorbecke's later classification a rural/urban dichotomy is combined with traditional/modern technological dualism, leading to a fourfold classificatory scheme. The four broadly defined sectors in this scheme are:

1. subsistence agriculture with traditional labor-intensive technologies, family

[13] Khan (1997) chapters. 2 and 3 gives an historical survey and a specific inter-temporal dualistic model, which is used to analyze the conflict between employment and output.

[14] I would like to acknowledge an observation by Frances Stewart regarding dis-aggregation along a column of a SAM during her visit to Cornell in 1979 that triggered the whole chain of thought leading eventually to my disaggregation of the textiles and energy sectors in the Republic of Korea SAM.

[15] Two types of decompositions that have been often used are the Stone decomposition and the structural path analysis. For details and examples of the former, see Khan (1997). For a discussion of the structural path analysis and examples from the Indonesian SAM-based work, see Khan and Thorbecke (1988).

farms and food crops for domestic consumption;

2. large scale agriculture producing mostly export crops using capital-intensive technology.

3. the urban informal sector ;

4. modern sector with industry and services in the urban areas.

Poverty analysis in this dual-dual model proceeds along the lines developed by Decaluwé et al (1999). This approach relies on varying prices and a fixed commodity basket to derive an endogenous (nominal) poverty line every time there is a shock resulting in a new equilibrium price vector for the economy. It also uses a beta distribution with varying parameters to capture differences in income distributions that are group specific. Within each group also the parameters can vary, resulting in a new distribution. Standard poverty measures are applied to pre-policy shock and post-policy shock income distributions to derive the impact on poverty.

Before proceeding to describe the equations of the model in detail, it may be useful to reflect on the data set, which was used to calibrate the model. Given our emphasis on the question of applicability of the model, the question of data is in a sense prior to the model. If the data are seriously incomplete or flawed, even the best theoretical model will not be very useful for policy analysis. Not much is mentioned in the paper as such about the specific sources of data; but the reference is to the socio-economic conditions in an African economy such as Cote d'Ivoire. There are some existing SAMs[16] for Cote d'Ivoire; but the high level of aggregation in the dual-dual model makes a direct comparison difficult. However, the constructed SAM, which is presented in the Stifel-Thorbecke paper is plausible and consistent. More important from the economic modeling and policy perspectives, the data do represent in schematic form the approximate structure of a dual-dual model at a point in time. We can now turn to the structure of the model itself.

The equations of the model are given below. As the first four equations show, the production activities have a dual-dual form. The informal rural sector produces staple foods for domestic consumption.. It is referred to simply as 'food'. There is also a rural formal sector that produces exportables. This is labeled 'exports'. In the African context, the former could be non-imported staples such as cassava and yams.. The exportables are cash crops such as cocoa and coffee. The urban informal sector, where many poor are located, produces services. This sector is labeled 'urban services'. Finally, the urban formal sector produces labor-intensive manufacturing and import competing goods. This is called simply the 'import competing' sector.

[16] One example is the SAM constructed at the World Bank by Chja and her co-authors, see Chia et al 1992). The 1986 SAM they use would seem to be out of date for the Stifel-Thorbecke model. This SAM had 15 production sectors of which 7 were tradable. McIntyre and Varangis (2001) mention a 1996 SAM; but the complete specification is not given. However, in their CGE model the elasticities of substitution are 0.5 for all rural goods(coffee, cocoa, cotton, forestry, fisheries, other agricultural exports, food crops) and 0.8 for all urban goods. This can be contrasted with the Cobb-Douglas specification in the Stifel-Thorbeke model where these elasticities are equal to one because of the Cobb-Douglas specification (see also the discussion in chapter 3 in this book). There are 21 sectors in the urban part of the 1996 SAM. Apparently, this SAM is based largely on the 1995 input-output matrix.

We now turn to the complete model. We have followed the original notation. Although there is sometimes two types of notation used for the same entity, the choices are intuitive. The reason is to clearly distinguish between formal and informal commodities at the beginning. Later the two types of formal sector outputs, namely exports and import competing goods are given appropriate symbols with subscripts. The same logic is used to choose notations for the two informal sector outputs, namely food and urban services. This logic is followed also throughout in choosing the subscripts (and in some cases also the superscripts) for skilled and unskilled labor and so forth.. In the description of equations that follows each and every equation, some variable and parameter definitions have been repeated if their earlier occurrence happened to be several equations before the current one. Thus it should be fairly easy to follow the model below equation by equation.

Representation of Dual-Dual Model

Production and Labor Market

$$X_{fc} = A_{fc}\overline{K}_{fc}^{\beta_K^{fc}} LS_{fc}^{\beta_{LS}^{fc}} LU_{fc}^{\beta_{LU}^{fc}} .....(1)-(2)$$

Here, X_{fc} = Output of formal sector. There are two such sectors, one is the export sector and the other is the urban import competing sector.

K_{fc} =fixed capital in formal sector;

LU_{fc} =unskilled labor in formal sector

LS_{fc} =skilled labor in formal sector

β_K^{fc} =share of capital in formal sector

β_{LS}^{fc} =share of skilled labor in formal sector

A_{fc} =Technology coefficient for formal sector

$$X_{ic} = A_{ic}\overline{K}_{ic}^{\beta_K^{ic}} LU_{ic}^{\beta_{LU}^{ic}} .....(3)-(4)$$

X_{ic} = Output of informal sector

K_{ic} =fixed capital in informal sector

LU_{ic} =unskilled labor in the informal sector

β_K^{ic} =share of capital in the informal sector

β_{LU}^{ic} =share of unskilled labor in informal sector

A_{ic} =Technology coefficient for the informal sector

$$i_{ic} = \frac{P_{ic} X_{ic}}{LU_{ic}} .....(5)-(6)$$

i_{ic} =Income in the informal sector

P_{ic} =Price of commodities in the informal sector

$$wu_{ex} = \frac{P_{ex} \beta_{LU}^{ex} X_{ex}}{LU_{ex}} .....(7)$$

wu_{ex} =Unskilled wage in export sector

P_{ex} =Price of commodities in export sector

β_{LU}^{ex} =share of unskilled labor in export sector

LU_{ex} =Unskilled labor in export sector

X_{ex} = Production in the export sector

$$wu_{ex} = i_{food}(1+\delta).....(8)$$

i_{food} =income in food sector

δ =transaction costs of work in rural formal sector (export) instead of working in food sector (for unskilled labor)

$$i_{srvc} = \frac{P_{im} \beta_{LU}^{im} X_{im}}{LU_{im}} .....(9)$$

i_{srvc} =income per unit of unskilled labor in urban service sector

P_{im} =Price of commodities in import competing sector

β_{LU}^{im} =share of unskilled labor in import competing sector

X_{im} =Output in import competing sector

LU_{im} =Unskilled labor in import competing sector

$$w_{im} = i_{srvc} + \gamma \frac{\Pi}{LU_{im}} \text{.....(10)}$$

w_{im} =wage in import sector

$\prod$ =profits of urban capitalists

γ =profits share of unskilled labor in import competing sector

$$\Pi = P_{im} X_{im} - i_{srvc} LU_{im} - ws_{im} LS_{im} \text{.....(11)}$$

ws_{im} =skilled wage in import competing sector

LS_{im} =Skilled labor in import competing sector

P_{im} =Price of commodities in import competing sector

X_{im} =Output in import competing sector

LU_{im} =Unskilled labor in import competing sector

i_{srvc} =income per unit of unskilled labor in service sector

$$wu_{ex} = (1 - \frac{hLU_{im}}{LU_{srvc} + LU_{im}}) wu_{srvc} + (\frac{hLU_{im}}{LU_{srvc} + LU_{im}}) wu_{im} \text{.....(12)}$$

wu_{ex} =Unskilled wage in export sector

LU_{im} =Unskilled labor in import competing sector

LU_{srvc} =Unskilled labor in service sector

wu_{srvc} =Unskilled wage in service sector

wu_{im} =Unskilled wage in import competing sector

h= a scale parameter which adjusts (lowers) the probability of getting a high paying job

$$ws_{fc} = \frac{P_{fc} \beta_{LS}^{fc} X_{fc}}{LS_{fc}} \text{.....(13)} - (14)$$

ws_{fc} =Skilled wage in formal sector

P_{fc} =Price in formal sector

X_{fc} = Output of formal sector

β_{LS}^{fc} =share of skilled labor in formal sector

LS_{fc} =skilled labor in formal sector

$$ws_{im} = \left[\frac{1-\beta_{LU}^{im}}{(1-\theta)\beta_{LU}^{im} + \theta(1-\beta_{LU}^{im})} \right]^{1/1-\theta} ws_{ex} \text{.....(15)}$$

ws_{im} =skilled wage in import competing sector

ws_{ex} =Skilled wage in export sector

θ = relative risk aversion of skilled workers

β_{LU}^{im} =share of unskilled labor in import competing sector

Disposable income and savings

$$I_{rih} = i_{food} LU_{food} \text{.....(16)}$$

I_{rih} =Disposable income of rural informal household

LU_{food} =Labor in food sector

$$I_{ruh} = wu_{ex} LU_{ex} \text{.....(17)}$$

I_{ruh} =Disposable income of rural unskilled household

LU_{ex} =Unskilled labor in export sector

$$I_{rsh} = ws_{ex} LS_{ex} \text{.....(18)}$$

I_{rsh} =Disposable income of rural skilled household

LS_{ex}= Skilled labor in the export sector

$$I_{rlh} = P_{ex} X_{ex} - ws_{ex} LS_{ex} - wu_{ex} LU_{ex} - S_{ex} \text{.....(19)}$$

I_{rlh} =Disposable income of rural large landholders (rural capitalists)

$$I_{uih} = i_{srvc} LU_{srvc} \text{.....(20)}$$

I_{uih} =Disposable income of urban informal household

$$I_{uuh} = ws_{im} LU_{im} \text{.....(21)}$$

I_{uuh} =Disposable income of urban unskilled household

$$I_{ush} = ws_{im} LS_{im} \text{.....(22)}$$

I_{ush} =Disposable income of urban skilled household

$$I_{ukh} = P_{im} X_{im} - ws_{im} LS_{im} - wu_{im} LU_{im} - S_{im} \text{.....(23)}$$

I_{ukh} =Disposable income of urban capitalist household

$$I_{bch} = tM \text{.....(24)}$$

I_{bch} =Disposable income of bureaucrat household
M=Imports
t=tax rate on imports

$$S_{fc} = \lambda_{fc}[P_{fc} X_{fc} - ws_{fc} LS_{fc} - wu_{fc} LU_{fc}] \text{.....(25)} - (26)$$

S_{fc} =Saving in the formal sector(S_{ex} =Saving in export sector and S_{im} =Saving in import competing sector)
λ_{fc} =Capitalists' saving rate

Demand

$$C_c^h = \frac{\alpha_c^h I_h}{P_c} \text{.....(27)} - (49)$$

C_c^h =Consumption by various household types of various commodities

P_c = Prices of particular commodities

I_h= Incomes of various household groups

α_c^h =household budget share of commodities

Foreign Trade

$$M = \sum_h C_{im}^h + \frac{S_{im}}{P_{im}} - X_{im} \text{.....(50)}$$

M=Imports

S_{im} =Saving in import competing sector

X_{im} =Output in import competing sector

$$EX = X_{ex} - \frac{S_{ex}}{P_{ex}} \text{.....(51)}$$

EX = exports

S_{ex} =Saving in export sector

X_{ex} = Production in the export sector

Equilibrium Conditions

$$\sum_c LU_c = LU \text{.....(52)}$$

$$\sum_{fc} LS_{fc} = LS \text{.....(53)}$$

$$X_{ic} = \sum_h C_{ic}^h \text{.....(54)} - (55)$$

$$P_{im} \equiv 1 + t \text{.....(56)}$$

$$P_{ex} \equiv 1 \text{.....(57)}$$

It is clear from the above formulation that the production sectors are specified as Cobb-Douglas with unitary elasticity of substitution for the two formal sector commodities in equations (1) and (2). The informal sector commodities also have Cobb-Douglas

specifications. All commodities are produced under capital constraints. Thus, capital, K, in each sector has an upper bound denoted by a bar above K. The assumption that capital stock is fixed in each sector may be relaxed, but it is in fact, a fairly standard assumption in models for developing economies. In addition to the simple description of all the equations given above, some further explanations of the other equations numbered from (5) to (57) are given below.

In the informal sectors each unskilled workers receive their average revenue product. Thus i_{ic} is income in informal sector as given in equations (5) and (6) as the average revenue product on the right hand side. The expressions on the left hand side in equations (5) and (6) refer to incomes the two informal sectors (the subscript 'ic' stands for 'informal commodity'), namely, food and urban services. Rural small holders may work on common land and these rural farming households share the total income equally among all the family members. Urban informal workers supply all their labor at the prevailing wage rate. Thus leisure is not an argument in their objective function on the grounds that they are at the margins of subsistence. Under these assumptions then, equations (5) and (6) can be defended as capturing the informal sectors' income determination.

It should be noted that the total income per household unit includes logically the returns also to non-labor assets for those who own land or capital. Hence, the relevant measure of average household income is total income per unit from all sources. The assumption of profit maximizing rural large landholders ensures that under competitive conditions wages for unskilled workers in the export sector are equal to the marginal revenue product of the unskilled labor they have to hire. Equation (7) reflects this condition. Here $wu_{ex,}$ which is the unskilled labor wage in the export sector, is determined according to the marginal productivity distribution rule, where the total product is completely exhausted after distribution to all the factors.[17]

Equation (8) shows the equilibrium allocation of unskilled labor in the rural informal sector. Here δ is thetransaction costs for unskilled labor of working in the rural formal sector (export) instead of working in the food sector); i_{food} is income in food sector. According to equation (8), in equilibrium the rural informal sector wage rate is below the wage rate in the formal sector by a fixed factor, which is equal to δ. This reflects the assumption by the authors that there are transactions costs in working in the rural formal sector that are captured by this mark-up.[18]

Turning now to the urban sectors, for unskilled workers in the formal urban sector the assumption is that they get the income per unit of labor in the urban informal services sector shown in equation (9), where i_{srvc} is income in the service sector for unskilled workers) plus a share of the profits as given in equation (10). The determination of profit itself is shown in equation (11).

[17] Technically, this follows from Euler's theorem for (linear) homogeneous functions. The economic meaning of linear homogeneity is constant returns to scale.

[18] An alternative more plausible explanation is that there is an 'insider' market wage equilibrium in the formal sector, and those unskilled workers lucky enough (or more likely, because they know someone already working in the formal sector) to get a job in the formal sector can enjoy this wage premium. This is not a hypothesis the authors consider, but the data will be consistent with this hypothesis as well.

The Harris-Todaro model features regarding rural-urban migration are captured in equation (12). Here in equilibrium the unskilled rural worker's wage in the export sector must equal the expected wage for unskilled workers in the urban sector, which will be a weighted average of the wages in the formal and informal components weighted by the probability of getting a job. In equation (12) the probability of getting a job in the import sector is given by the share of the urban uneducated labor force in that particular sector multiplied by a scale parameter, *h*.[19]

Skilled workers are employed only in the formal sectors. Their wages are determined in equations (13) and (14) by their marginal revenue products. We now turn to the determination of incomes for the households.

Household Income Determination:

There are nine types of households. Two in the rural area are landowning households, large and small. There are also urban capitalists and bureaucrats. The other five are households where the main source of income is from labor.

The rural informal households, which are really rural small holders, receive their total revenue from production as shown in equation (16). Rural unskilled and skilled households receive their wage incomes as shown in equations (17) and (18) respectively. Equation (19) gives the incomes of the large rural land- holders.

Equations (20) to (24) show the incomes of the urban households. The worker households receive wage income and the capitalists receive profits, in general. The bureaucratic households capture all of the rents from imports.[20] Admittedly, this is a simplistic assumption; but the bureaucrats really do not figure in the poverty analysis as such. This does mean ignoring the problems of some civil servants with low pay at the lower echelons, and there are probably more of these in the rural areas.

The formal sector employers (large rural land owners and urban capitalists) are the only savers in the model. They each save a constant fraction of their nominal incomes.

Household demand functions are captured by maximization of Cobb-Douglas utility functions subject to their income constraints. There are 23 such equations (equations 27-49) because the four rural household groups have access to only food and importables. This gives us eight equations. Each of the urban groups has access to three commodities--- food, importables and urban services. This gives another 15 equations. The prices for the three commodities can be used to define an overall deflator.

[19] The authors add in a footnote (footnote10) that this parameter(that is parameter h) "… permits a realistic (that is lower) calibration of the probability of getting a high paying job". There is no discussion as to how h is actually determined. It seems to have been chosen somewhat arbitrarily and given a value of 0.6 (Stifel and Thorbecke, 2003: 224.) There is virtually no variation in results for values of h between 0.6 and 1. Theoretically, a higher value of h should lead to a somewhat higher poverty reduction effect of any policy that leads to rural-urban or urban-rural migration of labor, but, empirically, this does not seem to be the case.

[20] Salaries are excluded in equation (24). The reasoning is that these are invariant to exogenous shocks.

Foreign Trade:

Imports in this model are the difference between domestic demand and production of import competing sector. Exports can be supplied at the prevailing price up to any quantity under the small country assumption. Thus exports are equal to total output less the savings in the form of exportables of the rural large landholders. Equations 50 and 51 show the import and export demand functions respectively. Note that for exports only the foreign price, that is the price of the export good set in the world market, is relevant. For imports there is a relative price effect domestically since the utility function includes food, the import-competing good and services. This will show up in savings in the import competing sector in each period. The exchange rate is assumed to be fixed. Although the authors do not explain the point, assuming a fixed nominal rate implies a changing real rate as the price of non-traded to traded goods will alter.

Equilibrium conditions for the model as a whole:

There are two sets of equilibrium conditions in the model. First, the labor market equilibrium conditions are given by equations (52) and (53). There is disguised unemployment due to income sharing in the informal rural sector, but no formal involuntary unemployment. The second set of equilibrium conditions given by equations (54) and (55) is that the domestic demand for the informal sector goods and services is matched by domestic supply. Prices in the formal sectors are set by the world market prices. The export price is normalized to one. The import price is equal to 1+t, where t is the tariff rate. The exchange rate is held fixed during the particular modeling period. It is clear that the current account balance must be exogenous. In line with our discussion in the previous section, this balance is equal to foreign savings (capital inflows), which are assumed to be zero by the authors. Hence current account balance is assumed to be zero.

Poverty Analysis in the Generic Model:

According to the authors, the initial conditions are so constructed in this model that 29 per cent of the population is urban and 71 per cent rural. In terms of work, 85 per cent of the population can be found in households supplying some unskilled labor., and only 10 per cent in households supplying skilled labor. Rural smallholders are the largest among all household groups--- their share being approximately 60 per cent of the total. This is followed by the urban informal (14 per cent), the urban skilled and rural unskilled(each with 7 per cent), the urban unskilled (5 per cent) and the rural skilled (3 per cent).In order to carry out the poverty analysis, it is important to realize that by construction, in the model economy the extent of poverty is unevenly spread across different households. By construction, and in accordance with the theory of dual-dual economic structure, the highest incidence of poverty is found among the urban informal households. Rural smallholders have both the second lowest average income and they have the second highest incidence of poverty. The households' sources of income and the contribution from each source are the proximate causes of poverty.

Table 2.1 below gives the sources of income and the contribution from each source in the model economy. The household types are listed across the rows and sources are shown as distinct columns below.

TABLE 2.1: FACTORIAL SOURCE OF HOUSEHOLD INCOME (%)

	Unskilled labor	Skilled labor	Capital	Agricultural capital	Total
Rural small holders	75.0			25.0	100.0
Rural unskilled	100.0				100.0
Rural skilled		100.0			100.0
Rural large holders				100.0	100.0
Urban informal	75.0		25.0		100.0
Urban unskilled	100.0				100.0
Urban skilled		100.0			100.0
Urban capitalists			100.0		100.0

Source: Stifel and Thorbecke (2003) Table 2.

Table 2.2 below shows the initial mean incomes and population shares before the policy experiment. This table also shows the headcount measure of poverty rates for each of the household groups that earn at least some labor income. It ignores three household groups, rural large landholders, urban capitalists and bureaucrats, as none of these households are assumed to be in poverty, nor does the particular policy shock results in poverty for any of these three groups. Although the authors do not make this point explicitly, one of the major distributional predictions of the dual-dual theory is that the poor and non-poor households have approximately a dichotomous distribution (Khan 1997).

TABLE 2.2: INITIAL INCOME AND DEMOGRAPHIC CHARACTERISTICS OF HOUSEHOLDS IN THE LABOR MARKET

	Mean income	Population share	Percent poor
Rural small-holders	1.00	0.59	83.4
Rural unskilled	1.05	0.07	82.5
Rural skilled	2.92	0.03	4.4
Urban informal	0.97	0.14	88.1
Urban unskilled	2.06	0.05	26.4
Urban skilled	5.85	0.07	0

Source: Stifel and Thorbecke (2003) table 3

From table 2.2 above, it appears that consistent with the uneven distribution of the poor across the various household categories, the mean incomes have a wide range--from 0.97 for the urban informal workers to 5.85 for the urban skilled workers. These incomes are scaled relative to the pre-tariff import price. Among the skilled groups, the richest are

in the urban sector. For the unskilled also, the urban unskilled group has the highest income, for reasons explained previously. Rural smallholders (60 per cent of the population) and other households with low education and skills such as rural unskilled, urban informal and urban unskilled comprise 85% of the total population and almost all of the poor come from these groups. Contrarily, households comprising of highly educated and skilled workers account for a mere 10 per cent of the total population and only 0.4% of those below the poverty line come from these groups.

For an adequate analysis of the policy impact on poverty one needs not just the information about the composition of households and their mean incomes, but also on the intra-group income distributions. As mentioned before, the statistical distribution function chosen to fit the various degrees of mean, variance, skew and other features related to the various moments of the income distribution statistically, is the *Beta* Distribution. This choice allows a certain flexibility. The density functions can be either symmetric or asymmetric. They can also be skewed to the left or to the right. Of course, the choice of parameter values that will result in a particular shape of the distribution function can not be arbitrary, but should be guided by the actual shapes, or some information regarding these shapes, of the distribution functions for each particular group of households. Here, well-designed and accurate household surveys can lead to a much improved policy analysis. In this particular exercise for the model economy, the assumption of within group distributional neutrality after the policy shock is maintained. Therefore, the impact on poverty comes from mainly the growth effects of the policy. A second, significant feature, however, is the urban-rural migration after the policy shock. This also affects the poverty reduction possibilities of liberalization, as we will see shortly.

Policy Simulation in the Model and Impact on Poverty:

As mentioned previously, according to the initial conditions postulated by the authors, at the outset 29% of the population is urban-based and 71% rural-based. The composition of households according to labor skills is 85% unskilled and 10% skilled. Rural smallholders are the largest group with close to 60% of the total population. Next is the urban informal with 14% of the total population. The urban skilled and rural unskilled each have 7% and the urban unskilled and rural skilled have 5% and 3% of the total population respectively.

The production of food in the rural informal sector makes up half the total output for the entire economy. The urban informal sector produces 10% and formal sector produces 20% of the total output. Finally, the rural export sector produces another 20%.

Prior to the policy experiment of tariff liberalization, the urban skilled workers in the model economy enjoy the highest level of wages. Their wages are more than twice the level of the rural skilled, two and a half times that of the urban unskilled and more than five times that of the other three groups.

The trade policy experiment involves a tariff reduction from 40% to 20%. The obvious and immediate effect is a drop in the price of imports and a relative increase in the price of exports. In keeping with the shape of the supply curves production rises for exports and falls for the import-competing sector, with the exact extent varying with relative price

changes and elasticities. Consistent with this, demand for both skilled and unskilled labor drops in the urban importables sector, and rises in the rural exportables sector. There is also a fall in wages in the former sector, and a reverse migration out of this sector in the urban area to the export sector in the rural area. For this particular policy experiment, in the new general equilibrium, the income share of urban skilled workers falls by 9%. At the same time the income share of rural skilled workers rises by about 22%. Correspondingly, there is also a movement of unskilled workers from the urban to the rural area as well. Finally, the fall in aggregate income in the urban formal sector reduces effective demand for the urban services sector as well, pushing out the urban informal sector workers towards the rural area also.

TABLE 2.3: CHANGES IN POVERTY

	Baseline level	**Simulation (t = 0.2)**	
		Level	Change
National poverty			
Poverty headcount (*P*0)	68.92	68.65	-0.27
Poverty gap (*P*1)	32.91	32.63	-0.28
Squared poverty gap (*P*2)	19.53	19.28	-0.25
Poverty headcount (*P*0)			
Rural small-holders	83.40	82.86	-0.54
Rural unskilled	82.53	82.09	-0.44
Rural skilled	4.37	3.15	-1.22
Urban informal	88.08	88.08	0.00
Urban unskilled	28.64	28.47	-0.17
Urban skilled	0.00	0.00	—
Poverty gap (*P*1)			
Rural small-holders	40.22	39.85	-0.28
Rural unskilled	37.04	36.62	-0.31
Rural skilled	0.45	0.29	-0.03
Urban informal	45.27	45.26	-0.01
Urban unskilled	4.35	4.33	0.00
Urban skilled	0.00	0.00	—
Squared poverty gap (*P*2)			
Rural small-holders	23.91	23.63	-0.28
Rural unskilled	20.52	20.21	-0.31
Rural skilled	0.07	0.04	-0.03
Urban informal	28.02	28.01	-0.01
Urban unskilled	0.95	0.95	0.00
Urban skilled	0.00	0.00	—

Note: Poverty measures are all multiplied by 100.
Source: Stifel and Thorbecke(2003) table 7

Tables 2.3 and 2.4 give the results for poverty reduction. Two implicit assumptions underlie these results. First, individuals who migrate take on the socio-economic characteristics of the group in which they end up. Second, both the groups, that is the group from which the individual migrates and the group to which the individual worker migrates, still have the same income distribution as before the migration.

TABLE 2.4: DECOMPOSITION OF CHANGES IN NATIONAL POVERTY

Percentage contribution to total change	P_0	P_1	P_2
Total change	100.0	100.0	100.0
Intra-group effects			
Rural small-holders	118.7	78.4	66.4
Rural unskilled	11.8	10.8	9.0
Rural skilled	13.4	1.7	0.4
Urban informal	0.0	0.5	0.5
Urban unskilled	3.0	0.3	0.0
Urban skilled	0.0	0.0	0.0
Migration effect	-53.4	5.7	21.5
Interaction effect	6.6	2.6	2.2

Source: Stifel and Thorbecke(2003) table 8

Under the assumptions, the results within the model show that all measures of poverty incidence decline for all rural groups. The largest drop in poverty incidence is recorded for rural smallholders and in the severity of poverty for the rural unskilled group. The changes for urban groups are smaller than for rural, although there is small decline in the incidence of poverty for the urban unskilled.

Table 2.4, which shows a decomposition of the changes in national poverty into the changes within the group and into the effects of migration between the groups, reveals that the decline in poverty among the rural smallholders accounts for most of the fall in national poverty. It can be recalled that about sixty per cent of the total population comes under this category. Hence, the result is to be expected. However, what could not have been anticipated is the extent by which the structure of wages and migration can dampen the poverty reduction impact of Structural Adjustment Programs, in this case of trade liberalization. As Stifel and Thorbecke (2003: 232) point out:

> In the absence of migration the reduction in poverty resulting from the trade reform would have been significantly overestimated. This results from the unskilled and skilled workers losing jobs in the import sector and migrating to the rural areas where they earn much lower wages. *Note that the migration result is negative despite the fact that 1.6% of the population migrates out of the poorest socio-economic group, the urban informal sector, into the better paying export sector. (Italics added)*

Although the positive effect on national poverty is still discernible, there are migrations taking place from both high paying to low paying and vice versa. The net effect is smaller than it would have been if only low paying to high paying job migration were taking place.

Conclusions

In this chapter we undertook a survey in order to gain a clear understanding of some of the challenges for analyzing poverty impacts of policies in a SAM-based CGE modeling framework. The main aspects of our understanding so far can be summarized quickly. The early models included distributional questions, but did not address poverty explicitly. The more recent models do address the question of poverty reduction impact of SAPs explicitly. The main strength for poverty analysis purposes is the CGE models' ability to capture the interdependence (the general equilibrium effects) in the economy.

In the dual-dual formulation, the further incorporation of interdependence among the labor markets in the rural and urban sectors leads to a more realistic assessment of the poverty reduction impact of trade liberalization. However, barring a few exceptions, the CGE models of the more recent generation still do not capture the structure of the financial markets and analyze the impact of financial liberalization on poverty reduction. There are no models in existence, which try in the spirit of the dual-dual approach to reduce the dimensionality of the standard static CGE models and still retain the causal structure essential for analyzing the poverty reduction impact of financial liberalization.

Therefore, there is considerable scope for experimenting with a new generation of stylized generic CGE models incorporating at least some financial sectors. However, in the Asian context the logically and empirically prior task must be to see if generic CGE models can be developed for the real sector for analyzing policies such as trade liberalization. After this task is completed, the next step can be the formulation and implementation of a class of new models for different groups of Asian economies. In the next chapters we take the initial step by attempting an economy-wide look at the real sector in a dual-dual context for a stylized South Asian economy. Within this type of model trade liberalization and poverty reduction exercises can be undertaken in the spirit of the Stifel-Thorbecke approach.

Appendix:

Macroeconomic Models for Developing Economies: SAMs and CGE

In order to implement empirically an economy wide CGE model, it is useful to create the economy wide data-base for such models in the form of Social Accounting Matrices (SAMs). In the following, we present a brief discussion of the basic construction of a SAM. Since the early formulations and policy experiments for dual-dual models were carried out in the context of simple SAM-based fixed price modeling, we have included a brief discussion of the basic features of this type of modeling as a background feature as well.

Social Accounting Matrices as Consistent Economy wide Data Bases and Fixed Price Multipliers

Here the Social Accounting Matrix is presented as a data gathering framework and an analytical tool for studying the effects of various macroeconomic policies as well as the impact of sectoral growth on poverty alleviation. The origins of social accounting can be traced as far back as Gregory King's efforts in 1681, but more recent work stems from the attempts by Richard Stone, Graham Pyatt, Erik Thorbecke and others.[21]

In the methodological framework of this particular study of CGE models, the SAM is viewed as a tool for mapping production and distribution at the economy wide level. Here we first describe a general SAM. Then it is shown how the method for studying the short-run effects of economic growth within this framework follows logically from its structure. The model used is a simple version of a class of SAM-based general equilibrium models.[22] It summarizes succinctly the interdependence between productive activities, factor shares, household income distribution, balance of payments, and capital accounts for the economy as a whole at a point in time. Given the technical conditions of production value added is distributed to the factors in a determinate fashion. The value added accrued by the factors is further received by households according to their ownership of assets and the prevailing wage structure. In matrix form the SAM consists of rows and columns representing receipts and expenditures, respectively. Receipts must equal expenditures as the accounting constraint implies.

One of the early uses of SAMs in the developing country context was to formulate some simple economy wide models. As is elaborated further in Khan and Thorbecke (1988), the SAM framework can be used to depict a set of linear relationships in a fixed coefficient model. For deciding the question of determination, the accounts need to be divided into exogenous and endogenous ones. For instance, in the South African SAM

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[21] For a description of SAM as a data-gathering device, see Pyatt and Thorbecke (1976).

[22] In Walrasian general equilibrium models the flexible price vector is a key feature. The zero excess demand condition in all markets determines the equilibrium. The price vector is endogenously determined in equilibrium. In a Keynesian (dis)equilibrium model in the short-run the quantities vary, while the price vector remains fixed.

used by Khan(1989) to analyze the impact of economic sanctions on the South African economy, there are three endogenous accounts. These are factors, households and production activities, leaving the government, capital and the rest of the world accounts as exogenous.[23]

In examining the poverty profiles in any country, one particular set of accounts assume special importance. These are the household accounts. The proper flow of income and expenditures need to be recorded for these accounts if an accurate picture of poverty as inadequate income or consumption is to emerge out of a given SAM. For this reason, the classification of households needs special care. There are at least six aspects that need careful attention.

These six aspects are:

(1) to classify households by socio-economic characteristics;
(2) to understand the income generation process by which the households receive their incomes;
(3) to pinpoint the distributional mechanisms;
(4) to understand household consumption patterns;
(5) to link household income and consumption to social capabilities and functionings;
(6) to estimate the resource generating capacity and resource absorbing capacity of households.

If items 1-6 can be investigated systematically by combining economic and social modes of inquiry in a SAM, proper policy intervention for poverty reduction will become a more tractable exercise than it is at present. In particular, if disaggregated SAMs can be constructed at the local, sub-national levels, then intervention at the local levels may be much more effective than it has been historically in many cases. This is yet to be realized, but clearly is an important goal to pursue.

We now turn to a discussion of another particular strength of the SAM framework for data gathering. SAMs have the consistency features that one needs in capturing economic flows for use in a general equilibrium framework.

[23] See Khan and Thorbecke (1988) chapter 3. The presentation here follows that work closely.

The following tables illustrate in the aggregate the consistency requirements for building a SAM. In table A1 we see an interesting early exercise, which has been reproduced with some minimum modifications. It can be noted that in this early version there was some confusion regarding the inclusion of the rest of the world (ROW) as a row, and the column was used to capture the surpluses or deficits in the ROW accounts Subsequent SAMs paid more attention to these details. The standard format now disaggregates both the export and import side by commodities. This is the format shown in table A2.

TABLE A 1. SAM-FORMAT OF SNA-AGGREGATES, KENYA, 1982

(in KE million pounds)

	FACTORS OF PRODUCTION	INSTITUTIONS	PRODUCTIO NACTIVITIES	CAPITAL ACCOUNT	INDIRECT TAXES	REST OF THE WORLD (NET)	TOTAL
FACTORS OF PRODCUTION			G.D.P. at factor cost (2931.87)			Net Factor Income from Abroad (-133.80)	Domestic Factor Inocme (2798.07)
INSITUTIONS	G.D.P. at factor cost (2798.07)				Net Indirect Taxes (467.59)	Net Non-Factor Income from Abroad (38.80)	Disposable National Income (3304.46)
PRODUCTION ACTIVITIES		Total Final Consumption (2793.15)		Gross Investments (764.71)		Trade Balance (158.40)	Net Final Demand (3399.46)
CAPTIAL ACCOUNT		Domestic Savings (511.31)				Balance of Payments Deficits (253.40)	Total Savings (764.71)
INDIRECT TAXES			Net Indirect Taxes (467.59)				Net Indirect Taxes (467.59)
TOTAL	Domestic Factor Income (2798.07)	Total Expenditure at Market prices (3304.46)	G.D.P. at Market prices (3399.46)	Total Gross Investments (764.71)	Net Indirect Taxes (467.59)	----------	

Source: Khan and Thorbecke (1988); reproduced in Khan (2004:22-23).

TABLE A2. MODULAR COMPOSITION OF THE SAM

	FACTORS OF PRODUCTIO N	INSTITUTIONS	PRODUCTI ON ACTIVITIES	CAPITAL ACCOUNT	INDIREC TT TAXES	REST OF THE WORLD	TOTAL
FACTORS OF PRODCUTION			Income Generation Module			Factor Income Received from Abroad	Total Factor Income Received
INSITUTIONS	Income Distribution Module	Income Redistribution Module			Total Net Indirect Taxes	Transfers Received from Abroad	Total Disposable National Income
PRODUCTION ACTIVITIES		Domestic Consumption Module	Industrial Transactions Module	Domestic Investment Module		Exports	Total Demand
CAPTIAL ACCOUNT		Domestic Savings Module				Balance of Payments Deficits	Total Savings
INDIRECT TAXES		Indirect Taxes on Final Consumption	Indirect Taxes on Intermediate Consumptio n	Indirect Taxes on Investment Goods			Total Net Indirect Taxes
REST OF THE WORLD	Factor Income Paid Abroad	Imports of Final Consumer Goods	Imports of Intermediate Consumer Goods	Imports Investment Goods			Total Payments Abroad
TOTAL	Total Factor Income Paid	Total Expenditure of the Institutions	Total Supply	Total Gross Investment s	Total Net Indirect Taxes	Total Receipts from Abroad	

Source: Khan and Thorbecke (1988)

In terms of the usefulness of the SAM information base, one can argue that not only is the national SAM a tool for overall poverty reduction analysis, perhaps even more importantly, the building of local and regional SAMs will help the field-worker to understand the interrelations between households characteristics, the immediate causes of poverty and the best way to help specific types of households out of poverty. We now turn to the discussion of a particular type of modeling exercise that can be carried out with both the national and regional SAMs.

Fixed Price Multipliers for National and Regional SAMs

In what follows, a national framework with distinct regions where the poor may be located is assumed. Suppose there are n regions indexed by i = 1, 2, ...,n. For each region i, there are intra-regional transactions as well as inter-regional transactions. Then, the national SAM can be disaggregated into 'n' Regional or RSAMs. The typical RSAM for region i can be schematically described as in table A3. Table A4 divides up the regional accounts according to whether these are endogenous or exogenous for the purpose of modeling.

TABLE A3. SIMPLIFIED SCHEMATIC SOCIAL ACCOUNTING MATRIX

				Expenditures				
				Endogenous accounts			Exogenous	Totals
				Factors	Households	Technology production activities	Sum of other accounts	
				1	2	3	4	5
Receipts	Endogenous accounts	Factors	1	0	0	$T_{1.3}$	x_1	y_1
		Households	2	$T_{2.1}$	$T_{2.2}$	0	x_2	y_2
		Production Activities	3	0	$T_{3.2}$	$T_{3.3}$	x_3	y_3
	Exog.	Sum. of other accounts	4	1^1_1	1^1_2	1^1_3	t	y_x
		Totals	5	y^1_1	y^1_2	y^1_3	y^1_x	

Source: Khan and Thorbecke(1988); also reproduced in Khan(2004:28)

The above SAM framework can be used to depict a set of linear relationships in a fixed coefficient model. This is the essential point behind fixed price multiplier modeling approach based on a SAM. For deciding the question of determination of the equilibrium quantities, the accounts need to be divided into exogenous and endogenous ones as in table A.4 below.

TABLE A4. SCHEMATIC REPRESENTATION OF ENDOGENOUS AND EXOGENOUS ACCOUNTS IN A SAM

		Expenditures				Totals
		Endogenous	Sum	Exogenous	Sum	
Receipts	Endogenous	T_{nn}	n	Injections T_{nx}	x	y_n
	Exogenous	Leakages T_{xn}	1	Residual Balances T_{xx}	t	y_x
Totals		y_n'		y_x'		

Source: Khan and Thorbecke (1988); also reproduced in Khan (2004:29).

Essentially the regional income SAM above describes the circular process in which production activities generate household incomes (via the aggregation of factorial income per household category), and household expenditures, which generate the demand for output. Other related variables such as government spending, imports, exports, and transfers are linked to this core process where necessary. Transfers to households from various other institutions including other household are also important for income determination and poverty analysis.

The 1978 income SAM for South Africa, which is used by Khan (1999) for poverty analysis, for example, contains 28 separate productive activities. There is clearly enough detail here on the production side. The value added generated in these productive activities is distributed among landowners, capitalists, and forty occupation-by-race groupings. The realism of the classifications captures the nature of the past apartheid regime by indicating the determination of many occupational categories by racial factors. Finally, there are seven groups of households within each of the four racial groups. These are stratified by income. Therefore, both racial and economic stratification are embodied here. For the purpose of studying the relationship between growth and poverty the households are separated into rural and urban types. Further, within urban and rural areas, households are classified as high, middle and low according to economic status. This six-fold classification is more relevant for exploring questions related to poverty than the aggregated (that is urban and rural combined) approach of the original SAM. The justification for reducing the household types to three within the urban or rural categories is that the original household classification was somewhat arbitrary. The top three household categories could be aggregated as high income. The remaining six could be

reclassified according to the information provided by the household expenditures survey data into low and middle categories.

The starting point for an analysis based on this SAM is the exogenous nature of the increased demand leading to sectoral output increase. The set of fixed price multipliers can then be used to ascertain the impact of this increase in output on the incomes of specific household groups.

Looking at tables A3 and A4 (particularly table A4) ,which represent a SAM, we can see immediately that

$$y = n + x \quad \text{(A.1)}$$
$$y = 1 + t \quad \text{(A.2)}$$

Now if we divide the entries in the matrix Tnn by the corresponding total income (i.e. Yn), we can define a corresponding matrix of average expenditure propensities. Let us call this matrix A. We now have:

$$y = n + x = Ay + x \quad \text{(A.2.1)}$$
$$y = (1 - A)^{-1}x = Mx \quad \text{A.2.2)}$$

M can be called the matrix of *accounting* multipliers. These multipliers, when computed, can account for the results (for income or consumption.) obtained in the SAM without explaining the process that led to them. Let us now partition the matrix A in the following way.

$$A = \begin{pmatrix} 0 & 0 & A_{1.3} \\ A_{2.1} & A_{2.2} & 0 \\ 0 & A_{3.2} & A_{3.3} \end{pmatrix}$$

Given the accounts, factors, household and the production activities, now we see that the income levels of these accounts (call them y_1, y_2, and y_3 respectively) are determined as functions of the exogenous demand of all other accounts. In this respect, what we have is a reduced-form model, which can be consistent with a number of structural forms. This is quite satisfactory as far as tracing the effects of a certain injection in the economy is concerned or for prediction purposes when the structural coefficients are more or less unchanged.

One limitation of the accounting multiplier matrix M as derived in equation (A.2.2) is that it implies unitary expenditure elasticities (the prevailing average expenditure propensities in A are assumed to apply to any incremental injection). A more realistic alternative is to specify a matrix of marginal expenditure propensities (C_n below) corresponding to the observed income and expenditure when prices remain fixed. Expressing the changes in income (dy) resulting from changes in injections (dx), one obtains,

$$dy_n = C_n dy_n + dx$$
$$= (I - C_n)^{-1} dx = M_c dx$$

M_c can be termed a fixed price multiplier matrix and its advantage is that it allows any nonnegative income and expenditure elasticities to be reflected in M_c. In particular, in exploring the macroeconomic effects of exogenous changes in the output of different product-cum-technologies on other macroeconomic variables, it would be very unrealistic to assume that consumers react to any given proportional change in their incomes by increasing expenditures on the different commodities by exactly that same proportion (that is assuming that the income elasticities of demand of the various socioeconomic household groups for the various commodities are all unitary). Since the expenditure (income) elasticity is equal to the ratio of the marginal expenditure propensity (MEP_i) to the average expenditure propensity (APE_i) for any given good i, it follows that the marginal expenditure propensity can be readily obtained once the expenditure elasticity and the average expenditure propensities are known so

Eyi = MEPi/AEPi

where Eyi is the income elasticity for good i.

Thus, given the matrix A_{32} of average expenditure propensities, and the corresponding expenditure elasticities of demand, Ey_i the corresponding marginal expenditure propensities matrix C_{32} can easily be derived.

For analyzing poverty both at the national and the subnational levels these multipliers can be further decomposed in terms of their effects on poor households incomes Tracing out these effects can be computationally demanding, but under assumptions of distributional neutrality of growth, the pure effects of growth on poverty have been estimated by Thorbecke and Jung(1996) for Indonesia and by Khan(1999) for South Africa. The latter used the South African SAM described above and found that the lack of human capital and more generally, basic capabilities in Sen's capabilities framework, was the main reason why growth left out the rural black poor.

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