POVERTY AND POLICY:

EXPERIMENTS WITH A SAM-BASED CGE MODEL FOR GHANA

Diego Colatei
Queen Elizabeth House, University of Oxford

and

Jeffery I Round
Department of Economics, University of Warwick

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Abstract

Ghana has often been regarded as one of the major success stories in sub-Saharan Africa in respect of the implementation of economic reform programmes during the 1980s and 1990s. However analyses of responses in terms of poverty reduction seem to indicate that structural adjustment may not be benefiting all segments of society. The aim of this paper is to carry out some counterfactual, numerical simulation experiments using variants of a stylised SAM-based CGE model, to ascertain possible effects on poverty of a range of revenue-neutral redistributive policies. The analysis is based on a social accounting matrix (SAM) for Ghana compiled for the year 1993. This SAM not only has a detailed commodity and activity accounts within a structure in line with the recommendations of the 1993 SNA but it also has some quite detailed representations of factor and household accounts. The CGE model is a real-side, static model and therefore excludes the monetary and financial sectors. The experimental design follows in the tradition of Adelman and Robinson (1978) for Korea and Chia, Wahba and Whalley (1992) for the Côte d'Ivoire. However the model design and experiments are also influenced by recent exchange by De Maio, Stewart and van der Hoeven (1999) and Sahn, Dorosh and Younger(1999) with a view to examining the sensitivity of the experimental results to alternative specifications and closures within broadly similar, general SAM-based model structures.

KEYWORDS: CGE modelling, Ghana, poverty, social accounting matrices

Preliminary version: please do not quote without permission: J.I.Round@warwick.ac.uk

1. Introduction

Ghana has often been regarded as one of the major success stories in Africa in terms of the implementation of structural adjustment and liberalisation reform programmes during the 1980s and 1990s. In terms of the broad aggregate indicators the most recent evidence is promising and even impressive, certainly in terms of comparisons of economic performance with the pre-SAP reform era. However, in analyses of the impact of the reform process, especially in terms of poverty profiles of those household groups containing significant proportions of the poor, the evidence to date suggests that the distribution of benefits may have been unevenly distributed and that the poor may not have benefited from policy reform in either absolute or relative terms. This raises questions as to what kinds of effects social policy interventions may have in helping to mitigate some of the adverse effects of reform and, instead, to help to promote positive outcomes for the poor.

This is a broad and ambitious objective which can be tackled in several ways. One way is to use computable general equilibrium models to conduct counterfactual numerical simulation experiments on the alternative policy options. A general approach is set out by Dervis, de Melo and Robinson (1982) and subsequently by Sarris (1990). Particular studies have been carried out by Adelman and Robinson (1978), Chia, Wahba and Whalley (1992), Demery and Demery (1992), Sahn, Dorosh and Younger (1997), and others. While there are general similarities between these studies there are significant conceptual differences in their scope, and in the experiments and approaches adopted. In this paper the multisectoral CGE modelling approach has been used to simulate the possible effects of a range of redistributive policies on poverty incidence in Ghana, very much in the tradition of Adelman and Robinson (1978) and of Chia *et al* (1992). The particular claims to novelty are twofold. The first is that the model is based on the first detailed and authoritative social accounting matrix (SAM) for Ghana, estimated for 1993 which is well inside the post-reform era. The second is that, rather than constructing one single (definitive) model several variants are constructed with the aim of seeing just how sensitive the results are to variations in the parameterisation, specification and closure rules. One particular aim here is therefore to address some of the recent criticisms of De Maio, Stewart and van der Hoeven (1999) in respect both of the study by Sahn, Dorosh and Younger(1997) and of CGE modelling more generally. A study of alternative closures also helps to highlight the differences between a more general CGE approach and one based on fixed price multipliers and input-output analysis as exemplified

by a related SAM-based study for Indonesia by Keuning and Thorbecke (1992).

Following this introduction, section 2 sets out the background to the policy analysis by reviewing the general structure of the macro-meso[1]-micro simulation modelling approach adopted. Section 3 then considers in more detail three aspects of the economic structure of Ghana that are built into the model: specifically, these are features of the SAM framework used, including household classifications; a profile of poverty incidence in these household groups; and some discussion of the model specification. Then in section 4 a range of simulation experiments are conducted to examine the possible effects of alternative distributive policies on poverty incidence and to examine the sensitivity of these results under alternative model specifications and closures. Finally, section 5 concludes with an overall assessment of the experiments.

2. Background to the policy simulations

CGE models are frequently used to simulate the effects of changes in policy- or exogenously-determined variables (e.g. tax rates, world prices, exogenous export demand shocks, etc.) on endogenous variables (usually domestic variables such as sectoral outputs, relative prices of products and factors, household incomes or welfare, etc). CGE models are often regarded as extensions of input-output and linear programming models in the sense that they are multisectoral models and capture interdependence between sectors. But in addition they capture the interdependence between other agents in the economic system such as households and other domestic institutions, as well as the external sector. The core of the CGE model is a representation of the markets for products and factors. Decisions by producers and consumers determine supplies and demands for products and factors which become mutually consistent through adjustments in relative prices.

Macro-meso models

CGE models may be regarded as a class of macro-meso models (World Bank, 1990). On the macro side CGE models are always firmly rooted within a macroeconomic framework: they

[1] The term 'meso' is derived from the Greek 'mesos' or middle. It is not often used in economics alongside the standard terms micro and macro, but it is particularly useful in the present context (World Bank, 1990).

integrally involve macro variables and are conditioned by macro 'closures' (that is, the rules which determine how the external, capital and government accounts are brought into balance). Similarly on the meso side the models explicitly involve markets and often portray some degree of institutional structure of the economy. What is important therefore is the extent to which the representation of markets and the level of institutional detail in the models adequately capture the characteristics of the meso economy and the effects of exogenous shocks. Thus, whether the model usefully addresses the impact of policies at the meso level is dependent on three key factors. First, it will depend on the macro-meso framework underpinning the model; second, whether the model specification of technology and behaviour in the economy is representative; and third, it will depend on the quality and detail of the benchmark dataset used to calibrate the model. The benchmark dataset mainly consists of a SAM. In this sense the classification detail in the SAM, the number and kinds of product and factor accounts and the classifications of household groups and other institutional features are crucial to determining the integrity of the model structure as a whole.

Recently De Maio, Stewart and van der Hoeven (1999) have been critical of the work of Sahn and others, and of the work of the Cornell Nutrition Program, on the grounds that their choice of classifications, in particular of factors and household groups, conceals some crucial within-group variations. Clearly, if the average effects of policies on household groups do not reflect the effects on household sub-groups, either in magnitude or direction, then this will undermine the value of the model in its ability to examine policy consequences at the meso level. The issue is most clearly exemplified in the case of rural households where sub-groups may have quite different degrees of exposure to agricultural export markets. Some agricultural households produce and sell export crops and/or their household members work in farms producing for export, while others are small landowners who are mainly subsistence farmers and/or are net purchasers of food. Obviously each group may be affected differently by exogenous shocks, and if such households are classified in a single group then the results could be misleading. These criticisms can partly be offset by a careful choice of classifications. For instance De Maio *et al* (1999) rightly criticise Sahn *et al* (1997) for basing their household classifications on the level of income (poor vs non-poor) and argue instead in favour of other classifications such as those based on socioeconomic and locality criteria. Their general point is that classifications should be chosen to minimise the effect of mobility between household groups (which income-based criteria would allow) as well as

maximising the between-group effect relative to the within-group effect.

Meso-micro extensions

The above considerations are clearly important in determining how well CGE models capture meso-level effects: the effects on markets, households and other institutional groups. Clearly, whatever classifications of products, factors, households and other institutions are chosen, they are usually too aggregative to assess the policy effects at a micro-level. Only if the group classifications happen to be perfectly homogeneous (so there is no intra-group variation) would the meso-level results be sufficient to describe the micro-level outcomes. Therefore it is necessary to introduce a further 'meso-micro' interface in order to assess the effects of policies on levels of poverty and on other distribution-related outcomes.

One approach to adding a micro extension has been examined by Dervis, de Melo and Robinson (1982) and implemented by Demery and Demery (1992) for Malaysia and Chia, Wahba and Whalley (1992) in a poverty-focused policy model for the Cote d'Ivoire. This is also similar to a recent model of an 'archetypal' African economy proposed by Decaluwe, *et al* (1999). The methodology rests on the availability or derivation of a distribution of income (or expenditure) for each household group identified in the SAM. A poverty line is then defined (either in relative or in absolute terms) and the part of population whose incomes falls below the line is categorised as poor. While the determination of a poverty line for involves important conceptual as well as data problems, a major difficulty is to estimate the distribution of income both in the base case and how it might change in response to shocks. Sample surveys of households are the main data source for this: although the data produced refer generally to households or families, they can nevertheless be used to provide an approximate distribution for individuals as well. In generalising from households to individuals, it is usually assumed that household income (or consumption) is equally distributed to all its members so that if the household's total income (or expenditure) falls below the poverty line, all its members are deemed to be poor. In other words, any intra-household inequality is ignored although there is evidence that this assumption may lead to a considerable understatement of poverty (Haddad and Kanbur, 1990).

A quantitative analysis of poverty requires the specification of a poverty index and the headcount index (P_0) is simple and has well-known properties within the broad class of FGT

P_a measures. In order to implement this measure, the distribution of income (or expenditure) within each group, must be specified. One approach is to estimate the distribution for each household group directly from data provided by household surveys. Another approach is to assume instead that the distribution can be approximated by a theoretical frequency density function and then to estimate the parameter characterising the functional form by using the information provided by the household surveys. The latter approach has the advantage that one can manipulate distributional changes resulting from exogenous impacts. The theoretical distribution most widely used in this context is the two-parameter lognormal distribution, although Ducaluwe *et al* (1999) have recently suggested that the Beta distribution may have preferred properties. One major disadvantage of the lognormal distribution is its poor description at the upper tail, although this deficiency is less serious when the function is separately parameterised for different and diverse household groups rather than for the population as a whole. On the other hand a prime advantage of using this distribution is relationship to the normal distribution, and therefore, its simplicity for statistical analysis. The use of the lognormal distribution in this context is examined by Dervis *et al* (1992).

The essential pieces of information required from the household survey are first, estimates of the mean and variance of the lognormal distribution for each household group and second, a measure of the poverty line. Data from the Ghana Living Standards Survey 1991-1992 has provided us with information on the mean and variance of income of separate decompositions of the population by household group, and the standard relationships between the mean and variance of the distribution of Y (where Y is per capita income) and the mean (m) and variance (s^2) of the distribution of $\ln Y$ means that base year estimates can be estimated. As regards the poverty line, it is by now standard to by-pass the conceptual difficulties of measuring absolute poverty lines and instead to use a poverty line based on a given percentage of mean per capita household income (or expenditure). This baseline poverty line (z) is then fixed in real terms throughout the simulations.

The extension of the meso-level analysis on to the micro-level (in terms of assessing the impact of policies on poverty levels) is now almost complete. The procedure is that macro-meso level policy changes are applied and the CGE model then generates the differential impact that these policies have on the mean incomes of each household group ($\bar{Y}_h$). The effect on poverty is then measured by translating the change in $\bar{Y}_h$ into a shift in m_h based on

the assumption that the variance of $\ln \bar{Y}_h$ (that is s_h^2) is unchanged. This assumption is largely (though not entirely) pragmatic, as it rests on an assumption that the effects of policies are uniformly spread across all households within a group. The shift in m_h (with a fixed s_h^2) represents a shift in the lognormal distribution, and the change in the cumulative density below *z* (which is equivalent to a change in P_0) can be calculated.

It is important to stress that any meso-micro application is bound to be a technically contrived extension of the meso outcomes and will rest on a range of assumptions. Therefore some general observations can be made at the outset, as these will determine areas where sensitivity experiments may need to be applied later. Clearly, changes in the headcount index will be sensitive to the position of both the poverty line *z* and the value of s_h^2. The sensitivity of P_0 to the poverty line is well-known: an incremental shift in a high-level poverty line will affect the headcount index more than the same incremental shift in a low-level poverty line. However, P_0 is also sensitive to the value of s_h^2 and for very similar reasons. If s_h^2 is relatively large then the change in P_0 resulting from a change in $\bar{Y}_h$ will be a smaller than if s_h^2 is small[2]. So the relative variability of incomes within each group will be a crucial determinant of the simulated effects of policies on this poverty measure.

Finally, note that there are some potential omitted effects on poverty of certain kinds of policy changes. Chia *et al* (1992) refer to this omission in connection with the 'social adjustments' that accompany structural adjustment policy changes[3]. For example, a reduction of government expenditures on social services (e.g. health, education, etc) will often have two sets of effects on households: first, the direct and indirect income effects due to reduced expenditures and, secondly, the welfare losses that stem from the reduction in the social benefits. We restrict our attention to policy experiments in which there are revenue-neutral switches from one kind of tax to another. These represent a limited range of experiments which essentially avoid the second set of potential effects on households because the tax-switching takes place in an expenditure-neutral environment as well.

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[2] If $F(x)$ is the lognormal distribution function then if $d^2F/dx^2 > 0$ will ensure this result providing the poverty line is below the median income. If the poverty line is above the median income then the opposite result is true.

[3] Chia *et al* (1992): p 3.

3. Structures: the SAM, poverty profiles and the model structure for Ghana

The Ghana SAM for 1993

A social accounting matrix for Ghana for the year 1993 has been prepared in collaboration with the Ghana Statistical Service (Powell and Round, 1997). This was the first stage of a substantive methodological revision of the Ghana national accounts, compiled in accordance with the recommendations of the United Nations 1993 System of National Accounts (SNA, 1993), involving a re-estimation and re-basing of all past estimates. The SAM integrally involved the compilation of supply and use tables (input-output tables), as well as detailed and extensive household survey information obtained from recent Ghana Living Standards Surveys. In fact, the compilation process involved the development of two SAMs. The first, called the 'mini SAM' (comprising 62 accounts), is basically a representation of the Ghana SNA (the supply and use table and the integrated economic accounts) in matrix format. The creation of the second SAM, the 'full SAM' (comprising 120 accounts) involved a further disaggregation of the factor and household accounts. The modelling experiments conducted here are based on a third variant which is referred to here as a 'consolidated SAM'.

The 'consolidated SAM' involves straightforward aggregations of the capital transactions accounts into a single 'savings/investment' account; and the consolidation of the SNA-based primary, secondary and use of income accounts into one single set of current accounts for institutions. As a result, there is some loss of information (for example on the nature of the inter-institutional transfers) but none that involved any compromise or imposed any limitations on the kind of model structures that were envisaged[4]. For example, the consolidation of the capital transactions accounts is largely motivated by the present emphasis on real-side modelling. Beyond these two main areas of consolidation were some other minor aggregations and adjustments. For example, six 'Urban (non-Accra)' household accounts were combined into two, due to the lack of available information from the GLSS on the numbers of households, etc, for the more detailed classifications that would be crucial to the poverty analysis and model simulations. On the other hand, the information on taxes on production provided in the original 'full SAM' were too aggregative for the purposes of the redistributive experiments. Hence, by drawing on extra information, assumptions and an application of the RAS technique, separate tax revenue accounts were generated for domestic

[4] The main advantage of the multiple distribution accounts arises at the compilation stage.

taxes, import duties and export taxes. The accounting detail in the consolidated SAM consists of: 10 product accounts (including trade margins); 12 activity accounts; 9 factor accounts; 14 current accounts of institutions (including 10 household groups); 1 capital account; 5 accounts for taxes; and 1 account for the rest of the world. The consolidated SAM and some discussion of relevant aspects of the compilation issues are shown and are discussed in Appendix 1.

Ghana poverty profiles

It is common practice to begin a poverty analysis with the identification of an indicator of individual welfare. This is usually a monetary indicator such as total consumption expenditure or total income. The second step is to define a single (or multiple) poverty lines and finally, a summary poverty measure has to be identified. Each step has been considered in the literature to be controversial. For example, there is an issue as to whether a welfare indicator should be a monetary value or an anthropometric measure, and if it is a monetary measure then what should be included and how it should be valued. There is dispute on the definition of the poverty line, whether it should be set at an absolute or relative value, and whether it should change over individuals, space or over time. In this study we follow Chia *et al* (1992) and base our welfare measure on per capita expenditure (cash and imputed in kind); the poverty line is set initially at a percentage of mean expenditure; and the poverty measure is based on P_0 (the headcount index). Per capita expenditure has often been argued to be a better measure of 'permanent' income; the choice of the poverty line, though initially arbitrary, becomes an absolute benchmark in the subsequent simulations; and P_0 is sufficient for making poverty comparisons providing first order dominance applies.

Previous studies on Ghana have highlighted the fact that poverty is highly concentrated in rural areas. This applies whether the study is based on the period prior to the economic reform programme (ERP) or subsequently; or whether poverty is defined through monetary measures or in terms of nutritional standards[5]. The results obtained from an analysis of the 1993 Ghana SAM and 1992/93 GLSS are in line with these findings.

Table 1 shows some summary statistics which are used as a basis for the model and

[5] See Boateng *et al.* (1990) for further figures and references to other studies.

simulations. It reports data relative to households and to per-capita cash expenditure as derived from the GLSS for the period 1992-93[6]. For Ghana as a whole, the contrasts between household groups are quite substantial. For example, while only 7.0 % of the population belong to households in the 'urban skilled' category this household group accounts for 21.8% of total household consumption. On the other hand 17.8% of the population belong to 'Savannah farm' households whereas this group accounts for only 3.3% of total household consumption. The comparisons across urban and rural households as a whole are also borne out by the figures: 66.8% of the population belong to rural households, whereas only 41.2% of total consumption expenditure is incurred by rural households[7]. The column for per capita consumption confirms significant disparities between household groups.

[Table 1 here]

As noted earlier, within group information is needed in order to calculate poverty measures and track changes in these measures between the simulations. Following Dervis, *et al* (1982) and Chia, *et al* (1992) and others, we assume expenditure in each group is lognormally distributed, with log-mean m and log-variance s^2. Hence for each household group (*h*) the mean (m_h) can be derived from the benchmark data set as follows

$$m_h = \ln \bar{Y}_h - \tfrac{1}{2} s_h^2 \qquad (1)$$

where $\bar{Y}_h$ is per capita expenditure in group *h* and the log-variance s_h^2 must be estimated. The GLSS is the source for estimating the log-variance but the disaggregations and hence the estimates differ from those used here[8]. Working from the estimates of s_h^2 shown in Table 1, the group log-means are estimated from the benchmark data set. These are also shown in the table.

[6] To take in account the fact that households vary greatly in size, a simple per capita adjustment has been used. It means that total expenditure has been divided by the number of households and taking account of the average household size in each household group. An alternative option would be the use of equivalence scales, in which individuals of different age are counted as consuming different fractions of total household expenditure.
[7] The income and expenditure estimates include imputations of subsistence and other non-monetary items.
[8] GLSS groups are more disaggregated by locality although not by skill category. It has been assumed that the distribution is less skewed for unskilled than skilled households.

Two poverty lines are derived and the same poverty lines are used for each group. The higher poverty line is set at 129199 cedis (two thirds of the mean per capita expenditure in 1993), while the lower ('hard core') poverty line is set at 64599 cedis (one third of the mean per capita expenditure). On this basis, and using the lognormal assumptions the poverty profiles can be calculated and the results are shown in the final columns of Table 1. It confirms the more general picture suggested earlier and more directly: poverty in Ghana is clearly substantially a rural phenomenon. On the basis of the 'high-level' poverty line 93.9 % of poverty is in rural areas; this rises to 99.6% if one restricts attention to a 'low-level' (hard core) poverty line. Also, poverty incidence is substantially higher in 'Forest farm', 'Forest non-agricultural', 'Coastal farm and 'Savannah farm' household groups: the incidence is correspondingly negligible in the 'Urban skilled', 'Accra skilled' and 'Coastal non-agricultural' household groups. The between-group disparities are really very high indeed.

Model structure

The CGE model is a real-side model of a small open economy and is purposely simple, having many standard features in common with existing models. The exchange rate is fixed and acts as the numeraire; the balance of payments is always in equilibrium, with foreign savings equal to the current account deficit. At the same time, it is assumed that the economy is investment-driven: the quantity of investment is fixed and that the government has a fixed budget for a pre-defined consumption plan. Domestic savings, on the other hand, adjust through changes in institutional income. For example household income changes endogenously due to changes in factor income (via employment, wage rates, mixed income and returns to capital) and government income depends endogenously on direct and indirect tax receipts. Investment must equal the sum of domestic and foreign savings, and there are no constraints on borrowing from abroad. Domestically-produced and imported commodities are combined to produce composite goods in accordance with the Armington hypothesis; this is equivalent to assuming a degree of imperfect substitution between domestically-produced and imported goods.

The labour and factor markets are an important aspect of the model structure, and deserve special mention in view of their direct link with the distribution of income across household groups. The factor market specification is embryonic although it is indicative of a possibly more sophisticated treatment of the informal sector and perceptions of how it interacts with the formal sector. In the SAM, and following the guidelines of the new SNA (1993), there

are separate accounts for 'compensation of employees' and 'mixed income' further distinguished by location and skill. The category 'mixed income' is the income of the self-employed or employers in household sector unincorporated enterprises and it represents the return to both labour and capital. Household enterprises will include formal as well as informal activities, but we may broadly characterise the compensation of employees as the formal sector labour market and mixed income as the informal labour market. In the base model specification wages in the formal labour market are assumed fixed. This means that firms will always be on their demand curve for labour and unemployment can result, so the labour market exhibits some structuralist features. But in the same base model specification the informal labour market is assumed to clear at an equilibrium 'wage'. So the treatment of the informal sector is quite rudimentary in the current model. A listing of the structural equations of the model is provided in Appendix 2.

One of De Maio *et al*'s main criticisms of the use of CGEs in poverty analysis concerns the sensitivity of the results to the model closures and to concerns about distinguishing the short run consequences from those of the long run. This leads us to a central aspect of our simulations, where we set up alternative closures for the factor markets. As previously noted, we introduce some structural features into the factor markets by assuming nominal wage rigidity in the formal labour markets. To mimic the short run we ought also to make capital sectorally fixed and to clear each factor according to a sectorally-determined capital rental rate. But in the present version of the model, capital is assumed fixed overall (though mobile between sectors) and the market therefore clears according to a single capital rental rate. MacGregor, Swales and Yin (1996) have argued that if factor prices are fixed and the supply side becomes entirely passive then, with an allowance for replacement investment, the resulting 'input-output' closure mimics the long-run equilibrium of the system. The detail of their argument is most appropriate to a regional economy, in which the economy is a price-taker and faces an inelastic supply of labour. Perhaps it is not any more unrealistic to assume similar conditions prevailing in a small developing economy with a substantial informal labour market. At any rate, here we configure the model according to two alternative sets of factor market closures: a short-run (structuralist) closure and a long-run (input-output) closure.

Alongside the model specification and closures are some well-known issues concerning calibration and parameter estimation. The calibration is governed by the benchmark data set,

comprising the base year SAM and other parameter values not included in the SAM. The principal sets of parameters in this category are the trade substitution (Armington) elasticities which have to be determined exogenously. There are no known estimates available and it is necessary to follow some principles which might lead to plausible values, which have been arrived at as follows. For most developing countries, the expectation is that elasticities of agricultural products are higher than for industrial goods and services. Also a high level of two-way trade can be considered to be consistent with a low substitutability between domestic and imported goods. Finally, export price elasticities are expected in general to be higher than import elasticities of substitution.

Based on these assumptions, the elasticities introduced in the model and the data used to determine these values are as reported in Table 2[9].

[Table 2 here]

The table also shows the features of the trade aspects of the SAM alongside the particular parameterisation adopted. However, the elasticity assumptions are unlikely to be as important as they would be in policy experiments concerning trade liberalisation or economic reform.

4. Policy experiments

Basic methodology

The main issue addressed in the experimental analysis previously conducted by Chia *et al* (1992) was to examine the general equilibrium effects of implementing a targeting program for the eradication of extreme poverty. Specifically, their aim was to examine whether the size of transfers calculated in a partial equilibrium framework would eliminate poverty when both direct and indirect effects are accounted for. In the case of the Cote d'Ivoire, a major influence on the indirect effects arose from substantial inter-household transfers. While inter-household transfers and remittances are known to occur in Ghana (as elsewhere), it is quite

[9] Saudolet and De Janvry (1995: p.354) state that '...the possible range of substitutability is relatively well represented by four values: 0.3 for very low substitutability, 0.8 for medium-low, 1.2 for medium-high, and 3.0 for very high'.

difficult to obtain estimates of their magnitude. Certainly the GLSS household surveys provide few clues of these transfers being as large in Ghana as were the case in the Cote d'Ivoire. So while we replicate these experiments for Ghana, even on *prima facie* grounds, the effects are unlikely to be nearly so dramatic. Two other aims have been added to this earlier aim. First, in the case of the Cote d'Ivoire the targeting program was simply financed by increases in the taxes on income. Here we consider the consequences of alternative financing schemes, by raising additional domestic commodity taxes and via increased import duties. The second aim is to examine the sensitivity of the results to the alternative short run and long run model configurations.

Determining the poverty-alleviating transfers

The first step of the analysis is to determine the total transfers necessary to eliminate poverty. In a perfect targeting scheme only individuals who are poor would be targeted and they would receive a transfer equal to the amount required to raise them above the poverty line. But this scheme is costly to administer. A polar alternative to this is to administer a universalistic scheme in which all individuals receive *z*, sufficient to eliminate poverty. But the cost of the transfers in this scheme is very high. Here we confine our attention to quasi-universalistic schemes whereby transfers are targeted to each socio-economic group separately, and are achieved under a self-financing rule. In a true universalistic scheme each individual in each group would receive a transfer from government equal to the poverty line income, z ; so the total transfers T_h in household group h would simply be the number of individuals in each group times *z*. Table 3 shows the resulting calculation of T_h in each socioeconomic group h , in column 3 (total universal transfers), alongside the group population sizes and the benchmark poverty incidence levels (P_0).

[Table 3 here]

There is a technical difficulty in effecting these (essentially micro) transfer payments in the macro-meso model, which also seems to be recognised in the work of Chia *et al*. Ideally, the result of the payments would involve a rightwards parallel shift of z in the income distribution. However, this is not possible if income is assumed to be lognormally distributed. The best it seems one can do in the circumstances is to shift the mean from $\overline{Y}_h$ to $\left(\overline{Y}_h + z\right)$ which simultaneously creates a lower degree of rightwards skew; as the lognormal

distribution must always begin at the origin. Equivalently, this means that although we can simulate the effect of an average transfer payment of z to each group (i.e. a quasi-universalistic scheme) we cannot ensure that the payments are distributed uniformly to all individuals with the group. Column 4 of Table 3 shows the effective poverty ratio under the lognormal assumption, when a quasi-universalistic transfer is made to each group.

As suggested by Chia *et al* (1992), the precise size of the transfers for each group can be obtained by shifting the theoretical function of $\ln Y$ so that the z-score equals -2.5 (i.e. a shift sufficient to ensure the head-count ratio is reduced to approximately equal zero). It is assumed that the variance of within-group log-expenditure (s^2) does not change under the transfers, and the shift is only in the mean. The two final columns of Table 3 show the per capita transfers and the total transfers necessary to shift the distribution and to eliminate poverty in each socioeconomic group. Note that for five groups, including 'Accra skilled', as well as those for 'Other urban skilled/unskilled', the poverty levels are already very low so no transfers are included. Clearly the transfers necessary under this quasi-universalistic scheme are much larger even than the universalistic scheme; in fact, they are in total almost three times as large. It underlines a weakness in translating simulations in an essentially macro-meso model in order to make assessments at the micro level.

There are three final issues concerning the nature transfer payments and the way they are financed. We can consider the transfers to be either in cash or a monetary equivalent 'in kind'. That is, the transfers might be made to individuals either as a form of disposable income or as an amount to be necessarily spent upon consumption goods and services. Both cases are analysed here because they may have quite different effects on the poverty profiles. Equally, alternative means may be proposed for financing the transfer schemes. It is assumed that the government finances its programmes by increasing the existing tax rates or by introducing potential taxes. In this paper three alternative financing schemes are considered: increasing income taxes, domestic commodity taxes, and import duties. The simulations therefore cover six sets of counterfactual scenarios for each of the five sets of transfers to the socioeconomic groups whose poverty ratios are to be reduced: amounting to a total of 30 simulations for each of the short-run (structuralist) and long-run (input-output) closures. Finally, it should be noted that in the present formulation on the fiscal side the financing rules are set on the basis of the need to raise an amount equal to the transfers. But there will be

secondary effects and the ultimate tax revenue will differ from the total transfers. Clearly, an alternative procedure could be to make the tax rates endogenous in order to ensure the redistribution is budget neutral.

Experiment 1: Structuralist closure: transfers financed through income taxes

We begin by presenting the results of an experiment whereby quasi-universalistic transfers are made to each of the five socioeconomic groups whose poverty ratios are significantly greater than zero in the benchmark, and we do so by examining the outcomes for the short-run (structuralist) closure where revenues are raised by increasing income taxes across all groups. The results of the experiments are shown in Table 4.1.

[Tables 4.1 here]

To illustrate the procedure adopted we consider the case of income transfers to the household group 'Accra unskilled'. Table 3 shows that the required transfer amounts to 50.197 billion cedis. These are obtained by increasing the tax rate of both the 'rich' household groups (that is, those household groups whose poverty ratios are near zero and therefore not in receipt of poverty- alleviating transfers) and companies (both financial and non-financial)[10]. For the results we now refer to Table 4.1 (panel A). The penultimate column of Table 4.1 shows the general equilibrium effects in this experiment of 'robbing the rich' to help alleviate poverty in the poor household groups. The benchmark poverty ratios are shown in the final column. Thus, we see that poverty in the 'Accra unskilled' households is indeed reduced, from 1.43 percent down to 0.40 percent. However, although this is a reduction, it is not reduced to zero, due to the secondary and induced price effects. Furthermore, there are spillover effects on to the poverty ratios of some other groups: 'Savannah farm' households, the group in which there is a highest incidence of poverty, the ratio drops slightly from 90.16 to 90.02 per cent. The foot of Table 3 (panel A) shows that the value of P_0 for Ghana as a whole also reduces slightly from 32.99 to 32.78 per cent.

Overall, the effects of poverty targeting on the 'Accra unskilled' group are very slight, predominantly because the initial relative poverty incidence is quite low. The same

[10] The assumed increase in tax rates was not uniform for companies: for illustrative purposes the tax rate on financial companies was increased by 50%, while non-financial companies the increase was almost 20%, as on households, as a proportion of base rates.

experiment applied to targeting those household groups with much higher poverty incidence leads to much more dramatic effects. Consider for example the effect of targeting 'Savannah farm' households. The poverty-alleviating transfer payment is very high: Table 3 shows this to be 861.594 billion cedis. Under the revenue-raising rule as above we note from Table 4.1 that poverty is reduced dramatically for that group (reducing from 90.16 to 1.92 per cent), although again poverty is not eliminated, and that there are again some spillover effects in terms of changes in poverty ratios for other groups. We note some slight reduction in the poverty ratios for the other 'poor' groups, and some slight increase in the poverty ratios for the five groups which are engaged in financing the transfers. Even for this group the spillovers are relatively slight, much smaller in fact than the spillovers recorded by Chia *et al* (1992) in their model for the Cote d'Ivoire. Some reasons for this are already clear: the CGE model is not identical either in specification nor (obviously) in parameterisation. But more significantly, Chia *et al* placed much of their explanation for large spillover effects on the existence of inter-household income transfers. However in the present case, our estimated transfers for Ghana are very small, and this may well have played a big part in reducing the spillover effects in the poverty analysis.

Table 4.1 (panel B) shows equivalent results for the same experiment (same closures, same financing rule) but where transfers are made as consumption rather than income transfers. In the case of the four groups with high initial poverty ratios the resulting reduction in poverty is higher than in the case of income transfers (panel A). But in the case of transfers to the 'Accra unskilled' household group the reduction is just slightly less, indicating that the secondary income and price effects in the CGE are not predictable.

Experiment 2: Structuralist closure: transfers financed through taxes on domestic products

Table 4.2 shows the results of a similar set of experiments, whereby the same income (and consumption) transfers are carried out, but are now financed by an increase in commodity taxes on domestically-produced goods. Even though it might be better to introduce explicitly a pro-poor policy, and to tax luxury goods more intensively than necessities, possibly not taxing public services at all, we have decided not to differentiate between the products and the extra tax is applied 'across the board'. The results of the experiment in Table 4.2 may be interpreted in exactly the same way as in Table 4.1. Here we note that while there is some variation in the effects on poverty profiles, in most cases the reduction in poverty ratios is not as great as under the income tax revenue-raising scheme – and this applies to both the income

and consumption transfer schemes. The spillover effects are now more substantial. For example, in all cases the poverty ratios rise for all groups other than the household group being targeted. Furthermore, in the case where transfers are made to 'Accra-unskilled' households the overall poverty ratio for Ghana as a whole actually rises in comparison with the benchmark case, due mainly to adverse effects on poverty in rural areas. There is a similar outcome when consumption rather than income transfers are applied.

[Table 4.2 here]

Experiment 3: Structuralist closure: transfers financed through import taxes

In Table 4.3 we show the results under the third alternative financing regime, where the transfers are financed by an increase in import duties. In the case of income transfers (Table 4.3: panel A) although the direct poverty-reducing effects on the targeted household group are again strong, the reduction is not as high as under the other two financing regimes:. The 'Savannah-farm' households poverty ratio reduces to 4.75 per cent as opposed to 1.92 per cent (income tax) and 2.64 (domestic commodity tax). But interestingly, some of the spillover effects to other household groups reduce by more. For example, again in the case of targeting 'Savannah-farm' households the poverty ratio for 'Forest-farm' households reduce to 55.09 per cent, which is lower than the equivalent ratio under either of the other two financing schemes.

[Table 4.3 here]

Experiments with the long-run (input-output) closure

We now consider the results of three replicate experiments to those considered above with the model run now being under a long-run (input-output) closure. Clearly, a more accurate description of the model closure is to relate it to the class of fixed price 'SAM-multipliers', on the grounds that the factor, household, and corporate sector accounts are all endogenous and that outlays in the remaining accounts respond only to exogenous changes. The outlays of government (and the relevant tax parameters) are the exogenous impacts, but in other respects the CGE model operates as a fixed price multiplier model. Tables 5.1, 5.2 and 5.3 set out comparable results to those already shown in Tables 4.1, 4.2 and 4.3.

[Tables 5.1, 5.2 and 5.3 here]

First we may consider the poverty ratios in Table 5.1, in relation to the experiment in which the revenue to finance the transfers is derived from adjustments to the (direct) income tax rates of households and corporations. Again, there are direct reductions in poverty ratios of the targeted households, but as expected, the indirect multiplier effects mean that these ratios are not reduced to zero. They are generally closer to zero under consumption transfers than for income transfers, but are still not reduced to zero. This confirms that there are some indirect effects which not only spillover on to other household groups but may feed back on to the household group being targeted. What is noteworthy, however, is the marked general reduction in these poverty ratios as compared with Table 4.1, which represents the equivalent results under the structuralist (but flexible price) closure. For example, looking at the columns for 'Savannah-farm' households when consumption transfers are involved (panel B), and we consider the poverty ratios for, say, 'Forest-farm' households, in Table 4.1 the ratio is 53.86 whereas in Table 5.1 it is 46.99 per cent which represents a significantly larger effect.

In part we may attribute the larger effect in the fixed price case to the (by now) standard result that fixed price models tend to overestimate the multiplier effects, by not taking sufficient account of supply-side constraints. Now consider the outcome with the financing rule based on increased domestic product taxes. The differences between the poverty ratios in the two cases is such that those in Table 5.2 are not consistently lower than those in Table 4.2. Indeed, in the case of targeting 'Savannah farm' households, the poverty ratios are higher in the fixed price case. And even the poverty ratios for the targeted household are not generally lower in the fixed price case. Clearly, one has to be cautious in making too strong an assertion about the direction of effect of varying the closure, and in particular what might happen in the long run as compared with the short run.

A comparison between Tables 4.3 and 5.3 further underlines how very different in magnitude the results in terms of the effects on poverty ratios may be under the two alternative closures. A comparison between the results for the income tax and domestic product tax financing regimes might suggest that the poverty ratios are fairly robust. However, again referring to the case where 'Savannah-farm' households are targeted, but now under an import duty financing regime, we see that in the input-output closure the simulated reductions in poverty are considerably larger than in the case of the structuralist closure. In particular, the poverty ratio for 'Forest-farm' households (income transfer) is reduced from 55.09 to 40.60 per cent,

and for consumption transfers the reduction in poverty is even greater – 53.09 down to 34.20 per cent.

5. Conclusions

This paper set out with dual objectives: first, to examine the possible consequences of a range of poverty-alleviating income and/or consumption transfers on the economy of Ghana. The present exercise has been effected through the use of a previously-estimated SAM for Ghana, for the year 1993, which falls well within the reform era for the country, together with a simple SAM-based CGE model. The second objective was to explore the effects (sensitivity) of the results to alternative representations of closures, in response to the recent criticisms of De Maio, Stewart and van der Hoeven (1999) about a growing indiscriminate use of CGE modelling for policy analysis in developing countries. In particular, we have examined a benchmark specification which is an attempt to characterise an economy with some structuralist features, especially in respect of the way the labour market responds to perturbations. But we have attempted to compare this with the sorts of results we might have obtained in a fixed-price (input-output) model: the fixed-price specification is very close to the sorts of outcomes that might have been obtained in a fixed-price SAM-based multiplier analysis. Not surprisingly, the results (in terms of the outcomes on headcount poverty ratios) are different. Just how different might be an area of some debate. Certainly, the broad criticisms put forward by De Maio, *et al*, are justified in one sense – the results *are* sensitive, at least to a degree – but the modelling approach adopted here underlines the possibility of substantial spillovers (and feedback effects) in terms of the targeted groups. The paper represents a first stage examination of the usefulness of such policy modelling for the Ghana economy.

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Table 1: Poverty profiles in the model

Household groups	Number of individuals	Total consumption	Per capita consumption	μ	σ^2	High z		Low z	
						Poverty ratio	Contribution to national poverty	Poverty ratio	Contribution to national poverty
		billion. cedis	thous. cedis			%	%	%	%
Rural Farmer Head Savannah	2728753	98.26	36.01	3.412	0.343	99.33	33.87	90.16	48.79
Rural Farmer Head Forest	2919500	209.51	71.76	4.072	0.403	89.32	32.58	56.02	32.43
Rural Farmer Head Coast	1168915	116.51	99.67	4.426	0.352	76.85	11.22	33.21	7.70
Rural Non Agr. Head Savannah	803056	327.12	407.34	5.846	0.327	4.24	0.43	0.17	0.03
Rural Non Agr. Head Forest	1603251	169.18	105.52	4.449	0.420	73.77	14.78	33.26	10.57
Rural Non Agr. Head Coast	991167	301.76	304.44	5.587	0.263	7.87	0.97	0.28	0.06
Other Urban Unskilled	2743123	663.56	241.90	5.385	0.206	12.42	4.26	0.37	0.20
Other Urban Skilled	1074731	646.46	601.50	6.242	0.315	0.69	0.09	0.01	0.00
Accra Skilled Head	489385	235.43	481.07	6.011	0.330	2.28	0.14	0.07	0.01
Accra Unskilled Head	765519	194.88	254.57	5.385	0.309	17.32	1.66	1.43	0.22
Ghana	**15287400**	**2962.67**	**193.80**			**52.35**	**100.00**	**32.99**	**100.00**
Rural	10214642	1222.34	119.665			73.54	93.85	49.16	99.57
Urban	5072758	1740.33	343.074			9.70	6.15	0.42	0.43

High z poverty line=129.199 Low z poverty line=64.599

Source: Ghana Statistical Service (1995) *Ghana Living Standards Survey: Report on the Third Round 1991-92*, Accra, Ghana.

Table 2: Two-way trade and the elasticity values assumed in the model

Products	*Total**	*Exports (X)*	*Imports (M)*	*X Share (%)*	*M Share (%)*	*Intra-Trade (%)*	σ	η
Agriculture Foresty & Fisheries Products	2013.75	224.92	91.9	11.2	4.6	6.6	2.5	4.0
Ores Minerals Electricity Gas & Water	528.24	308.98	79.0	58.5	15.0	43.5	0.8	1.8
Food Beverages Textile Apparel & Leather	834.47	3.30	215.1	0.4	25.8	-25.4	2.0	2.5
Other Non Metal Transportable Goods	601.15	110.53	148.8	18.4	24.8	-6.4	1.5	2.3
Metal Products & Machinery	768.84	38.22	709.7	5.0	92.3	-87.3	0.6	1.4
Business Services	423.42	0.00	196.0	0.0	46.3	-46.3	0.4	
Community Social & Personal Services	758.03	7.33	0.0	1.0	0.0	1.0		1.2

* Totals = domestic production plus imports

Table 3. Total transfers for universal (imperfect) targeting

Household groups	Number of individuals	Benchmark poverty ratio (P_0)	Total universal transfers	New poor poverty ratio (P_0)	Universal transfer pc (*ln* adjusted)	Tot universal transfers (*ln* adjusted)
		%	billion cedis	%	thousand cedis	billion cedis
Rural Farmer Head Savannah	2728753	90.2	176.276	32.2	315.746	861.594
Rural Farmer Head Forest	2919500	56.0	188.598	19.5	339.540	991.287
Rural Farmer Head Coast	1168915	33.2	75.511	10.1	260.649	304.677
Rural Non Agr. Head Savannah	803056	0.2	51.877	0.1		
Rural Non Agr. Head Forest	1603251	33.3	103.569	12.1	324.537	520.315
Rural Non Agr. Head Coast	991167	0.3	64.029	0.1		
Other Urban Unskilled	2743123	0.4	177.204	0.1		
Other Urban Skilled	1074731	0.0	69.427	0.0		
Accra Skilled Head	489385	0.1	31.614	0.0		
Accra Unskilled Head	765519	1.4	49.452	0.5	65.573	50.197
Ghana	15287400	32.99	987.557		178.452	2728.069
Rural	10214642	49.16	659.860		262.160	2677.872
Urban	5072758	0.42	327.697		9.895	50.197

Table 4.1. Experiment 1: Income tax - poverty indices (%) (P_0)
(Structuralist closure)

A. Income transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	1.92	89.01	90.00	89.76	90.02	90.16
Forest farm	55.52	0.80	55.41	55.21	55.65	56.02
Coast farm	32.99	31.57	0.58	32.23	32.87	33.21
Savannah non agr.	0.62	0.59	0.26	0.37	0.17	0.17
Forest non agr.	33.16	31.92	32.84	0.73	32.95	33.26
Coast non agr.	1.00	0.97	0.44	0.60	0.28	0.28
Urban unskilled	0.97	0.87	0.50	0.64	0.36	0.37
Urban skilled	0.14	0.15	0.03	0.06	0.01	0.01
Accra skilled	0.28	0.32	0.11	0.15	0.07	0.07
Accra unskilled	1.36	1.14	1.35	1.32	0.40	1.43
Ghana	**17.30**	**22.13**	**30.34**	**29.35**	**32.78**	**32.99**
Rural	25.51	32.77	45.16	43.65	48.93	49.16
Urban	0.79	0.70	0.49	0.57	0.26	0.42

B. Consumption transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	0.67	89.76	89.97	89.61	90.04	90.16
Forest farm	53.86	0.69	55.32	54.78	55.71	56.02
Coast farm	31.74	31.49	0.50	31.86	32.92	33.21
Savannah non agr.	0.52	0.57	0.26	0.35	0.17	0.17
Forest non agr.	31.96	31.70	32.77	0.52	32.99	33.26
Coast non agr.	0.85	0.95	0.43	0.58	0.29	0.28
Urban unskilled	0.80	0.83	0.49	0.60	0.36	0.37
Urban skilled	0.12	0.15	0.03	0.05	0.01	0.01
Accra skilled	0.26	0.32	0.11	0.15	0.07	0.07
Accra unskilled	1.17	1.10	1.34	1.27	0.46	1.43
Ghana	**16.48**	**22.20**	**30.30**	**29.19**	**32.81**	**32.99**
Rural	24.34	32.89	45.11	43.41	48.96	49.16
Urban	0.66	0.68	0.48	0.54	0.27	0.42

Table 4.2. Experiment 2: Indirect domestic tax - poverty indices (%) (P_0) (Stucturalist closure)

A. Income transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	2.64	93.55	91.53	92.28	90.33	90.16
Forest farm	66.33	1.21	59.34	61.81	56.48	56.02
Coast farm	43.19	43.10	0.68	38.21	33.58	33.21
Savannah non agr.	0.44	0.41	0.23	0.29	0.17	0.17
Forest non agr.	41.68	41.61	35.76	0.91	33.55	33.26
Coast non agr.	0.70	0.65	0.38	0.47	0.30	0.28
Urban unskilled	1.04	0.94	0.51	0.65	0.38	0.37
Urban skilled	0.03	0.03	0.02	0.02	0.01	0.01
Accra skilled	0.14	0.14	0.08	0.09	0.07	0.07
Accra unskilled	2.73	2.56	1.74	2.02	0.42	1.43
Ghana	**21.21**	**24.95**	**31.69**	**31.56**	**33.12**	**32.99**
Rural	31.25	36.89	47.16	46.90	49.43	49.16
Urban	0.99	0.91	0.55	0.67	0.28	0.42

B. Consumption transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	0.95	94.10	91.50	92.16	90.35	90.16
Forest farm	64.70	1.05	59.25	61.37	56.54	56.02
Coast farm	41.74	43.02	0.60	37.80	33.63	33.21
Savannah non agr.	0.37	0.39	0.22	0.28	0.18	0.17
Forest non agr.	40.33	41.36	35.69	0.65	33.60	33.26
Coast non agr.	0.59	0.63	0.37	0.45	0.30	0.28
Urban unskilled	0.84	0.90	0.50	0.62	0.39	0.37
Urban skilled	0.03	0.03	0.02	0.02	0.01	0.01
Accra skilled	0.13	0.14	0.08	0.09	0.07	0.07
Accra unskilled	2.37	2.50	1.73	1.94	0.48	1.43
Ghana	**20.28**	**24.98**	**31.65**	**31.39**	**33.14**	**32.99**
Rural	29.94	36.95	47.10	46.65	49.46	49.16
Urban	0.83	0.88	0.54	0.64	0.29	0.42

Table 4.3. Experiment 3: Import tax - poverty indices (%) (P_0)
(Structuralist closure)

A. Income transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	4.75	90.35	90.56	90.66	90.18	90.16
Forest farm	55.09	2.09	55.32	54.97	55.84	56.02
Coast farm	34.19	32.30	0.83	33.16	33.14	33.21
Savannah non agr.	0.13	0.10	0.15	0.14	0.16	0.17
Forest non agr.	34.36	32.60	33.42	1.23	33.20	33.26
Coast non agr.	0.26	0.19	0.26	0.25	0.28	0.28
Urban unskilled	0.33	0.23	0.34	0.32	0.36	0.37
Urban skilled	0.01	0.01	0.01	0.01	0.01	0.01
Accra skilled	0.08	0.08	0.07	0.07	0.07	0.07
Accra unskilled	1.29	1.01	1.33	1.28	0.41	1.43
Ghana	**17.74**	**22.53**	**30.45**	**29.49**	**32.89**	**32.99**
Rural	26.35	33.57	45.38	43.95	49.09	49.16
Urban	0.38	0.28	0.39	0.38	0.27	0.42

B. Consumption transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	2.05	90.82	90.53	90.51	90.20	90.16
Forest farm	53.05	1.87	55.22	54.48	55.90	56.02
Coast farm	32.56	32.12	0.73	32.73	33.18	33.21
Savannah non agr.	0.11	0.09	0.15	0.13	0.16	0.17
Forest non agr.	32.77	32.31	33.35	0.91	33.25	33.26
Coast non agr.	0.20	0.18	0.26	0.24	0.28	0.28
Urban unskilled	0.25	0.22	0.33	0.30	0.36	0.37
Urban skilled	0.01	0.01	0.01	0.01	0.01	0.01
Accra skilled	0.07	0.07	0.07	0.07	0.07	0.07
Accra unskilled	1.07	0.98	1.32	1.22	0.47	1.43
Ghana	**16.54**	**22.52**	**30.41**	**29.30**	**32.92**	**32.99**
Rural	24.61	33.57	45.32	43.67	49.13	49.16
Urban	0.30	0.27	0.39	0.36	0.28	0.42

Table 5.1. Experiment 4: Income tax - poverty indices (%) (P_0)
(Input-output closure)

A. Income transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	1.73	84.72	89.10	88.76	89.54	90.16
Forest farm	53.48	0.49	53.39	52.98	54.55	56.02
Coast farm	31.20	24.83	0.51	30.32	31.90	33.21
Savannah non agr.	0.52	0.31	0.22	0.31	0.15	0.17
Forest non agr.	31.59	25.97	31.30	0.65	32.10	33.26
Coast non agr.	0.85	0.50	0.36	0.50	0.26	0.28
Urban unskilled	0.81	0.41	0.41	0.51	0.32	0.37
Urban skilled	0.12	0.07	0.02	0.05	0.01	0.01
Accra skilled	0.25	0.19	0.10	0.13	0.06	0.07
Accra unskilled	1.19	0.65	1.18	1.14	0.37	1.43
Ghana	**16.52**	**20.00**	**29.59**	**28.55**	**32.31**	**32.99**
Rural	24.40	29.76	44.09	42.50	48.24	49.16
Urban	0.66	0.35	0.41	0.47	0.24	0.42

B. Consumption transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	0.44	85.16	88.95	88.00	89.64	90.16
Forest farm	46.99	0.40	53.02	51.29	54.77	56.02
Coast farm	25.99	24.09	0.44	28.91	32.10	33.21
Savannah non agr.	0.29	0.27	0.21	0.26	0.15	0.17
Forest non agr.	26.90	25.17	31.02	0.43	32.27	33.26
Coast non agr.	0.49	0.45	0.35	0.43	0.26	0.28
Urban unskilled	0.42	0.36	0.39	0.43	0.33	0.37
Urban skilled	0.06	0.06	0.02	0.04	0.01	0.01
Accra skilled	0.16	0.17	0.09	0.12	0.06	0.07
Accra unskilled	0.73	0.60	1.15	1.00	0.43	1.43
Ghana	**14.03**	**19.91**	**29.46**	**27.93**	**32.41**	**32.99**
Rural	20.82	29.64	43.89	41.61	48.38	49.16
Urban	0.36	0.31	0.40	0.40	0.25	0.42

Table 5.2. Experiment 5: Indirect domestic tax - poverty indices (%) (P_0) (Input-output closure)

A. Income transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	3.23	93.29	91.55	92.69	90.27	90.16
Forest farm	69.70	1.15	59.39	62.89	56.32	56.02
Coast farm	46.83	42.36	0.69	39.31	33.44	33.21
Savannah non agr.	0.60	0.38	0.23	0.32	0.17	0.17
Forest non agr.	44.83	40.99	35.81	0.97	33.43	33.26
Coast non agr.	0.95	0.62	0.38	0.51	0.29	0.28
Urban unskilled	1.44	0.88	0.51	0.73	0.38	0.37
Urban skilled	0.05	0.03	0.02	0.02	0.01	0.01
Accra skilled	0.18	0.14	0.08	0.10	0.07	0.07
Accra unskilled	3.37	2.45	1.74	2.16	0.42	1.43
Ghana	**22.70**	**24.76**	**31.71**	**31.96**	**33.05**	**32.99**
Rural	33.32	36.62	47.18	47.46	49.33	49.16
Urban	1.31	0.87	0.55	0.73	0.28	0.42

B. Consumption transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	0.91	93.63	91.43	92.16	90.35	90.16
Forest farm	64.13	0.96	59.04	61.33	56.54	56.02
Coast farm	41.19	41.54	0.59	37.80	33.64	33.21
Savannah non agr.	0.35	0.35	0.22	0.28	0.18	0.17
Forest non agr.	39.86	40.10	35.53	0.65	33.61	33.26
Coast non agr.	0.56	0.56	0.37	0.45	0.30	0.28
Urban unskilled	0.80	0.79	0.49	0.62	0.39	0.37
Urban skilled	0.03	0.03	0.02	0.02	0.01	0.01
Accra skilled	0.12	0.13	0.08	0.09	0.07	0.07
Accra unskilled	2.29	2.29	1.70	1.94	0.48	1.43
Ghana	**20.06**	**24.59**	**31.58**	**31.38**	**33.15**	**32.99**
Rural	29.63	36.41	47.00	46.64	49.46	49.16
Urban	0.80	0.79	0.54	0.64	0.29	0.42

Table 5.3. Experiment 6: Import tax - poverty indices (%) (P_0)
(Input-output closure)

A. Income transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	2.12	77.22	86.83	85.00	89.49	90.16
Forest farm	40.60	0.50	47.47	43.73	54.25	56.02
Coast farm	22.01	15.91	0.51	23.74	31.74	33.21
Savannah non agr.	0.03	0.01	0.07	0.05	0.14	0.17
Forest non agr.	23.60	17.93	27.53	0.67	31.98	33.26
Coast non agr.	0.06	0.02	0.13	0.09	0.24	0.28
Urban unskilled	0.07	0.02	0.15	0.10	0.31	0.37
Urban skilled	0.00	0.00	0.00	0.00	0.01	0.01
Accra skilled	0.03	0.01	0.04	0.03	0.06	0.07
Accra unskilled	0.48	0.22	0.79	0.60	0.37	1.43
Ghana	**12.33**	**16.99**	**27.57**	**25.47**	**32.21**	**32.99**
Rural	18.40	25.41	41.16	38.04	48.10	49.16
Urban	0.11	0.05	0.20	0.15	0.23	0.42

B. Consumption transfers

	Sf	Ff	Cf	Fna	Ausk	Base Case
Savannah farm	0.57	77.40	86.65	84.03	89.58	90.16
Forest farm	34.20	0.41	47.10	42.03	54.48	56.02
Coast farm	17.45	15.27	0.44	22.44	31.93	33.21
Savannah non agr.	0.02	0.01	0.07	0.04	0.14	0.17
Forest non agr.	19.31	17.23	27.26	0.45	32.16	33.26
Coast non agr.	0.03	0.02	0.12	0.07	0.25	0.28
Urban unskilled	0.03	0.02	0.14	0.08	0.31	0.37
Urban skilled	0.00	0.00	0.00	0.00	0.01	0.01
Accra skilled	0.02	0.01	0.04	0.03	0.06	0.07
Accra unskilled	0.27	0.20	0.77	0.52	0.43	1.43
Ghana	**10.02**	**16.89**	**27.43**	**24.84**	**32.31**	**32.99**
Rural	14.96	25.25	40.96	37.11	48.24	49.16
Urban	0.06	0.04	0.20	0.12	0.24	0.42

Appendix 1: A Social Accounting Matrix for Ghana, 1993

Consolidated SAM framework

The consolidated SAM (shown in Table A1) has six principal blocks of accounts together with some significant disaggregation in four of the blocks. It is a variant of the two existing versions of the Ghana SAM: the 'Full SAM' and the 'Mini SAM'. The compilation details of the Full and Mini SAM versions of the Ghana SAM (the base versions) have been set out and discussed previously in Powell and Round (1996). A comparison of the dimensions of the two base SAMs and the consolidated SAM compiled for this study is shown in Table A2 and some of the features and differences between the variants are highlighted below.

In accordance with the 1993 SNA guidelines, at the compilation stage of the base versions of the SAM, the institutions current accounts were subdivided into three separate accounts: the primary income distribution, the secondary income distribution and the use of income. Apart from providing useful information on the processes of income distribution and redistribution the separation of these accounts does allow the different types of transfers[11] to be more easily distinguished and hence estimated. One major difference between the base SAMs and the consolidated SAM is therefore that the three sets of current accounts for institutions have been combined into one single set of accounts. Once the estimation of the transfers is complete one consolidated income account for institutions is all we need for modelling purposes.

Table A1 shows that the production *activity accounts* are represented at two levels of aggregation. At the first level there are just three sectors: agriculture, industry and services, while at the more detailed level there are 12 activities. The mapping between the output of these activities and the supply of *products* is asymmetric (i.e. the mapping through the 'make' matrix is not square). However this accords with the 1993 SNA guidelines: 10 products are distinguished, including one which represents the trade service margins in delivering goods at market prices. Alongside these are the 12 activity accounts. The *factor accounts* (which are referred to as 'generation of income' accounts in the SNA terminology) include nine accounts and cover three broad categories: employee compensation, operating surplus and mixed income, plus an account recording the indirect taxes on production. Employee compensation and mixed income are further distinguished by the gender and skill (defined according to the level of education attained) of the employee, employer or own account worker. Operating surplus is identified as a return to the capital employed in corporate or quasi-corporate enterprises and is aggregated in the Consolidated SAM into a single account. By contrast, the equivalent income arising in unincorporated (i.e. household sector) enterprises is often indistinguishable from employee compensation and for this reason it is termed 'mixed income' in accordance with the 1993 SNA terminology. Most of this represents ‘informal’ activity in the broadest sense of the term. Thus the estimates shown in the SAM in Table A1 confirm our expectation that the informal sector contributes a significant proportion of the domestic product of Ghana.

The *institution current accounts* (the ‘distribution and use of income’ accounts) are subdivided into broad institutional sectors according to standard international statistical

[11] In the matrix for property income are registered the transactions for rent, interests, dividends and other property income. The current transfer matrix shows taxes on income, social contributions and benefits in income kind, and other miscellaneous transfers. The capital transfer matrix consists of intersectoral transfers.

conventions, and these comprise households, corporate enterprises (both financial and non-financial), government, and non-profit institutions serving households ('NPISH', which include private schools, clinics, etc). The household sector is further disaggregated into Accra, other-urban, and rural household categories, with further subdivisions according to the occupational status of the household head and region (in rural areas only) and skill level (also in rural areas only). In the Full SAM the household sector is disaggregated into a total of 14 household groups, so that the characteristics of households in each group are relatively homogeneous. Therefore, the pattern of consumption and income distribution in Ghana is likely to be adequately captured in respect of these broad socio-economic groups. However, due to the lack of information in the available household survey data, some consolidation and further assumptions have had to be made to the basic framework in arriving at the consolidated SAM. In most cases this has resulted in simply aggregating some accounts.

Finally, there are other aggregations of the more detailed accounts in the Full SAM. Thus, although the asset and financial characteristics of households are likely to be a contributing factor to poverty determination, our modelling efforts take no account of asset accumulation or financial issues, hence the *capital accounts* are simply consolidated into a single account. Similarly, there is just one *external transaction* account. However we require more detail on different kinds of indirect direct taxes than is shown in Table A1 because of their importance in our policy simulations.

Some compilation aspects

The Full SAM was the principal starting point for developing the consolidated SAM, although more detailed estimates were required on taxes and some inter-institutional transfers for modelling purposes. This note explains how some of the estimates were obtained.

As regard *taxes on production*, the base SAMs only distinguish between taxes on products and other taxes on production. However, the Integrated Economic Accounts (IEA) (Powell and Round, 1996) provides us with additional information. This source gives us the total government revenues from indirect taxes on domestic products, import duties and export taxes, respectively. On the basis of certain assumptions, it is therefore possible to break down taxes on products into three separate categories. Table A3 helps to explain the procedure followed. Panel A of the table shows quantities of imported, exported and domestically produced commodities to which indirect taxes have been applied as recorded in the original SAM. The row account for taxes refers to the values reported in the SAM, whilst the column account indicates the figures provided by the IEA. It can be seen that product 7 is neither imported nor exported and therefore the tax of 1.4 billion cedis can be attributed entirely to it. If we then assume that export taxes are imposed only on agricultural products[12], it is possible to follow a RAS methodology and spread import duties and indirect taxes on domestic products among the individual products.

The first step, therefore, consisted of determining a new submatrix (Panel B) which does not include exports and product 7. A simplifying assumption is then made in order to estimate the tax rates on imported and domestic commodities. More precisely, a tax rate is initially calculated for each domestic product which would generate an amount of revenue equal to

[12] This assumption is not unreasonable. In fact, estimates of export taxes based on data from *Quarterly Digest Statistics 1991*, show that cocoa taxes account for the bulk of export taxes. Moreover, the average export tax rate for both the total and non-cocoa exports has declined since 1983, and in 1988-1989 no export taxes were recorded for products other that cocoa.

that recorded in the IEA. The same procedure is then applied to imports (Panel C). Although this initial guess does not lead to balanced and consistent results, starting from the initial guesses, it is possible to obtain a balanced matrix of taxes (Panel D), with product-specific rates, through an iterative (RAS) procedure.

Finally, it is worth mentioning another assumption that has been imposed on the original data in order to obtain a consistent SAM. This is due to the fact that, in expanding the Mini SAM to produce the Full SAM, not all the transactions relative to the household accounts have been broken down into corresponding transactions for the different household groups. In other words, although the Full SAM should show all the transactions for each household group, some of them were only recorded at an aggregate level. In fact savings, shown as capital transfers to financial institutions and transfers to and from abroad, are only shown for households as a whole and not for individual household groups. However, if two of these sets of transfers are distributed among households according to well-defined allocation rules, then the others two can be obtained as residuals.

Table A.1 Consolidated Ghana SAM: 1993 (billions cedis)

					PRODUCTS										ACTIVITIES											
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	P		Agriculture Forestry & Fisheries Products	1											6.77	235.30	0.00	0.00	0.00	142.86	0.00	0.00	0.00	0.00	0.00	0.00
	R		Ores, Minerals, Electricity, Gas & Water	2											0.43	0.00	0.51	0.00	10.66	46.86	23.70	14.41	56.72	3.57	3.02	1.01
	O		Food,Beverages,Textile,Apparel & Leather	3											0.00	0.00	0.00	0.00	1.08	221.53	0.00	0.00	0.00	0.00	0.00	0.00
	D		Other Non Metal Transportable Goods	4											13.02	16.97	9.83	53.22	37.47	50.30	8.89	68.29	16.02	159.59	8.42	64.13
	U		Metal Products and Machinery	5											5.22	2.64	14.14	0.00	29.34	49.79	6.08	37.60	0.00	12.18	3.40	0.00
	C		Construction Work	6											1.12	0.00	0.00	0.00	0.00	5.31	3.19	0.00	0.00	0.58	7.20	0.00
	T		Trade Services	7	196.29	6.66	64.41	94.83	75.41		-437.60				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00
	S		Transport Storage & Communication Services	8											24.41	58.84	8.35	2.87	1.34	13.22	0.00	15.51	130.00	2.14	3.98	32.89
			Business Services	9											3.83	17.85	10.70	10.16	15.21	22.06	0.54	9.78	10.32	38.57	42.35	144.09
			Community Social and Personal Services	10											0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.71	0.00
		Agri-	Cocoa	11	126.89																					
	A	culture	Agriculture & Livestock	12	1331.21		4.19																			
C	C		Forestry and Logging	13	151.19																					
U	T		Fishing	14	286.44																					
R	I		Mining and Quarrying	15		306.47																				
R	V	Industry	Manufacturing	16	5.62	0.33	529.70	326.35	53.16																	
E	I		Electricity and Water	17		142.03																				
N	T		Construction	18						432.43																
T	I		Wholesale,Retail,Hotels & Restaurants	19							437.80															
	E	Services	Transport, Storage & Communication	20								383.99														
			Financial, Real Estate & Business Services	21									227.47													
			Government services	22		0.37								758.03												
			Comp of Employees Skilled Male	23											8.62	25.42	6.33	4.49	28.99	33.41	9.99	11.16	3.65	38.23	43.72	151.22
			Comp of Employees Unskilled Male	24											24.89	73.41	9.78	27.71	57.94	21.79	9.92	13.01	4.62	33.22	24.39	99.87
		Generation	Comp of Employees Skilled Female	25											1.35	3.97	0.00	0.00	0.00	2.37	7.65	0.66	0.70	1.82	6.29	65.83
A			Comp of Employees Unskilled Female	26											4.19	12.37	0.42	0.00	3.99	4.40	3.91	0.70	3.78	4.43	9.17	51.15
C		of	Mixed Income (Gross) Skilled Male	27											3.46	111.33	57.12	39.79	1.29	23.56	0.00	75.71	12.04	29.52	3.76	22.33
C			Mixed Income (Gross) Unskilled Male	28											15.68	505.42	7.79	125.33	11.54	18.20	0.00	127.84	16.49	24.74	6.90	14.57
O		Income	Mixed Income (Gross) Skilled Female	29											0.11	3.49	0.00	0.00	1.10	11.22	0.00	0.00	19.63	0.00	1.18	3.22
U			Mixed Income (Gross) Unskilled Female	30											5.72	184.19	0.00	1.54	1.28	78.88	0.00	2.00	141.52	0.32	4.33	14.42
N			Operating Surplus (Gross)	31											8.08	84.19	24.78	21.34	105.25	164.20	68.16	54.54	21.08	32.25	58.65	93.88
T			Household Rural Farmer Head Savannah	32																						
S			Household Rural Farmer Head Forest	33																						
		Primary	Household Rural Farmer Head Coast	34																						
			Household Rural Non Agric. Head Savannah	35																						
		and	Household Rural Non Agric. Head Forest	36																						
			Household Rural Non Agric. Head Coast	37																						
		Secondary	Household Urban Unskilled	38																						
			Household Urban Skilled	39																						
		Distribution	Household Accra Skilled Head	40																						
			Household Accra Unskilled Head	41																						
		of	Non Financial Corporations	42																						
			Financial Corporations	43																						
		Income	Government	44																						
			Non Profit Institutions Serving Households	45																						
			Indirect taxes on production	46											0.00	0.00	1.44	0.00	0.00	5.20	0.00	1.23	1.24	1.51	0.00	-0.21
			Indirect domestic taxes	47	20.48		85.44	125.97	6.00		1.44															
		Taxes	Taxes on exports	48	34.09																					
			Taxes on imports	49	0.97		29.30	41.00	70.99																	
			Taxes on income	50																						
SAVINGS				51																						
REST OF THE WORLD (Current account)				52	90.95	79.04	185.84	107.83	638.69				195.95													
TOTAL				53	2244.13	534.90	898.88	695.98	844.25	432.43	1.64	383.99	423.42	758.03	126.89	1335.40	151.19	286.44	306.47	915.16	142.03	432.43	437.80	383.99	227.47	758.40

	FACTORS									INSTITUTIONS													TAXES					INV	ROW
	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
1										61.17	146.14	67.01	216.97	87.94	174.46	372.97	467.16	105.31	100.03			0.00	0.00						-164.88	224.92
2										1.76	4.15	2.25	7.67	2.25	4.23	13.33	11.84	2.14	3.01			0.00	0.00						12.40	308.98
3										17.12	34.80	21.14	60.75	22.85	41.59	137.98	81.12	37.84	32.49			0.00	0.00						185.29	3.30
4										7.64	8.28	11.67	24.16	14.58	24.03	70.81	41.98	14.99	10.33			0.00	0.00						-149.17	110.53
5										3.13	2.73	1.72	2.26	6.47	8.58	15.47	6.19	8.65	8.28			0.00	0.00						582.16	38.22
6										0.90	2.02	2.55	4.84	2.08	2.73	14.37	9.12	4.70	3.09			0.00	0.00						368.63	0.00
7										0.04	0.06	0.06	0.14	0.07	0.10	0.40	0.18	0.11	0.08			0.00	0.00							0.00
8										1.20	3.26	0.51	1.57	19.99	27.13	9.65	15.09	8.14	3.90			0.00	0.00							0.00
9										3.59	7.27	4.31	8.76	5.08	9.71	21.54	11.15	5.03	5.76			15.76	0.00							0.00
10										1.71	0.80	5.29	0.00	7.87	9.20	7.04	2.63	48.52	27.91			552.44	85.66							7.33
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32	49.27	0.00	8.07	2.49	43.21	0.00	2.88	14.34	6.71	1.77	0.92									1.46	0.38	2.05								4.72
33	2.06	62.10	1.04	17.85	0.07	58.34	1.04	58.82	13.14		0.04				0.52					0.95	0.29	1.31								3.02
34	40.86	0.31	2.27	0.08	45.69	0.90	4.93	14.15	7.30		0.08	3.38	0.25							0.79	0.24	1.10								2.51
35	0.00	43.91	0.45	2.68	0.61	91.19	0.95	80.53	19.25				2.42							1.44	0.39	1.99								4.56
36	45.98	2.26	10.72	6.33	79.21	0.14	8.29	14.39	11.34					3.32	0.99					1.82	0.54	2.51								5.77
37	2.80	83.09	4.33	12.92	0.14	86.63	1.43	49.49	15.30					0.08	1.34		0.08			1.37	0.57	1.89								4.35
38	71.70	89.10	7.14	19.29	114.37	322.36	3.51	100.27	60.06							8.96	0.28			2.87	0.92	3.97								9.10
39	21.68	58.48	3.06	9.49	40.32	276.92	2.41	51.41	41.23			0.41	0.06			1.47	3.34			5.26	1.33	7.27								16.66
40	130.10	0.73	48.96	5.38	56.29	0.00	13.89	12.05	9.14								2.64	2.42		1.61	0.55	2.23								5.11
41	0.78	60.57	4.60	22.00	0.00	38.02	0.61	38.75	8.60										0.08	0.03	0.07	0.04								0.08
42									386.81											17.68	-16.28	0.05	-40.50							0.00
43									55.74	1.01	0.65	0.54	0.99	1.25	0.94	1.96	3.61	1.10	0.02	2.16	20.28	126.58	2.08							10.13
44									94.26												66.74	99.55		10.41	239.33	34.09	142.26	205.46		147.61
45									7.52											0.00	0.00	0.00	38.26							47.70
46																														
47																														
48																														
49																														
50										9.85	6.30	5.25	9.53	12.05	9.08	19.01	34.82	10.67	0.18	24.76	63.79		0.17							
51										27.08	2.90	-1.41	-90.28	7.35	-49.11	118.35	-151.51	41.14	-20.95	285.56	89.23	220.97	7.81							347.30
52										0.30	0.19	0.16	0.29	0.37	0.28	0.59	1.08	0.33	0.01	0.00	0.00	0.00	0.00							
53	365.23	400.55	90.64	98.51	379.91	874.49	39.95	434.19	736.39	138.27	220.59	124.84	250.38	193.60	265.80	813.90	540.80	291.09	174.22	347.76	229.0	1039.71	93.48	10.41	239.33	34.09	142.26	205.46	834.43	1301.90

Table A2: Comparative Dimensions of the Ghana SAMs

Main account	Full SAM	Mini SAM	Consolidated SAM
Production	24	24	22
Factors	9	3	9
Indirect taxes	1	1	5
Institutions (current)	18	5	14
Combined capital	30	17	1
External	2	2	1
TOTAL	84	52	52

Table A3: Estimation of taxes on domestic products, imports and exports

A. Quantities

	Commodity 1	Commodity 3	Commodity 4	Commodity 5	Commodity 7	*TAXES*
Domestic	1923.2	533.7	326.4	53.2	437.8	*239.4*
Import	90.9	185.8	107.8	638.6	0	*142.3*
Export	224.9	3.4	110.5	38.2	0	*34.1*
TAXES	*55.5*	*114.7*	*167.1*	*77.1*	*1.4*	

B. Quantities

	Commodity 1	Commodity 3	Commodity 4	Commodity 5
Domestic	1923.2	533.7	326.4	53.2
Import	90.9	185.8	107.8	638.6
TAXES	*21.4*	*114.7*	*167.1*	*77.1*

C Initial tax rates assumed

	Commodity 1	Commodity 3	Commodity 4	Commodity 5
Domestic	0.0839	0.0839	0.0839	0.0839
Import	0.1391	0.1391	0.1391	0.1391

D Taxes

	Commodity 1	Commodity 3	Commodity 4	Commodity 5	Commodity 7	*TAXES*
Domestic	20.45	85.43	126.11	6.02	1.40	*239.4*
Import	0.95	29.27	40.99	71.08	0.00	*142.3*
Export	34.10	0.00	0.00	0.00	0	*34.1*
TAXES	*55.5*	*114.7*	*167.1*	*77.1*	*1.4*	

Appendix 2: Specification of the CGE model for Ghana

	Equations	Labels
1. Household commodity demand	$C_i = \sum_h a_{ih}^{C} Y_h$	*i* product *h* household group
2. Investment demand	$I_i = \bar{I}_i$	*i* product
3. Intermediate commodity demand	$W_i = \sum_j a_{ij} DA_j$	*i* product *j* activity
4. Export demand	$E_i = a_i^e \left(\frac{p_i^e}{pw_i^e . R} \right)^{h_i}$	*i* product
5. Government current expenditure	$G_i = \overline{G_i}$	*i* product
6. Value added	$V_j = a_j^v DA_j$	*j* activity
7. Factor demand (labour)	$L_l = \sum_j a_{lj} \frac{p_j^v V_j}{w_l}$	*j* activity *l* labour (type *l*)
8. Factor demand (capital)	$K_k = \sum_j a_{kj} \frac{p_j^v V_j}{w_k}$	*k* capital (type *k*)
9. Composite commodity demand	$Q_i = W_i + C_i + I_i + G_i + E_i$	*i* product
10. Make matrix	$DA_j = b_{ji} DC_i$	*i* product *j* activity
11. Composite commodity supply	$Q_i = a_i^q \left[d_i DC_i^{r_i} + (1 - d_i) M_i^{r_i} \right]^{1/r_i}$	*i* product
12. Import share	$\frac{M_i}{DC_i} = \left[\left(\frac{d_i}{1 - d_i} \right) \left(\frac{p_i^d}{p_i^m} \right) \right]^{s_i}$	*i* product
13. Price of imported goods	$p_i^m = pw_i^m (1 + t_i^m) . R$	*i* product
14. Price of exported goods	$p_i^e = p_i^d (1 + t_i^e)$	*i* product
15. Household income	$Y_h = b_{hl} w_l L_l + b_{hk} w_k K_k + T_h$	*h* household
16. Corporate enterprise income	$Y_c = b_{ck} w_k K_k + T_c$	*c* corporate enterprise
17. Government revenue	$Y_g = TX_g + \sum_{h,c} (t_h Y_h + t_c Y_c) + T_g + \sum_k b_{gk} w_k K_k$	*h* household *c* corporate enterprise *k* capital (type *k*)
18. Savings	$S = S_h + S_g + S_c + FSAV$	*h* household *c* corporate enterprise *g* government
19. Balance of payments	$\sum_i p_i^d E_i - \sum_i pw_i^m . R . M_i + T_r + FSAV = 0$	*i* product

Additional notation

DA_j	Domestic activity output (j)
DC_i	Domestic product output (i)
pw_i^e	world price of goods (i) in export markets
pw_i^m	world price of goods (i) in import markets
p_j^v	price of net output (activity j)
w_l	wage rate (type l)
w_k	capital rental rate
M_i	imports of goods (i)
T_h , T_c , T_g	transfers received by households (h), companies (c), government (g)
S_h , S_c , S_g	savings of households (h), companies (c), government (g)
TX_g	Indirect taxes received by government (domestic products, import duties, export taxes)
$FSAV$	foreign savings (Balance of Payments deficit)