# POVERTY REDUCTION STRATEGIES IN A BUDGET-CONSTRAINED ECONOMY: THE CASE OF GHANA

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**Abstract**

Analyses of responses to reforms in Ghana seem to indicate that current policies may be benefiting different segments of society disproportionately. Also, experience in the 1990s suggests that recurring budget deficits may adversely affect reform and poverty alleviation programmes. The aim of this paper is to carry out some experiments using variants of a stylised CGE model, to ascertain the possible effects on poverty of a range of budget-neutral redistributive income transfers. The analysis is based on a social accounting matrix (SAM) for Ghana for the year 1993, which has been substantially modified for the present application. The CGE model is a real-side, static model and therefore excludes the monetary and financial sectors and is designed in the tradition of other OECD Development Centre models. The experimental design follows one employed by Adelman and Robinson (1978) for Korea and Chia, Wahba and Whalley (1992) for the Côte d'Ivoire. However the experiments are designed with a view to examining the sensitivity of the results to alternative specifications, within otherwise broadly similar, SAM-based model structures. The main outcome is to show that the results are very sensitive to (long and short run) closure rules, to the financing rules in a budget-neutral setting, and to the method of computing poverty ratios (parametric and non-parametric approaches). A new decomposition method is introduced to assist in interpreting the results. A wide range of simulations demonstrates that poverty is not eradicated via redistributive income transfers, and may even increase, especially in the short run, after taking into account the secondary effects.

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

# 1 Introduction

Ghana has often been regarded as one of the success stories in the context of economic reform in sub-Saharan Africa. In terms of comparisons with the pre-reform era (i.e. pre-1983) the broad aggregate economic indicators are impressive, although the period since 1992 has again witnessed some setbacks, not least in terms of recurring budget deficits. In terms of impact on the well-being of the population and on poverty and inequality in particular, the evidence to date is less clear-cut. Not surprisingly perhaps, some groups and individuals have been adversely affected by the external and/or policy shocks during this period, while others have gained, and overall the outcomes are ambiguous.

This paper is set in the general context of examining the potential effects of policy measures on the poor. Specifically, we examine the effects of introducing poverty-alleviating income transfers to poor households in a budget-neutral (and, specifically, a revenue-neutral) regime. The inclusion of a budget constraint is important in view of the policy context in Ghana (and this is true in Africa more generally) and the desire to minimise the macroeconomic repercussions. The approach has previously been described by Dervis, de Melo and Robinson (1982) and subsequently by Sarris (1990) in terms of modelling distributional mechanisms within a CGE framework. Thus we use a computable general equilibrium (CGE) model in order to conduct a series of counterfactual numerical simulations based on alternative policy shocks. Similar studies have previously been carried out by Adelman and Robinson (1978), Chia, Wahba and Whalley (1994), Demery and Demery (1992), Sahn, Dorosh and Younger (1997), Dorosh and Sahn (2000), and more recently by Decaluwé, Dumont and Savard (1999), Cockburn (2001) and Robilliard, Bourguignon and Robinson (2001). Nevertheless there are significant conceptual differences in the scope, the range of experiments conducted and the technical approaches adopted in these studies.

There are five distinctive features of this paper. 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 how sensitive the results are to variations in the parameterisation, specification and closure rules. In particular we examine how the results vary according to the functioning of the factor markets; and we introduce model closures that broadly characterise the long run and the short run situations.

Thirdly, while the financing rule that supports the income transfers is likely to be country-specific, we are able to demonstrate that the ranking in terms of effects on poverty differ in the long run from what it is in the short run. The fourth novelty is that we address one of the main criticisms of these models, namely that they appear to be 'black boxes', thereby limiting their credibility as analytical tools for policy-makers. We introduce more transparency to understand the mechanisms underlying the distributional outcomes of the experiments, using a new decomposition procedure. Finally, there is an emerging debate in the modelling literature about the efficacy of using parametric versus non-parametric methods to portray income distribution within these models. In this paper we report on some comparisons between the parametric and non-parametric approaches, relying on detailed results for a large sample of households from the Ghana Living Standards Surveys.

Following this introduction, section 2 sets out the background to the policy analysis by briefly describing the general structure of the macro-meso[1]-micro simulation modelling approach adopted in this and related studies. 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 the household classifications; a profile of poverty incidence in these household groups; and some brief discussion of the CGE model. A range of simulations is conducted to examine the possible effects of alternative distributive policies on poverty incidence. In section 4 we examine the sensitivity of these results under alternative model specifications and closures, all of which are conducted under revenue-neutral rules. There are significant differences in the poverty responses for different socio-economic groups, and notably, some increases in poverty in the short term if resources are constrained. Finally, section 5 concludes with an overall assessment of the outcomes of the experiments.

## 2. Background to the policy simulations

In practice many external and policy shocks are introduced and initially impact on an economy at the macro-level. Recent experience in Ghana suggest examples of these shocks, such as terms of trade shocks from changes in key world commodity prices of gold, cocoa and oil (late 1990s), and policy-induced shocks due to increased expenditures on the wages and salaries of government employees (early 1990s). These macro-level shocks are transmitted through the

[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).

economy and ultimately impact on households and individuals at the micro-level. However, it is generally recognised that capturing these effects in an economic model is a difficult and complex exercise. The models depend on many methodological choices as well as on data availability. Here we rely on the application of a CGE model for Ghana to examine possible consequences of a particular set of policy shocks based on poverty-alleviating income transfers. CGE models are especially useful for counterfactual analysis although there are several types of model.

Robinson (1989) has distinguished between stylised (AGE) models and CGE models and their use in policy modelling exercises. Stylised (pure Walrasian) models typically include only producers and consumers (households) as agents; they are usually dimensionally small models and, most significantly, they do not contain any macroeconomic features. On the other hand CGE models are frequently used in development applications in order to simulate the effects of changes in exogenously-determined variables (e.g. policy shocks such as changes in tax rates, or external shocks such as changes in world prices or export demands) on endogenous variables (usually domestic variables such as sectoral outputs, relative prices of products and factors, household incomes and/or welfare, etc). Thus CGE models capture both macroeconomic features and the interdependence between agents in the economic system such as households, government and other domestic institutions, as well as the external sector. Correspondingly they are usually higher dimensional models. The core of a real-side static CGE model is the representation of markets for products and factors and the equilibrating mechanisms of these markets via adjustments in relative prices

### *2.1 Macro-meso models*

CGE models may be generally 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: macro variables are an integral part and are conditioned by macro 'closures' (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 depict the ways in which these markets close, together with some degree of institutional structure of the economy. What is important therefore is the extent to which the key features of the meso economy are adequately captured by the model. This is dependent on three key factors. It depends first on the macro-meso framework underpinning the model; second, on whether the model specification is representative of technology and behaviour in the economy; and third, on the quality and detail of the benchmark dataset used to calibrate the model. The benchmark dataset consists of a SAM plus other data such as elasticities, population, labour force and household survey statistics. Nevertheless the classification detail in the SAM, including the number and kinds of product and factor accounts and the classifications of household groups and other institutional features, is crucial in defining the integrity of the model structure as a whole. The SAM is essentially a macro-meso data framework, in the sense that it portrays the transactions between markets and institutions, and the latter include representative household groups which are crucial for poverty analysis. In principle, these representative household groups may be defined at the level of broad socio-economic groups or at an even more detailed level.

Amongst the commentators on CGE modelling applications, De Maio, Stewart and van der Hoeven (1999), are critical of the work of the Cornell Nutrition Program (Sahn *et al*, 1997) in their assessment of the impact of adjustment on the poor in Africa. Their specific criticisms include the choice of household and factor classifications, the appropriateness of the chosen macroeconomic closure rules for an African economy, and the neglect of important within household-group variations. Clearly, if the average behaviour of household groups is not truly representative of between group behaviour, or of all the households within groups, then this will undermine the performance of the model. This especially applies to its ability to examine policy consequences at both the meso and the micro levels. The issue is most clearly seen in the case of the rural sector where sub-groups of households 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. Rural non-farm economic activity also varies across households and household groups. Obviously, this variation means that each group may be affected differently by the exogenous shocks. In this paper we attempt to address these criticisms by exercising a careful choice of household groups and by examining the effect of alternative closures and model specifications on the results.

### *2.2 Meso-micro extensions*

To assess the policy effects on individuals or household groups, and ultimately their effects on poverty, it is necessary to introduce a further 'meso-micro' interface. There are two broad approaches. One approach was first suggested by Adelman and Robinson (1978) in a model for

Korea, later discussed by Dervis, de Melo and Robinson (1982), and used in many applications subsequently. The methodology relies on defining a parametrically-based representation of the distribution of income of each household group in the SAM (i.e. by assuming an analytical distribution). From this representation a shift in the group mean income arising from an exogenous shock translates into a shift in the distribution. This may or may not be a parallel shift, depending on the relationship of the group mean income with the mean and other parameters of the analytical distribution. A second approach, explored more recently (Cockburn, 2001, and Robilliard, Bourguignon and Robinson, 2001), is to pursue the effects on the income distribution non-parametrically. It uses the sample of households from the household survey as though they are a representative set of all households within each socioeconomic group. In this study we adopt both approaches and compare the results obtained.

To implement both the parametric and non-parametric approaches household size and income data can be derived from the household survey and used to provide summary statistics on income distributions at the individual level. As regards the parametric approach, we have chosen to use the lognormal distribution although Decaluwé, *et al* (1999) have argued that the Beta distribution may have some more desirable properties. One disadvantage of the lognormal distribution is its poor description of the distribution in the tails, although this deficiency is less serious when the function is separately parameterised for different and diverse household groups as we do here rather than to depict the distribution for the economy as a whole. Also the lognormal distribution has a simple relationship to the normal distribution, and therefore, is simple to apply.

The methodology based on the parametric approach is fairly standard. Macro-meso level policy shocks are applied and the CGE model computes the differential impact that these policies have on the mean incomes of each household group *h* ($\overline{Y}_h$). The effect on poverty is then measured by translating the change in $\overline{Y}_h$ into a shift in $m_h$ based on the assumption that the log-variance ($s_h^{\ 2}$) is unchanged. This assumption is largely (though not entirely) pragmatic; it is based on an assumption that there is some degree of uniformity in terms of the policy effects across all households within a group although because the distribution is lognormal it does not amount to a uniform shift in $Y_h$. Based on this assumption the change in the cumulative density below z (which is equivalent to a change in $P_0$) can be calculated given only the changes in group-mean incomes.

The non-parametric approach is computationally more demanding but is otherwise straightforward. The effects of the shocks on product and factor markets are translated into effects on the incomes and expenditures of the large number of representative households, and headcount poverty indices for socio-economic groups are computed directly. In either approach there is one potentially significant simplifying assumption. Translating survey data from households to individuals, it is assumed that a household's resources (income or consumption) are equally distributed across all its members. Hence if the household's per capita income (or expenditure) falls below the poverty line, then all its members are deemed to be poor for the purposes of the poverty calculation. Thus, and in common with other studies any intra-household inequality is ignored, although there is evidence that this assumption may substantially understate actual levels of poverty (Haddad and Kanbur, 1990).

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

### *3.1 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, 1998). This formed part of a substantive methodological revision of the Ghana national accounts (SNA) 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 (up to and including GLSS3). 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 input-output table together with the SNA 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' (comprising 40 accounts).

The 'consolidated SAM' involves straightforward aggregations of the capital transactions accounts into a single 'savings/investment' account; the consolidation of the SNA-based primary, secondary and use of income accounts into one single set of current accounts for institutions; and the consolidation of the activity and product accounts. As a result, there is some loss of information (for example on the nature of the inter-institutional transfers and on the activity-product relationship) but none that imposed major limitations on the particular model structures that have been envisaged[2]. For example, the consolidation of the capital transactions accounts is largely motivated by the present emphasis on real-side modelling.

Beyond these three main areas of consolidation were a series of other aggregations and adjustments to the original Ghana SAM[3]. For example, six 'Urban (non-Accra)' household accounts were reduced to two, due to the lack of available information from the GLSS on the numbers of households and household sizes at the more detailed level that would have been 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, some assumptions and an application of the RAS technique, separate tax revenue accounts were generated for domestic taxes, import duties and export taxes. Another major adjustment to the SAM was to eliminate the seemingly negative savings that appeared in some household accounts and for the household sector as a whole. The original negative estimates seemed implausible and would be problematic in executing the present CGE model.

### 3.2 A brief description of Ghana's initial equilibrium

Appendix 1 sets out some detailed discussion and associated tables showing some characteristics of the Ghana economy as implied by the structure of the SAM. Clearly, these structural characteristics, which represent the initial equilibrium, will play a major role in determining the numerical outcomes of the experiments. A brief summary follows:

- *Basic economic structure*

  The primary (and light manufacturing) sectors accounts for a large share of gross production, and of value added (both labour and capital). Household demand is also concentrated in these sectors, amounting to over 70% of consumers' expenditure. Hence any increase in households' disposable incomes should initially strongly affect these sectors. Exports are also heavily concentrated in the primary goods sectors – agriculture and minerals – although import intensity is low for agriculture, and quite low for minerals,

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

[3] The derivation of the consolidated SAM and some relevant aspects of these compilation issues are discussed in a note available from the authors.

so any increase in domestic demand has to be satisfied via domestic supply.

- *Labour intensity*

  Unincorporated business income, or 'mixed' income (formally a mixture of labour and capital income), is treated here as a category of labour income on the grounds that this may be predominantly informal sector activity. Labour is distinguished by gender, skill and formality. The largest component of labour income is received by the category 'informal/male/unskilled' (37% of total labour value added) and 74% of all labour income is received by unskilled labour. Agriculture is quite intensive in the use of 'informal/male/unskilled' labour so any stimulus in the demand for agricultural goods is likely to increase the generation of income to this factor.

- *Household groups*

  Six rural and four urban household groups are distinguished in the SAM; rural according to farm/non farm and locality, and urban according to Accra/other urban and skill level of the household head. Gross income per capita markedly varies across household groups. Rural households receive a significant share of their labour income from the 'informal/male/unskilled' labour category. Correspondingly, though to a lesser degree, 'informal/female/unskilled' labour features relatively more prominently in the incomes of rural, non-agricultural, and urban (not Accra) households. As expected, skilled labour income constitutes a large majority of income in 'skilled' urban/Accra households. Due to our treatment of mixed income as labour income, all capital income is routed through the corporate sector. This includes income from some farms as well as large corporations, so some of this is distributed to rural households as well as urban households. Government transfers to households constitute only a small fraction of household incomes (less than 1% in all except one household category). While the patterns of household income receipts are as expected they are nevertheless complex, and overall there is no clear-cut expectation of how changes in labour remunerations of different types will feed into households and affect poverty levels of the different household groups.

- *Government accounts*

  Table 1 sets out the government accounts implied by the SAM. It is divided into two vertical panels, where the left hand panel shows the receipts in terms of tax rates, actual amounts (in billion cedis), and percentage structure. The right hand panel shows the expenditures in terms of amounts and percentages. This table is relevant to an examination of different transfer-financing schemes in the counterfactual experiments. In particular, financing the pro-poor transfers via an increase in distortionary taxes (i.e. tariff, indirect taxes or export taxes) will have quite different structural and welfare effects than would financing via higher direct taxes (household or corporate taxes). Note that in the absence of more detailed evidence, a uniform income tax rate has been assumed across all households (1.3%).

*Ghana poverty profiles*

There is some controversy in the literature on the definition of the poverty line, whether it should be set at an absolute or relative value, and whether it should be defined differently across individuals, by geographical location or over time. In this study we follow local practice and base our welfare measure on per capita expenditure (cash and imputed expenditure 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). We also include additional 'international' poverty lines set at the one and two dollar a day levels. In support of these choices we note that per capita expenditure has often been argued to be a better measure of 'permanent' income; the choice of the poverty line, though initially arbitrary and based on relative concepts, becomes an absolute benchmark in the subsequent simulations; and $P_0$ is sufficient for making poverty comparisons providing first order dominance holds.

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[4]. The results obtained from an analysis of the 1993 Ghana SAM and GLSS3 are in line with these findings.

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

**Table 1: Government accounts**

| | Receipts Structure | | | | | | | | | | | | | | Expenditures Structure | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rates | | | | Revenues 10^9 cedis | | | | | Receipts in % | | | | | Expen. 10^9 cedis | | | Expenditures % | | |
| | Tariffs | Exp Taxes | Ind. Taxes | Y Taxes | Tariffs | Exp Taxes | Ind. Taxes | Y Taxes | Other | Tariffs | Exp Taxes | Ind. Taxes | Y Taxes | Other | Cons. | Transfers | Other | Cons. | Transfers | Other |
| Agri. Forest & Fish. Products | 1 | 18 | 1 | | 1 | 34 | 21 | | | 0 | 5 | 3 | | | 0 | | | 0 | | |
| Ores, Min., Elect., Gas Water | 0 | 0 | 0 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | | | 0 | | |
| Food, Bev.,Textiles, Leath. | 13 | 0 | 9 | | 25 | 0 | 86 | | | 4 | 0 | 13 | | | 0 | | | 0 | | |
| Other Non Metal Prod. | 32 | 0 | 29 | | 35 | 0 | 125 | | | 5 | 0 | 19 | | | 0 | | | 0 | | |
| Metal Prod, Machinery | 9 | 0 | 4 | | 61 | 0 | 7 | | | 9 | 0 | 1 | | | 0 | | | 0 | | |
| Construction Work | 0 | 0 | 0 | | 0 | 0 | 1 | | | 0 | 0 | 0 | | | 0 | | | 0 | | |
| Transp. Comm. Trade Serv. | 0 | 0 | 0 | | 0 | 0 | 2 | | | 0 | 0 | 0 | | | 0 | | | 0 | | |
| Business Services | 0 | 0 | 0 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 13 | | | 2 | | |
| Personal and Other Services | 0 | 0 | 0 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 546 | | | 81 | | |
| **Economywide** | **9** | | | | **121** | **34** | **242** | | | **18** | **5** | **36** | | | **559** | | | **83** | | |
| | | | | | | | | | | | | | | | | | | | | |
| Rural Farmer Head Savannah | | | | 1 | | | | 4 | | | | | 1 | | | 1 | | | 0 | |
| Rural Farmer Head Forest | | | | 1 | | | | 7 | | | | | 1 | | | 2 | | | 0 | |
| Rural Farmer Head Coast | | | | 1 | | | | 2 | | | | | 0 | | | 1 | | | 0 | |
| Rural Non Agric. Head Savannah | | | | 1 | | | | 2 | | | | | 0 | | | 0 | | | 0 | |
| Rural Non Agric. Head Forest | | | | 1 | | | | 6 | | | | | 1 | | | 3 | | | 0 | |
| Rural Non Agric. Head Coast | | | | 1 | | | | 4 | | | | | 1 | | | 1 | | | 0 | |
| Urban Unskilled | | | | 1 | | | | 7 | | | | | 1 | | | 4 | | | 1 | |
| Urban Skilled | | | | 1 | | | | 5 | | | | | 1 | | | 4 | | | 1 | |
| Accra Skilled Head | | | | 1 | | | | 3 | | | | | 0 | | | 3 | | | 0 | |
| Accra Unskilled Head | | | | 1 | | | | 3 | | | | | 0 | | | 1 | | | 0 | |
| **All Households** | | | | **1** | | | | **44** | | | | | **7** | | | **21** | | | **3** | |
| Corporations | | | | 7 | | | | 66 | | | | | 10 | | | | | | | |
| **Total Direct Taxes** | | | | | | | | **110** | | | | | **16** | | | | | | | |
| Transfers with Corporations | | | | | | | | | 0 | | | | | 0 | | 45 | | | 7 | |
| Transfers with ROW | | | | | | | | | 166 | | | | | 25 | | | | | | |
| Savings | | | | | | | | | | | | | | | | | 49 | | | 7 |
| **All Accounts** | | | | | | | | | **674** | | | | | **100** | | | **674** | | | **100** |

Table 2 shows some summary statistics that are used as a basis for the model and the simulations. It reports data relative to households and to per-capita cash expenditure as derived from the GLSS3 for 1991-92[5]. For Ghana as a whole, the contrasts between household groups are quite substantial. For example, while only 11.7% of the population belong to households in the 'Accra/urban skilled' category this household group accounts for 18.5% of total household consumption. On the other hand 17.8% of the population belong to 'Savannah farm' households whereas this group accounts for only 11.0% of total household consumption. The comparisons across urban and rural households as a whole are also borne out by the figures: 68.4% of the population belong to rural households, whereas only 58.3% of total consumption expenditure is incurred by rural households[6]. The column for per capita consumption confirms significant disparities between household groups.

[5] 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.
[6] The income and expenditure estimates include imputations for subsistence and other non-monetary items.

**Table 2: Poverty Statistics –1991-92**

| | Number of individuals | Total C 10^9 cedis | Per capita C 10^3 cedis | m | s2 | High z Poverty ratio | High z % of national poverty | Low z Poverty ratio | Low z % of national poverty | International z 1 $ a day | International z 2 $ a day |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Base Year - No Shock** | | | | | | | | | | | |
| **R. Farmer Head Sav.** | 2,584,200 | 338.6 | 131.0 | 4.6 | 0.6 | 71.2 | 27.3 | 59.4 | 31.6 | 23.3 | 56.5 |
| **R. Farmer Head Forest** | 2,739,690 | 464.8 | 169.7 | 5.0 | 0.4 | 53.5 | 21.7 | 36.9 | 20.8 | 5.5 | 33.3 |
| **R. Farmer Head Coast** | 1,005,940 | 188.5 | 187.4 | 5.1 | 0.3 | 45.9 | 6.9 | 29.5 | 6.1 | 3.3 | 26.1 |
| **R. Non Agric. Head Sav.** | 864,320 | 140.5 | 162.5 | 4.8 | 0.6 | 60.9 | 7.8 | 48.0 | 8.5 | 15.2 | 45.1 |
| **R. Non Agric. Head Forest** | 1,649,070 | 396.8 | 240.6 | 5.2 | 0.5 | 37.0 | 9.0 | 24.4 | 8.3 | 3.8 | 21.9 |
| **R. Non Agric. Head Coast** | 1,090,620 | 265.7 | 243.6 | 5.2 | 0.5 | 37.0 | 6.0 | 24.6 | 5.5 | 4.1 | 22.2 |
| **U. Unskilled** | 2,265,920 | 530.5 | 234.1 | 5.2 | 0.5 | 40.4 | 13.6 | 27.9 | 13.0 | 5.4 | 25.3 |
| **U. Skilled** | 1,233,700 | 357.3 | 289.6 | 5.4 | 0.5 | 26.0 | 4.8 | 15.5 | 3.9 | 1.7 | 13.5 |
| **Accra Skilled Head** | 466,470 | 214.0 | 458.9 | 5.9 | 0.5 | 9.6 | 0.7 | 4.7 | 0.5 | 0.3 | 4.0 |
| **Accra Unskilled Head** | 625,610 | 181.4 | 290.0 | 5.5 | 0.4 | 24.4 | 2.3 | 14.0 | 1.8 | 1.3 | 12.1 |
| **Ghana** | 14,525,540 | 3078.0 | 211.9 | | | 46.4 | 100.0 | 33.5 | 100.0 | 8.1 | 30.7 |
| **Rural** | 9,933,840 | 1794.8 | 180.7 | | | 53.4 | 78.7 | 39.5 | 80.8 | 10.3 | 36.5 |
| **Urban** | 4,591,700 | 1283.2 | 279.5 | | | 31.2 | 21.3 | 20.3 | 19.2 | 3.3 | 18.2 |

*Sources:* GLSS 3 and authors' calculations; High poverty line = 149,776 cedis, Low z = 116,492 cedis, and 1 $ a day transformed with PPP exchange rates is equivalent to 55,013 cedis.

A crucial feature is that poverty affects more severely the rural population, which includes about 80% of the poor; and among the rural groups, those living in the Savannah regions record the highest poverty ratios, and farmers are in general poorer than non-agriculture rural workers; finally households living in Accra, are considerably less poor, including Accra unskilled headed households, than other urban groups.

As noted earlier, and following Dervis, *et al* (1982), 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

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

where $\overline{Y}_h$ is per capita expenditure in group $h$ and the log-variance $s_h^2$ is estimated from the GLSS[7].

Two poverty lines are derived and the same poverty lines are used for each group. The higher poverty line is set at 149,776 cedis (two thirds of the mean per capita expenditure in 1993), while the lower ('hard core') poverty line is set at 116,492 cedis (one third of the mean per capita expenditure). On this basis, and using the lognormal assumptions the poverty profiles can be calculated. The results are shown in the final columns of Table 2. The table confirms the more general picture suggested earlier but more explicitly: poverty in Ghana is substantially a rural phenomenon. On the basis of the 'high-level' poverty line 78.7 % of poverty is in rural areas; this rises to 80.8% if one restricts attention to a 'low-level' (hard core) poverty line. Also, poverty incidence is much higher in 'Farm Savannah', 'Farm Forest', and 'Other Urban unskilled' household groups: the incidence is correspondingly negligible in the 'Other Urban skilled', 'Accra skilled' and 'Accra unskilled' household groups. The between-group disparities are very high indeed.

### *3.3 Model structure*

The CGE model is a real-side model appropriate to 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 fixed and equal to the current account deficit. At the same time, it is assumed that the economy is savings-driven: the quantity of investment adjusts to the level of savings and the government has a fixed budget for a pre-defined consumption plan. Domestic savings 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. 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 still 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 SNA, 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

[7] GLSS groups are disaggregated by locality although not by skill category. It has been assumed that the

sector unincorporated enterprises and therefore 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.

One of the main criticisms of De Maio *et al* (1999) 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. We broadly characterise and distinguish between long run and short run closures in the following way. In the long run closure, capital and labour are perfectly mobile across sectors and they are also in excess supply (i.e. their returns are fixed); in other words, this closure forces our flexible price model to behave as if it were an input-output model, in the sense that everything is demand-driven and there are no supply constraints. In the short run, capital and labour supply are fixed and fully employed (no slack capacity in the economy); additionally capital is sector specific and only labour remains perfectly mobile across sectors. Other smaller differences among the long and short run closures include larger elasticity of substitution in the long run closure (although this is not really important given that factor returns are fixed).

Alongside the model specification and closures are some 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 for Ghana and it is necessary to follow some principles which might lead to plausible values. 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[8]. Clearly, the trade elasticity assumptions are unlikely to be as important in redistributive experiments as they would be in experiments concerning trade liberalisation or economic reform.

distribution is less skewed for unskilled than skilled households.

# 4 Policy experiments

## 4.1 Basic methodology

Our aims in terms of policy experiments are threefold. First, in previous studies (e.g. Chia *et al*, 1992) the targeting program was financed only by increases in the taxes on household income. Here we consider the consequences of alternative financing schemes, by raising additional domestic taxes via import duties, indirect taxes on production and direct corporate taxes. Our second aim is to address a criticism of De Maio *et al* (1999) and examine the sensitivity of the results to the alternative short run and long run closures. Thirdly, we consider the sensitivity of the results to alternative poverty calculations based on the parametric and non-parametric aproaches.

## 4.2 Experiment design

The experiments performed with our CGE model consist of applying a series of poverty-reducing lump-sum transfers to households. This simulated policy shock is assumed not to affect the initial government budget position (i.e. government real savings are fixed at the initial SAM level), so that the transfers have to be financed by either increased tax revenues or by reduced expenditures; here we limit ourselves to the former.

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 $z$, which would be a sufficient amount to eliminate poverty. 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 $h$ with $n_h$ individuals would simply be $n_h z$. However there is a technical difficulty in applying these (essentially micro) transfer payments in a CGE model under the parametric approach. Ideally, the effect of transferring $z$ to each individual should be to shift the income distribution to the right by $z$. But we achieve this by transferring sufficient income to each

[8] 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'.

household group. Thus, the mean shifts from $(\overline{Y}_h)$ to $\left(\overline{Y}_h + z\right)$ but individual households receive transfers proportional to their income, and not equal amounts $z$. Income transfers to each group are therefore effectively lognormally-distributed within groups. We refer to this as a quasi-universalistic scheme whereby sufficient transfers are targeted to each socio-economic group as a whole, and not to individual households.

The transfers are self-financing via alternative financing schemes. We consider four different financing schemes entailing increases in (a) corporate direct taxes, (b) direct personal income taxes, (c) indirect production taxes, and (d) tariff rates. Also we perform the experiments under two different factor market adjustment rules (closures) which are supposed to loosely represent the functioning of the economy in the short and in the long run. An important point about the experiments is that the transfer policy can be simulated in two ways. The first is to assume a transfer equal to the poverty line to *all* individuals in *all* households groups (and this involves more than doubling the initial SAM total public expenditure, a huge shock!); the second is to assume household group-specific transfers. We assume the former. The final aim of the experimentation – to assess the differences between parametric and non-parametric approaches to the poverty calculations – is dealt with subsequently as a separate exercise.

Table 3 sets out the range of experiments whose main results are reported in this paper. Experiments 1L to 4L represents the cases where the transfers are financed by the four alternative financing rules, under the long run closure. Experiments 1S to 4S are similar, but apply to the short run closure. However because the tax base for tariffs and indirect (production) taxes are quite modest, the transfer shocks in cases 3 and 4 (both L and S versions) are scaled down to one quarter of the level of the shocks in experiments 1 and 2.

**Table 3: Model experiments**

| Closure | Size of the shock | Exp # | Description |
|---|---|---|---|
| Long Run | 100% | Exp1L | Corporate taxes adjust to keep real government savings constant |
| | | Exp2L | Households direct taxes adjust |
| | 25% | Exp3L | Indirect taxes adjust |
| | | Exp4L | Tariffs adjust |
| Short Run | 100% | Exp1S | Corporate taxes adjust to keep real government savings constant |
| | | Exp2S | Households direct taxes adjust |
| | 25% | Exp3S | Indirect taxes adjust |
| | | Exp4S | Tariffs adjust |

### *4.3 Some initial results*

Applying the shocks under the various experiments set out in Table 3, and coupling the outcomes on changes in prices and mean incomes with the lognormal assumptions as outlined in section 3, we generate a series of implications for the poverty ratios. Percentage variations in the resulting poverty ratios ($P_0$) with respect to the initial situation are summarised in Table 4. We should recall that, experiments 1 and 2 (versions L and S) are the full transfer shock and are comparable with each other, and likewise experiments 3 and 4 (versions L and S) are also comparable as they results from the reduced shock, but it is not possible to make a direct comparison between experiments from these two blocks – so, for example, experiments 1 and 3 are not comparable.

**Table 4: Redistribution policy - poverty effects**

| | Bench-mark | Long Run | | | | Short Run | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | corp tx Exp 1L | dir tx Exp 2L | i tax Exp 3L | tariff Exp 4L | corp tx Exp 1S | dir tx Exp 2S | i tax Exp 3S | tariff Exp 4S |
| **Poverty Ratios P0** | | Percentage change with respect to benchmark | | | | | | | |
| **Rural Farmer Head Savannah** | 59.4 | -20.4 | -23.3 | -56.7 | -56.9 | 9.4 | -20.1 | -11.3 | -4.8 |
| **Rural Farmer Head Forest** | 36.9 | -7.8 | -13.8 | -78.3 | -78.5 | 64.0 | -7.0 | -10.0 | 1.3 |
| **Rural Farmer Head Coast** | 29.5 | -42.1 | -23.4 | -84.0 | -84.1 | 15.3 | -16.0 | -9.1 | -4.8 |
| **Rural Non Agric. Head Savannah** | 48.0 | -48.3 | -13.4 | -59.9 | -60.0 | -30.6 | -9.2 | -0.7 | -1.9 |
| **Rural Non Agric. Head Forest** | 24.4 | -38.7 | 5.7 | -76.0 | -76.2 | 4.9 | 14.2 | 6.1 | 7.6 |
| **Rural Non Agric. Head Coast** | 24.6 | -63.3 | 2.7 | -78.7 | -78.8 | -39.6 | 11.5 | 16.4 | -0.4 |
| **Urban Unskilled** | 27.9 | -53.0 | -7.1 | -74.3 | -74.4 | -24.9 | -0.1 | 4.1 | 2.6 |
| **Urban Skilled** | 15.5 | -55.3 | 8.7 | -79.6 | -79.7 | -22.8 | 19.2 | 16.3 | 5.4 |
| **Accra Skilled Head** | 4.7 | -49.6 | 63.6 | -80.7 | -80.9 | -9.8 | 82.8 | 34.0 | 24.5 |
| **Accra Unskilled Head** | 14.0 | -75.1 | 15.9 | -85.9 | -86.0 | -53.9 | 29.5 | 23.9 | 9.8 |
| **Poverty Line** | 116.5 | 0.0 | 0.0 | -2.0 | -2.1 | 0.8 | 0.5 | -1.3 | 24.1 |
| **Rural** | 39.5 | -26.5 | -15.1 | -68.1 | -68.3 | 15.9 | -9.6 | -6.0 | -1.3 |
| **Urban** | 20.3 | -55.5 | 0.0 | -76.6 | -76.8 | -26.8 | 8.6 | 9.1 | 4.3 |
| **Ghana** | 33.5 | -32.1 | -12.2 | -69.8 | -69.9 | 7.7 | -6.1 | -3.1 | -0.3 |

Note: shaded cells are those for which poverty index worsens. The computations are all carried out using a low poverty line.

The first and not at all surprising feature of these results is that, when resources are constraining the economy (the short run closure) - shown in the right hand panel - poverty alleviation via budget-neutral government transfers is not very effective. The aggregate (all Ghana) poverty index is, at best, reduced by 6.1% (experiment 2S) and, with increased corporate and trade taxes as the financing methods, poverty actually increases (experiments 1S and 4S). In the long run, when resource constraints are freed up (shown in the left hand panel), poverty reductions are generally much more widespread. Note the relative shifts in the poverty line as a result of the policy shocks: under experiments 1L and 2L (long run closure) prices do not change, so the poverty line does not change. But it does shift slightly under other experiments in one direction or the other due to relative price changes.

In experiment 1L (first column), when government transfers are financed with increased corporate income direct taxes and there are no supply constraints, poverty is reduced for the whole of Ghana by 32.1%, and on average urban poverty is reduced more than rural poverty. But although *all* household groups benefit and show poverty reductions, these reductions are uneven across groups. In particular – among the three groups that account for the largest shares of poverty[9] – 'Rural Forest Farmers' record only a small reduction whereas 'Urban unskilled' households enjoy a considerable reduction (53.0%). The same financing method employed under tight factor markets (exp 1S) produces quite different aggregate results: Ghana-wide poverty worsens by 7.7%, with rural population seeing its poor getting worse (15.9%) and urban population getting better (-26.8%). Notice that, in this short-run scenario, the across household-group ranking of poverty variations is similar to that of the long-run case, although probably less politically viable, given that rural groups experience a worsening of poverty and urban groups gain. Interestingly, under the short-run simulations especially, the corporate tax (experiments 1L and 1S) and household tax (experiments 2L and 2S) financing rules lead to marked differences between gainers and losers in the poverty stakes. In the former, urban (and some rural non-agricultural) households experience poverty reductions, whereas in the latter it is rural households who gain. This is of course not surprising in view of our earlier observations about the patterns of labour and capital income payments across households, and the fact that profits from farm enterprises are treated as corporate income in the SAM.

## 5 Seeking more transparency from the results

As Devarajan and Robinson (2002) have recently commented: 'A CGE model can, and often does, generate empirical surprises, but it cannot generate theoretical surprises.' It is therefore of interest to seek more transparency in the results. A better picture of the transmission mechanisms at work when the initial shock hits the economy can be obtained by considering a decomposition analysis based the total differentials of a subset of the model's equations that generates aggregate household consumption (poverty ratios are calculated based on aggregate consumption rather than income). As we shall see, applying marginal changes in combination with non-marginal shocks yields linear approximations of the individual effects contributing to the outcomes.

[9] According to Table 2, Rural Farmer Head Savannah, Rural Farmer Head Forest, and Urban Unskilled account for 65.4% of all poor when a low poverty line is used.

### *5.1 Decomposition algebra*

Six equations in the model are relevant to the decomposition.

The *poverty index* $(P_a)$ is a function of the consumption in value (*CT*) and the poverty line expressed in nominal terms (*z(P)*):

$$P_{a,h} = f(CT_h, z(P)) \quad (2)$$

The *consumption in value* is the sum of commodities prices ($P_i$) times the quantities demanded ($C_i$):

$$CT_h = \sum_i P_i \cdot C_{i,h} \quad (3)$$

*Quantities demanded* are determined from ELES equations, expressed as functions of prices ($P_i$) and disposable income ($Y^D$), and where $q_i$ and $m_i$ are the committed quantities and supernumerary shares respectively:

$$C_{i,h} = q_{i,h} + \frac{m_{i,h}}{P_i}\left(Y_h^D - \sum_j P_j q_{j,h}\right) \quad (4)$$

*Commodities prices* are Armington CES functions of domestic prices $(P_i^d)$ and imported prices $(P_i^m)$:

$$P_i = CES(P_i^d, P_i^m) \quad (5)$$

*Disposable income* for household group *h* adjusted for taxes (tax rate $t_h$) and private transfers (*TR*) in nominal prices (price index $P^I$):

$$Y_h^D = (1 - t_h)Y_h^H + P^I \cdot TR_h^{NG} \quad (6)$$

*Total pre-tax income* represents factor income (labour and capital) and transfer income from corporate sector, government and the rest of the world (exchange rate *e*):

$$Y_h^H = \sum_l f_{h,l}^L Y_l^L + f_h^K(1-k)Y^K + f_h^C(1-k)Y^C + P^I \cdot TR_h^G + e \cdot TR_h^R \quad (7)$$

Note that in the above equation, *k* represents the proportion of retained capital earnings, $k$ is the corporate tax rate, and $f_h^C$, $f_h^K$, $f_h^L$ represent distribution matrices derived from the initial SAM and used to allocate to households corporate, capital and labour incomes respectively.

With the exception of the poverty index, now we consider the equations of the total differential in detail. Note that the differentials represent approximate (linear) changes from the benchmark 0 to the post shock 'period' *t*.

*Changes in nominal consumption*

$$\Delta CT_h = CT_{h,t} - CT_{h,0} = \Delta QC_h + \Delta PC_h \tag{8}$$

where

$$\Delta QC_h = \sum_i P_{i,h,0}\left(C_{i,h,t} - C_{i,h,0}\right) \tag{9}$$

$$\Delta PC_h = \sum_i C_{i,h,t}\left(P_{i,h,t} - P_{i,h,0}\right) \tag{10}$$

Equation (8) simply states that for household $h$ the total difference in the nominal value of consumption ($\Delta CT_h$) between the benchmark (0) and the new equilibrium ($t$) is equal to a consumption quantity difference ($\Delta QC$) and a consumption price difference ($\Delta PC$). Equations (9) and (10) define the total quantity and price differences.

From equation (4) the change in consumption quantities ($\Delta QC_h$) can be decomposed into an increment due to a change in disposable income ($\Delta C_i^{Y^D}$) and to a change in prices ($\Delta C_i^{PC}$).

*Change in consumption quantities due to change in disposable income ($\Delta Y^D$):*

$$\Delta C_i^{Y^D} = \frac{m}{P_{i,0}}\left(Y_t^D - Y_0^D\right) \tag{9a}$$

*Change in consumption quantities due to change in prices ($\Delta P$):*

$$\Delta C_i^{PC} = -\left(\frac{m_i}{P_{i,t}}\right)\left(Y_t^D - \sum_j P_{j,t}\, q_j\right)\left(P_{i,t} - P_{i,0}\right) \tag{9b}$$

The last two equations are aggregated across all goods to determine the change in total real consumption for each household group ($h$ is suppressed for clarity):

Aggregating these equations across goods:

$$\Delta C_h^{Y^D} = \sum_i \Delta C_{i,h}^{Y^D} \tag{11}$$

$$\Delta C_h^{PC} = \sum_i \Delta C_{i,h}^{PC} \tag{12}$$

Note that the sum of $\Delta C_h^{Y^D}$ and $\Delta C_h^{PC}$ from equations (11) and (12) are approximately the same variation as is calculated in equation (9).

Also,

$$\Delta S_h = \Delta Y_h^D - \Delta CT_h \tag{13}$$

*Change in disposable income ($\Delta Y^D$)*:

The total change in disposable income can be decomposed into three component changes which are due to changes in taxable income, taxes, and the price index ($h$ is suppressed here for clarity).

$$\Delta Y^D = \Delta Y^{D\_YH} + \Delta Y^{D\_Tax} + \Delta Y^{D\_PI} \tag{14}$$

where:

Change in $Y^D$ due to a change in taxable income is

$$\Delta Y^{D\_YH} = (1 - t_0)(Y_t^H - Y_0^H) \tag{15}$$

Change in $Y^D$ due to a change in tax rates is

$$\Delta Y^{D\_Tax} = -(t_t - t_0)Y_t^H \tag{16}$$

Change in $Y^D$ due to a change in the price index

$$\Delta Y^{D\_PI} = -TR^{NG}(P_t^I - P_0^I) \tag{17}$$

*Change in taxable income* ($\Delta Y^H$):

This mainly arises from factor income but in principle it can be decomposed into changes due to variations in the components of total household taxable income (equation (7)): labour income, capital income, distributed corporate profits, corporate taxes, the price index and transfers, as follows:

$$\Delta Y_h^H = \Delta Y_h^{H\_YL} + \Delta Y_h^{H\_YK} + \Delta Y_h^{H\_YC} + \Delta Y_h^{H\_TaxC} + \Delta Y_h^{H\_PI} + \Delta Y_h^{H\_TR} \tag{18}$$

where the:

change in $Y^H$ due to change in labour income is:

$$\Delta Y_h^{H\_YL} = \sum_l f_{h,l}^L \left(Y_{l,t}^L - Y_{l,0}^L\right) \quad (19)$$

change in $Y^H$ due to a change in capital income:

$$\Delta Y_h^{H\_YK} = f_h^K (1-k)\left(Y_t^K - Y_{t0}^K\right) \quad (20)$$

change in $Y^H$ due to a change in distributed corporate profits:

$$\Delta Y_h^{H\_YC} = f_h^C (1-k_t)\left(Y_t^C - Y_0^C\right) \quad (21)$$

change in $Y^H$ due to a change in the corporate tax rate:

$$\Delta Y_h^{H\_TaxC} = -f_h^C Y_t^C (k_t - k_0) \quad (22)$$

change in $Y^H$ due to a change in the price index:

$$\Delta Y_h^{H\_PI} = TR_t^G \left(P_t^I - P_0^I\right) \quad (23)$$

change in $Y^H$ due to a change in government transfers:

$$\Delta Y_h^{H\_TR} = P_t^I \left(TR_t^G - TR_0^G\right) \quad (24)$$

### 5.2 Decomposition results

Table 5 sets out some results of an analysis of the differential effects that make up the aggregate effects on total consumption in value. These results refer to experiments 1L and 1S, which compare long and short run closures for the case where household transfers are financed by corporate taxes. The table shows results for the ten household groups separately as well as for 'all Ghana'. Consider the first row, for 'Rural-farmer-Savannah' households, relating to experiment 1L for illustration. The seventeen columns correspond directly to equations (8) to (24). Reading from the right, column (17) records the initial income transfer from government to this household group, amounting to 301 (billion cedis) which comes from equation (24). This constitutes the first component of the change in taxable income ($\Delta Y^H$). Continuing to work from the right, we note that with no supply constraints prices do not change, so there is zero effect on $Y^H$ from equation (23) hence column (16) is zero. Given that corporate taxes have to increase to finance the transfers, column (15) records a large reduction in $Y^H$ (-293). Note however that corporate incomes increase and this has an offsetting positive increase in distributed income to households (column (14)) amounting to 37. The change in labour income accruing to this household group is 48, shown in column (12), coming from equation (19).

**Table 5: Redistribution policy: transmission mechanism for experiments 1L and 1S**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\Delta CT_h$ | $\Delta QC_h$ | $\Delta PC_h$ | $\Delta S_h$ | ΔC_Ydh | ΔC_Pch | ΔYd | ΔYd_Yhh | ΔYd_Tax | ΔYd_PI | ΔYhh | ΔYhh_YL | ΔYhh_YK | ΔYhh_YC | ΔYhh_TaxC | ΔYhh_PI | ΔYhh_TR |
| **Experiment 1L (Corporate Taxes, Long Run)** | | | | | | | | | | | | | | | | | |
| R. Farmer Head Sav. | 91 | 91 | 0 | 0 | 91 | 0 | 91 | 91 | | | 92 | 48 | | 37 | -293 | 0 | 301 |
| R. Farmer Head Forest | 22 | 22 | 0 | 5 | 22 | 0 | 27 | 27 | | | 27 | 83 | | 54 | -429 | 0 | 319 |
| R. Farmer Head Coast | 50 | 50 | 0 | 0 | 50 | 0 | 51 | 51 | | | 51 | 33 | | 14 | -113 | 0 | 117 |
| R. Non Agric. Head Sav. | 88 | 88 | 0 | 13 | 88 | 0 | 101 | 101 | | | 102 | 34 | | 5 | -37 | 0 | 101 |
| R. Non Agric. Head Forest | 108 | 108 | 0 | 25 | 108 | 0 | 132 | 132 | | | 134 | 95 | | 22 | -176 | 0 | 192 |
| R. Non Agric. Head Coast | 156 | 156 | 0 | 17 | 156 | 0 | 173 | 173 | | | 175 | 77 | | 4 | -33 | 0 | 127 |
| U. Unskilled | 255 | 255 | 0 | 5 | 255 | 0 | 260 | 260 | | | 263 | 121 | | 17 | -139 | 0 | 264 |
| U. Skilled | 131 | 131 | 0 | 7 | 131 | 0 | 139 | 139 | | | 141 | 73 | | 11 | -87 | 0 | 144 |
| Accra Skilled Head | 50 | 50 | 0 | 11 | 50 | 0 | 61 | 61 | | | 61 | 43 | | 5 | -41 | 0 | 54 |
| Accra Unskilled Head | 111 | 111 | 0 | 8 | 111 | 0 | 119 | 119 | | | 120 | 51 | | 0 | -4 | 0 | 73 |
| Tot HH | **1061** | **1061** | **0** | **90** | **1061** | **0** | **1152** | **1152** | **0** | **0** | **1166** | **657** | **0** | **169** | **-1352** | **0** | **1692** |
| **Experiment 1S (Corporate Taxes, Short Run)** | | | | | | | | | | | | | | | | | |
| R. Farmer Head Sav. | -34 | -37 | 3 | 0 | -34 | -2 | -34 | -34 | | | -40 | 2 | | -16 | -316 | -5 | 296 |
| R. Farmer Head Forest | -137 | -140 | 3 | -30 | -136 | -2 | -167 | -167 | | | -175 | 3 | | -23 | -463 | -6 | 313 |
| R. Farmer Head Coast | -12 | -14 | 2 | 0 | -12 | -2 | -12 | -12 | | | -14 | 1 | | -6 | -122 | -2 | 115 |
| R. Non Agric. Head Sav. | 49 | 47 | 2 | 7 | 49 | -1 | 57 | 57 | | | 56 | 1 | | -2 | -40 | -2 | 99 |
| R. Non Agric. Head Forest | -7 | -11 | 4 | -2 | -7 | -3 | -9 | -9 | | | -12 | 2 | | -10 | -190 | -4 | 189 |
| R. Non Agric. Head Coast | 79 | 77 | 2 | 8 | 79 | 0 | 87 | 87 | | | 86 | 1 | | -2 | -36 | -2 | 125 |
| U. Unskilled | 99 | 93 | 6 | 2 | 98 | -4 | 101 | 101 | | | 97 | 1 | | -8 | -150 | -5 | 259 |
| U. Skilled | 44 | 43 | 1 | 2 | 44 | 1 | 47 | 47 | | | 45 | 4 | | -5 | -93 | -3 | 141 |
| Accra Skilled Head | 9 | 7 | 2 | 2 | 9 | -2 | 11 | 11 | | | 10 | 4 | | -2 | -44 | -1 | 53 |
| Accra Unskilled Head | 61 | 60 | 2 | 4 | 61 | -1 | 66 | 66 | | | 65 | 0 | | 0 | -4 | -1 | 72 |
| Tot HH | **151** | **126** | **25** | **-6** | **151** | **-17** | **146** | **146** | **0** | **0** | **117** | **19** | **0** | **-74** | **-1459** | **-31** | **1661** |

The final effect on taxable income is a change of 92, shown in column (11). This is then translated into a direct effect on disposable income ( $\Delta Y^D$ ) via column (8), by deducting income taxes, which amounts to an increase of 91. This is the only change in disposable income (column (7), equation (4)) as there are no changes in household taxes (column (9)) or changes in the price index (column (10)), these being the other possible contributory affects. The resulting increase in disposable income then impacts on consumption quantities (column (5)) and savings (column (4)). The former is the only impact on the change in consumption quantities, 91 (column (2)) as price effects are zero. For the same reason, in this case the effect on consumption in value (column (1)) is entirely due to the change in consumption quantities. Overall, with no change in prices and hence no change in the nominal poverty line, the increase in nominal consumption will lead to a reduction in the poverty ratio, as confirmed in Table 4.

The effects are quite different when experiment 1S is considered. These are shown in the lower panel of Table 5. Considering the same initial shock (an income transfer to 'Rural-farmer-

Savannah region' households) of approximately 300 billion cedis[10] results in a final change in nominal consumption of –34 billion. Notably now it is both resource constraints and price effects that determine this result. In experiment 1S, the total change in taxable income is negative due to: reduced corporate incomes (-16 under column (14)), a negative price index effect (column (16)), and a much smaller labour income effect (2 under column (12)). Indeed, it can be observed that, in both experiments, the negative changes due to increased corporate taxes almost entirely offset the initial positive transfer shock. And also we observe that differences between the two experiments are entirely due to different factor market responses, which, in turn, are due to the differences in the factor market closure rules.

In summary, we see that if the transfer policy is financed by an increase in corporate direct taxes then their impact on the poverty ratios will strongly depend on the adjustment mechanism in factor markets. Also, given the fixed pattern of allocation of corporate incomes (shown in Table A4), urban poverty will be reduced more sharply than rural poverty[11].

The differential general equilibrium effects of experiments 1L and 1S can also be observed in the sectoral variations of final consumption and output as shown in Table 6. The main points here are that in experiment 1L consumption varies in fairly similar proportion across all sectors whereas in experiment 1S certain sectors, notably agriculture, record smaller variation with respect to the others. This is due to the fact that, in the short run case, rural household consumption is generally reduced in contrast with the increasing consumption of urban households, coupled with the differentials between rural and urban consumption patterns (rural households consume a much larger share of agricultural commodities than urban households).

Finally, the second panel of Table 6, again shows the strong dependency of changes in sectoral real outputs on the factor market closure. In particular, with resource constraints (i.e. short-run closure), there is very little economy-wide real output variation and only a small sectoral reallocation is observed. Construction output goes down due to the reduction in savings, which affects total investment and this is mainly concentrated in the construction sector.

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[10] It is the same transfer in real terms, but now valued at the post-shock price index.
[11] More after tax corporate income is distributed to rural households than to urban households, so if corporate taxes increase and distributed income falls then rural households will be fair worse than urban households.

**Table 6: Total final consumption and Real Output**

| | Bench-mark | Long Run corp tx Exp 1L | dir tx Exp 2L | i tax Exp 3L | tariff Exp 4L | Short Run corp tx Exp 1S | dir tx Exp 2S | i tax Exp 3S | tariff Exp 4S |
|---|---|---|---|---|---|---|---|---|---|
| | 10^9 cedis | Percentage change with respect to benchmark | | | | | | | |
| **Tot Nominal Consumption** | | | | | | | | | |
| **Agri. Forest & Fish. Products** | 1190 | 32 | 7 | 85 | 85 | 2 | 3 | 0 | 24 |
| **Ores, Min., Elect., Gas Water** | 162 | 38 | 2 | 82 | 82 | 10 | -1 | -4 | 22 |
| **Food, Bev.,Textiles, Leath.** | 798 | 35 | 4 | 83 | 83 | 6 | 0 | -2 | 23 |
| **Other Non Metal Prod.** | 237 | 34 | 4 | 83 | 83 | 5 | 0 | -2 | 23 |
| **Metal Prod, Machinery** | 112 | 37 | 0 | 79 | 79 | 9 | -4 | -5 | 21 |
| **Construction Work** | 52 | 35 | 4 | 83 | 83 | 6 | 0 | -3 | 23 |
| **Transp. Comm. Trade Serv.** | 150 | 36 | 2 | 81 | 82 | 7 | -2 | -4 | 22 |
| **Business Services** | 238 | 37 | 2 | 81 | 81 | 9 | -2 | -4 | 22 |
| **Personal and Other Services** | 138 | 35 | 2 | 81 | 81 | 7 | -2 | -3 | 22 |
| **Real Output** | | | | | | | | | |
| **Agri. Forest & Fish. Products** | 1531 | 36 | 7 | 96 | 97 | 1 | 1 | 7 | -1 |
| **Ores, Min., Elect., Gas Water** | 565 | 29 | 2 | 110 | 113 | 0 | 0 | 1 | -1 |
| **Food, Bev.,Textiles, Leath.** | 999 | 27 | 3 | 81 | 81 | 0 | 0 | -7 | 6 |
| **Other Non Metal Prod.** | 562 | 36 | 4 | 97 | 96 | 1 | 0 | -31 | 5 |
| **Metal Prod, Machinery** | 194 | 2 | 1 | 68 | 67 | -2 | 0 | 8 | 6 |
| **Construction Work** | 438 | -3 | 1 | 49 | 49 | -9 | 0 | 1 | -12 |
| **Transp. Comm. Trade Serv.** | 423 | 28 | 3 | 88 | 89 | 0 | 0 | -1 | -19 |
| **Business Services** | 381 | 26 | 2 | 70 | 70 | 0 | 0 | 3 | -1 |
| **Personal and Other Services** | 693 | 7 | 0 | 17 | 17 | 1 | 0 | 2 | 1 |
| **Economywide** | 5786 | 25 | 4 | 79 | 79 | 0 | 0 | -2 | -1 |

Now let us consider experiments 2L and 2S, in which we switch the financing rule from corporate taxes to household income taxes. Overall, Table 4 showed that Ghana-wide poverty reduction is lower in experiment 2 than in experiment 1. Also, in experiment 2, rural poverty is reduced more than urban poverty which either is unchanged (long run) or increases (short run). This differential rural-urban effect is explained by observing that rural households, in contrast with urban households, receive more in transfers than they pay in taxes. The way transfers are calculated, *per capita* transfers are equal across all household groups. However, when transfers are aggregated by household type, rural groups receive a higher aggregate sum than urban households. In contrast, direct tax *rates* are the same for all households groups (see Table 1). Therefore, when the transfer is financed by increasing direct taxes, a uniform financial burden is spread across all households even though some groups receive lower transfer income than others. This is clearly illustrated by observing columns (9) and (17) in Table 7.

A similar pattern of inter-household poverty effects is found in experiment 2S (not shown in Table 7), but with the major difference that urban households now record an increase in poverty ratios. As shown in Table 6, total real output shows a positive change in experiment 2L but it is a smaller increase than in experiment 1L because the consumer demand boost through the net increase in household incomes is so much lower. Notice also that aggregate savings slightly increases so that investment is maintained and the construction sector does not show the reduction recorded in experiment 1L.

**Table 7: Redistribution Policy – Transmission mechanism for experiments 2L and 2S**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\Delta CT_h$ | $\Delta QC_h$ | $\Delta PC_h$ | $\Delta S_h$ | ΔC_Ydh | ΔC_Pch | ΔYd | ΔYd_Yhh | ΔYd_Tax | ΔYd_PI | ΔYhh | ΔYhh_YL | ΔYhh_YK | ΔYhh_YC | ΔYhh_TaxC | ΔYhh_PI | ΔYhh_TR |
| **Experiment 2L (Direct Taxes, Long Run)** | | | | | | | | | | | | | | | | | |
| R. Farmer Head Sav. | 106 | 106 | 0 | 1 | 106 | 0 | 106 | 310 | -204 | | 314 | 8 | | 4 | | 0 | 301 |
| R. Farmer Head Forest | 40 | 40 | 0 | 9 | 40 | 0 | 49 | 336 | -287 | | 340 | 14 | | 6 | | 0 | 319 |
| R. Farmer Head Coast | 25 | 25 | 0 | 0 | 25 | 0 | 25 | 123 | -98 | | 124 | 6 | | 2 | | 0 | 117 |
| R. Non Agric. Head Sav. | 19 | 19 | 0 | 3 | 19 | 0 | 22 | 105 | -84 | | 107 | 5 | | 1 | | 0 | 101 |
| R. Non Agric. Head Forest | -12 | -12 | 0 | -3 | -12 | 0 | -14 | 207 | -222 | | 210 | 15 | | 3 | | 0 | 192 |
| R. Non Agric. Head Coast | -4 | -4 | 0 | 0 | -4 | 0 | -4 | 138 | -142 | | 140 | 12 | | 1 | | 0 | 127 |
| U. Unskilled | 24 | 24 | 0 | 0 | 24 | 0 | 24 | 282 | -258 | | 286 | 20 | | 2 | | 0 | 264 |
| U. Skilled | -13 | -13 | 0 | -1 | -13 | 0 | -14 | 153 | -167 | | 155 | 10 | | 1 | | 0 | 144 |
| Accra Skilled Head | -33 | -33 | 0 | -7 | -33 | 0 | -40 | 60 | -100 | | 60 | 5 | | 1 | | 0 | 54 |
| Accra Unskilled Head | -11 | -11 | 0 | -1 | -11 | 0 | -12 | 80 | -92 | | 81 | 8 | | 0 | | 0 | 73 |
| Tot HH | **140** | **140** | **0** | **1** | **140** | **0** | **141** | **1793** | **-1653** | **0** | **1816** | **104** | **0** | **20** | **0** | **0** | **1692** |
| **Experiment 2S (Direct Taxes, Short Run)** | | | | | | | | | | | | | | | | | |
| R. Farmer Head Sav. | 91 | 88 | 3 | 0 | 91 | -3 | 92 | 299 | -207 | | 303 | 2 | | -1 | | 0 | 301 |
| R. Farmer Head Forest | 22 | 19 | 3 | 5 | 22 | -3 | 27 | 317 | -290 | | 322 | 3 | | -1 | | 0 | 320 |
| R. Farmer Head Coast | 17 | 16 | 1 | 0 | 17 | -1 | 17 | 117 | -99 | | 118 | 1 | | 0 | | 0 | 117 |
| R. Non Agric. Head Sav. | 13 | 12 | 1 | 2 | 13 | -1 | 15 | 100 | -85 | | 102 | 1 | | 0 | | 0 | 101 |
| R. Non Agric. Head Forest | -27 | -28 | 2 | -6 | -26 | -2 | -33 | 191 | -224 | | 194 | 2 | | -1 | | 0 | 192 |
| R. Non Agric. Head Coast | -15 | -16 | 1 | -2 | -15 | -1 | -16 | 127 | -143 | | 129 | 1 | | 0 | | 0 | 127 |
| U. Unskilled | 3 | 1 | 2 | 0 | 3 | -2 | 3 | 264 | -260 | | 267 | 3 | | 0 | | 0 | 264 |
| U. Skilled | -26 | -27 | 1 | -1 | -25 | -1 | -27 | 142 | -169 | | 144 | 0 | | 0 | | 0 | 144 |
| Accra Skilled Head | -40 | -40 | 0 | -8 | -40 | 0 | -48 | 53 | -101 | | 54 | -1 | | 0 | | 0 | 54 |
| Accra Unskilled Head | -18 | -19 | 0 | -1 | -18 | 0 | -19 | 73 | -92 | | 74 | 1 | | 0 | | 0 | 73 |
| Tot HH | **23** | **7** | **16** | **-11** | **22** | **-16** | **11** | **1682** | **-1671** | **0** | **1706** | **14** | **0** | **-4** | **0** | **2** | **1694** |

The next pair of experiments to be compared is that of experiments 3L and 3S. We refer to the results in Table 8. The results for experiment 3L (long run) are dominated by the effect of increased factor supplies (the overall boost in real GDP dominates every other effect). The general equilibrium mechanism is as follows: initially there is an increase in demand by the households receiving the transfers; demand pressure is satisfied by increased output, which then generates more income and more demand. Additionally, higher output levels produce more indirect tax revenues that are used to finance the initial transfers, indeed the net result is that indirect tax rates could go down instead of up to maintain the revenue balance for the transfer policy. Notice that since prices are ultimately determined by the domestic resource cost (and this is fixed, given the flat factor supply schedules) plus the cost of intermediates, a small reduction in the indirect tax rates generates an increase in production and in the demand for primary resources without an increase in costs. From this simple mechanism a huge boom in the economy is generated[12]. In summary, the large real GDP effect produces almost a 70% reduction in economy-wide poverty ratios coupled with a slight pro-urban bias in the poverty reduction.

**Table 8: Redistribution Policy – Transmission mechanism for experiments 3L and 3S**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $DCT_h$ | $DQC_h$ | $DPC_h$ | $DS_h$ | DC_Ydh | DC_Pch | DYd | DYd_Yhh | DYd_Tax | DYd_PI | DYhh | DYhh_YL | DYhh_YK | DYhh_YC | DYhh_TaxC | DYhh_PI | DYhh_TR |
| **Experiment 3L (Indirect Taxes, Long Run)** | | | | | | | | | | | | | | | | | |
| R. Farmer Head Sav. | 323 | 337 | -14 | 2 | 330 | 14 | 325 | 325 | | | 327 | 130 | | 125 | | -2 | 74 |
| R. Farmer Head Forest | 396 | 414 | -18 | 87 | 404 | 18 | 483 | 483 | | | 488 | 228 | | 183 | | -2 | 78 |
| R. Farmer Head Coast | 166 | 173 | -7 | 0 | 169 | 7 | 166 | 166 | | | 168 | 91 | | 48 | | -1 | 29 |
| R. Non Agric. Head Sav. | 118 | 123 | -5 | 18 | 120 | 5 | 135 | 135 | | | 137 | 97 | | 16 | | -1 | 25 |
| R. Non Agric. Head Forest | 317 | 332 | -14 | 72 | 324 | 15 | 390 | 390 | | | 394 | 273 | | 75 | | -1 | 47 |
| R. Non Agric. Head Coast | 239 | 250 | -10 | 25 | 244 | 11 | 265 | 265 | | | 268 | 223 | | 14 | | -1 | 31 |
| U. Unskilled | 458 | 478 | -20 | 8 | 467 | 20 | 467 | 467 | | | 471 | 349 | | 59 | | -1 | 65 |
| U. Skilled | 260 | 272 | -12 | 15 | 265 | 12 | 274 | 274 | | | 277 | 206 | | 37 | | -1 | 35 |
| Accra Skilled Head | 122 | 128 | -6 | 26 | 124 | 6 | 147 | 147 | | | 149 | 119 | | 17 | | 0 | 13 |
| Accra Unskilled Head | 154 | 160 | -7 | 11 | 157 | 7 | 165 | 165 | | | 167 | 148 | | 2 | | 0 | 18 |
| Tot HH | **2553** | **2666** | **-113** | **265** | **2605** | **116** | **2818** | **2818** | **0** | **0** | **2845** | **1863** | **0** | **577** | **0** | **-9** | **415** |
| **Experiment 3S (Indirect Taxes, Short Run)** | | | | | | | | | | | | | | | | | |
| R. Farmer Head Sav. | 43 | 51 | -8 | 0 | 43 | 10 | 43 | 43 | | | 33 | -25 | | 3 | | -10 | 65 |
| R. Farmer Head Forest | 22 | 30 | -9 | 5 | 22 | 10 | 27 | 27 | | | 16 | -47 | | 5 | | -11 | 69 |
| R. Farmer Head Coast | 6 | 9 | -3 | 0 | 6 | 4 | 6 | 6 | | | 2 | -20 | | 1 | | -4 | 25 |
| R. Non Agric. Head Sav. | -1 | 1 | -2 | 0 | -1 | 3 | -1 | -1 | | | -4 | -23 | | 0 | | -3 | 22 |
| R. Non Agric. Head Forest | -18 | -14 | -4 | -4 | -18 | 5 | -22 | -22 | | | -28 | -65 | | 2 | | -7 | 42 |
| R. Non Agric. Head Coast | -25 | -23 | -3 | -3 | -26 | 4 | -28 | -28 | | | -33 | -56 | | 0 | | -4 | 28 |
| U. Unskilled | -20 | -13 | -6 | 0 | -20 | 8 | -20 | -20 | | | -29 | -79 | | 2 | | -9 | 57 |
| U. Skilled | -28 | -24 | -4 | -2 | -28 | 5 | -30 | -30 | | | -35 | -62 | | 1 | | -5 | 31 |
| Accra Skilled Head | -23 | -21 | -1 | -5 | -23 | 2 | -28 | -28 | | | -30 | -40 | | 0 | | -2 | 12 |
| Accra Unskilled Head | -18 | -17 | -1 | -1 | -18 | 1 | -19 | -19 | | | -22 | -35 | | 0 | | -3 | 16 |
| Tot HH | **-62** | **-21** | **-41** | **-10** | **-62** | **52** | **-72** | **-72** | **0** | **0** | **-129** | **-452** | **0** | **15** | **0** | **-59** | **367** |

Experiment 3S represents the same financing method in an economy with fully employed resources and here the effects are dramatically different. The indirect tax rate now has actually to go up to finance the transfers and poverty is still reduced by just by 3.1%, although urban households suffer from poverty increases (Table 4). The reasons for this anti-urban bias are shown in Table 8 where there are strong reductions in urban households' labour income to overcome the initial positive transfers. Labour incomes are reduced by the sectoral resource reallocation due to the fact that indirect taxes are not uniform across sectors (Table 1). We may also note that the highest indirect tax rates are for 'Food, Beverages, Textiles, Leather' and for 'Other non Metal Products', two of the most labour intensive sectors, as shown by the low

[12] In fact it is possible to check this by running an experiment where indirect taxes are exogenously reduced, instead of being endogenously calculated to accommodate the transfers, and it is shown that all these aforementioned

capital-labour ratios in Table A1 in the Appendix.

Experiments 4L and 4S based on tariff increases show a similar pattern of poverty effects to those involving indirect taxes (Table 4) with obvious differences arising from the differences in the sectoral distribution of tariffs as compared to indirect taxes.

A final remark on the poverty outcomes shown in Table 4 is to observe the overall ranking of the financing methods, in terms of aggregate poverty reduction as follows:

- in the short run, (1) households direct taxes, (2) indirect taxes, (3) tariffs, (4) corporate direct taxes; and
- in the long run, (1) tariffs, (2) indirect taxes, (3) corporate taxes, (4) household direct taxes.

Clearly the choice of financing method choice is crucially dependent on the factor market situation. In this case we characterise the factor market closures in terms of the long and short run, so this also highlights the possibility that the financing rule will be dependent on whether the aim is to target poverty reduction in the long or the short run. This is potentially a significant insight from the simulations.

### *5.3 Parametric versus non-parametric approaches*

A final simulation exercise has been carried out to compare the parametric approach (use of the lognormal distribution) for the poverty calculations as opposed to applying a non-parametric approach using the household survey results (GLSS3) directly. This exercise has been prompted by the work of Cockburn (2001) who applied the non-parametric approach in a model of Nepal, and is some way towards incorporating a microsimulation approach as suggested by Robilliard *et al* (2001). But first we should note that in the case of Ghana, as in many other developing countries, there are some significant conceptual and technical difficulties involved in matching household survey data and the macroeconomic accounts, due partly to definitional difficulties and to under-recording of incomes by households. These data issues are not discussed further here, and we simply present a comparison of the outcomes for the parametric and non-parametric approaches, but they are significant issues nonetheless and make the implementation of the non-parametric approach a non-trivial exercise.

Table 9 shows the $P_a$ poverty ratios calculated directly from the GLSS3 data , which can be

effects are generated.

compared to those derived by applying a lognormal distribution and shown earlier in Table 2. In Table 9 we compute the $P_0$ (headcount), $P_1$ (depth) and $P_2$ (severity) ratios, for three alternative poverty lines (high, low and the '1$ per day' international benchmark). The comparisons of $P_0$ with Table 2 show that the ratios are quite close for some household groups and some way apart from others, and that there is no consistency across poverty lines. This immediately suggests that the lognormal may not be an adequate approximation to the income distribution for all Ghana household groups. Using the 'low' poverty line, as in the earlier experiments, the lognormal-based $P_0$ ratios are underestimated relative to the 'actual' ratios for all ten household groups, which means that they are also under-estimated at the 'all-Ghana' level too.

**Table 9: Poverty Statistics –1993 (non parametric case)**

| | Benchmark | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *High poverty line* | | | *Low poverty line* | | | *1$ a day* | | |
| | *p0* | *p1* | *p2* | *p0* | *p1* | *p2* | *p0* | *p1* | *p2* |
| **Rural Farmer Head Savannah** | 80.7 | 41.0 | 24.7 | 72.4 | 30.7 | 17.0 | 25.7 | 8.5 | 4.3 |
| **Rural Farmer Head Forest** | 71.2 | 29.5 | 15.4 | 56.8 | 19.8 | 9.2 | 12.4 | 2.3 | 0.8 |
| **Rural Farmer Head Coast** | 62.2 | 21.6 | 9.8 | 43.8 | 12.4 | 4.9 | 4.5 | 0.6 | 0.1 |
| **Rural Non Agr. Head Savannah** | 70.4 | 32.5 | 18.4 | 58.8 | 23.2 | 11.9 | 15.8 | 4.7 | 2.3 |
| **Rural Non Agr. Head Forest** | 52.5 | 20.1 | 10.1 | 38.7 | 12.8 | 5.9 | 6.9 | 1.9 | 0.8 |
| **Rural Non Agr. Head Coast** | 46.1 | 15.9 | 7.2 | 31.9 | 9.0 | 3.7 | 3.1 | 0.7 | 0.4 |
| **Other Urban Unskilled** | 47.3 | 17.2 | 8.7 | 32.3 | 10.7 | 5.2 | 6.0 | 2.2 | 1.4 |
| **Other Urban Skilled** | 38.8 | 11.8 | 5.0 | 22.7 | 6.0 | 2.5 | 2.1 | 0.7 | 0.4 |
| **Accra Skilled Head** | 23.6 | 5.5 | 1.8 | 9.0 | 1.9 | 0.6 | 0.0 | 0.0 | 0.0 |
| **Accra Unskilled Head** | 29.5 | 9.2 | 3.8 | 20.1 | 4.6 | 1.7 | 0.9 | 0.4 | 0.3 |
| **Rural** | 65.3 | 27.7 | 14.9 | 52.1 | 18.8 | 9.2 | 12.3 | 3.3 | 1.5 |
| **Urban** | 39.3 | 13.1 | 6.1 | 24.9 | 7.4 | 3.4 | 3.4 | 1.2 | 0.8 |
| **Ghana** | 56.8 | 22.9 | 12.0 | 43.2 | 15.1 | 7.3 | 9.4 | 2.6 | 1.3 |

Recall that the results of the CGE experiments generate changes in the group-specific consumption expenditures, as well as prices, for the purpose of computing the corresponding impacts on the $P_0$ poverty ratios. The information can be used to calculate revised poverty ratios under the GLSS-based (non-parametric) as well as parametric situations.

In the former case, expenditures of all households in each household group are scaled according to the aggregate change in expenditures for that group, thereby enabling us to recalculate the percentage of individuals falling below the (possibly revised) poverty line. A more sensitive procedure would be to recompute the nominal consumption of each household in accordance with the changes for each commodity, reflecting the changes in each household's commodity bundle. This has not been calculated and is for the future.

**Table 10: Redistribution Policy - Poverty Effects – Parametric vs. non-Parametric**

| | Bench-mark | Long Run corp tx Exp 1L | dir tx Exp 2L | i tax Exp 3L | tariff Exp 4L | Short Run corp tx Exp 1S | dir tx Exp 2S | i tax Exp 3S | tariff Exp 4S |
|---|---|---|---|---|---|---|---|---|---|
| | | Percentage change with respect to benchmark | | | | | | | |
| **Poverty Ratios P0 (parametric LogNormal distribution)** | | | | | | | | | |
| **Rural Farmer Head Savannah** | 59.4 | -20.4 | -23.3 | -56.7 | -56.9 | 9.4 | -20.1 | -11.3 | -4.8 |
| **Rural Farmer Head Forest** | 36.9 | -7.8 | -13.8 | -78.3 | -78.5 | 64.0 | -7.0 | -10.0 | 1.3 |
| **Rural Farmer Head Coast** | 29.5 | -42.1 | -23.4 | -84.0 | -84.1 | 15.3 | -16.0 | -9.1 | -4.8 |
| **Rural Non Agric. Head Savannah** | 48.0 | -48.3 | -13.4 | -59.9 | -60.0 | -30.6 | -9.2 | -0.7 | -1.9 |
| **Rural Non Agric. Head Forest** | 24.4 | -38.7 | 5.7 | -76.0 | -76.2 | 4.9 | 14.2 | 6.1 | 7.6 |
| **Rural Non Agric. Head Coast** | 24.6 | -63.3 | 2.7 | -78.7 | -78.8 | -39.6 | 11.5 | 16.4 | -0.4 |
| **Urban Unskilled** | 27.9 | -53.0 | -7.1 | -74.3 | -74.4 | -24.9 | -0.1 | 4.1 | 2.6 |
| **Urban Skilled** | 15.5 | -55.3 | 8.7 | -79.6 | -79.7 | -22.8 | 19.2 | 16.3 | 5.4 |
| **Accra Skilled Head** | 4.7 | -49.6 | 63.6 | -80.7 | -80.9 | -9.8 | 82.8 | 34.0 | 24.5 |
| **Accra Unskilled Head** | 14.0 | -75.1 | 15.9 | -85.9 | -86.0 | -53.9 | 29.5 | 23.9 | 9.8 |
| **Poverty Line** | 116.5 | 0.0 | 0.0 | -2.0 | -2.1 | 0.8 | 0.5 | -1.3 | 24.1 |
| **Rural** | 39.5 | -26.5 | -15.1 | -68.1 | -68.3 | 15.9 | -9.6 | -6.0 | -1.3 |
| **Urban** | 20.3 | -55.5 | 0.0 | -76.6 | -76.8 | -26.8 | 8.6 | 9.1 | 4.3 |
| **Ghana** | 33.5 | -32.1 | -12.2 | -69.8 | -69.9 | 7.7 | -6.1 | -3.1 | -0.3 |
| **Poverty Ratios P0 (Non parametric distribution)** | | | | | | | | | |
| **Rural Farmer Head Savannah** | 72.4 | -22.0 | -24.9 | -59.9 | -59.7 | 5.5 | -21.1 | -14.5 | -3.5 |
| **Rural Farmer Head Forest** | 56.8 | -5.5 | -11.2 | -69.1 | -68.7 | 34.4 | -5.3 | -10.9 | 1.8 |
| **Rural Farmer Head Coast** | 43.8 | -38.8 | -25.2 | -81.0 | -81.0 | 14.3 | -14.3 | -9.5 | -3.4 |
| **Rural Non Agric. Head Savannah** | 58.8 | -46.8 | -9.9 | -62.4 | -61.7 | -30.5 | -7.1 | -2.1 | -0.7 |
| **Rural Non Agric. Head Forest** | 38.7 | -33.2 | 6.4 | -71.8 | -71.4 | 5.5 | 11.8 | 3.6 | 8.6 |
| **Rural Non Agric. Head Coast** | 31.9 | -69.7 | 6.6 | -86.1 | -84.4 | -38.5 | 13.1 | 13.1 | 4.1 |
| **Urban Unskilled** | 32.3 | -55.7 | -6.2 | -77.1 | -77.1 | -26.7 | 0.0 | 1.0 | 3.3 |
| **Urban Skilled** | 22.7 | -57.5 | 12.6 | -79.3 | -79.3 | -25.3 | 23.0 | 14.9 | 10.3 |
| **Accra Skilled Head** | 9.0 | -50.0 | 143.7 | -81.3 | -81.3 | -18.7 | 156.3 | 75.0 | 81.3 |
| **Accra Unskilled Head** | 20.1 | -82.2 | 11.1 | -93.3 | -93.3 | -60.0 | 22.2 | 13.3 | 11.1 |
| | | | | | | | | | |
| **Rural** | 52.1 | -26.3 | -12.5 | -68.7 | -68.2 | 8.1 | -7.1 | -7.1 | 0.6 |
| **Urban** | 24.9 | -59.2 | 7.3 | -79.9 | -79.9 | -30.2 | 15.4 | 9.2 | 9.5 |
| **Ghana** | 43.2 | -32.5 | -8.8 | -70.8 | -70.4 | 0.9 | -2.8 | -4.0 | 2.3 |

Note: shaded cells are those for which poverty index worsens. The computations are all carried out using a low poverty line.

Table 10 presents summary results for eight sets of experiments, in the same format as previously. The upper panel reproduce the results previously reported in Table 4, whereas the lower panel records a new set of results based on the non-parametric distribution of income and expenditure. The results show some interesting features. First, reflecting the different initial estimates of the poverty ratios, the benchmarks in the two panels of the table are clearly quite different. However, second, the percentage changes in the poverty ratios under the alternative experiments differ between the two panels, and in some cases quite markedly though not necessarily to the same degree, across household groups. But thirdly, the pattern showing poverty increases and poverty decreases is exactly the same in both panels. So the comparisons between the parametric and non-parametric approaches suggest differences in magnitude though not in direction.

## 6 Conclusions

This paper has set out to tackle a range of issues to do with analysing the impact of policy shocks in a CGE modelling framework. It is partly prompted by a debate between Sahn *et al* (1999) and De Maio *et al* (1999) about the general efficacy of the CGE modelling approach in this context. Our paper also represents a policy modelling application for the economy of Ghana, which has received a good deal of attention as a test-bed of economic reform in sub-Saharan Africa, but which has relatively little attention in terms of analysis of its poverty-reducing or poverty-enhancing outcomes. All the experiments are conducted under strict conditions to ensure the maximum degree of comparability. In particular, in assessing the effects of poverty-alleviating transfers we constrain the model to perform according to a revenue-neutral regime. This is important, not only to limit the simulation effects and to and gain transparency in the results, but also because recent evidence has shown that relaxing the government deficit may exacerbate rather than alleviate problems for Ghana.

Our results are preliminary but are clearly indicative of several broad conclusions. First, the results confirm our intuition that the financing rule matters. The poverty outcomes are very different according to which of the four rules (income taxation, corporate taxation, indirect taxes or tariffs) is chosen. The ranking is most likely going to be country-specific, and it varies according to whether we consider the short run or the long run. In our experiments, the long run results are unambiguous, the ranking of financing rules in terms of the largest poverty reductions are (1) tariffs (2) indirect taxes (3) corporate taxes and (4) household direct taxes. Because of the different exogenous shocks the short run rankings are less clear, except that there appears to be an increase in overall poverty under the corporate tax financing rule. In terms of the effects on different types of households the structure of the SAM provides us with important clues as to which socio-economic groups may gain relative to the others. Secondly, the factor market closures (roughly corresponding to the long run and the short run) are seen as being crucially important in determining the outcomes. The results are very different under the two closures. Insights have been gained through the introduction of a new decomposition procedure designed to provide more transparency in CGE analysis. Thirdly, tests have been conducted on the use of parametric (lognormal) and non-parametric approaches to coupling the distributional outcomes, and for measuring poverty ratios. Again, the results are most interesting; suggesting that while the outcomes appear different in terms of the magnitude of poverty change (in levels and percentages), the direction of change across household groups is the same whether the parametric or non-parametric approach is used.

Overall the results confirm that while some households do gain from poverty-alleviating income transfers the general equilibrium effects of these shocks mean that there will be losers too. What is particularly intriguing is the degree of variation in outcomes across different socio-economic household groups. Not surprisingly, in the short run, when resources are more likely to be constrained poverty actually increases for many households under some financing rules. Is this a robust result, or is it entirely conditioned by our data and model specifications? This, and other questions await further analysis.

## References


Adelman, I. and S. Robinson (1978) *Income Distribution Policies in Developing Countries*, Stanford University Press: California.

Boateng E. O., K. Ewusi, R. Kanbur and A. McKay (1990) 'A Poverty Profile for Ghana, 1987-88', *SDA, Social Dimensions of Adjustment in Africa*, Working Paper No 5, World Bank: Washington D. C.

Chia, N-C., S. M. Wahba and J. Whalley (1994) 'Assessing Poverty-reducing Programmes: a General Equilibrium Approach', *Journal of African Economies*, 3(2): 309-338.

Cockburn, J. (2001) ‘Trade Liberalisation and Poverty in Nepal: A Computable General Equilibrium Micro Simulation Analysis’, Discussion Paper 01-18, CRIFA, Université of Laval.

Colatei, D. and J. I. Round (2000) ‘Poverty and Policy: Experiments with a SAM-based CGE Model for Ghana’, paper presented to the XIII International Conference on Input-Output Techniques, Macerata, Italy (August).

Decaluwé, B. A. Party, L. Savard and E. Thorbecke (1999) ‘Poverty Analysis Within a General Equilibrium Framework’, CRÉFA, Département d’economique, Université of Laval, Working Paper 9909.

Devarajan, S. and S. Robinson (2002) ‘The Impact of Computable General Equilibrium Models on Policy’, paper presented to the conference ‘Frontiers in Applied General Equilibrium Modelling’, Cowles Foundation, Yale University (April).

De Maio L., F. Stewart, S. van der Hoeven (1999) 'Computable General Equilibrium Models, Adjustment and the Poor in Africa', *World Development*, 27(3): 453-470.

Demery D. and L. Demery (1992) *Adjustment and Equity in Malaysia*, OECD Development Centre, Paris.

Dervis, K., J. de Melo and S. Robinson (1982) *General Equilibrium Models for Development Policy*, Cambridge University Press and the World Bank: Washington D.C.

Dorosh, P. A. and D. E. Sahn (2000), 'A General Equilibrium Analysis of the Effect of Macroeconomic Adjustment on Poverty in Africa', *Journal of Policy Modelling*, 22 (6), 753-76.

Haddad, L. and R. Kanbur (1990) 'How Serious is the Neglect of Intra-household Inequality?', *Economic Journal*, 100: 866-881.

Powell M. and J. I. Round (1998) 'A Social Accounting Matrix for Ghana: 1993', Ghana Statistical Service, Accra.

Robinson S (1989) ) 'Multisectoral Models', chapter 18 in Chenery and Srinivasan (Eds) *Handbook of Development Economics*, Vol II, North Holland; 885-947.

Robilliard, A-S, F. Bourguignon and S. Robinson (2001) 'Crisis and Income Distribution: A Micro-Macro Model for Indonesia', mimeo, World Bank, DIAL, and IFPRI.

Sadoulet E. and A. de Janvry (1995) *Quantitative Development Policy Analysis*, Johns Hopkins University Press.

Sahn D., P. A. Dorosh and S. D. Younger (1997) *Structural Adjustment Reconsidered: Economic Policy and Poverty in Africa*, Cambridge University Press.

Sahn D., P. A. Dorosh and S. D. Younger (1999) 'A Reply to De Maio, Stewart and van der Hoeven', *World Development*, 27(3): 471-475.

Sarris, A. H. (1990) *A Micro-Macro Framework for Analysis of the Impact of Structural Adjustment*, Cornell University, Ithaca, New York.

World Bank (1990) *Making Adjustment Work for the Poor*, World Bank, Washington D.C.

# Appendix: Structural features based on the Ghana SAM, 1993

## Table A1: Ghana's economic structure (percentages)

| | Gross Prod XP | Labour VA | Kap VA | K / L | Hh demand | Govern. Dem | Invest. Dem | Exp Supply X | Imp Demand M | Exp Intens. X / XP | Imp Intens. M / Tot D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Agri. Forest & Fish. Products | 26 | 39 | 14 | 13 | 39 | 0 | -17 | 25 | 6 | 12 | 6 |
| Ores, Min., Elect., Gas Water | 10 | 4 | 29 | 252 | 5 | 0 | 1 | 41 | 6 | 55 | 24 |
| Food, Bev.,Textiles, Leath. | 17 | 17 | 8 | 16 | 26 | 0 | 22 | 0 | 13 | 0 | 16 |
| Other Non Metal Prod. | 10 | 5 | 5 | 37 | 8 | 0 | -17 | 15 | 8 | 20 | 19 |
| Metal Prod, Machinery | 3 | 3 | 1 | 17 | 4 | 0 | 68 | 5 | 45 | 20 | 80 |
| Construction Work | 8 | 5 | 16 | 106 | 2 | 0 | 43 | 0 | 0 | 0 | 0 |
| Transp. Comm. Trade Serv. | 7 | 5 | 7 | 54 | 5 | 0 | 0 | 12 | 8 | 21 | 25 |
| Business Services | 7 | 5 | 12 | 83 | 8 | 2 | 0 | 0 | 14 | 0 | 34 |
| Personal and Other Services | 12 | 16 | 7 | 16 | 4 | 98 | 0 | 1 | 0 | 1 | 0 |
| **Economywide** | **100** | **100** | **100** | **36** | **100** | **100** | **100** | **100** | **100** | **13** | **24** |

Source: authors' calculations based on the revised Ghana SAM for 1993

## Table A2: Labour sectoral intensity

| | Skill Male | Unsk. Male | Skill Female | Unsk. Female | Inf.Skill Male | Inf.Unsk. Male | Inf.Skill Female | Inf.Unsk. Female | All Skills |
|---|---|---|---|---|---|---|---|---|---|
| | **Value Added structure by Sector** | | | | | | | | |
| Agri. Forest & Fish. Products | 2 | 18 | 0 | 8 | 12 | 64 | 3 | 42 | **37** |
| Ores, Min., Elect., Gas Water | 4 | 7 | 6 | 3 | 16 | 1 | 22 | 4 | **6** |
| Food, Bev.,Textiles, Leath. | 2 | 9 | 2 | 13 | 13 | 22 | 10 | 29 | **18** |
| Other Non Metal Prod. | 3 | 6 | 3 | 8 | 13 | 4 | 17 | 12 | **8** |
| Metal Prod, Machinery | 2 | 2 | 3 | 4 | 15 | 1 | 20 | 5 | **6** |
| Construction Work | 2 | 9 | 0 | 4 | 0 | 1 | 0 | 0 | **2** |
| Transp. Comm. Trade Serv. | 8 | 20 | 3 | 3 | 8 | 2 | 8 | 1 | **5** |
| Business Services | 12 | 6 | 11 | 12 | 15 | 1 | 19 | 3 | **6** |
| Personal and Other Services | 65 | 24 | 71 | 45 | 8 | 4 | 1 | 3 | **11** |
| **Economywide** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** | **100** |
| | **Value Added structure by Skill** | | | | | | | | |
| Agri. Forest & Fish. Products | 0 | 5 | 0 | 0 | 1 | 64 | 1 | 27 | **100** |
| Ores, Min., Elect., Gas Water | 3 | 11 | 3 | 1 | 7 | 5 | 57 | 13 | **100** |
| Food, Bev.,Textiles, Leath. | 1 | 5 | 0 | 1 | 2 | 44 | 9 | 38 | **100** |
| Other Non Metal Prod. | 1 | 7 | 1 | 2 | 4 | 16 | 32 | 35 | **100** |
| Metal Prod, Machinery | 2 | 4 | 1 | 1 | 7 | 8 | 55 | 22 | **100** |
| Construction Work | 6 | 58 | 0 | 4 | 1 | 28 | 2 | 1 | **100** |
| Transp. Comm. Trade Serv. | 6 | 43 | 1 | 1 | 4 | 14 | 24 | 5 | **100** |
| Business Services | 8 | 11 | 5 | 4 | 7 | 4 | 50 | 11 | **100** |
| Personal and Other Services | 28 | 25 | 17 | 9 | 2 | 12 | 1 | 7 | **100** |
| **Economywide** | **5** | **11** | **3** | **2** | **3** | **37** | **16** | **24** | **100** |

Source: authors' calculations based on the revised Ghana SAM for 1993

## Table A3: Households – basic statistics

| HH groups | Pop. % | Income % | PerCapY 10^9 cedis |
|---|---|---|---|
| Rural Farmer Head Savannah | 18 | 10 | 0.13 |
| Rural Farmer Head Forest | 19 | 17 | 0.21 |
| Rural Farmer Head Coast | 7 | 5 | 0.19 |
| Rural Non Agric. Head Savannah | 6 | 5 | 0.19 |
| Rural Non Agric. Head Forest | 11 | 14 | 0.31 |
| Rural Non Agric. Head Coast | 8 | 9 | 0.29 |
| Urban Unskilled | 16 | 16 | 0.24 |
| Urban Skilled | 8 | 11 | 0.31 |
| Accra Skilled Head | 3 | 7 | 0.56 |
| Accra Unskilled Head | 4 | 6 | 0.34 |
| All population | 100 | 100 | 0.24 |

Source: authors' calculations based on the revised Ghana SAM for 1993

## Table A4: Households - income distribution

| **Across Households percentages** | Skill Male | Unsk. Male | Skill Female | Unsk. Female | Inf.Skill Male | Inf.Unsk. Male | Inf.Skill Female | Inf.Unsk. Female | All Skills | Capital | Factor Income | Corp. distrib. Y | Gov. Transf. | Row Transf. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rural Farmer Head Savannah | 0 | 0 | 1 | 0 | 0 | 17 | 2 | 8 | 6 | 0 | 6 | 22 | 4 | 11 |
| Rural Farmer Head Forest | 0 | 2 | 3 | 4 | 0 | 26 | 4 | 18 | 11 | 0 | 11 | 32 | 11 | 36 |
| Rural Farmer Head Coast | 0 | 1 | 0 | 0 | 0 | 7 | 2 | 11 | 4 | 0 | 4 | 8 | 4 | 11 |
| Rural Non Agric. Head Savannah | 8 | 6 | 4 | 0 | 7 | 5 | 4 | 5 | 5 | 0 | 5 | 3 | 2 | 4 |
| Rural Non Agric. Head Forest | 16 | 22 | 9 | 12 | 15 | 13 | 11 | 15 | 15 | 0 | 15 | 13 | 15 | 18 |
| Rural Non Agric. Head Coast | 8 | 15 | 4 | 3 | 5 | 5 | 20 | 15 | 11 | 0 | 11 | 2 | 7 | 3 |
| Urban Unskilled | 2 | 33 | 8 | 31 | 1 | 20 | 18 | 15 | 18 | 0 | 18 | 10 | 20 | 7 |
| Urban Skilled | 33 | 0 | 28 | 5 | 53 | 0 | 25 | 1 | 13 | 0 | 13 | 6 | 17 | 1 |
| Accra Skilled Head | 32 | 0 | 38 | 9 | 20 | 0 | 9 | 3 | 9 | 0 | 9 | 3 | 14 | 4 |
| Accra Unskilled Head | 0 | 20 | 5 | 36 | 0 | 5 | 4 | 9 | 8 | 0 | 8 | 0 | 7 | 6 |
| | | | | | | | | | | | | | | |
| **Across Income sources percentages** | Labour Categories' Income as % of Total Labour Income | | | | | | | | Lab. Y as % of Factor Y | Cap. Y as % of Factor Y | Factor Y as % of Tot Y | Corp. Y as % of Tot Y | Gov. Transf. % of Tot Y | Row Transf.% of Tot Y |
| Rural Farmer Head Savannah | 1 | 1 | 1 | 0 | 0 | 70 | 6 | 21 | 100 | 0 | 45 | 49 | 0.3 | 5 |
| Rural Farmer Head Forest | 1 | 3 | 1 | 1 | 0 | 59 | 7 | 28 | 100 | 0 | 47 | 42 | 0.4 | 10 |
| Rural Farmer Head Coast | 0 | 3 | 0 | 0 | 0 | 42 | 9 | 46 | 100 | 0 | 56 | 34 | 0.4 | 9 |
| Rural Non Agric. Head Savannah | 18 | 19 | 4 | 0 | 6 | 24 | 13 | 17 | 100 | 0 | 83 | 13 | 0.3 | 4 |
| Rural Non Agric. Head Forest | 13 | 24 | 3 | 2 | 5 | 22 | 13 | 18 | 100 | 0 | 74 | 20 | 0.6 | 6 |
| Rural Non Agric. Head Coast | 8 | 21 | 2 | 1 | 2 | 11 | 32 | 23 | 100 | 0 | 92 | 6 | 0.5 | 1 |
| Urban Unskilled | 1 | 30 | 2 | 4 | 0 | 28 | 18 | 15 | 100 | 0 | 82 | 15 | 0.8 | 2 |
| Urban Skilled | 30 | 0 | 11 | 1 | 20 | 1 | 36 | 2 | 100 | 0 | 86 | 13 | 0.9 | 1 |
| Accra Skilled Head | 42 | 0 | 21 | 3 | 11 | 0 | 19 | 5 | 100 | 0 | 87 | 9 | 1.1 | 3 |
| Accra Unskilled Head | 0 | 40 | 3 | 12 | 0 | 15 | 10 | 20 | 100 | 0 | 94 | 1 | 0.6 | 5 |
| All Households | 12 | 16 | 5 | 3 | 5 | 24 | 18 | 17 | 100 | 0 | 100 | | 1 | 5 |

Source: authors' calculations based on the revised Ghana SAM for 1993