

Impacts of Public Policy on Poverty in Arab Countries: Review of the CGE Literature^{*}

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Abstract*

Poverty impacts of public policies as well as public policies designed to alleviate poverty in developing countries are increasingly drawing both domestic and international attention. This paper provides a review of some of the contemporary developments in the CGE-related literature on poverty. A specific focus in the paper is with respect to the status of poverty-related CGE work on Arab countries. Drawing on the literature and the particular situation in Arab countries, the paper provides a general framework to guide country studies aiming at assessing public policy impacts on poverty in the Arab region.

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1. Introduction

Over the last two decades, developing countries have witnessed major macroeconomic shocks that have had significant impacts on the level of poverty and the distribution of incomes in these countries. Some of these shocks are the result of fluctuations in the world prices of crucial developing countries export products, whereas others are endogenously produced by economic policy reforms such as structural adjustment programs and trade liberalization that have been implemented by these countries during the period.

Quantifying and assessing the size of these impacts as well as designing public policies to mitigate them are now among the top national issues in the debate around economic policy reforms in developing countries. Further, many multilateral agencies, such as the World Bank and the International Monetary Fund (IMF) started to condition their funding operations in developing countries on the progress achieved nationally with respect to poverty reduction policies and measures. In particular the preparation of Poverty Reduction Strategy Papers (PRSPs) to meet the World Bank funding conditions for some developing countries requires the assessment and the quantification of the impacts of economic policies to be taken on the poor. This requires answering important policy questions such as how specific changes in public spending or the delivery of public goods, particularly education, infrastructure, and health affect the poor? What is the poverty impact of structural reforms such as tax policy, trade policy, and privatization? How inflation and exchange rate management affect poverty? and what are the poverty impacts of exogenous shocks such as price and capital flows fluctuations, and emergences of financial crises?.

Answering such questions necessarily requires the development of economic tools that are capable of linking the macroeconomic structure with the microeconomic behavior. Computable General Equilibrium (CGE) models provide one of these tools. These models have been used widely to simulate the impacts of exogenous shocks and changes in policies on the socioeconomic system including households welfare and income distribution. Some good examples of such applications in developing countries are Adelman and Robinson (1979) for Korea, Dervis, de Melo and Robinson (1982) for Kenya, Thorbecke (1991) for Indonesia, De Janvry, Sadoulet and Fargeix

(1991) for Ecuador, Morrisson (1991) for Morocco, Chia, Wahba and Whelley (1994) for Côte d'Ivoire, Löfgren et al. (1999) for Morocco and Cogneau and Robilliard (2000) for Madagascar.

There are two approaches used to address the question of poverty and income distribution within the CGE framework. The first and the most common one is the representative household (RH) approach in which the household agent is disaggregated according to socioeconomic or geographical criteria and where the solution from the CGE model is sequentially augmented with household survey data to simulate poverty and inequality indices (Decaluwe et al. (1999), Hertel et al. (2001), Stifel and Thorbecke (2003)). The main shortcoming of this approach with respect to poverty analysis is its assumption that income distribution within the groups represented by the household agents is not affected by the policy shock. The other approach is the micro simulation (MS) approach in which the household agents in the CGE model correspond to the observed individual households in a survey (Cogneau and Robilliard, 2000). By endogenizing intra-group distributions, this approach effectively circumvents the shortfalls of the RH approach, but on the other hand it creates significant demands in terms of data, statistical procedures and modeling that may not be affordable in a developing country context. The first objective of this paper is to review and compare the various versions of these two approaches with special emphasis on data requirements, applicability to developing countries, and on how public policy targeting poverty may be modeled and assessed within the CGE framework.

The situation in the Arab countries with respect to vulnerability, poverty, and economic reform policies is not different from that prevailing in other developing countries. Indeed, faced by acute economic imbalances during the 1980s, many Arab countries have embarked the path of economic reforms and structural adjustment programs (Sudan in 1983, Morocco in 1983, Tunisia in 1987, Jordan in 1989, Egypt in 1991 and Algeria in 1995) with the help of the international financial institutions. The implementation of these reforms, however, has invoked wide concerns on their socioeconomic and political implications and increased the calls for public policies to correct their detrimental effects on poverty and income distribution. A second objective of this paper is to review the available CGE studies that were undertaken to

address the poverty impacts of economic policies in the Arab region. The emphasis in this review will be more on methodology and data availability than on the specific results of these studies.

Thus the overall objective of this paper is rather a pedagogical one in the sense that the paper aims at drawing a road map for how poverty analysis might be conducted within a CGE framework for a typical developing country. The rest of the paper is organized as follows. Section 2 reviews model construct and outlines the poverty analysis methodologies within the CGE framework, section 3 reviews contemporary CGE literature on poverty in Arab countries, section 4 suggests a framework for modeling public policy impacts on poverty taking into consideration existing data gaps in Arab countries, and section 5 concludes.

2. Computable General Equilibrium Modeling and Poverty

2.1 Overview

An analysis of the impacts of economic policy on poverty and income distribution requires an economy-wide framework that includes considerable details on household income and expenditure patterns. The conventional CGE construct provides a starting point for this framework. A CGE model is a simultaneous system of non-linear equations that characterizes the general equilibrium in an economy. Typically such a system is calibrated on a Social Accounting Matrix (SAM), which is a comprehensive accounting framework that incorporates all major transactions within a socioeconomic system in a given year (Pyatt et al. (1977), Pyatt and Round (1979)). The structure, the level of disaggregations, and the scope of a CGE model usually depend on the type of questions to be answered by the model. Accordingly there is a spectrum of model structures including static vs. dynamic, single sector vs. multisectoral, single region vs. multiregional, and single agent vs. multiagents CGE models. For the purpose of poverty analysis, the CGE model should include as much disaggregation as possible of the household sector and the factors of production accounts to represent the pre-existing heterogeneity with respect to the sources and uses of incomes. This usually requires augmenting the model database with survey data on household income and expenditure characteristics. To simulate the impacts of a policy shock, the CGE model is first solved to generate the SAM (Static) or a

projected baseline (Dynamic) as an initial solution path. Next, the model is solved for the counterfactual policy shock and the results are usually reported as percentage deviations from the initial solution. For poverty analysis, poverty measures are computed either endogenously (MS approach) or exogenously following the solution of the CGE model (RH approach).

2.2 The Structure of SAM

The Social Accounting Matrix (SAM) provides an accounting as well as a conceptual framework for understanding the impact of economic policies on poverty. This is because the SAM framework includes all the major socioeconomic relationships that would be affected by the policy shock besides an organizational setup for classifying and discussing the actual components that would be included in a CGE model.

Table 1 outlines the basic structure of a SAM, in which each account is represented by a row displaying the receipts and a column displaying the expenditures of the corresponding account. There are six accounts in SAM; factors of production, institutions (households, companies, government), capital account, production activities, and the rest of the world (ROW) account. Factors account receives, factor earnings from production activities and ROW, and allocates them to households and companies. Institutions receive incomes from factors account and from domestic and foreign transfers and spend them on tax payments, consumption, and transfers, with the residual constituting net savings. Production activities account generates receipts from sales to households, government, capital account, other production activities and to the rest of the world and spends on value added payments to factors, indirect taxes and purchases of domestic and imported raw materials. The capital account receives savings from households, companies, and the government, and net capital flows from abroad and uses its receipts to purchase domestic and foreign investment goods. The rest of the world account generates receipts from factor earnings, transfers and exports and spends on factor payments, transfers and imports with the residual being the net capital outflow (foreign savings).

Table 1. Basic SAM Structure

Receipts		Expenditures								
		Activities	Commodities	Factors	Institutions				Rest of the World (RoW)	Total
					Households	Enterprises	Government	Capital		
Activities			Domestically marketed outputs		Home-consumed outputs		Export subsidy		Exports	Production
Commodities		Intermediate inputs			Private consumption		Government consumption	Investment		Domestic demand
Institutions	Factors	Value-added							Factor income from RoW	Factor income
	Households			Factor income to households	Inter-households transfers	Distributed profits to households	Transfers to households		Transfers to households from RoW	Household income
	Enterprises			Factor income to enterprises		Undistributed profits	Transfers to enterprises		Transfers to enterprises from RoW	Enterprise income
	Government	Producer taxes, value-added tax	Sales taxes, tariffs	Factor income to government, factor taxes	Transfers to government, direct household taxes	Surplus to government, direct enterprise taxes			Transfers to government from RoW	Government income
Capital					Household savings	Enterprise savings	Government savings		Foreign savings	Savings
Rest of the World (RoW)			Imports	Factor income to RoW		Distributed profits to RoW	Government transfers to RoW			Foreign exchange outflow
Total		Activity expenditures	Domestic supply	Factor expenditures	Households expenditures	Enterprise expenditures	Government expenditures	Investment	Foreign exchange inflow	

Among these, the most important endogenous accounts with respect to poverty analysis are the factors of production account, the households account, and the production activities account. Indeed, the key to poverty analysis is the mapping from the factorial income distribution to the household income distribution. Therefore, the more disaggregated these two accounts the better suited the given SAM for poverty analysis. In contrast, the only truly exogenous account in the context of economic policy impacts on poverty is the government account. This is obvious, since any policy measures such as structural adjustment, trade liberalization or policies to alleviate poverty will be carried through this account. For example, a reduction in government expenditure would effect transfers and subsidies to households and government expenditure on education, health and infrastructure. A trade liberalization regime, in contrast, could lead to an increase in domestic taxes to compensate the government for the loss of tariff revenues.

On the other hand, exogenous economic shocks such as terms of trade and capital flows volatilities will be transmitted into the SAM framework through the rest of the world account. In that sense and with the trade assumption of small open economy, the rest of the world account may be largely considered as exogenous. Alternatively, when the government actively engages in trade policies such as trade liberalization and foreign exchange management, the rest of the world account may be considered as endogenous even with the assumption of small open economy.

The investment-saving account can be viewed either as exogenous or endogenous, depending on the time horizon and the type of the policy shock in question. In the static context, investment is usually considered as exogenous whereas in a dynamic context and where the policy shock is likely to affect the structure of the economy, e.g. a policy associated with structural adjustment, the investment account should be treated as endogenous.

As an organizational tool, SAM provides an orderly way of identifying the main components of a CGE model. These modules include production and technology, household income and expenditure account, investment-savings behavior, foreign trade and balance of payment account, and the government activity account.

2.3 Income Distribution and Measurement of Poverty

2.3.1 *Income distribution*

Knowledge of income distributions within and between socioeconomic groups is essential for conducting analysis of poverty incidence. Fine disaggregation of the household sector in SAM into homogenous groups is a first step towards this goal. Three main criteria seem important in classifying households: location, endowment and wealth, and occupation. Different researchers have adopted different schemes of classifications. For example Decaluwé et al. (1999) used a hybrid location – education – ownership criterion to divide the households into rural land-less, small landowner, large landowner, urban low-education, urban high-education, and capitalist households. Löfgren and El-Said (1999) used a location-income criterion classifying the Egyptian households into rural and urban groups disaggregated by quintile. Hertel et al. (2001) classified households, in a cross-country study of trade liberalization effects on poverty, according to the sources of income into households relying exclusively on transfers, self-employed households in agriculture, self-employed households in non-agricultural enterprises, wages/salaries earners, and diversified-income households. Stifel and Thorbecke (2003) adopted a location-employment criterion and accordingly classified their households into the six groups: rural small-holders, rural unskilled, rural skilled, urban informal, urban unskilled and urban skilled.

Alarcon et al. (1986) argued that the classification scheme should meet the following criteria to be useful for policy analysis: (a) consists of relatively homogenous groups; (b) be composed of groups that are recognizable for policy purpose; and (c) be based on comparatively stable characteristics that are easily identifiable and measurable.

Nevertheless, even if it is possible to disaggregate the household sector in the SAM following the preceding lines, a model based on such a structure will not be able to assess poverty incidence. This is because a model with such a structure may only explain the determination of mean incomes and inter-group income inequalities but not the intra-group income distribution, which is necessary for poverty analysis. Hence, it is necessary to augment the SAM database with additional outside information on intra-group income distribution. One source for this additional

information is household micro surveys, which by now are available for many developing countries from national and international sources. Provided that it is complete and compatible with the SAM, the survey information on intra-group distributions may either be integrated directly into SAM, so that the model will endogenously generate the post-shock intra-group distributions, or be augmented with the solution from the model to characterize the poverty incidence of the policy shock exogenously.

Unfortunately, complete and compatible intra-group distributions based on household survey data may not be possible in many cases. This is due to either data gaps and incomplete coverage of the survey or to differences in statistical procedures, classification, and time lags between the survey and the given SAM. In cases where satisfactory intra-group distributions can not be generated from the survey data or when survey data are unavailable, resort is made in the poverty literature to the statistical theory.

There are a number of studies in the CGE literature that made use of this approach to assess the impact of economic policies on poverty. The earliest attempt is by Adelman and Robinson (1979), who used a lognormal model to simulate the intra-group income distributions in their study. De Janvry et al. (1991) used both the lognormal and the Pareto distribution functions to depict the income distribution of each household group in their model. The properties of the constructed intra-group distributions for some groups in these two studies are, due to the restrictiveness of these functional forms, are however, not satisfactory. The latter literature (e.g. Decaluwé et al. (1999), Stifel and Thorbecke (2003), and AKA (2003)) attempts to use more flexible functional forms such as the Beta distribution.

The Beta distribution is a flexible functional form that is characterized by three arguments: the minimum, the maximum, and the skewness. For the case of income distribution, the Beta density function has the form:

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

$$\text{where } \beta(p, q) = \int_{\min}^{\max} \frac{(y - \min)^{p-1} (\max - y)^{q-1}}{(\max - \min)^{p+q-1}} dy$$

Unlike the lognormal, the Beta function can be skewed to the left or to the right and can be symmetric. If $p > q$ the distribution is skewed to the left. If $p < q$ the distribution is skewed to the right and is symmetric if $p = q$ ¹. In applied work the main problem with the Beta distribution is that in the absence of a survey data, from which p and q can be estimated, the choice of these parameters is adhoc.

2.3.2 Measurement of Poverty

Given the intra-group income distributions a number of poverty indices may be computable (Ravallion, 1994). The most widely used class of poverty indices in the literature is the FGT, following Foster, Greer and Thorbecke (1984). The FGT indicators, denominated p_α , belong to a class of additively decomposable poverty measures. These indicators allow the measurement of the proportion of poor population (the headcount ratio) as well as the depth and the severity of poverty at both the group and the national levels.

The FGT poverty measure is defined as:

$$P_\alpha = \frac{1}{n} \sum_{i=1}^q \left(\frac{z - y_i}{z} \right)^\alpha \quad (2)$$

where n is the total number of individuals under consideration, q is the total number of poor, y is the income of the i th poor individual, z is the poverty line, and α is a parameter characterizing the degree of poverty aversion.

For z , most of the literature uses the national absolute poverty line. The absolute poverty line can either be assumed as exogenous in the analysis, e.g. using the one or two dollars World Bank estimates adjusted or unadjusted for purchasing

¹ These conditions are true only if both p and q are greater than one.

power, or generated endogenously using the national basket of basic needs and the commodity prices generated by the CGE solution, i.e.

$$Z = \sum_{com} \omega_{com} PC_{com} \quad (3)$$

where ω is the basket of basic needs and PC is consumer price of the corresponding commodity.

The value of α in (2) can be specified exogenously by the policy maker. For $\alpha = 0$, the poverty index becomes the headcount ratio,

$$P_0 = \frac{q}{n}$$

As is obvious the P_0 implies a complete insensitivity of the measure to the degree of poverty. When $\alpha = 1$,

$$P_1 = \sum_{i=1}^q \frac{(z - y_i)}{nz}$$

which reflects the poverty depth in the sense that it measures the total additional incomes necessary to bring every poor to the poverty line in proportion to the total incomes needed to support the poverty line income as an average income for the population.

Finally, for $\alpha > 1$, the weight assigned to the poor individual increases with the income gap. In the case $\alpha = 2$, each of the poors is given a weight in proportion to the shortfall of his/her income from the poverty line, i.e.,

$$P_2 = \sum_{i=1}^q \frac{(z - y_i)^2}{nz^2}$$

An important property of the FGT index is that it is additively decomposable among population subgroups, allowing a consistent quantitative mapping from changes in subgroup poverty to changes in aggregate poverty. Hence the poverty

impacts of a given policy may first be assessed at the subgroup level and then mapped to the aggregate level using the subgroup relative population shares as weights, i.e.,

$$P_{\alpha} = \sum_{g=1}^k \frac{n_g}{n} P_{g,\alpha}, \quad \sum_{g=1}^k n_g = n$$

where $P_{g,\alpha}$ is the FGT subgroup poverty index. Some authors (e.g., Jensen and Tarp, 2003) have considered renormalizing the subgroup FGT indices (dividing by subgroup population) to ease comparability of poverty intensities across the different socioeconomic groups in the population.

Ravallion and Huppi (1991) extends the FGT decomposition to account for inter-group migration. The change in national poverty measures between the baseline and the policy simulation is accordingly decomposed into the sum of subgroup poverty changes at the baseline population shares, plus the sum of changes in subgroup poverty arising from migration at the baseline, plus the sum of poverty changes arising from the correlation between the policy shock and migration:

$$P_{\alpha}^s - P_{\alpha}^B = \sum_g (P_{g,\alpha}^s - P_{g,\alpha}^B) POP_g^B + \sum_g (POP_g^s - POP_g^B) P_{g,\alpha}^B + \sum_g (P_{g,\alpha}^s - P_{g,\alpha}^B) (POP_g^s - POP_g^B)$$

where POP is the population share, s is the policy simulation, and B is the baseline.

When the Beta distribution is used to characterize the intra-group income distributions, the FGT poverty measure will have the form (Decaluwé et al. (1999)):

$$P_{\alpha} = \int_{\min}^z \left(\frac{z-y}{z} \right)^{\alpha} f(y; p, q) dy \quad (4)$$

2.4 The Standard General Equilibrium Model

The Conventional CGE model follows the standard structure of SAM, adding to it the specification of technologies, macroeconomic balances, and the optimization behavior of the active decision units (Agents) in the economy. In its simplest form, the CGE model should describe production activities and technologies in the

economy, factor and commodity markets, the composition and the behavior of the household sector, the government activity, foreign trade and the balance of payment account. The level of disaggregation and the structural complexity in modeling these components depend on the nature of the study and the policy shocks in question. For poverty analysis, the detailed representation of the household block and the factor markets in the CGE model is of critical importance. This subsection provides a non-mathematical description of the main modules in the CGE model with particular emphasis on poverty analysis (For a complete mathematical description of a standard CGE model see www.ifpri.org).

2.4.1 Production Activities and Technologies

Producers are typically assumed to maximize profits subject to technologies and input prices. Technologies are usually assumed to exhibit constant returns to scale (CRS). Inputs and outputs are produced and sold in competitive markets with the result that output prices equal marginal costs.

To capture the effect of relative price changes on poverty, production activities should be distinguished with respect to at least the three following criteria: (a) whether the commodity is tradable or non-tradable; (b) the type of technology characterized by its labor and capital intensities; and (c) the form of organization, e.g. family business relying on family labor or a company relying on hired labor, formal sector or informal sector.

On the output side, production of tradable goods may be characterized by market segmentation, in which case goods are made either for the domestic market or for exports. In CGE models, this segmentation is represented by constant-elasticity-of-transformation (CET) production functions in which the elasticity of transformation determines the split of output between the domestic market and the export market in response to changes in relative prices.

On the input side, production technologies are usually specified by nested constant-elasticity-of substitution (CES) functions, in which input aggregates of similar substitutability are put together, e.g. on the top nest value-added and intermediate input aggregates are used in fixed proportions, and on the second nest the

value-added aggregate is represented by a CES function of primary factors. For agriculture, the inputs of land and water may further be bundled on a separate layer under the value-added aggregate along with fertilizers input to describe the technology specificity in developing countries irrigated agriculture. The possibility of multiple commodities in agricultural activities such as crop or livestock production needs to be considered in modeling these activities either by assuming that multiple outputs are produced in fixed proportions or by specifying a CET function to describe the trade off among these outputs.

The production elasticities as well as the other elasticities used in the CGE model are obtainable from various sources including econometric estimates, past studies, expert elicitations, and knowledge of the technology. It is always recommended that special care be exercised when borrowing elasticities from other studies and that extensive sensitivity analysis be performed on the crucial elasticities.

2.4.2 Factor Markets

Factor markets represent the primary channel for transmitting the impacts of economic policy to poverty. Hence, a more detailed and realistic representation of the factor markets in the CGE model is essential to carry out poverty analysis properly. A detailed representation requires distinguishing factors by type, quality, substitutability and by mobility. According to type and quality, the different factors (land, labor and capital) may be classified as follows:

- (a) Land and other natural resources may be classified by type, fertility, the size of holding, or/and by location.
- (b) Labor may be classified by occupation and skills, hired vs. self-employed, location (rural vs. urban), organization (formal vs. informal), education, and/or by sex.
- (c) Capital may be classified by origin (domestic vs. foreign), ownership (private vs. public), and/or by vintage or type of capital (e.g. old vs. new).

Factor substitutability within as well as across factor groups may differ according to the type of activity, e.g. for some production activities skilled labor is

more substitutable to capital than unskilled labor whereas for other activities skilled labor and capital may actually be compliments. A realistic representation of the factor markets, thus, also requires a careful distinction of degree of substitutability within and across the factor categories. In the CGE model this distinction is described through extending the nesting structure of the CES value-added aggregate.

As for mobility, some factors are mobile across production activities while others are sector-specific. For labor, skilled labor is mostly sector-specific whereas unskilled labor may move freely within as well as between the rural agricultural sector and the urban manufacturing and service sectors. Land is mostly sector-specific but may be allocated easily to different crop and livestock production activities. The new vintage of capital may be allocated to the various production activities and hence is mobile, whereas the old vintages are mostly sector-specific. For policy purposes, factor mobility is important for assessing poverty impacts of economic policies since the benefits or the costs of such policies would mostly accrue to owners of sector-specific factors such as the small land holders in the agricultural sector.

Alternative mechanisms for clearing the factor markets are used in the CGE literature. In the static context factor are treated as inelastically supplied, thereby the effects of policy shocks are transmitted through factor prices or/and unemployment to the affected socioeconomic groups. The widely used clearing mechanisms include the standard neoclassical full employment assumption with factor prices adjusting endogenously to clear the markets, possibly with a labor-leisure choice and voluntary unemployment; and the Keynesian fixed price regime with unemployment adjusting endogenously to clear the factor markets. In the dynamic context, the same mechanisms apply with factor supplies being updated exogenously (recursive models) or physical and human capital being accumulated endogenously (inter-temporal models).

2.4.3 Foreign Trade and Commodity Markets

Most CGE models focus on the merchandise side of the balance of payment account, i.e. the trade balance. The rest of the items in the current account such as transfers and invisible payments as well as the net capital flows are fixed or projected

exogenously in the CGE model. These exogenous accounts are usually denominated in the foreign currency and hence represent one channel through which foreign exchange policies, such as those associated with structural adjustment packages, would be transmitted to the rest of the economy. The trade account consists of the merchandise exports and imports. The small economy assumption means that exporters and importers have no influence on international prices, i.e. countries face horizontal export demand and import supply curves. The exports supply and the imports demand are determined endogenously by the optimization behavior in the CGE model. Given international export prices, exchange rate, domestic taxes and transaction costs, exporters maximize profits by deciding on how much to supply to the different export markets using the production technology in (2.4.1).

In particular, the greater the transformation elasticity the more responsive the exporters to changes in international prices and domestic export policies. Importers maximize profits by deciding on how much to import from the different markets given international import prices, the exchange rate, tariffs, transaction costs, and consumer preferences. The responsiveness of the importers and hence the effectiveness of domestic import policies will hinge on the Armington elasticity to be discussed soon. The implications of foreign trade and hence trade policies are important in conducting poverty analysis. Indeed both domestic tax and exchange rate policies have crucial differential income distributional impacts among the socioeconomic groups engaged in export, import, and import competing activities. In the CGE model the nature of these impacts depend on how the current account is closed. For a fixed level of the current account deficit, the balance of payment account is usually closed in CGE models by endogenizing the real exchange rate, i.e. the real exchange rate adjusts to equilibrate the supply and demand for foreign exchange in the economy. Alternatively, if the real exchange rate is fixed, then the current account deficit must be endogenized through permitting foreign borrowing and lending to take place in the CGE model.

In reality, however, many developing countries adopt a mixed regime of an administered foreign exchange in which the real exchange rate is partially fixed and partially flexible. Hence, predicting the poverty impacts of the typical structural

adjustment policies in developing countries requires careful modeling of the exchange rate regime.

The aggregate supply of goods in the economy consists of goods produced domestically and goods imported from foreign markets. Following Armington (1969), imperfect substitutability is generally assumed between commodities domestically produced and imported varieties of the same commodities as well as across imports from different origins. In CGE models this is usually represented by two-level nested CES structure, where on the top nest an elasticity governs the substitution between domestic and foreign goods and on the bottom nest another elasticity governs the substitution among goods from the different foreign origins. These elasticities are crucial for determining the responsiveness of imports demand to changes in international prices and domestic import policies, and generally referred to as the Armington elasticities. Technically, these elasticities help to dampen the effects of sharp movements in the terms of trade and insulate the domestic price system from the exogenous international price shocks.

On the demand side, aggregate absorption consists of private consumption, government consumption, intermediate input demands by industry, and investment demand. The supply-demand balance in the commodity markets is, in turn, achieved through the price mechanism. Market structure consideration could also be incorporated in the CGE model to add more realism to the representation of the commodity markets. Under constant returns to scale, sellers in perfectly competitive markets maximize profits by selling at prices equal to their marginal costs whereas sellers in imperfectly competitive markets maximize profits by selling at markups upon their marginal costs. The magnitude of the markup is determined by the demand elasticity and the number of firms in the market, the larger the number of firms and the higher the demand elasticity the smaller the markup.

2.4.4 Households

This module is the most important component in the poverty assessment exercise. The primary step is to disaggregate the household sector into as many homogenous socioeconomic groups as practically possible following any of the methods outlined in section (2.3). The key question is then the mapping from the

factorial income distribution to the household distribution. This is done by specifying the factor endowments for each household group (Agent) in the model. Next, non-factor incomes need also be mapped to the household groups. These incomes include government transfers, remittances from abroad (denominated in foreign currency), intra household transfers, and distributed profits from the business sector. In CGE models, these non-factor incomes are usually treated as exogenous flows. Among these non-factor incomes, government transfers clearly represent an important policy channel for alleviating poverty. The aggregate household income is used to pay direct taxes, make transfers, save, and to consume. Tax rates are represented in ad-valorem form in CGE models and may either be exogenous or be endogenously determined to meet a given government budgetary constraint. Transfers are usually treated as fixed shares of income. Household saving is either determined as a fixed share of income or endogenously determined in the CGE model to generate a total level of savings needed to finance a targeted aggregate investment level.

The household consumption bundle is usually modeled as a system of demand equations in the CGE model. Popular functional forms used in deriving the demand system include nested CES, Almost Ideal Demand System (AIDS), and the Linear Expenditure System (LES). Income and price elasticities are either estimated using household income and expenditure surveys or obtained from previous similar studies. By introducing fixed household expenses, the LES form is useful for representing non-homotheticity and income elasticities in the model. In LES the fixed expenses are inversely proportional to the level of household income and therefore are generally calibrated from the household income elasticities in the model. The level and the composition of these fixed expenses can differ from one household to another and thus it is distinct from the uniform fixed commodity basket used to define the national poverty line referred to in equation (3).

Finally, the optimization behavior deriving the demand system and the household module in the CGE model is that households maximize utility subject to their budget constraints.

2.4.5 *Government*

The government account is the main source of policy shocks in the CGE model. Hence for the analysis of public policy impact on poverty, this component is crucial. The government revenue mainly consists of transfers from the rest of the world (denominated in foreign currency) and taxes. Variety of taxes may be represented in the CGE model. These include direct taxes on household incomes, indirect taxes, sale taxes, export taxes, and import tariffs. Tax instruments are the main vehicle for carrying out economic policies and therefore are integral part of any structural adjustment package.

Foreign transfers are usually treated as exogenous in CGE models. In contrast, taxes may be treated exogenously in the CGE model or some taxes may be endogenously determined to meet a budgetary target, e.g., revenue neutral tax reforms.

Government expenditure consists of purchases of consumption and investment goods and transfers. Along the baseline government transfers to the household sector in the CGE model are fixed in real terms or as a share of GDP. Under the policy scenarios these transfers may be varied to target poor household groups in the model. In addition to transfers government may use price subsidies (negative taxes) or the coupon rationing system to target the poor. Alternatively, the government may change the level or the composition of its purchases of goods and services to alleviate poverty, e.g., its expenditure on education, health, and infrastructure. The modeling of government cash transfers and price and coupon subsidies in the CGE framework is mostly straight forward using the existing instruments in the government module. In contrast modeling the poverty impact of changes in government expenditure on education, health and infrastructure is a challenging exercise. The key difficulty is how to map the current government expenditure on these items to the different household groups in the model. This may require the difficult task of breaking down the current government capital expenditure by geographical regions and the estimation of benefit incidence ratios to map it to the socioeconomic groups in the model. Even if this is possible, two issues remain to be resolved. The first is the public goods element of the government provision and the second is the nature of the

capital element involved in such expenditure, the treatment of which would require a dynamic model.

Unfortunately, in spite of the importance of these issues for assessing poverty alleviation measures, only a few CGE studies have attempted to tackle them. One such study is Löfgren et al. (1999) which attempts to capture the effect of government education expenditure on the poor by applying an exogenous upgrading ratio to transfer the rural unskilled labor into the skilled category of labor in the model. The relative neglect of the government expenditure aspect in the contemporary CGE literature on poverty is due to the fact that most of the relevant CGE studies have focused on the poverty impacts of economic policies rather than on public policies specifically designed to target the alleviation of poverty. The usual practice in most CGE studies is, then, to treat the aggregate of government expenditures on goods and services as fixed in real terms or in relation to the GDP. The government account is then closed by targeting the budget deficit (savings) and endogenizing some tax instruments (usually the direct taxes on households) to meet the target.

2.4.6 Investment-Savings Behavior

This is the most unsatisfactory component in static CGE models, because the determination of the investment-savings behavior is conceptually a dynamic issue. In practice most CGE models treat government savings and the rest of the world savings (foreign borrowing) as fixed in real terms or in relation to a pre-specified aggregate investment level. In contrast, some models specify household savings as a fixed share of income and the economy is said to be savings driven whereas in other models household savings is endogenously determined to achieve a given aggregate investment target, in which case the economy is said to be investment-driven. In dynamic CGE models savings and investment are determined by the process of capital accumulation. In recursive dynamic models the exogenous growth rate of capital stock determines the investment target for the next period and hence the needed level of savings. In inter-temporal models the endogenous process of capital accumulation determines simultaneously the equilibrium rates of savings and investment in the model.

2.5 Measuring Poverty Impacts in CGE

2.5.1 *The Representative Household (RH) Approach*

To restate, the key to poverty analysis in CGE models is the availability of a detailed disaggregation of the household sector and the factors account in the SAM. In most cases, exogenous data linking factor earnings and household composition is needed to achieve this disaggregation. The solution of the CGE model generates for each representative household (RH) in the model data on incomes (disaggregated by source), quantities consumed, consumer prices, factors employment and factor earnings (factor prices and total earnings). Under the RH approach this data, augmented with additional information on the individual households belonging to each RH group, is fed into a separate household module, which generates the intra-group income distributions and computes poverty indices. The actual implementation of the procedure depends on whether the additional information is sufficient to generate the intra-group distribution or not.

When sufficient data to generate complete intra-group distributions is lacking, the practice is to use parametric probability models such as the lognormal or the Beta distributions to specify these intra-group distributions. The solution of the CGE model provides the household module with total income (or total consumption) for each representative household group and consumer prices. The household model, then, requires the additional data on: the exogenous national poverty line or the national basket of basic needs required to generate the poverty line endogenously using the simulated consumer prices, the size of each RH group to be used in computing mean incomes or consumption levels, and the dispersion of each intra-group distribution (the variance for the lognormal and the minimum and the maximum for the Beta distribution). The dispersion is typically assumed to be fixed across simulations and hence only the location of the intra-group distribution changes in response to a policy simulation. For each simulation these intra-group distributions are generated for all RHs and then summed horizontally to generate an overall income distribution for the economy.

The overall distribution along with the intra-group distributions are then used to generate poverty measures using the methodology of section (2.3).

In contrast, when a consistent, complete and disaggregated household survey data exists, use may be made of it in both the CGE model and the household module. In the CGE model the data may be used to disaggregate the household sector and the factor accounts. In the household module the survey data may be used to generate directly the intra-group distributions through mapping each survey observation into its corresponding RH group in the CGE model. As before CGE solution supplies the household module with data on total income (consumption) for each RH and consumer prices. The CGE solution for each policy simulation is used to update the initial intra-group distributions and the poverty line in the household module. Aggregate and group poverty measures are then computed in the usual way. The details of the treatment depend on the scope and the quality of the survey data.

One alternative is that the survey classification is consistent with the CGE household classification but only data on individual incomes or consumption spending, not necessarily consistent with the SAM totals, exist. For this case, intra-group distributions are updated by scaling each individual household consumption or income in the survey by the relative real change in consumption or income from the base level for the corresponding RH in the CGE model.

Alternatively, if the survey classification is only consistent with the factors classification in the CGE model, then the intra-group distributions in the household module are updated by scaling the survey household incomes by the relative changes in the real incomes of the factors corresponding to the survey observations in the CGE model.

2.5.2 The Micro Simulation (MS) Approach

Micro simulation is relatively a new technique in the CGE studies of poverty. The main objective of the approach is to integrate the household level data into the macroeconomic model, hence enabling the endogenous assessment of poverty incidence in the CGE model. The main advantage of the MS approach compared to the RH approach is, thus, the endogenization of the variances of the intra-group distributions. A first difficulty with the MS approach is the ability to find a representative household survey that is consistent with the macro data in the SAM. The second difficulty relates to the availability of computational resources and

solution algorithms that are capable of handling large scale models. This latter difficulty limits the use of the approach in practice to highly aggregated models with only a few thousands households.

When the proper survey data exists, the implementation of the approach is straightforward. First, the household sector and factor accounts in SAM are fully broken down to the level of the individual households in the survey using the survey income and consumption data after properly being adjusted to the population totals in SAM through applying the relevant sample weights in the survey.

The second step is to calibrate and solve the integrated CGE-MS model with the full households as agents in the model. The solution of model then generates the overall distribution of income or consumption along with the consumer prices needed to compute the national poverty line. Aggregate and group poverty measures are then computed in the usual way.

2.5.3 A Hybrid RH-MS Approach

When the survey data, though consistent with the SAM, is too large to be accommodated in a tractable CGE model, a sequential two-stage approach may be proposed. The objective of the approach is to reduce the size of the model and the same time preserve the endogeneity of the variances of the intra-group distributions.

In the first stage, a CGE model with as many representative household agents as practical is solved to generate prices, incomes and consumption levels for each agent to be used in the second stage MS models. In the second stage, a series of MS models, one for each RH group, are solved to generate intra-group distributions. In each MS model, factor earnings and other incomes are mapped from the RH agent to the MS individual households belonging to the agent using the household benchmark earnings data and the corresponding sample weights. Next, the MS model is solved as a partial equilibrium problem to determine the optimal individual consumption bundles subject to the exogenous prices, individual budget constraints, and the balancing constraint that the sum of individual consumption bundles equal the sample adjusted aggregate consumption bundle of the RH agent.

The solution of the MS along with the exogenous consumer prices generate an intra-group distribution of the consumption spending for the given household group, which can then be used to compute poverty measures in the usual way.

3. Contemporary CGE Literature on Poverty in Arab Countries

3.1 Overview

Poverty incidence and reduction strategies in Arab countries are getting more publicity, following the implementation of structural adjustment programs by many countries in the region during early 1990s. Rising unemployment, with rates in excess of 30% in some countries, and the deterioration in the living standards of the poor have been key Public Policy worries in the region. Indeed, in a number of the reforming countries in the region, the social cost of restructuring and downsizing associated with the structural adjustment programs appears to have been unevenly shouldered by the poor. In addition to the structural adjustment programs, the 1990s have also witnessed the accession of a number of Arab countries to the WTO agreement (Oman, Lebanon, Jordan, Mauritania, and Yemen) and a number of bilateral partnership agreements with the EU (Morocco, Tunisia, Egypt, Jordan, and Lebanon). Major elements in these agreements are tariff reforms, trade liberalization and market access, which would undoubtedly affect public revenues and the composition and the structure of foreign trade with clear implications on income distribution and poverty in these countries. In response, Public Policy in the region has taken active role in designing policy measures and strategies to address the adverse consequences of these developments on poverty. These measures and strategies range from the short-run focus on financial transfers, subsidies and social safety-net programs targeting the poor to the long-run focus on education, health, infrastructure, social security and labor market policies.

In fact, under the world bank poverty reduction program, eligible Arab countries, such as Yemen and Mauritania, have already posted their poverty reduction strategies papers (PRSP) on the world bank website, signaling the importance of the poverty issue in the region.

The ability to assess and quantify the poverty impacts of structural adjustment and trade policy reforms, on one hand, and to investigate the impact and the effectiveness of public policy on poverty reduction, on the other hand, is thus clearly needed to evaluate performance and guide future policy in the region. As indicated in the proceeding sections, CGE models are major vehicles for accomplishing this. CGE applications on public policy analyses in the Arab region are relatively recent, dating back to the early 1990s. Since then and with the help of international organizations, a few country studies have been conducted in the region. Almost all of these CGE studies, however, have a primary trade focus with minor or no emphasis on poverty. The leading examples are the CGE studies that have been sponsored by the world bank in connection with the EU-Mediterranean partnerships, e.g. Rutherford et al. (1993) for Morocco, Rutherford et al. (1995) for Tunisia, and Konan and Maskus (1997) for Egypt. Studies with explicit treatment of poverty in the CGE model are lacking. In contrast, the main examples of CGE studies that have more visible focus on poverty are an OECD sponsored study on Morocco by Morrisson (1991), studies conducted by the International Food Policy Research Institute (IFPRI) for Egypt (1999, 2001) and for Morocco (1999), and a study by Chemingui and Thabet (2001) for Tunisia. The following subsection reviews this latter group of studies.

Among the major obstacles that have been hindering the wide use of CGE models for the purpose of economic policy analyses in the region is the availability of proper country databases. With the exception of a few countries (Morocco, Tunisia, Egypt, Algeria, Jordan, and Kuwait) reasonably recent social accounting matrices data is lacking in the region. In many Arab countries, wide data gaps, large statistical discrepancies, and errors exist in the national accounting systems. Nevertheless, fair amount of progress in the various data areas seems to have been made with a number of countries starting, more recently, the process of updating or constructing SAMs for their economies, e.g. Oman, Qatar and Mauritania. In addition, a number of countries have conducted relatively recent household surveys that may be used for CGE analysis of poverty, e.g. Algeria (2000), Egypt (1999), Jordan (1997), Mauritania (1995), Morocco (1999), Tunisia (2000) and Yemen (1998). Further, handy numerical techniques are now available for the treatment of data gaps and the empirical estimation of social accounting matrices (Robinson and El-Said (1997)) that may be employed by CGE modelers to address data deficiencies in the region.

3.2 A Review of Country Studies with Poverty Focus

3.2.1 *Morocco*

Morocco is among the earliest Arab countries to start implementing structural adjustment and economic reform programs. The structural adjustment program was introduced in September 1983 in the face of a growing internal and external imbalances aggravated by stagnating economy coupled with a fall in phosphates prices and a drain on foreign exchange reserves.

The essential features of these programs include short-term stabilization measures such as fiscal and monetary restraints and exchange rate management, and medium to long-term structural measures such as tax reforms and trade and financial sector liberalization. Two CGE studies that have looked into these issues with a primary focus on poverty are Morrisson (1991) and Löfgren et al. (1999).

3.2.1 (a) *Morrisson (1991) Study*

i. Objective

The study reviews the performance of the Moroccan structural adjustment program and its impacts on employment, incomes, household living standards, and poverty in contrast to the impacts of alternative policy measures and a more focus on poverty.

ii. The CGE Model

A recursive dynamic macro-micro model that includes a representation of both the standard real side and the financial side of the economy. This representation is intended to capture the short-run effects of the stabilization measures and the medium-term effects of the structural adjustment policies. The model includes 6 production activities, 5 labor markets and 3 asset markets. The 6 production activities are primary exports, agriculture, consumer goods, intermediate and capital goods, non-traded formal goods, and informal non-agriculture. The household sector is categorized into 6 groups according to occupation and economic activity of which 3 groups are rural and the other 3 are urban. The 3 rural household groups are medium-to-large farmers, small farmers, and agricultural rural workers. The 3 urban groups are wage earners in the modern sector, entrepreneurs in the modern sector, and

informal sector workers. Incomes are mapped from factors to household groups with entrepreneurs owning the specific factor in the primary export sector and the greater part of the capital in the other sectors, in addition to their holding of foreign securities. Among the other household groups only medium-to-large farmers have capital and domestic securities. The informal production sector does not employ capital and uses labor as the only factor of production. Imperfect competition and mark-up pricing are allowed in the modern sector markets, whereas perfect competition and marginal-cost pricing are assumed in the other markets. The model is calibrated on the 1980 database and solved recursively for 1980-1986 in the base simulation.

iii. Modeling and Measuring Poverty

Poverty is accounted for in the CGE model through the detailed socioeconomic and geographical classification of the household sector and the detailed representation of the factor markets in the model. Income inequalities are measured by the Theil inter-group values. The poverty indices used are the head count measured by the percentage of the poor and poverty intensity measured by the poverty gap. The intra-group distributions are provided by the 1985 household expenditure survey. In measuring the poverty indices, intra-group variances are assumed to be constant, the national average number of 6 dependents is assumed for all household types, and the poverty line is taken as exogenous.

iv. Policy Scenarios

A base simulation with the adjustment policies that actually have been implemented is conducted for 1980-1986 to validate the model and to investigate the poverty impacts of the Moroccan structural adjustment program. Next, several stabilization scenarios are simulated for 1981 to test the poverty impacts of alternative policy measures that the Moroccan government could have introduced to reduce the current account deficit. These stabilization measures include public expenditure policies such as cuts in operating expenditure, capital expenditure, wages or public sector employment; fiscal measures such as increasing import tariffs or indirect taxes; and monetary policy options such as reducing money supply or devaluing the exchange rate.

v. Results

The main results from the base simulation with respect to poverty are the cut in social spending, a decrease in urban-rural income gap, an increase in poverty among urban households, and a decrease in poverty among rural households. Overall, both poverty indices showed national poverty to increase in 1983-1984 and to return to the base level in 1985-1986. The study attributes the smaller social cost of the Moroccan structural adjustment program to the good management of the program, the good rainfall in 1985 and 1986, and the increase in foreign remittances.

The results on the alternative stabilization scenarios showed that, among the different policy options, devaluation and wage cuts are the most effective shorter term measures for Morocco with respect to the different social criteria. Hence, the study underscores their use by the Moroccan government as major policy tools in its stabilization program during 1983-1984.

3.2.1 (b) Löfgren et al. (1999) Study

i. Objective

The study aims at assessing the distributional impacts of alternative trade and domestic policy scenarios for implementing the Moroccan-EU partnership agreement during the period 1998-2012.

ii. The CGE Model

A standard recursive dynamic general equilibrium model with a detailed sectoral representation. The detailed representation is intended to capture the various distributional aspects of trade liberalization. There are 45 production activities in the model, 38 rural and 7 urban. Most of rural production activities are either livestock or crop agriculture. All production activities use labor and capital as factor inputs. In addition to these two factors, agriculture also uses agriculture-specific factors such as land and water. Production technologies are represented by nested CES functions. Specific technology features such multiple commodity output, excess supply in abundant factors, and technique change are incorporated in the model. The model includes 7 types of factors: irrigated land, water, rainfed land, pasture, skilled labor, unskilled labor, and capital. There are four types of households: rural poor, rural non-poor, urban poor, and urban non-poor. The breakdown of the factor account and the

household sector in the initial SAM is based on data from various sources including disaggregated agricultural information from the Moroccan government and disaggregated population, consumption, and labor force data from the World Bank. A very detailed representation of foreign trade with particular emphasis on trade between Morocco and EU is incorporated in the model. Two international markets are distinguished, the EU and the rest of the world. The international trade assumption of small open economies is assumed to govern trade between Morocco and these two markets. An exception is the treatment of Moroccan agricultural exports to the EU market, where a dual-regime formulation is adopted. According to this formulation the EU responds negatively to a Moroccan price increase but purchases the same base-year quantity when the Moroccan price decreases. The model is calibrated on a disaggregated SAM for 1994, updated to the model base year of 1998, and solved recursively for the period 1998-2012. A cross-entropy technique is used to handle data gaps and reconcile the various data sources, as well as in disaggregating and balancing the SAM.

iii. Modeling and Measuring Poverty

Poverty concerns are expressed in the modeling framework through the detailed representation of the activities in the rural sector as well as in the disaggregation of the household sector and the factor accounts. With respect to measurement, no direct poverty measures are computed. Instead, policy impacts on poverty are assessed indirectly through the policy effects on factor incomes and household welfare.

iv. Policy Scenarios

The policy simulations are intended to explore both the distributional consequences of trade liberalization and the potential role of complementary public policy to mitigate their negative impacts on the poor.

First, four alternative trade policy scenarios under the Moroccan-EU agreement have been considered: no change in other tariff and non-tariff barriers (status quo), a tariff unification on all commodities except industrial imports from the EU at the 1994 average rate, an elimination of non-tariff barriers in addition to tariff unification, and a trading liberalization scenario that reduces the unified tariff from

29% to 10%. Second, two complementary policy scenarios aim at compensating rural-vulnerable losers under the trade liberalization regime are considered: a transfer program aims at fully compensating the owners of rainfed agricultural resources and a skill-upgrading program aims at augmenting the stock of rural skilled labor each period by 5% to be transferred from the stock of rural unskilled labor.

v. Results

The main result with respect to the different trade liberalization measures is the negative income and growth effects in agriculture and the increase in the rural-urban income gap in Morocco. Alternatively, the results from the two complementary domestic policy scenarios underscore the role of public policy in redistributing the gains from trade liberalization. Further, the political feasibility of the different outcomes have also been assessed in the study.

The single most important result is that trade liberalization with complementary redistributive policies can lead to win-win outcomes.

3.2.2 Tunisia

Like Morocco, Tunisia is also among the earliest reformers in the Arab region. The implementation of economic reforms and structural adjustment programs in Tunisia dates as early as the mid-1980s. In addition, Tunisia is a member of WTO and has signed a partnership agreement with EU. The Tunisian commitment to gradual liberalization of trade during the period 2000-2010 under these two agreements would doubtlessly have impacts on income distribution and poverty in the country. In particular, the gradual liberalization of trade in agricultural products between Tunisia and the EU will expose the domestic market that has been protected for long time to competition and international price fluctuations. Given the close links between agriculture and poverty and the importance of the agricultural sector in Tunisia, such opening up of the domestic market would have critical implications for the rural poor. A recent study (Chemingui and Thabet, 2001) has addressed these implications:

i. Objective

The study aims at quantifying the distributional impacts of alternative scenarios of agricultural trade liberalization in Tunisia.

ii. The CGE Model

A standard recursive dynamic general equilibrium model with a detailed representation of agriculture. The model includes 57 production activities of which 26 related to agriculture or food production. Production technologies are described by nested CES functions. There are two factors of production in the model, labor and capital. Labor is distinguished by skill and geographical mobility into 5 types: 3 rural, 1 urban, and a perfectly mobile labor type. The model distinguishes three forms of capital: physical capital, reserves of natural resources (crude oil and phosphates), and land. Land is classified into 6 categories based on the degree of permanence of its cultivation, the level of irrigation, and the type of crop variety. Physical capital is vintaged into an old type and a new type, with the new type being more substitutable for other primary factor types. Further, full employment and flexible factor prices are assumed in the model.

The household sector is disaggregated into 10 types, 9 rural distinguished by type of activity, and one urban. The breakdown of the factor accounts and the household in the rural sector is based on the 1994/1995 agricultural farmers survey released by the Ministry of Agriculture and the 1998 household expenditure survey.

Foreign trade is modeled following the small open economy assumption. Two international markets are distinguished: the EU and the rest of the world. Export supplies are determined by transformation elasticities that differ across markets. Import demands are determined by a nested CES structure that differentiates between goods of domestic origin and goods of foreign origin on one hand, and among goods from different foreign origins on the other hand.

The model also includes a detailed description of the different types of taxes, subsidies and tariffs as well as non-tariff barriers. The model is calibrated on a Tunisian SAM for 1992 and solved recursively in 3-year steps for the period 1992-2010.

iii. Modeling and Measuring Poverty

Poverty aspects in the rural sector are captured in the model through the detailed representation of rural production activities, rural household groups, and the types of rural factor earnings. No direct measures of poverty is computed by the study. Instead, policy impacts on rural poverty is assessed through the distributional implications of the policy shock.

iv. Policy Scenarios

The study considered a base simulation with the status-quo trade and agricultural policies provided the Tunisian commitments under the WTO and the EU partnership agreements, and six alternative policy simulations to explore the effects of liberalizing trade in agricultural products. The six policy scenarios are: a unilateral reduction in agricultural tariffs, a unilateral cut in government agriculture support, a reciprocal reform of agricultural trade between Tunisia and the EU, a scenario which combines the three previous scenarios, a rise in the world price of food prices, and a scenario considering a progressive increase in the GDP share of public expenditures aimed at improving yields in agriculture.

v. Results

Overall, the different liberalization scenarios, whether unilateral, bilateral or multilateral, are found to aggravate the urban-rural income gap, with most of the gains accruing to the urban household group. Both the unilateral and the bilateral measures result in income and welfare losses to most of the rural household groups, namely the most poor households such as those practicing the activities of field crops, livestock, and vegetable production. Fruit and olive growers and agricultural workers are the main rural winners from the Tunisian-EU bilateral agricultural trade reform scenario. Multilateral trade liberalization, however, is found to lead to a win-win outcome, in which both the urban household group and the rural households as one group gain from trade liberalization. Nonetheless, the majority of gains are captured by the urban household group. The agricultural productivity enhancement scenario along with trade liberalization is also found to lead to a win-win situation. In particular all rural household groups practicing farming are experiencing income and welfare gains under this scenario. In a sense, the scenario demonstrates the role of public policy

(e.g. public expenditure on infrastructure and research and development) in poverty alleviation among the rural household groups.

3.2.3 Egypt

Economic reforms and structural adjustment programs have been introduced in Egypt since early 1990s. The implementation of these programs has put increasingly harder constraints on the government budget. This in turn creates pressing needs to better manage the government budget and at the same time increase the effectiveness of its social spending programs to ameliorate the social costs associated with the adjustment programs. Food subsidies constitute for long time one of the largest spending items in the Egyptian government budget. In 1980/1981 the Egyptian food subsidy system covered more than twelve commodities and accounted for 14% of the total government spending. With the implementation of the structural adjustment program the coverage was reduced to only four items (bread, flour, cooking oil, and sugar) in 1996/1997 and with a total spending accounted for only 5.5% of the total government expenditure. An essential problem with the existing Egyptian food subsidy system is the poor targeting of the needy families which has resulted in substantial leakage. Löfgren and El-Said (1999) study has addressed this issue:

i. Objective

The study aims at exploring the short-term effects of a set of alternative options for operating the Egyptian food subsidy system. These options include targeting, reducing, and reorganizing the subsidy system.

ii. The CGE Model

A food-agriculture focused static general equilibrium model. The model includes 28 production activities of which 19 relate to agriculture and food processing. The crop activities are differentiated according to period of land occupation into winter crops, summer crops, and perennial crops. Production technologies are modeled as nested CES functions. Features such as multiple outputs, excess factor supplies, and technique change are included in modeling the agricultural activities. There are 5 factors, 2 of which are used by all sectors (capital and labor) and 3 are agriculture-specific factors (water, summer land, and winter land). Capital

and labor are differentiated into agricultural and non-agricultural types. The agricultural capital is further differentiated into crop-specific capital and animal-specific capital. In modeling the crop production activities, land, water, and crop-specific capital are assumed freely mobile across the different crops varieties. Outside agriculture, non-agricultural capital is differentiated according to the type of activity whereas non-agricultural labor is mobile across sectors. All factors are inelastically supplied. For land and non-agricultural labor, prices are differentiated across activities on the basis of fixed ratios. With exception to land and water, one of which may be in excess supply, all other factors are assumed to be fully employed, i.e. all other factors have flexible prices.

The household sector is broken down into rural and urban household groups, each of which is further disaggregated by quintile. Household incomes consist of factor earnings, foreign transfers (fixed in foreign currency), and government transfers. Disaggregated consumption is determined by a nested demand system with income and price elasticities coming from actual econometric estimates.

The model is calibrated on a disaggregated SAM for 1996/1997. The SAM was constructed by IFPRI on the basis of various official publications and the most recent official Social Accounting Matrix for Egypt. Data on household consumption and benefits from food subsidies is provided by Egypt Integrated Household Survey (EIHS) for 1996/1997.

iii. Modeling and Measuring Poverty

Poverty concerns are addressed via the detailed classification of household groups, factors used by agriculture, and rural production activities as well as via the detailed modeling of household consumption options. With respect to measurement, no direct poverty measures are computed by the study. Instead, poverty impacts are implicitly addressed by assessing the welfare impacts of the policy in question on the different socioeconomic groups in the model.

iv. Policy Scenarios

The study considers two sets of simulations. The first set addressed the implications of targeting or eliminating food subsidies. The second set addressed the

leakage issue. The first set of scenarios include targeting oil and sugar subsidies, targeting total food subsidy, eliminating oil and sugar subsidies, and eliminating the food subsidy system and replacing it with direct transfers. The second set of scenarios consider the introduction of a wheat-maize mixed flour to replace the pure wheat flour along with cracking down on subsidy leakage. The last of the simulations in this second set focuses on totally eliminating the leakage and transferring the money saved to the needy families. In all scenarios, except the one dealing with eliminating subsidy and the one dealing with eliminating leakage, savings from subsidy reforms are used to reduce direct taxes.

v. Results

The targeting of all food subsidies has pro-needy and pro-rural effects, with the greatest gains accrued to the lowest two quintiles in rural areas. The distributional consequences of a full elimination of subsidies in combination with a tax cut is still pro-rural but no longer pro-needy. The non-needy households are found to experience considerable welfare gains whereas the needy households are found to suffer losses. In contrast when the subsidy elimination program is combined with direct transfers to the needy, the program is found to lead to large welfare gains for the lowest two rural quintiles with minimal losses for the urban and the non-needy households. Favorable welfare effects and reduced subsidy costs are achieved when pure wheat flour is replaced by a wheat-maize mix, specially if the program is combined with elimination of leakage. Finally, entire reforms of the subsidy system are found to have a positive impact on Egypt foreign trade account.

4. A Framework for Modeling Public Policy Impacts on Poverty in Arab Countries

4.1 Overview

The objective of this section is to outline a common framework to guide country studies aiming at assessing public policy impacts on poverty in the Arab region.

Specifically, the framework should take into account the socioeconomic characteristics of the Arab countries, data availability and data gaps problems, and the

common public policy objectives in the region for the next two decades. The components of this framework are a database, a standard CGE model, a methodology for modeling public policies, a methodology for modeling and measuring poverty, and a set of scenarios describing the future policy environment.

4.2 Database

Availability of a Social Accounting Matrix (SAM) is essential for building a CGE model. Like other developing countries, many Arab countries don't have either SAMs or the necessary data to construct appropriate ones. Some Arab countries have SAMs but are either old or highly aggregated ones. Only a few countries (e.g. Morocco and Egypt) do have recent and detailed SAMs. The construction of a SAM that is appropriate for policy analysis requires in addition to national income accounts and bilateral trade data, survey data on industrial establishments, labor types and earnings, and on household incomes and expenditures. With exception to national income accounts and trade data, many countries in the region seem to have problems with survey data. These problems range from the simple lack of survey data to the various sorts of statistical inconsistencies, data gaps, and time lags problems. Given these sorts of data availability problems some kind of guess work and estimation are unavoidable in SAMs construction. Fortunately, numerous numerical techniques and methods are now available for constructing, updating, and reconciling SAMs (see for examples, www.IFPRI.org).

The procedure to be followed in assembling a SAM, then, is to start with identifying all sorts of available data for the country in question. If a recent SAM exists then that SAM constitutes the first step. If an old SAM exists, recent national income accounts and trade data may be used to update it. If a SAM does not exist but some kind of survey data (at least sufficient to construct an Input-Output (I-O) table) exist, then recent national income accounts and trade data may be combined with this data to construct a SAM for the country. If neither a SAM nor a sufficient survey data exist, for the country, then the easiest way is to borrow the I-O structure of a similar country and use it along with national income accounts and trade data to construct a SAM for the country in question.

The next step is to adapt the SAM to poverty analysis. This requires the various sorts of disaggregations for the production activity, the households, and the factors accounts in the SAM. The objective here is to make the maximum use of whatever available data to breakdown as detailed as possible these accounts. Ideally, these disaggregations would be carried following any of the criteria outlined in section 2 of the paper, but in practice available data may not permit doing so. Further illustrations on the disaggregation aspects will be provided in the CGE modeling subsection.

In addition to a disaggregated SAM, the model database also requires exogenous projections of GDP, population, labor force, and capital stock as well as data on intra-group distributions, poverty line, and elasticity estimates.

4.3 The CGE Model

The standard CGE model described in section 2 provides the basic building block. The essential additional features that need to be incorporated to suit the model for poverty analysis include:

4.3.1 Disaggregation and Modeling of Production Activities

The focus here should be on the detailed disaggregation of the activities associated with the poor and the vulnerable groups in the economy. In most Arab countries agriculture and the informal sector are the major sources of incomes for the poor households. Hence, a proper specification of these sectors in the CGE model appears essential. In particular, for countries such as Egypt, Morocco, Tunisia, Syria, Yemen, Mauritania, and Sudan, the model should include detailed representation of crops, vegetables, livestock and fishing activities. This is usually accomplished at the SAM level by using agricultural survey data. In addition to disaggregation, specific features such as subsistence production, multiple output, technique change, and excess factor supply need also be incorporated in modeling the agricultural sector activities. The IFPRI's studies (for Morocco and Egypt) and the Tunisian study reviewed in section 3 provide good examples.

Outside agriculture, in a number of countries such as Egypt and Syria, the public enterprise sector provides an important source of income for the lower middle

class (a group that is vulnerable to poverty). In addition, it is the sector that is directly affected by government employment and privatization policies.

Within the manufacturing sector at least two sets of detailed activity representations need to be made. The first is a detailed representation of the consumer goods sector and the second is the detailed representation of the activities producing the export goods in the economy. The rest of the manufactured goods sectors may be aggregated in one sector. Finally, if possible, the public services sector may be disaggregated into the different forms of services provided by public utilities, such as electricity, gas distribution, and water.

4.3.2 Disaggregation of the Household Sector

Detailed household classification is a key to poverty analysis. As outlined in section 2, several classification schemes are used in the literature. The choice among these schemes, in addition to the availability of data, depends on the socioeconomic and geographical characteristics of the population and on the type of policy analyses proposed in the study. With respect to geography it is essential at least to distinguish between rural and urban households in the model. Since agriculture is the major source of income for poor families in many Arab countries, rural households may be classified by land holdings, e.g., landless, small land, and medium and large land holders; by type of activity, e.g., crop farmers classified by crop, vegetable farmers, livestock owners, and fishers; or alternatively by income quintiles. The classification of households by quintiles is, however, appropriate only for analyzing policies that have little effects on intra-group distributions, e.g. it is generally not suitable for policies whose effects are transmitted through the factor markets. Since the largest urban groups vulnerable to the risk of poverty for many Arab countries are junior public sector employees, the informal workers, and the private sector workers, urban households may be classified according to occupation, e.g. informal workers, private sector employees, public sector employees, professional and self employed, and capitalists or alternatively by income quintiles.

Bearing in mind the later poverty measurement exercise, it is important that the above classifications be made as detailed as possible. A special focus should be

on the homogeneity of the socioeconomic groups (the intra-group variance) and on the ability to map public policy to targeted groups (poverty targeting).

4.3.3 Disaggregation of Factors

Because factors are the primary channel for transmitting the impacts of many types of policy shocks to incomes, the CGE model should include a detailed representation of the structure of factors ownership in the economy. In the Arab countries context, a detailed classification of land and labor is of a clear significance for poverty analysis.

Land may be categorized according to the permanency of cultivation (e.g. summer, winter, and fallow) or according to fertility (e.g. marginal, low, and high). Labor may be classified according to occupation and skills (e.g. agricultural workers, informal labor, unskilled labor and skilled labor). The skilled labor category may further be classified by level of education. The other factors (water and capital) may also be categorized. Water can be classified as rainfed or irrigated. Capital may be distinguished by sector (e.g. agricultural vs. non-agricultural) or by malleability (e.g. old vs. new vintage capital).

4.3.4 Dynamics

Many economic policies such as those associated with poverty reduction and structural adjustment may have quite different effects on poverty when comparing the short-run to the medium and the long-run. To capture the dynamic effects of such policies, a dynamic model is obviously needed. There are different methods for representing dynamics in a CGE model. The simplest method to suggest is the recursive dynamic method. This method involves solving the CGE model for each period separately, connecting the different periods through updating the exogenous variables in the model, e.g. factor supplies, investment, balance of payment deficit, government expenditure, and world prices. For each period, the values of the exogenous variables are either derived from the previous periods solutions or completely determined exogenously.

For examples, the investment and capital stock paths may be based on previous periods rates of return on capital and sectoral output growth rates, the

government expenditure path may be based on previous periods GDP growth rates, and the net capital flows (balance of payment deficit) may be based on previous periods rates of return on capital and GDP growth rates.

4.4 Modeling Public Policies

Variety of economic policies, such as tax, trade, industrial, employment, and public spending policies are likely to have important impacts on poverty. The clear specification and representation of such policies in the CGE model, thus, constitutes an essential component in the poverty analysis exercise. The incorporation of tax, trade, and industrial policies in the CGE model is more or less standard in the literature. This usually involves adjusting the price and quantity instruments in the model, e.g. tax rates, exchange rates, and trade volumes (quota), exogenously or endogenously to meet the policy constraint under the simulated shock. The incorporation of employment policies is a bit more involved and may require some modeling tricks in terms of elasticities, factor mobility, and production techniques. In contrast, as reviewed in section 2, modeling the aspects of public spending policies in the CGE framework is more challenging. Nevertheless, public spending is the focal instrument in any poverty reduction program and therefore need to be somehow incorporated in the poverty analysis exercise. In principle, two difficulties involved in modeling the poverty impacts of public spending in the CGE framework. The first relates to the breakdown of government spending by type, e.g. education, healths, infrastructure, and social spending. The second difficulty relates to the mapping from the functional spending categories to the socioeconomic groups in the model.

The conventional Benefit Incidence and Incremental Incidence analyses provide the first step for constructing such mappings. The Benefit Incidence Analysis (BIA) deals with the distribution of benefits from public services and spending programs among different groups in the population classified by income quintile, ethnicity, geographical region, or by illiteracy. The Incremental Benefit Analysis (IBA), in contrast, is concerned with how the new public spending (excluding fixed spending) is distributed among these socioeconomic groups. These analyses are usually based on information from household surveys on utilization of education and health facilities, the use of infrastructure facilities such as roads, water and electricity, and on the consumption patterns of certain subsidized goods.

Unfortunately, detailed benefit incidence or incremental benefit mappings may not be possible for many countries in the region due to lack of such survey data. In such cases, approximations and judgment need to be used to assess the distribution of benefits from the public spending programs among the socioeconomic groups in the country.

Provided the mappings of benefit ratios and abstracting from the dynamics and externality aspects of public spending, one may directly allocate the proposed change in public spending (in monetary terms) among the representative households in the model based on these benefit ratios. On the source side, the proposed change in public spending could involve either adjusting the tax structure or the composition of public spending in the model depending on the option to be taken by the policy maker.

On the use side, the allocated portion of the change in public spending to each representative household in the model may take the form of direct transfers, change in consumer prices, or change in factor incomes depending on the nature of the public provision. General social spending programs such as social security nets usually take the form of financial transfers and commodity subsidies. Education and health spending may either be represented as factor-augmented technical change (e.g., enhancing labor endowment) or be represented as commodity-specific subsidies for these services in the household consumption bundle. Public spending on infrastructure, e.g. roads, electricity and water may also be represented as capital-enhancing technical change or as commodity-specific subsidies to consumer prices of transport, electricity and water in the CGE model.

4.5 Measuring Poverty

The key to poverty measurement is whether a survey with classifications consistent with those in the CGE model does exist. Though, as mentioned earlier, a number of Arab countries have household survey data, they may not be good enough to support completely integrated CGE-MS modeling exercises. A reasonable option, then, is to use the representative household approach outlined in section 2. If survey data permits, the intra-group distributions of incomes or expenditures may be directly

generated from the data; otherwise parametric distributions such as the Beta or the Lognormal need to be specified. The national poverty line may be generated endogenously if the national basic- needs basket exists; otherwise the national poverty line may be deflated using the aggregate consumer price index computed from the model. To allow assessing poverty impacts at the aggregate level as well as at the groups level, the F-G-T poverty indices need to be computed at both levels. Finally, to facilitate comparability, poverty measures need to be computed on the basis of both incomes and expenditures if existing data would permit that.

4.6 Policy Scenarios

Many of the countries in the region have various types of policy commitments over the next ten to twenty years. Among these are the country-specific obligations under the WTO and the EU partnership agreement, in addition to the domestic policy commitments under the structural adjustment programs. The poverty impacts of such policy commitments may be simulated as a part of a baseline scenario covering the period 2000-2015. Additional policy scenarios may also be thought. One such a set of scenarios includes those regarding future economic reforms and/or those relating to future poverty-reduction policies. Another and a more obvious candidate is the set of scenarios relating to the achievement of the UN third-millennium development objectives. In terms of modeling, the most relevant among these objectives are those with respect to poverty, health, and primary education.

5. Concluding Remarks

Worldwide concerns about poverty issues in developing countries have increasingly drawn the attention of both the international organizations and the domestic politicians. At the international level, many developmental and funding organizations started to question the impacts of their operations in developing countries on poverty. At the domestic level politicians are becoming more watchful on the poverty consequences of their economic policies as well as on the need to devise public policies and measures to alleviate the incidence of poverty in their countries. The assessment of the impacts of such policies and measures necessarily requires some methodological tools. Computable General Equilibrium (CGE) models have been for long time important tools for assessing economy-wide impacts of

economic policies. Nevertheless, for poverty assessments, these models need to include some additional features. Some of the most important features that need to be incorporated in the CGE model are the detailed representations of household's activities, groups and factor earnings. The additional data needed for the incorporation of such representations as well as for computing poverty measures are usually obtained from household income and expenditure surveys.

This paper has attempted a focused review of poverty modeling and data issues in a typical developing-country CGE model. A special emphasis in the paper has been devoted to the status quo of data and poverty-related CGE modeling in the Arab region. The paper concludes its review by offering some guidelines and modeling tips to guide country CGE-studies aiming at assessing the poverty impacts of public policies in the Arab region.

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