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Agricultural and Non-agricultural  
Sectors in South Asia**

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**Analyzing Poverty Impact of Trade Liberalization Policies in CGE Models: Theory and Some Policy Experiments in Agricultural and Non-agricultural Sectors in South Asia**

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## **Abstract**

The paper uses a dualistic, compact and “generic” (macroeconomic) computable general equilibrium (CGE) model specially constructed for the purpose of investigating the implications of trade liberalization for poverty reduction in South Asia. The model is a stylized representation of economies with large populations including large numbers of both urban and rural poor as in India, Pakistan or Bangladesh. The current “generic” model uses CES production functions and Harris-Todaro type migration model together with representative data to generate economy wide results. It is found that a dualistic production structure with sufficient details on the labor markets and household side can capture some of the effects of trade liberalization on poverty reduction. The model’s general equilibrium results suggest that trade liberalization can complement other specific policy interventions for poverty reduction.

## Executive Summary

The main purpose of this paper is to use a “generic” computable general equilibrium model in order to understand the poverty reduction impact of trade liberalization policies in South Asia. Understanding the impacts of trade liberalization policies in South Asia on poverty is important because of the vulnerability of the poor as a group in developing economies in general and in South Asia in particular.

There are at least two aspects of any poverty impact analysis for a particular policy. These are: i) the impact on economic growth; ii) the impact on income and asset distribution. The growth effect on poverty reduction is then given by some estimated growth-poverty elasticity. In the second case, a more (less) favorable income/asset distribution for the poor may reduce (increase) poverty. A distributional neutrality assumption in a model simply allows one to look at the growth aspect by itself. Here, too, different sectoral growth rates and different sectors themselves may affect poverty differently.

The paper is structured in such a way that the connection between the basic policy issues and the particular modeling approaches can be discussed in a transparent manner. It begins with a discussion of the general macroeconomic policy issues arising out of program lending and their relevance to the poverty reduction strategy in the “post-Washington consensus” policy environment. This raises some relevant questions regarding the measurement of poverty and the nature of macroeconomic environment in the developing economies. Consequently, it becomes necessary to discuss these measurement issues in the context of particular environments in South Asian economies. Thus the measurement aspects of poverty are followed up by a discussion of some pertinent issues regarding the generic structure of macro-models for South Asian economies. A concrete discussion of reforms, in particular, trade liberalization in South Asia is taken up next. After this section, the question of what is the relevant class of CGE models for an analysis of trade liberalization and poverty in South Asia is addressed in section 6. Specifically, this section explores the questions related to income distribution and poverty in CGE models for South Asian developing economies. In the penultimate section (section 7), I discuss the structure of what has been termed the “dual-dual” model. Results from a modified “dual-dual” model using largely a data set from India are presented and discussed.

Within this particular CGE model, the policy experiments show that in this region, trade liberalization can lead to further poverty reduction. This is true at both the national level and at the level of the various household groups. This is indeed good news that conforms to the general prediction of the standard comparative advantage based trade theory.

Under the assumptions of the model, the results show that in general, both the extent and depth of poverty decline for each household group. The largest headcount ratio drop is recorded for the rural unskilled group. Poverty severity also falls for each household group with the exception of the urban unskilled workers.

But when the tariff rates fall from 15 to 12 percent, this group benefits as well. In general though, much of the poverty reduction impact of trade liberalization can be reaped earlier. Further reductions leading to a rate below 10 per cent may not have much more of an impact than earlier tariff reductions. One surprise, however, is the largely nonlinear impact of tariff reductions on poverty. There seems to be a big jump nationally when the tariff rate is finally reduced to a low range of 15 to 18 percent.. However, there is very little change for even lower rates, for example, from 15% to 12%. Given the stylized nature of the exercise, no magical properties need to be attributed to these particular numbers. The general lesson is that tariff reduction will ultimately benefit the poor; but the trickling down process is uneven and may require some time to work through the socio-economic system.

The extent of poverty reduction impact of trade liberalization turns out to be limited. There are several reasons for this. The main reason is that the Harris-Todaro mechanism allows reverse migration to lower paid jobs for the potentially unemployed as protection is removed. Furthermore, the impact of further tariff reductions becomes attenuated for most groups when the tariff levels are lowered sufficiently. On the whole, the high tariff barriers should be dismantled, but beyond a certain point---say about 15 per cent average tariff rate--- the further impacts become negligible.

Several policy conclusions can be reached regarding poverty reduction strategies in South Asia in light of the findings here. Trade liberalization certainly does not conflict with poverty reduction and hence can be pursued without fearing adverse poverty impact. However, the approach may need to be a firm but gradual liberalization with special sensitivity to agriculture and the rural poor. It should also be kept in mind that trade liberalization can certainly help reduce poverty, but by itself it may not be the magic bullet against poverty. The actual poverty reduction impact in South Asia is most likely to remain small for this policy instrument. Hence other growth enhancing reforms need to be pursued simultaneously.

Furthermore, targeted poverty reduction programs may also be needed with emphasis on increasing the efficiency of targeting and improving their cost-effectiveness. Programs such as food-for-work and other employment schemes, microfinance, agricultural credit etc. need to be pursued with a focus on making them more effective in terms of reaching the targeted groups at minimum cost to the programs. Rural industrialization and increase in productivity through investment in social sectors and human capital also remain viable policy options. In terms of Sen's capabilities approach, the capabilities of the poor--- particularly their basic functionings--- need to be enhanced so that they can better participate in income earning activities. Some of these policy areas are related to trade, but many are not. This paper does not analyze these further policy issues that are not related to trade directly but the need to use existing works along these lines and to continue doing careful research in the South Asian context in particular is apparent.

## 1. Introduction

The debate about the impact of globalization on the well-being of people has already generated a large literature.<sup>1</sup> Here I focus on one particular aspect of globalization, namely, trade liberalization. I also focus on the well-being of one particular group, namely, the poor.<sup>2</sup> Understanding the impacts of trade liberalization on income (and wealth) distribution and poverty is important because of the vulnerability of the poor as a group in developing economies. The literature on trade liberalization emphasizes the elimination of distortions leading to both gains from trade and an increase in domestic economic activities leading to sustained growth. To the extent that the poor are also beneficiaries of these outcomes, poverty is expected to decline.

However establishing the link between this type of trade liberalization or trade reform in general associated, for example, with WTO entry and poverty reduction requires more than just a description or projection of trade patterns. A counterfactual “no-change” scenario must be compared with an estimated scenario after liberalization. An appealing way of addressing this is to formulate and use an appropriate computable general equilibrium (CGE) model that compares the non-liberalized case with scenarios based on trade liberalization. For example, Roland-Holst (2002) and (2003) applies a version of the well-known GTAP model to assess the impact of reform on trade and income for some regions of Asia and PRC. His model is aggregated and covers 16 countries and 18 sectors with CES production functions.<sup>3</sup> Recent work on trade and development has also emphasized the importance of considering the response of the informal sector to trade liberalization and the importance of modeling specific

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<sup>1</sup> For a recent survey, see Weiss and Khan (2007), Khan(2007), Khan(2004d), and Rahman(2004).

<sup>2</sup> One way to defend this approach theoretically is to appeal to the Rawlsian maximin criterion. Alternatively, Sen’s capabilities approach can be used to argue that addressing issues related to poverty reduction will help a society towards equalization of capabilities.

<sup>3</sup> See Weiss(2004), pp. 17-19, for a succinct discussion of the strengths and weaknesses of such models, and for further details see Roland-Holst (2002), and Lee et. al.(2004). Their models are based on Van der Mensbrugghe’s LINKAGE model. A recent documentation with technical details can be found in Van der Mensbrugghe(2003) See also, Van der Mensbrugghe(1998). More directly relevant to our generic modeling approach with special emphasis on poverty reduction is the paper by Stifel and Thorbecke(2003).

institutional aspects of particular labor markets.<sup>4</sup> The complexity of the links between trade and poverty have been analyzed by Alan Winters and his coauthors in particular (Winters 2000, 2002 and the references therein).

This paper has two related goals. The first and the main aim is to present a “generic”, stylized CGE model for South Asia within which certain policy experiments about trade liberalization can be carried out. The second, related objective is to use ‘real world’ country data from South Asia to carry out some experiments with respect to the progressive removal of tariff barriers. I use largely data from India with some exceptions. However the results should be indicative of what can be expected for other South Asian economies with large populations and large numbers of poor people in both the urban and rural areas.

The emphasis on poverty reduction at the national and international levels as embodied for example, in the Millennium Development Goals, calls for a careful methodological approach to the estimation of the poverty reduction impacts of changes in macroeconomic, trade and other policy variables. A recent report produced at the Asian Development Bank sorts out many of the complex issues involved at the macro-, meso- and micro-economic levels and pinpoints the need for further conceptual and modelling work at the appropriate levels of (dis)aggregation (Bolt et al. 2003). The identification of the three different levels and treating the meso-economic level as the (institutional) link between the other two levels are encouraging in terms of understanding the complex causal relations that are involved in understanding and reducing poverty.

There are at least two aspects of any poverty impact analysis for a particular policy. These are: i) the impact on economic growth; ii) the impact on income and asset distribution. The growth effect on poverty reduction is then given by some estimated growth-poverty elasticity. In the second case, a more (less) favorable income/asset distribution for the poor may reduce (increase) poverty. A distributional neutrality assumption in a model simply allows one to look at the growth aspect by itself. Here, too, different sectoral growth rates and different sectors themselves may affect poverty differently. (Quibria 2002; Khan 1999; Thorbecke and Jung 1996). Thus the dynamic and disaggregated growth impacts of trade liberalization may ultimately be the key intervening variables. From this overall perspective, the present endeavor may be seen as a first step to capture the poverty impact of trade liberalization through a comparative statics experiment in a generic CGE model.

The structure of the paper is as follows. In the following section I discuss the general macroeconomic policy issues arising out of program lending and their relevance to the poverty reduction strategy in the “post-Washington consensus” policy environment and trade liberalization. This raises some pertinent questions regarding the

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<sup>4</sup> See for example, Goldberg, P. K. and N. Pavcnik (2004) and Galiani and Sanguinetti (2004).



measurement of poverty and the nature of macroeconomic environment in the developing economies. Consequently, in the two sections following immediately, I discuss these issues in the context of developing economies. In section 3, I deal with some fundamental issues for the measurement of poverty. This is followed up in section 4 by a discussion of some issues regarding the general structure of macro-models as they may relate to the salient characteristics related to the dualistic nature of some South Asian economies. Section 5 then takes up the specific issue of recent history of reforms in South Asia via a discussion of the Indian case from 1991 to 2004. Section 6 explores specifically the questions related to income distribution and poverty in CGE models for developing economies in general and for South Asia in particular. In the penultimate section (section 7), I discuss the structure of what has been termed the “dual-dual” class of models and offer a modified version of the Stifel-Thorbecke dual-dual model for analyzing the poverty impacts of trade liberalization in South Asia. The model is implemented empirically by using largely data from India. In the concluding section I raise the question of how applicable the model is for other regions, e.g., some middle income Asian economies with large pockets of poverty. I end with some tentative suggestions regarding poverty analysis in an “extended dual-dual” framework for a middle income Asian economy such as Thailand and China as well as some other modifications including a more micro poverty analysis.

At the outset it is fair to mention that even the poverty ‘incidence analysis’ at the micro level is not as straightforward as it seems. For example, even cash transfers may modify behavior. Such modifications can lead to general equilibrium effects in an economy wide set of repercussions. Typically, of course, most transfers are made indirectly--- through public spending and indirect taxation. The allocation rules are not always transparent and implementation is incomplete or distorted (Bourguignon et. al. 2002). More relevant to our purpose here, often macroeconomic and structural adjustment instruments and outcomes are also involved. The declared purpose of such reforms is to enhance economic activity and long-term rate of growth. In the short-run, however, the effects may even run in the opposite direction. A careful specification of the macro-models and the macro-micro linkage is thus a prerequisite for any meaningful and policy-relevant economic analysis.

Essentially there are three levels that such a relatively complete analysis of poverty reduction impacts of macro-policy changes would involve. First level includes the macroeconomic tools and models that will allow us to estimate and evaluate the impact of various exogenous shocks and policies on macro or aggregate variables such as the GDP/capita and its macro-components, the rate of interest, inflation/deflation via changes in the aggregate price level, the exchange rate and so on. The time frame must also be made explicit. At the second level we need to have tools and procedures for disaggregating the values of the variables obtained through our modelling and estimation exercises at the first level. Thus, at the end of our procedures at this level we will have at our disposal a disaggregated picture of the effects of policies on sectoral activities, and returns to factors and households at the appropriate levels of disaggregation. The last, bottom layer usually consists of a micro-module where an ‘incidence analysis’ can be carried out through the manipulation of household micro data with the help of relevant theories of distribution, household income generation and

consumption.

Our earlier review of the CGE models (Khan2004a) revealed that for developing economies the useful CGE models can be conveniently categorized in three “generational” classes.<sup>5</sup> The first generation, starting with the pioneering works of Taylor and Lysy (1980) and Adelman and Robinson (1979) in the late 70s and the 80s focused increasingly on trade policy issues. The second generation in the late 80s and 90s made income distribution in the context of structural adjustment policies as the main focus, although it must be added that the pioneering works in both the Lysy and Taylor volume, and the Adelman-Robinson volume did not neglect distribution. The main difference is the explicit reckoning with Structural Adjustment Programs (SAPs). In the late 90s, explicit attention began to be paid to the poverty impact of SAPs within a CGE modelling context. In this context, with the Work of Decaluwe et. al. (1999), we seem to be in the third generation of CGE models where poverty impact has been modeled explicitly. The present work may be said to belong to this “third generation” of models for poverty analysis under globalization in a general equilibrium setting for Asian Developing Economies(ADEs).<sup>6</sup>

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<sup>5</sup> Like all historical classifications of ideas or schools of thought, this one also involves some arbitrariness. There is much overlap among the “generations” and at times, prescient anticipations of latter work. However, the categorization according to some prevalent general features during a particular period can still serve as a convenient marker or guidepost if we do not apply it in too rigid a manner.

<sup>6</sup> See also Clautier et. als.(2002) for a review of the CGE literature on the impact of trade liberalization on welfare and poverty. Cororaton(2003) is a detailed study of the Philippine tariff reform using the CGE-Microsimulation approach.

## **2. Some General Considerations: Trade Liberalization and Poverty Reduction in the Post- Washington Consensus Environment**

The policy environment after the Washington consensus has increasingly moved towards both consolidating and augmenting the first generation reforms (Kuczynski and Williamson 2003). As is well known, in 1989, John Williamson had dubbed a list of ten reforms in Latin America “the Washington consensus”(Williamson 1990). The appellation gained wide currency and some may say, even notoriety. It covered the following ten points:

1. Budget deficits ... small enough to be financed without recourse to the inflation tax.
2. Public expenditures redirected from politically sensitive areas that receive more resources than their economic returns can justify... toward neglected fields with high economic returns and the potential to improve income distribution, such as primary education, health and infrastructure.
3. tax reform ... so as to broaden the tax base and cut marginal tax rates.
4. Financial liberalization, involving an ultimate objective of market determined interest rates.
5. A unified exchange rate at a level sufficiently competitive to induce a rapid growth in nontraditional exports.
6. Quantitative trade restrictions to be rapidly replaced by tariffs, which would be progressively reduced until a uniform low rate in the range of 10 to 20 per cent was achieved.
7. Abolition of barriers that impede the entry of new firms or restrict competition.
8. Privatization of state-owned enterprises.
9. Abolition of regulations that impede the entry of foreign direct investment.
10. The provision of secure property rights, especially to the informal sector.

As Williamson himself admits, “...from the start, the term “Washington Consensus” evoked controversy”. Moreover the mixed results in the decade of the 1990s and the

financial crises in Latin America, Asia and Russia led to some recent rethinking and a proposal from some economists for an “Augmented Washington Consensus” (Rodrik 2002). The augmented list includes as “second generation” reform agenda a wide range of items from social safety nets and poverty reduction to anti-corruption policies and legal and institutional reforms. Some have pointed out that the expanded list sometimes expresses hopes and goals rather than specific policies. There is some truth to this. However, the expanded list does put the task of poverty reduction squarely on the agenda and raises important questions regarding whether and how the program loans and the conditionalities attached to them would lead to increased poverty reduction in the developing world.<sup>7</sup>

In this paper I focus on item no. 6 on Williamson’s list of “first generation” reforms. However, it should be acknowledged that the trade liberalization part of the reforms usually does not occur in isolation, but rather is part of a larger package of reforms. This has certainly been true in South Asia where budgetary retrenchments and other reforms have accompanied trade liberalization.

On the macroeconomic side, the indirect effects of policy reform including trade liberalization on poverty reduction are mainly expected to work through generating rapid growth( Berg and Krueger 2003, Srinivasan 2001, Quibria 2002). The growth-poverty elasticity is the crucial parameter here. We do have some evidence from a survey of the existing macro-models. In particular, the empirical relation between growth and poverty (Ravallion and Chen(1997), de Janvry and Sadoulet(1998), Agenor(2002)) estimated by using linear regressions where the change in the measured levels of poverty are explained by the growth of income or GDP/ capita and other variables can offer some useful policy guidance. The main lessons are that growth tends to reduce poverty, but the cross-sectional nature of this work makes it hard to apply it to any specific country.(see also Bourguignon(2002)). Hence the estimate in the cross-section that the poverty elasticity of growth is about 2, is not automatically operational for every case. Estimates for particular countries derived from plausible models using reliable econometric methodology are necessary.<sup>8</sup> The postulation of an

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<sup>7</sup> There is, of course, the question of whether even the second generation of reforms will lead to the kind of sustained growth and poverty reduction that is anticipated. See for example, Hayami(2003) for questioning the view that growth and poverty reduction are sustainable. In particular, Hayami raises the issues of infrastructure building and other public investment projects that may still need to be undertaken by the public sector in order to make growth and poverty reduction sustainable. See also Naim(1994,2000,2002).

<sup>8</sup> An important ADB document(Weiss 2003) recognizes this point by pointing to the link between growth and specific social expenditure categories and refers to some specific programs in three different countries. This type of analysis is clearly necessary, but may be too disaggregated for macromodels to address. However, much insight can be gained by such specific analyses alongside the standard multisectoral macro models. As the document points out:

automatic trade-poverty reduction causality that works directly and rapidly is a hypothesis that needs to be tested, rather than to be accepted as an *a priori* axiom.

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Growth "...would allow greater expenditure to meet social development goals. Whether this expenditure is actually made by the public sector will vary depending upon government commitments to social targets, although a lack of public sector response can be compensated in part by private or NGO provision. Efficiency in public provision of social – essentially health and education services – has been addressed by recent program loans for these sectors, although their share of total program lending is small. A survey of program lending since mid-1999 reveals three main loans aimed explicitly at social development goals – the Health and Nutrition Sector Development Policy loan to Indonesia (March 1999), the Bangladesh Secondary Education Sector Development Program loan (June 1999) and the Bhutan Health Care Reform loan (September 2000). Of these the first aimed at maintaining social services in the face of declining government revenue in the wake of the Financial Crisis. The other two loans aimed at general improvement in the efficiency of the education and health sectors, respectively. Governance issues are addressed directly by loans for public sector reform and privatization, as well as by programs designed specifically to address the legal and justice system. The more common program lending for governance purposes has had as the major objective improved public resource management and increased revenue collection capacity; for example the Madhya Pradesh Public Resource Management program (December 1999) and the Governance Reform program in Mongolia (December 1999). Overtly political governance issues have been addressed in just a very small number of cases, notably the Decentralization Support program in Pakistan (November 2002) and the Access to Justice program in Pakistan (December 2001).”See also ADB(2001;2002a,b,c;2003a,b)

### 3. Measurement of Poverty: Some Fundamental Issues

There is by now a vast literature on measurement of poverty. Theoretically, the seminal paper was Sen's 1976 axiomatization and the associated index that attempted to bring together the headcount ratio the income gap ratio and income inequalities among the poor within a consistent axiomatic framework. Since then, Sen and others following him have moved in the direction of a multidimensional approach to poverty as inadequate capabilities. However, for the purposes of this paper, I will keep within the income poverty concept where a single scalar, money income, is the only relevant variable of interest in measuring poverty and computing the various indexes.

The general intuition behind poverty measurement is that 'poverty' exists when a group of people in a particular society can not attain a 'minimum' level of well-being. The 'minimum' is at least partly dependent upon the prevailing standards of society. However, there are dimensions of well-being such as nutritional requirements that might actually constitute an absolute biological minimum. The idea behind absolute as opposed to relative poverty is that by using generally agreed upon minimum standards of well-being, we can, in fact, define an income poverty line. Such income poverty line gives the cut-off point below which everyone is deemed to be poor. The key questions in applying this idea of poverty for applied policy issues are:

1. How do we assess well-being?
2. How do we decide on a certain poverty line so that when a poor person crosses that threshold s/he is no longer poor?

These are the questions which ask us to identify who the poor are. Therefore, this can be called, using Sen's terminology, the "identification" of poverty. As a second step, the total picture of poverty is arrived at by aggregating. Hence, Sen's coinage of the term "aggregation problem". Head count ratio is one obvious example in which one simply counts the number of people below the poverty line and then divides this number by the total number of individuals in a particular society.

In terms of identifying the poor through the setting of the poverty line, a number of issues can arise. The following four questions are one way of raising some these issues (Fields 2001):

1. Is the basis income or consumption, and how comprehensively will either one be measured?
2. What is the income-receiving unit: individual, family, per capita, or adult equivalent?
3. Will there be a single poverty line or will there be separate ones for urban and rural areas or different regions of the country?
4. Is the poverty line income determined scientifically, politically, subjectively, or as a matter of convenience?

In terms of both identification and aggregation of poverty, the procedure depends partly on axiomatizing the concept of poverty so that any particular measure has a number of desirable properties. The most common axioms are focus, anonymity, population homogeneity, monotonicity or strong monotonicity, and distributional sensitivity. Among the commonly used indexes, the head count ratio fails both the strong monotonicity and distributional sensitivity axioms.

Since Sen's (1976) axiomatic treatment of poverty comparisons several new indexes of poverty have emerged. Among them is the one developed by Foster, Greer and Thorbecke (FGT).

The FGT index which we will meet later again as the index used most frequently in the macroeconomic models incorporating poverty analysis has many desirable properties. In addition to satisfying the monotonicity and distributional sensitivity axioms, it also has the property of being additively sub-group decomposable. This means that the index is decomposable by subgroups (according to region, income class etc.) among the poor.

Thus this index can take into account the intensity of poverty for different groups of poor people. This is done by looking at the deprivation of calories. The poverty measure is given by:

$$p = 1/n \sum (G_j/z)^a$$

where

$n = \text{total population}$

$q = \text{the number of poor}$

$z = \text{the poverty line}$

$G_j = \text{food expenditure shortfall of the } j\text{th individual } (j = 1, 2, \dots, q)$

In the simulation a value of  $a = 2$  is used. At a lower value of 'a' some of the axioms are violated. At a higher value of 'a' the shortfalls of the poorer segments are weighted more heavily; therefore the intensity of deprivation by the poorer segments (in particular the poorest) will be magnified for value of 'a' greater than 2. For this value of 'a' both the monotonicity and transfer axioms of Sen are satisfied. We may recall that both these axioms have to do with the sensitivity of the index to the incomes of the poor as opposed to simply the number of poor. Thus, the monotonicity axiom states that, ceteris paribus, a decrease in the income of a poor person should increase the poverty index. The transfer axiom states that, ceteris paribus, a transfer of income from a lower income poor person to a higher income poor person increases the poverty index. It can be checked easily that this is true for the FGT index when  $a = 2$ .

#### **4. Macroeconomic Models for Developing Economies: Some Characteristics Related to Dualism in South Asia**

It is well known that the developing economies have special features that need to be recognized. Below, I first discuss some of these aspects of developing economies from the macroeconomic modelling perspective that will be relevant for formulating a “generic” model for South Asia. Later in this section, a brief discussion of some “micro” institutional features that are also relevant for poverty reduction strategies in South Asia in particular, are mentioned in order to round out the discussion. From the macroeconomic side, the following points are important<sup>9</sup>:

- 1) First, there must be an accounting framework and behavioral equations capturing some key aspects of macroeconomic modelling for developing countries. The most straightforward way of giving economic content to a set of aggregate accounting relationships is by adding appropriate behavioral equations and equilibrium conditions.
- 2) The accounting relationships that are relevant for a particular case depend on the structure of the economy. There could, for example, be a) “benchmark” accounting framework; b) particular features, modelling aspects such as alternative choices of disaggregation of production and consumption, structural features of labor market, degree of development of the financial system etc. c) behavioral functions, liquidity constraints on aggregate consumption; credit and foreign exchange rationing, debt overhang and its effects on production and private investment uncertainty and irreversibility effects on investment decisions; effects of financial repression, currency substitution, and informal financial markets on money demand etc.
- 3) Fiscal, monetary and exchange rate policies in developing countries are important features in most models. Data must cover a wide range of variables including industrial output, prices, wages, various monetary aggregates, domestic private sector credit, fiscal variables, exchange rates and trade variables.
- 4) Nature and implications of fiscal rigidities and the effect of fiscal deficits on a variety of macroeconomic variables are also important.
- 5) Developing country fiscal problems require special attention. Some of the most important features here are: high tax rates levied on a narrow tax base and heavy reliance on revenues from financial repression and multiple

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<sup>9</sup> See also, Agenor and Montiel (1999), Thorbecke and Morrison(1989), Khan(1983,1996,1997), Khan and Sogabe(1994), Khan and Sonko(1994) Khan and Thorbecke(1988),and Fields(2001).



currency practices, on the inflation tax, and on excessive debt financing.

- 6) Exchange rates modelling require special attention as well. In particular, one needs to identify special features such as “fixed” with rationing and simultaneous transactions in parallel markets when these are present. Credibility and inflation under a fixed exchange rate regime also need particular attention. The association of quasi-fixed exchange rates with currency and financial crises makes this issue specially significant. Contractionary effects of devaluation may also destabilize the economy, and could be included as a theoretical possibility that may sometimes become a practical problem.
- 7) The role of labor markets in the context of short-run macroeconomic adjustment in developing countries is particularly important for analyzing the poverty reduction implications of macroeconomic policies. More specifically, labor market segmentation and sectoral wage rigidity need special attention.
- 8) It should also be recognized that by now there are both orthodox and “heterodox” programs and models of structural adjustment in developing economies. Alternative models of inflationary process are also available. However, the approach I have adopted here is intended to skirt unnecessary terminological (and at times, ideological) controversy. This ‘ecumenical approach’--- to use Sherman Robinson’s felicitous term--- adopted here is more concerned with the real contents of the models and their real world policy relevance.
- 9) Macroeconomic dynamics associated with monetary and exchange rate policy rules in a context where international capital mobility is imperfect need to be emphasized.
- 10) Three important issues that models must focus on in the context of exchange-rate based disinflation programs in developing economies are: i) output, ii) interest rates, iii) real wages.
- 11) It should be pointed out that with humility that none of the modelling approaches that are widely used in developing countries is at present able to adequately address the complex dynamic interactions between stabilization, growth and distribution. This makes the intermediate and longer-term analysis of issues related to external debt, capital inflows, and currency crises particularly difficult.

Trade and financial liberalization and macroeconomic performance likewise become issues where the dynamic aspects are often treated simplistically. Problems of short-run macroeconomic management during the liberalization process are also well known and need little commentary.

- 12) Political factors in the adoption and abandonment of stabilization and structural adjustment programs in developing countries effects are also of obvious importance, but are very difficult to incorporate in the standard macroeconomic models of applied general equilibrium variety. For example, it would obviously be important to include the effects of the presidential and parliamentary electoral cycle on the pattern of public spending in many Asian and Latin American countries. One could also make the same case for including an analytical framework for examining the linkage between exchange rate policy and electoral cycles.

Some questions that are relevant rise in light of the features discussed above are:

- a. What structural changes need to be preceded by macroeconomic stabilization? Or, alternatively, can the two proceed concurrently?
- b. What is the proper sequencing of the liberalization and reform measures ?
- c. What “structural” differences between developed and developing economies, and “structural” similarities among the latter. Are relevant to model?

In response to the third question above, the following shared structural characteristics may be important:

- 1) Many agents possess significant market power
- 2) Macroeconomic causality in developing countries tends to run from “injections” such as investment, exports, and government spending to “leakages”, such as imports and saving;
- 3) Money is often endogenous
- 4) The structure of the financial systems can influence macroeconomic outcomes in important ways
- 5) The role of imported intermediate and capital goods as well as direct complementarity between public and private investment are empirically important.

Partly as a consequence of these features some have questioned the wisdom and efficiency of orthodox short-run macroeconomic policy prescriptions, particularly “shock treatment” in the form of fiscal austerity coupled with devaluation and tight monetary policy.

Disagreements among modelers also exist with respect to the identification of the source of inflation. The key controversy is about whether one should ascribe an accommodative rather than a causal role to money supply growth. According to the nonmonetarist view frequently the source of inflation is slow relative productivity

growth in agriculture (arising from poor land distribution and land tenure patterns) combined with administered prices (arising from noncompetitive market procedures and implying downward price rigidities) in industry, together with wage indexation. Monetary policy is perceived to be passive in the face of these already pervasive inflationary forces. Moreover, in part because of the roles of working capital and imported inputs, and in part because substitution possibilities are more limited than assumed by the proponents of orthodox macroeconomic management, a policy package combining devaluation with tight fiscal and monetary policies will result in stagflation in the short-run with little or no improvement in the external accounts. The alternative new structuralist policy prescription is not always clear, but it would in all likelihood contain a greater element of gradualism, direct intervention, and employ many of the means of medium term resolution of structural problems that are contained in traditional stabilization programs.

For the sake of parsimonious modelling, quite often a three good modelling approach is adopted. The three aggregated goods are non-traded domestic good, exportable good, and importable good.<sup>10</sup> Here, too, some important differences between the developed and developing countries need to be kept in mind. For example,

- 1) Developing economies, like small industrial countries, tend to be much more open to trade in goods and services than are the major industrial countries. In 1995 trade share of developing countries was 45% compared to G-7s trade share of 25 percent.
- 2) Developing countries typically have little control over the prices of goods they export and import. In particular, they often face exogenous terms of trade.
- 3) Over half of the exports typically consist of agricultural and primary commodities. Such an export structure needs to be modeled explicitly. The Mundell-Fleming model which has long been the work-horse of open economy industrial country model, assumes endogenous terms of trade determination, with the domestic economy completely specialized in the production of a good over which it exerts significant market power. The production structure most suitable for the analysis of developing country macroeconomic phenomena is instead likely to be the Salter-Swan dependent economic model or (as mentioned before) a three good model consisting of exportables, importables, and nontraded goods.

Such a production structure permits a distinction to be drawn between the exogenous terms of trade and an endogenous real exchange rate, which is the central intertemporal macroeconomic relative price in these economies.

In terms of the exogenous prices faced by the typical developing economy,

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<sup>10</sup> Later in the case of the “dual-dual” approach to modelling, we will find basically the same classification scheme. However, the number of production sectors in the particular model discussed in section 7 is four. The reasons will be explained in section 7.

both oil and non-oil commodities prices fluctuate a great deal.

The extent of external trade in assets have tended to be more limited in developing countries than in developed countries although this situation has recently begun to change in dramatic fashion for an important group of developing economies. The resulting instabilities however have also caused serious dislocations. In particular the increase in poverty in the affected Asian economies after the Asian Financial Crisis from July 1997 on should be kept.

In particular, the macroeconomic consequences of pegging, of altering the peg (typically devaluation) and of the rules for moving the peg are of particular importance in macro-modelling in developing countries. It is also useful to remind ourselves in trying to model the financial sectors that financial markets in many developing countries have long been characterized by the prevalence of rudimentary financial institutions. This is of particular relevance in analyzing the impact of policies on poverty reduction in low-income countries.

In light of the above, it should be apparent that in the modelling of these economies some macro-behavioral relationships may need to be modified. For example, we may need to incorporate the implications of credit and foreign exchange rationing in private decision rules where such rationing is present. This will affect, for instance, private consumption, investment, asset demand, export supply and import demand functions.

### *Some Relevant Aspects of Public Sector Behavior*

The *Government Budget* is another important segment of a macro-model requiring careful handling. In particular, we need to remember that the composition of the government budget differs markedly between industrial and developing countries. Even though reduction of government expenditures and the omnipresence of state has been on the agenda of the IFIs and national policy makers for at least two decades, there are still some lingering features. Perhaps the state is no longer as much of a behemoth as in the past. Nevertheless, a prominent role of the state in many developing economies is reflected through the following factors, among others:

- a. nonfinancial public sector – central government, local governments, specialized agencies, and nonfinancial public enterprises;
- b. financial institutions owned by the government;
- c. the central government absorbs a smaller fraction of output of developed countries than in developing countries;
- d. the composition of spending differs between the two groups of countries. Developing countries spend proportionately more of their budget on general public service, defense, education and other economic services. Developed countries spend more on health and substantially more on social security.

- e. Revenue: tax collection is hindered by limited administrative capacity and political constraints. This means that direct taxation plays a much more limited role than in developed countries. Direct taxes, taxes on domestic goods and services, and taxes on foreign trade account for roughly equal shares of total tax revenue in developing countries; in industrial countries income taxes account for the largest shares and taxes on foreign trade are negligible. In developing countries, the share of tax revenue raised from individuals is much higher than corporate income tax.
- f. greater reliance on seigniorage (change in base money stock divided by nominal GDP). Seigniorage and inflation are positively related.

Three other dimensions of the budget institutions that have relevance for both growth and poverty reduction have been much discussed recently:

- i. The nature and credibility effects of the constitutional rules that can be implemented to impose constraints on the size of the fiscal deficit, e.g., the balanced budget rule
- ii. The procedural rules that guide the articulation and elaboration of the budget by the executive branch, its approval by the legislative branch, and its execution.
- iii. The type of rules (whether collegial or hierarchical) that may enhance the transparency of the budgetary process e.g., Debt/ GDP upper limit constraint.

#### *Aggregate Supply and Labor Markets: some further issues*

Aggregate supply and the labor market are aspects that need some further attention before we close our discussion of institutional and macroeconomic aspects of macro-modelling. Here it is important to point out that through the cost of intermediate inputs that are imported; the exchange rate has an important influence on the position of the economy's short-run supply curve (SRSC).

SRSCs in developing countries may be significantly affected by working capital considerations. Many have claimed that costs of working capital tend to give interest rates and credit availability an important short-run supply-side role, although this is controversial and the empirical evidence is mixed.<sup>11</sup>

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11 See Agenor, Pierre-Richard and Peter J. Montiel, Development Macroeconomics and the references there for evidence on the empirical importance of the costs of financing working capital in Argentina and Korea respectively. If empirically relevant, the role of working capital in the short run supply curve would imply, for instance, that contractionary monetary policy may have short-term stagflationary consequences.

Although labor market institutions vary substantially across developing countries, the informal sector continues to play an important role in the determination of wages and employment in many of them. The modelling of short-run wage-setting behaviour represents one of the key differences between some of the major schools of modern macroeconomics, but most participants in the disputes acknowledge that country-specific institutional differences (such as the prevalence of staggered overlapping contracts in the U.S. or synchronized wage bargaining in Scandinavia) are important in determining the economy's SRSC. In this context, the role of economy-wide backward indexation mechanism in the context of disinflation programs has been studied extensively. Developing countries, as is well known, often have disguised unemployment. What is less well known is the prevalence of flexibility in many of the developing country labor markets as well. It would appear from the available evidence that many developing country labor markets have a high degree of real wage flexibility (Horton et al., 1994). Thus, for proper modelling of these markets in developing economies, a properly nuanced mix of flexibility and rigidity in specific labor markets is called for, rather than following one specific characterization for all labor markets.

As a result of the foregoing, the macroeconomic environment in developing countries is often much more volatile than that in industrial countries. The fundamental causes of the macroeconomic instability in developing countries are both external and internal. Small developing countries are price takers in the international markets for goods and services as well as financial assets. Therefore, these countries are directly affected by volatility in international markets. If we add to this the inflexibility and paucity of domestic macroeconomic instruments and we then face get a situation that is not easily amenable to control. There is also political instability in many countries resulting in frequent jumps in policy regimes. Such regime switch in a weak institutional environment creates the unfortunately typical developing countries scenario of a macroeconomic trajectory punctuated by a series of crises.

To sum up, economic boom and bust are much more prevalent in developing countries than developed countries. Such a history of macroeconomic volatility has serious economic costs—sometimes reaching into double-digit percentage points (See Khan, 2004b).

The above discussion is intended to give a fair summary of what is special about development macroeconomics. However, in order to link poverty analysis to the macromodels, more explicit recognition of the nature of market imperfections and of informal institutions that arise to fill the gaps is necessary. The literature in this area has experienced a tremendous explosion drawing on advanced work in game theory and the economics of information.<sup>12</sup> These new approaches try to explain empirical institutional features that include the following (Mookherjee and Ray, 2001).

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<sup>12</sup> See for example, the papers collected in D. Mookherjee and D. Ray, *Readings in the Theory of Economic Development*, Oxford: Basil Blackwell, 2001, for a representative sample. See also, P. Bardhan and C. Udry. *Development Microeconomics*, Oxford: Oxford University Press, 1999, Hayami, *Development Economics* (1997) and Otsuka(2001,2000).

- 1) Fragmented credit markets;
- 2) Segmented labor markets;
- 3) Lack of market clearing manifested in unemployment and credit rationing;
- 4) Co-presence of different types of contracts, e.g., tenancy contracts of both fixed rent and share cropping varieties;
- 5) Pervasive long-term relationships between borrowers and lenders, employers, and employees, or farmers and traders;
- 6) Dual labor markets in which some workers enter into long-term contracts while others are employed to carry out similar task without such contracts at a lower level of wages;
- 7) Interlinked transactions and exclusive dealing between specific groups of agents across many markets for instance, credit and tenancy may be bundled together. Likewise, credit may also be bundled with employment or marketing contracts;
- 8) Asset ownership is the key to access to credit, tenancy or employment markets. Thus the poor have limited or no access to credit because they lack collateral assets. The poor also have limited or no access to employment owing to malnutrition, debilitating diseases or low levels of human capital.
- 9) Small farms show higher yields even when the large farms have better access to credit and technology.
- 10) Some markets such as the market for land sales are quite thin, leading to the persistence of tenancy and unequal land ownership in spite of the superior productivity of owner cultivated small farms.
- 11) Informal cooperatives and kinship networks are significant determinants of access to credit, insurance, technological information, water and common lands.

As Stiglitz (1994) and others have pointed out, the standard Arrow-Debreu model with a complete set of markets and optimizing agents cannot explain these phenomena. However, models using game theory and the approach of information economics largely pioneered by Stiglitz have amassed an impressive analytical record in explaining these features. While macromodels cannot be expected to accommodate all these features, in detail, at least the labor and credit markets need to be modeled carefully. This point is beginning to be recognized by development macroeconomists of virtually all

persuasions (Agenor and Montiel, 1999).

In South Asia in particular many of these features which are distortions of the standard neoclassical general equilibrium model are still observed. One objective of reforms has been to give these economies more of a market orientation to varying degrees. The Indian case is illustrative. I turn next to a brief discussion of the post-1991 reforms in India with particular attention to reforms in the area of international trade.

## **5. An Example of Economic Reform in South Asia:India 1991-2004**

For its May 4, 1991 issue, the Economist chose the image of a tiger in a cage for the cover of an in-depth survey of the Indian economy.<sup>13</sup> The Indian economy was indeed in deep trouble. There were both short run problems of stabilization related in particular to problems of external balance and lack of reserves, and medium and long term issues of structural reforms including trade and financial liberalization.

In 1991, after the balance of payments crisis hit India, Dr. Manmohan Singh, a professional economist and an economic administrator, was appointed Finance Minister. Manmohan Singh is undoubtedly the architect of the most far reaching reforms in India since independence in 1947. Despite initial resistance, his personal integrity was a big factor in the eventual acceptance of some major policy shifts. However, from the mid-90s, there was increased criticism of both the results of the reforms---particularly on the distributional side--- and their inadequate formulation(Virmanani 2004). In response, government economists such as Dr. Arvind Virmani took upon themselves the task of clarifying the goals, objectives and methods of the reform package.

According to these Indian economists, there were two main objectives. One was to promote competition by eliminating protection. The other was to "...simultaneously" increase "... the ability of producers to meet such competition by removing policy barriers and distortions."<sup>14</sup> Clearly, trade liberalization was and remains an important plank of these reforms.

Although 1991 is conventionally given as the year when big changes began, the reform process itself was begun in the 80s.<sup>15</sup> However, the emergency in 1991 led to both a painful stabilization package to handle the short run external balance problems and also to the longer term reform agenda of dismantling the 'licence raj', giving market forces a bigger role to play.

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<sup>13</sup> I am grateful to Amartya Sen for drawing my attention to this. See also, Dreze and Sen(2002) chapter 9, "Well Beyond Liberalization" for a deep and insightful assessment and suggestions for the future course of the Indian economy.

<sup>14</sup> Virmani(2004), p. 17.

<sup>15</sup> See Virmani(2004). Dr. Kurian of the National Institute of Public Finance made some particularly insightful observations regarding the continuity of social objectives such as poverty reduction, and the moderation and relatively nonideological stance of leaders such as Manmohan Singh in particular.



Focusing on trade liberalization in particular, a considerable increase in exports took place with tariff reduction and removal of other barriers. Prior to the reforms all imports were either submitted to licensing or prohibited altogether. All bulk items such as cereals, petroleum, mineral ores, metals, fertilizers etc. could be imported only by specified government agencies. Hence the market structure was close to being a monopsony. There was also a massive increase in tariff rates in the 1980s.

As Joshi and Little(2001,pp64-65) argue forcefully, there were not good reasons for the level of protection that the inefficient manufacturing sector had enjoyed historically. As they also note, the really significant change on the import side was the introduction of a 'negative' list. Any item not on the list could be imported freely except for some bulk items still controlled by the government agencies in mid-90s.

In accordance with trade theory the import of consumer goods in line with consumer preferences should enhance welfare. The long standing official Indian attitude towards foreign made consumer goods seems to have reversed itself. After making the people to suffer through many homemade goods of lower quality produced inefficiently, the trade policy liberalization has led to an increase of imported consumption goods.

On the export side, quantitative export restrictions came under attack. The list of restricted items has indeed shrunk as a result. Export promotion schemes are also being pursued with more than usual vigor. However, many export promotion schemes still carry large administrative costs and are quite complex in practice.

India's main success in trade reform has been in the area of tariffs. In 1990-91, the unweighted average tariff was 125 per cent. That figure came down to 71 percent in 1993-94. The peak tariff rate in 1990 was an unbelievably high 355 percent. The peak rate in 1993-94 came down to 85 per cent. In 1995 the highest rate of tariff was further reduced to 50 percent. Today the average tariff rate is only 18 percent with the peak rate below 30 per cent. For this reason, in the policy experiments that follow in section 7, I concentrate on exploring the effect of tariff reduction on poverty reduction.

One last observation relates to the elections of 2004 and the replacement of the BJP government with the Centrist government headed by Dr. Manmohan Singh and supported--- with occasional criticisms--- by the left from outside the government. Initially there were great fears in the financial markets that a more populist regime will undermine the reforms if not reverse them altogether. That fear was calmed when Manmohan Singh became the prime minister with Mr. Chidambaram as the finance minister. However, the government has honestly admitted the failure of reforms to benefit the poor and the rural sectors in general. Along with the continuation of reasonable reforms, the government seems to be sincerely committed to the goal of poverty reduction.<sup>16</sup>

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<sup>16</sup> At least this is the consensus position I heard frequently from government advisers in the ministry of finance, planning commission members, private think tanks, university professors and political leaders during my visit to India in July 2004.



## 6. Towards A Generic CGE Model for South Asian Trade Liberalization

### 6.1: What is the “appropriate” class of CGE models for dualistic economies?

In order to discuss how to incorporate poverty analysis in a CGE model, we need a clear understanding of the structure of CGE models as such. As a first step in understanding the CGE models, we can start with the Walrasian “fundamentalist” approach to general equilibrium. Essentially, the problem here is to find a set of prices (a price vector) that will clear all markets.<sup>17</sup>

The producers maximize profit and the consumers maximize utility. All markets including futures markets must exist and all uncertainty must be subject to actuarial calculation of risk<sup>18</sup>. It is clear that while theoretically elegant and analytically impressive, the conditions in many actual economies do not approximate this theoretical model.

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

As Robinson (2003) observes:

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

It is not relevant here to outline the contours of this debate, except to keep in mind that neither the fully Walrasian nor the standard Keynesian model is likely to correspond exactly to the actualities of a developing economy. However, we need to keep firmly in mind that a CGE model in its origin--- and initial historical development--- is Walrasian in spirit.

At the applied level, a CGE model incorporates all the flow variables

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<sup>17</sup> Actually, it is necessary and sufficient for all but one of the markets to be in equilibrium. As is well known, by “Walras’ law” when all but one markets clear, the last one must clear also.

<sup>18</sup> Formally, the maximization of expected utility must be possible. For this, an axiomatic characterization was given by von Neumann and Morgenstern. A necessary condition is the possibility of expressing all states as quantifiable probability distributions.

that can be captured in a SAM.<sup>19</sup> The origins of social accounting can be traced as far back as Gregory King's efforts in 1681, but more recent work stems from the attempts by Richard Stone, Graham Pyatt, Erik Thorbecke and others.<sup>20</sup> The relevant SAM accounts must be specified clearly for the particular CGE model one wishes to construct and implement.

These accounts will usually include production activities, factorial income distribution and household income distribution among other variables. The importance of both the factorial income distribution and household income distribution for poverty analysis in a CGE model are intuitively obvious. However, proper modelling strategy for these distributions in a CGE model is far from obvious. Later, we will have an occasion to deal with the issues that arise in this context in some concrete examples of CGE models for poverty analysis, and finally to formulate an appropriate model for South Asia incorporating the dualistic structure of South Asian economies.

As implied before, the Walrasian spirit of a CGE model is shown in its determination of only relative prices, with some price index being chosen as the numeraire. The model also incorporates the assumption of 'no money illusion'--- all supply and demand equations are homogeneous of degree zero with respect to prices.<sup>21</sup> If all prices are multiplied by a fixed number, the equilibrium quantities do not change at all.

As a matter of historical record, it has been a standard practice of CGE modelling to specify fixed supplies of factors of production such as various types of labor and capital, or aggregate indexes of these, and carry through the implications of the assumption that all markets must clear. These "classical" CGE models calibrate wage and rental rates to employ all of the exogenously specified labor and capital. In many "applications", the guiding idea has been to introduce distortions to the 'equilibrium price vector' and calculate the resulting inefficiencies. In this sense, CGE models have been used as a normative check for distortions and their costs against the benchmark of a Walrasian market clearing price system.<sup>22</sup>

There is also much discussion in the CGE modelling literature about the various "closure rules" for the models. The discussion about macro-closures, initiated by Sen (1963), was revived by Taylor and Lysy (1979) who found that the choice of macro-closure to a large extent affected the policy simulation results obtained with a CGE model. As the previous discussion already indicates, the macroeconomic

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<sup>19</sup> For a succinct discussion of some of the relevant features of the applied models for policy analysis, see Yao, Shujie and Aying Liu, "Policy Analysis in a General Equilibrium Framework" *Journal of Policy Modelling*, 22(5):589-610, 2000.

<sup>20</sup> For a description of SAM as a data gathering device, see G. Pyatt and E. Thorbecke, *Planning Techniques for a Better Future* (Geneva: ILO, 1976). See also Khan(1983,1997,1998,2004b) and, Khan and Thorbecke(1988,1989).

<sup>21</sup> In macroeconomic terms, we can include the assumption of neutrality of money. And thus create a 'classical' model.

<sup>22</sup> It should be noted, however, that the assumption of full employment means that the economy is at the wrong point of the (multidimensional) production possibilities frontier, not inside it.

modelling is forced to depart from the Walrasian assumptions embodied in a “fundamentalist” CGE model. This also leads to the “closure rule problem”. Because the short-run macro CGE models do often deviate from the Walrasian closure, a separate literature has grown up around the various alternatives.

There are mainly two ways to interpret and define the closure rule problem. In mathematical terms, the problem boils down to the simple notion that the model should consist of an equal number of equations and endogenous variables.<sup>23</sup> Thus, the closure rule problem is the decision the model builder has to make on which variables are endogenous and which variables are exogenous. Alternatively, if the model is built in the Walrasian tradition and all decisions are based on optimizing behavior, the closure rule problem involves the introduction of macroeconomic constraints that impinge upon the microeconomic behavior of individual agents. One then needs to introduce additional balancing equations. (Ginsburgh and Keyzer, 1997). In general, a closure rule is determined by the theoretical preferences of the model builder and, in her view, empirically the most plausible adjustment processes.

In the early works that used CGE models for development policy work, much time was spent in finding ways to model the various distortions in the foreign trade sectors. Thus, modelling exports, imports, balance of trade and balance of payments became important items on the modelling agenda during the 1980s. After trying various approaches, a general consensus was reached. The consensus approach admits imperfect substitutability between imported goods and their domestic counterparts. The Armington assumption is invoked by almost all modelers.<sup>24</sup> The Armington assumption regarding imperfect substitutability has been extended to the modelling of exports as well. The most common approach now is to specify sectoral constant elasticity of substitution (CES) import demand functions, export transformation functions that assume constant elasticity of transformation (CET) and aggregation functions based on these.<sup>25</sup>

We may recall that starting with Hume and his price-specie flow mechanism, the classically inspired trade theories have implied a trade balance of zero in equilibrium. But in the real world data the trade balance is rarely zero. Does this mean that the equilibrium assumption is somehow violated? The most widely practiced way of handling this nonzero trade balance is to make it exogenous. Typically, trade imbalances find their counterpart in the saving-investment imbalance.

Looked at in this way, trade imbalances can be treated as foreign saving flowing in with a trade deficit, and of savings flowing abroad when trade balance is positive. However, this does raise the question of why people at home or abroad would be willing to save and lend--- a question that can only be answered in an explicitly

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<sup>23</sup> More precisely, the system must satisfy solvability conditions. For a linear system this means that the number of linearly independent equations must equal the number of endogenous variables.

<sup>24</sup> See Armington(1969).

<sup>25</sup> The theoretically inclined reader will recognize this as being in line with the Salter-Swan model.

intertemporal model. Thus, static CGE models which treat trade balance as exogenous are, in fact, compressions at a point in time of a more fully specified intertemporal equilibrium model.

There is also the related issue of how to bring in balance the traded with the nontraded sector, and the domestic economy with the rest of the world. This is done by making flexible another relative price. This is the relative price of traded and nontraded goods, or under the purchasing power parity and small country assumption, the real exchange rate. Naturally, modelers tend to specify an implicit functional relationship between the real exchange rate and the trade balance. Increased flow of foreign savings raises the relative price of nontraded goods which is equivalent to an appreciation of the real exchange rate in these models (Devarajan, Lewis and Robinson, 1993). There is a shift of production away from exports goods producing sectors to nontraded goods and services. Consumers shift demand to cheaper imports and the new trade balance equals the exogenous flow of higher foreign savings.<sup>26</sup>

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

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

The question of private savings is also related to that of public savings and dissavings, as the case may be. But the government does more than simply generating savings or dissavings. It collects taxes, makes transfer payments and purchases goods and services. Through all these activities it can affect the flow of income and consumption of all or at least some socioeconomic groups. Hence, an intuitive link between government’s actions and poverty is justified. Later, we will see how this link can be made more explicit in a causal sense. For the moment, let us simply observe that

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<sup>26</sup> Therefore, this is properly described as a comparative statics exercise with the chain of causality starting with the exogenous change in foreign savings and ending with a new trade balance.

in most CGE models government is a rules-based (but not necessarily a utility maximizing) actor. Typically, the monetary side is absent or sketchy. Usually, there is a flow-of-funds specification, but no consideration of how the government finances its deficit. There is simply a crowding out of private investment.

Thus, the trade balance, private saving-investment balance and the public sector balance are all treated in a somewhat *ad hoc* fashion, but in a way this treatment broadly respects the relative price flexibility in the Walrasian spirit. However, the previous discussion also raises the question of including dynamic considerations explicitly. In particular asset endowments, markets and expectational dynamics may need to be included. Opening up the model in this way, also carries the danger of making it less tractable. This explains why dynamic CGE models to this day are not as well developed as a reasonable theoretical critique would demand. It would seem reasonable, for example, to expect that an “ecumenical” approach could postulate the possibility of unemployment, informal labor markets, financial markets for various assets and their relation to the real sectors. Such a “realistic” model could better capture the location and dynamics of poverty among other things. Better policy analysis prospects may be an important motivation for searching for such models. However, this is beyond the scope of this paper. What can not be ignored in an exercise in poverty analysis even if it is technically limited to comparative statics is the distributional side I now turn to a consideration of distribution within CGE models leading towards the formulation of an appropriate model for South Asia.

## 6.2 *Income Distribution, poverty and dualism:*

The seminal contribution by Adelman and Robinson(1979) had used an implicit SAM to capture both factorial and household income distribution in a disaggregated manner. At about the same time the work of Lysy and Taylor(1980) focused on Brazil and made distributional aspects a part of the overall analysis. Dervis, De Melo and Robinson(1982) also addressed distributional issues in the general equilibrium modelling context. However, real concern with distribution and poverty analysis started towards the end of 1980s, after a decade of structural adjustment policies. Under the aegis of the OECD, Thorbecke (1991) for Indonesia, de Janvry, Sadoulet and Fargeix( 1991) for Ecuador, Morrison(1991) for Morocco and Chia, Wahba and Whalley for the Ivory Coast are some modelling examples from this “second generation” of CGE models for developing countries that addressed income distribution and welfare issues in greater detail than before. A number of papers by Bourguignon and others also contributed to this stream.<sup>27</sup>

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

However, by utilizing the information in household income and expenditure surveys, it is now possible to generate intrahousehold groups income distribution and poverty profiles. It is also possible to use these profiles as part of the initial calibrating exercise in CGE models. A set of recent modelling efforts have been directed in precisely this direction.<sup>28</sup> Here, the paper by Decaluwé, Bernard, A. Patry, Luc Savard,

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<sup>27</sup> See in particular, Bourguignon, F., J. de Melo, and A. Suwa, 1989. *Distributional Effects of Adjustment Policies: Simulations for Two Archetype Economies*, Background Paper for 1990 WDR, World Bank.

Bourguignon, F., J. de Melo, and A. Suwa, 1991. *Modelling the Effects of Adjustment Programmes on Income Distribution*, *World Development*.19:11 1527-1544.

Bourguignon, F., W. Branson, and J. de Melo, 1989. *Adjustment and Income Distribution: A Counterfactual Analysis*. World Bank, PPR Working Paper 215.

For a concise review of recent issues in both macro and micro aspects of poverty analysis, see Bourguignon, F., L. Pereira da Silva and N. Stern (2002), *Evaluating the Poverty Impact of Economic Policies: Some Analytical Challenges*, draft paper, World Bank.

<sup>28</sup> See Decaluwé, Bernard, A. Patry, Luc Savard, and Erik Thorbecke, 1999. *Poverty Analysis within a General Equilibrium Framework*. Working Paper No. 99-09, African Economic Research Consortium (June).

Also Dorosh, Paul A. and David E. Sahn, 2000, “A General Equilibrium Analysis of the Effect of Macroeconomic Adjustment on Poverty in Africa”, *Journal of Policy Modelling* 22(6):753-776.



and Erik Thorbecke (1999) is a pioneering piece. Another paper by Decaluwé, Dumont and Savard (1999) tests the relevance of intrahousehold distributional information for poverty analysis. Based on an archetypal economy with four areas of activity (agriculture, industry, marketable and nonmarketable services), three factors of production (capital, skilled and unskilled labor) and four types of agents (rest of the world, government, firms and households), their approach is to isolate the contribution of average income variations, poverty line changes, and income distributional changes and then to look at the effect of these variations on various poverty indicators. Their results are unambiguous. They clearly highlight the relevance and significance of intrahousehold group information. Of the three influences they discuss, the changes in poverty line in a price-endogenous model accounts for most of the changes in poverty. Therefore, both intra-household group information and price endogeneity that allows us to compute a new nominal poverty line after each policy change are important. Azis (2002) is an example of the use of this approach for analyzing poverty after the Asian financial crisis.<sup>29</sup> Another set of papers exemplified by Cogneau and Robillard (2000) and Cororaton (2003) utilizes the household expenditure survey results to carry out microsimulations. Here each household is treated effectively as an individual economic agent and its decisions are modeled directly.

Since the purpose of this paper is to see if there are "generic" models of poverty analysis within the CGE family of models applicable to South Asia, I now turn to a detailed discussion and evaluation of a generic model which is a slight modification of Stifel and Thorbecke (2003) and present the empirical results from my work on South Asia.

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<sup>29</sup> See Azis, Iwan J. (2002), *A New Approach to Modelling the Impacts of Financial Crises on Income Distribution and Poverty*, Tokyo: *ADBI Research Paper* no. 35.

## **7. Results from the “Dual-Dual” CGE Model and their Interpretation :Poverty Analysis in a Generic CGE Model for South Asia**

Among the models mentioned in the previous section, the closest to being a generic model is the Stifel-Thorbecke (2003) model of an archetype African economy. They build a CGE model in order to simulate the welfare effects of trade liberalization. In particular, their effort is directed towards an analysis of the effects of trade liberalization on poverty. They use what can be called a “dual-dual” frame work (Thorbecke,1993,1994,1997). This corresponds to the characteristics of a developing economy with not only the traditional and modern sectors but also a kind of dualism within each of these sectors in terms of formal/informal dichotomy.<sup>30</sup> Furthermore, the process of development for economies at a higher level of development may modify the traditional sector further in the direction of a more market-based modern sector.

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

The starting point is the dual economy models of Lewis(1954) and Fei and Ranis (1964)<sup>31</sup>. These pioneering efforts, however, could not or did not take into account the co-presence of dualism within each sector of the two sector models of the dual economy. Erik Thorbecke first raised this issue in 1979 during the course of a National Science Foundation interdisciplinary project on technology and development and Svejnar and Thorbecke (1982) was the first published work on a prototypical of dual-dual technology classification scheme. Khan (1982a,b) and Khan(1983) were applications of this scheme to the energy and textiles sectors in South Korea. Khan (1983) raised the issue of linking technological dualism to poverty theoretically, following an early observation of Pyatt and Thorbecke (1976). Khan and Thorbecke(1988,1989) were further applications of technological dualism to Indonesia.

In Thorbecke’s later classification a rural/urban dichotomy is combined with traditional/modern technological dualism, leading to a fourfold classificatory scheme.<sup>32</sup> The four broadly defined sectors in this scheme are:

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<sup>30</sup> See also, Svejnar and Thorbecke (1980,1982), Khan(1983,1985,1997). In these analyses, the particular country chosen was South Korea in the 1970s. Instead of CGE flex-price models, SAM-based models of fixed price variety were used.

<sup>31</sup> See Khan (1997) chs. 2 and 3 for a historical survey and a specific intertemporal dualistic model which is used to analyze the conflict between employment and output.

<sup>32</sup> See Svejnar-Thorbecke(1980,1982) and Khan(1983) for early developments.

1. subsistence agriculture with traditional labor-intensive technologies, family farms and food crops for domestic consumption;
2. large scale agriculture producing mostly export crops using capital-intensive technology.
3. the urban informal sector defined in an operational manner;
4. modern sector with industry and services in the urban areas.

Poverty analysis in this dual-dual model proceeds along the lines developed by Decaluwé, Bernard, A. Patry, Luc Savard, and Erik Thorbecke (1999). This approach relies on varying prices and a fixed commodity basket to derive an endogenous (nominal) poverty line every time there is a shock resulting in a new equilibrium price vector for the economy. It also uses a beta distribution with varying parameters to capture differences in income distributions that are group specific. Within each group also the parameters can vary, resulting in a new distribution. Standard poverty measures are applied to pre-policy shock and post-policy shock income distributions to derive the impact on poverty. I have modified the model on the production side by replacing the Cobb-Douglas production functions of the Stifel-Thorbecke model with more general CES production functions. The trade liberalization policies' impact on poverty reduction are given for this new, CES specification in this paper. As is well known, on the production side, the latter specification allows a choice from a much wider range of elasticities than does the Cobb-Douglas production function. On the distribution side, Cobb-Douglas production functions with the unitary elasticity of substitution imply fixed factor shares. Thus CES functions( of Cobb-Douglas production functions is a special case) allow more flexibility on both the production and the distribution sides. Of course, the actual elasticities of sectoral production functions are empirical issues. But for this reason in particular, Cobb-Douglas production functions with the unitary elasticity of substitution may be a priori too restrictive. The equations of the modified model are as follows:

**Representation of Dual-Dual Model with CES Production Functions(complete description of the notation is given in appendix II)**

*Production and Labor Market*

$$X_{fc} = A_{fc} \left[ \beta_K^{fc} \bar{K}_{fc}^{\frac{\mu_{fc}-1}{\mu_{fc}}} + \beta_{LS}^{fc} LS_{fc}^{\frac{\mu_{fc}-1}{\mu_{fc}}} + \beta_{LU}^{fc} LU_{fc}^{\frac{\mu_{fc}-1}{\mu_{fc}}} \right]^{\frac{\mu_{fc}}{\mu_{fc}-1}} \dots\dots\dots(1) - (2)$$

$$X_{ic} = A_{ic} \left[ \beta_K^{ic} \bar{K}_{ic}^{\frac{\mu_{ic}-1}{\mu_{ic}}} + \beta_{LU}^{ic} LU_{ic}^{\frac{\mu_{ic}-1}{\mu_{ic}}} \right]^{\frac{\mu_{ic}}{\mu_{ic}-1}} \dots\dots\dots(3) - (4)$$

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

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

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

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

$$w_{im} = i_{srtc} + \gamma \frac{\Pi}{LU_{im}} \dots\dots\dots(10)$$

$$\Pi = P_{im} X_{im} - i_{srtc} LU_{im} - wS_{im} LS_{im} \dots\dots\dots(11)$$

$$wu_{ex} = \left(1 - \frac{hLU_{im}}{LU_{srtc} + LU_{im}}\right) wu_{srtc} + \left(\frac{hLU_{im}}{LU_{srtc} + LU_{im}}\right) wu_{im} \dots\dots\dots(12)$$

$$wS_{fc} = \frac{P_{fc} \beta_{LS}^{fc} X_{fc}}{LS_{fc}} \dots\dots\dots(13) - (14)$$

$$wS_{im} = \left[ \frac{1 - \beta_{LU}^{im}}{(1 - \theta) \beta_{LU}^{im} + \theta(1 - \beta_{LU}^{im})} \right]^{\frac{1}{1-\theta}} wS_{ex} \dots\dots\dots(15)$$

*Disposable income and savings*

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

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

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

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

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

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

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

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

$$I_{bch} = tM \dots\dots\dots(24)$$

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

*Demand*

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

*Foreign Trade*

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

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

*Equilibrium Conditions*

$$\sum_c LU_c = LU \dots\dots\dots(52)$$

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

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

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

$$P_{ex} \equiv 1 \dots\dots\dots(57)$$

The production sectors are specified as CES with the choice of nonunitary<sup>33</sup> elasticities

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<sup>33</sup> Stifel-Thorbecke paper uses Cobb-Douglas production functions with elasticities of substitution restricted to a value of 1.

of substitution for the two formal sector commodities in equations 1 and 2. The informal sector commodities also have CES specifications. All commodities are produced under capital constraints. Thus, capital,  $K$ , in each sector has an upper bound denoted by a bar above  $K$ . The assumption that capital stock is fixed in each sector may be relaxed, but it is in fact, a fairly standard assumption for developing economies.

In the informal sectors each worker receives her average revenue product. Rural small holders may work on common land and these rural farming households may share the total income equally among all the family members. Urban informal workers supply all their labor at the prevailing wage rate. Thus leisure is not an argument in their objective function. This may be defended as an extreme assumption when people are at the margins of subsistence. Equations 5 and 6 show the informal sectors' income determination.

The total income per unit includes logically the returns also to nonlabor assets for those who own land or capital. Hence, the relevant measure of income is total income per unit from all sources.

The profit maximizing rural large landholders ensure that under competitive conditions wages for unskilled workers in the export sector are equal to the marginal revenue product of the unskilled labor they have to hire. Equation 7 reflects this condition.

Equation 8 shows the equilibrium allocation of unskilled labor in the rural informal sector. In equilibrium, the rural sector wage rate is below the wage rate in the formal sector by a fixed factor. This reflects the assumption that there are transactions costs in working in the rural formal sector that is captured by this mark up.<sup>34</sup>

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<sup>34</sup> Alternatively, one could also postulate that there is an 'insider' market wage equilibrium in the formal sector, and those unskilled workers lucky enough (or more likely, because they know someone already working in the formal sector) to get a job in the formal sector can enjoy this wage premium. This is not a hypothesis the authors consider, but the data will be consistent with this hypothesis as well.

Turning now to the import sector, for unskilled workers in the urban area the assumption here is that they get the income per unit of labor in the urban services sector (shown in equation 9) plus a share of the profits as given in equation 10. The profit determination itself is shown in equation 11.

The Harris-Todaro model features regarding rural-urban migration are captured in equation 12. Here, in equilibrium, rural wage must equal the expected wage in the urban sector. In equation 12, the probability of getting a job in the import sector is given by the share of the urban uneducated labor force in that particular sector multiplied by a scale parameter,  $h$ .

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

#### *Household Income Determination:*

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

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

Equations 20- 24 show the incomes of the urban households. The working class households receive wage income and the capitalists the profit incomes, in general. The bureaucratic households capture part of the rents from imports by colluding with the rent seekers.<sup>35</sup> The formal sector employers (rural large land owners and urban capitalists) are the only savers in the model. They each save a constant fraction of their nominal incomes.

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

#### *Foreign Trade:*

Imports in this model are the difference between domestic demand and production of

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<sup>35</sup> Salaries are excluded in equation 24. The reasoning is that these are invariant to exogenous shocks.

import competing sector. Exports can be supplied at the prevailing price up to any quantity under the small country assumption. Thus exports are equal to total output less the savings in the form of exportables of the rural large landholders. Equations 50 and 51 show the import and export demand functions respectively.

*Equilibrium conditions for the model as a whole:*

There are two sets of equilibrium conditions in the model. First, the labor market equilibrium conditions are given by equations 52 and 53. There is disguised unemployment, as discussed before, but no formal involuntary unemployment. The second set of equilibrium conditions given by equations 50 and 51 is that the domestic demand for the informal sector goods and services is matched by domestic supply. Prices in the formal sectors are set by the world market prices. The export price is normalized to one. The import price is equal to  $1+t$ , where  $t$  is the tariff rate. Exchange rate is held fixed during the particular modelling period. It is clear that the current account balance must be exogenous. In line with our discussion in the previous section, this balance is equal to foreign savings which are assumed to be zero here. Hence current account balance is assumed to be zero.<sup>36</sup> The SAM below in table 1 which is largely compiled from data for India below summarizes the relevant information for our generic South Asian economy. Note that in the SAM, the labor and capital are shown in aggregate forms; but in actual modeling exercise these are further disaggregated as discussed during the model description above.<sup>37</sup>

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<sup>36</sup> Implicitly, this amounts to claiming for a reforming economy (see section 5 above) that the stabilization policies indeed succeed in restoring the external balance.

<sup>37</sup> Namely, skilled and unskilled labor, and capital and agricultural capital.



Table 1: SAM for a generic dual-dual South Asian Economy

	Food	Import Competing	Urban Services	Exports	Labor	Capital	Rural Small Holders	Rural Unskilled	Rural Skilled	Rural Large Landholders	Urban Informal	Urban Unskilled	Urban Skilled	Capitalists	Bureaucrats	Priv. Corp.	Pub. Enter.	Govt.	Ind. Taxes	Capital A/C	ROW	Total
Food	6,161.51	1,488.26	343.58				1,135.46	507.49	162.45	64.07	396.97	22.67	122.27	59.37	767.42			21.66		40.64	128.24	11,422.07
Import Competing	376.79	14,734.31	1,395.77	22.04			863.66	334.49	141.55	65.38	394.25	14.48	93.70	158.99	1,087.03			266.62		3,304.04	959.64	24,212.76
Urban Services	349.89	2,315.85	9,368.31	54.50			894.14	287.20	101.65	45.62	420.07	12.36	78.55	124.20	969.17			1,370.21		204.73	504.03	17,100.48
Exports	41.31	330.05	346.04	1,068.81			51.07	15.20	5.63	2.06	22.90	0.65	4.07	6.01	46.76			52.30			7.89	2,000.74
Labor	2,162.79	1,757.51	2,585.17	224.70																	(2.35)	6,727.82
Capital	2,108.53	1,917.65	2,602.60	615.56																	(129.70)	7,114.65
Rural Small Holders					1,222.67	2,562.15												444.19			26.08	4,255.09
Rural Unskilled					1,133.52	14.91												90.60			19.45	1,258.48
Rural Skilled					350.09	70.07												28.89			0.94	449.98
Rural Large Landholders					50.19	93.96												25.02			44.10	213.28
Urban Informal					417.16	1,077.89												154.26			134.26	1,783.57
Urban Unskilled					38.12	11.23												2.51			0.22	52.08
Urban Skilled					199.20	112.64												24.95			4.61	341.40
Capitalists					60.61	267.16												42.00			97.82	467.59
Bureaucrats					3,256.26	654.07												173.34			110.15	4,193.82
Priv. Corp.						407.87												51.40				459.27
Pub. Enter.						166.24																166.24
Govt.						131.98	180.39			9.04	75.61			19.82	177.79	200.16			1,312.00			2,106.80
Ind. Taxes	(156.68)	506.35	230.16	2.69			158.24	61.50	22.10	9.52	66.33	2.70	16.05	18.73	154.26			24.26		204.91	(9.12)	1,312.00
Capital A/C						1,544.49	972.13	52.61	16.61	17.59	407.44	(0.78)	26.76	80.46	991.39	259.11	166.24	(665.43)			(114.30)	3,754.32
ROW	377.91	1,162.77	228.84	12.44																		1,781.97
Total	11,422.07	24,212.76	17,100.48	2,000.74	6,727.82	7,114.65	4,255.09	1,258.48	449.98	213.28	1,783.57	52.08	341.40	4,193.82	459.27	166.24	2,106.80	1,312.00	3,754.32	1,781.97		

*Poverty Analysis in the Generic Model:*

In order to carry out the poverty analysis, it is important to realize that the extent of poverty is unevenly spread across different households. The sources of income poverty can be traced to the sources of income of the various households. Table 2 below gives the factorial sources of household incomes of poor households in the model economy. The numbers are hypothetical and are the same as Stifel- Thorbecke's specifications.

TABLE 2: FACTORIAL SOURCE OF HOUSEHOLD INCOME (%)

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

Among all the household groups, rural smallholders have the second lowest average income and they have the second highest incidence of poverty. The highest incidence of poverty is found among the urban informal households. As table 2 shows they derive 75 percent of their income from wages in the unskilled labor market and 25 per cent from capital.

Table 3 below shows the initial mean incomes and population shares before the policy experiment. This has been created by taking the demographic and other characteristics of households in South Asia---particularly in India and Bangladesh. This table also shows the headcount measure of poverty rates for each of the household groups that earn at least some labor income. It ignores three household groups, however. The groups thus ignored are rural large landholders, urban capitalists and bureaucrats. The reason is simple. None of these households are assumed to be in poverty, nor does the particular policy shock results in poverty for any of these three groups.

TABLE 3: INITIAL INCOME AND DEMOGRAPHIC CHARACTERISTICS OF HOUSEHOLDS IN THE LABOR MARKET

	<b>Mean income</b>	<b>Population share</b>	<b>Percent poor</b>
Rural small-holders	1.00	0.41	90.20
Rural unskilled	1.05	0.01	20.57
Rural skilled	1.75	0.01	21.18
Urban informal	0.92	0.38	74.71
Urban unskilled	1.95	0.05	5.34
Urban skilled	3.50	0.09	1.49

From table 3 above, it appears that the mean incomes have a wide range---from 0.92 for the urban informal workers to 3.50 for the urban skilled workers. These incomes are scaled relative to the pre-tariff import price which is the numeraire in the model. Among the skilled groups, the richest are in the urban sector. For the unskilled also, the urban unskilled group has the highest income, for reasons explained previously. Rural smallholders (41 per cent of the population) and other households with low education and skills such as rural unskilled, urban informal and urban unskilled comprise about 80% of the total population and almost all of the poor come from these groups. Contrarily, households comprising of highly educated and skilled workers account for about 10 per cent of the total population and only 0.4% of those below the poverty line come from these groups.

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

*Policy Simulation in the Model and Impact on Poverty:*

Prior to the policy experiment of tariff liberalization, the urban skilled workers in the model economy enjoy the highest level of wages. Their average wages are exactly twice the level of the rural skilled, almost three times that of the urban unskilled and

more than three times that of the other three groups.

The trade policy experiment involves a tariff reduction that ranges from 87% to below 20%.<sup>38</sup> The obvious and immediate effect is a drop in the price of imports and a relative increase in the price of exports.<sup>39</sup> In keeping with the shape of the supply curves production rises for exports and falls for the import-competing sector.<sup>40</sup> Consistent with this, demand for both skilled and unskilled labor drops in the urban importables sector, and rises in the rural exportables sector. There is also a fall in the wages in the former sector, and a reverse migration out of this sector in the urban area to the export sector in the rural area. For this particular policy experiment, in the new general equilibrium, the share of urban skilled workers falls by 9%. At the same time the share of rural skilled workers rises by about 22%. Correspondingly, there is also a movement of the unskilled workers from the urban to the rural area as well. Finally, the fall in the aggregate income in the urban formal sector reduces effective demand for the urban services sector as well, pushing out the urban informal sector workers towards the rural area also.

Table 4 below gives the results for poverty reduction. Two implicit assumptions underlie these results. First, individuals who migrate take on the socio-economic characteristics of the group in which they end up. Second, both the groups---i.e., the group from which the individual migrates and the group to which the individual worker migrates--- still have the same income distribution as before the migration.

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<sup>38</sup> This reflects approximately, the actual Indian policy changes and the consequent trajectory of tariffs. See Joshi and Little(2004(1996)), Virmani(2004) and Ahluwalia and Little(1998). A 'generic' set of experiments in tariff reductions starting with an index of 100 and going down to 0 in steps of 10 per cent reductions is given in the appendix.

<sup>39</sup> The nominal price of exports which is the numeraire remains constant.

<sup>40</sup> The exact extent will naturally vary with the extent of relative price changes and the supply elasticities.

TABLE 4: CHANGES IN POVERTY

	Base Case TX_87	Sim_87_ 20	Change	Sim_20_ 18	Change	Sim_15_ 12	Change
<b>National Poverty</b>							
Poverty Headcount (P0)	24.56	24.417	-0.56%	24.08	-1.39%	24.42	0.00%
Poverty Gap (P1)	5.60	5.607	0.18%	5.55	-1.11%	5.60	-0.02%
Poverty Severity (P2)	2.09	2.092	0.14%	2.07	-1.00%	2.09	0.00%
<b>Poverty Headcount (P0)</b>							
Rural Small-Holders	90.20	90.204	0.00%	89.39	-0.90%	90.20	0.00%
Rural Unskilled	20.57	20.566	0.00%	19.87	-3.40%	20.57	0.00%
Rural Skilled	21.18	21.178	0.00%	20.82	-1.70%	21.18	0.00%
Rural Capitalist	-	0		-		-	
Urban Informal	74.71	74.014	-0.93%	74.01	0.00%	74.01	0.00%
Urban Unskilled	5.34	4.577	-14.29%	3.81	-16.67%	4.58	0.00%
Urban Skilled	1.49	1.49	0.00%	1.49	0.00%	1.49	0.00%
Urban Capitalist	-	0		-		-	
<b>Poverty Gap (P1)</b>							
Rural Small-Holders	26.91	26.961	0.18%	26.72	-0.88%	26.91	-0.01%
Rural Unskilled	0.99	1.003	1.21%	0.94	-6.48%	0.99	-0.10%
Rural Skilled	1.93	1.947	0.83%	1.87	-4.21%	1.93	-0.05%
Rural Capitalist	-	0		-		-	
Urban Informal	27.09	27.087	-0.02%	27.02	-0.26%	27.09	0.00%
Urban Unskilled	0.16	0.158	0.00%	0.15	-3.80%	0.16	0.00%
Urban Skilled	0.02	0.015	0.00%	0.01	-20.00%	0.02	0.00%
Urban Capitalist	-	0		-		-	
<b>Poverty Severity (P2)</b>							
Rural Small-Holders	10.51	10.535	0.25%	10.41	-1.17%	10.51	-0.02%
Rural Unskilled	0.07	0.075	1.35%	0.07	-8.00%	0.07	0.00%
Rural Skilled	0.23	0.237	1.28%	0.22	-5.91%	0.23	0.00%
Rural Capitalist	-	0		-		-	
Urban Informal	11.73	11.722	-0.03%	11.68	-0.39%	11.72	-0.01%
Urban Unskilled	0.01	0.008	0.00%	0.01	-12.50%	0.01	0.00%
Urban Skilled	-	0		-		-	
Urban Capitalist	-	0		-		-	

Note: Poverty measures are all multiplied by 100.

Under the assumptions, the results within the model show that in general, both the extent and depth of poverty decline for each group. The largest headcount ratio drop is recorded for the rural unskilled group. Poverty severity also falls for each household group with the exception of the urban unskilled workers. But when the tariff rates fall from 15 to 12 percent, this group benefits as well. In general though, much of the poverty reduction impact of trade liberalization can be reaped earlier. Further reductions leading to a rate below 10 per cent may not have much more of an impact than earlier tariff reductions. One surprise, however, is the largely nonlinear impact of tariff reductions on poverty. Although there is a progressive gain from liberalization, there seems to be a big jump nationally when the rate is in the range of 15 to 18 per cent. However, there is very little change for even lower rates, for example, from 15% to 12%. Given the stylized nature of the exercise, no magical properties need to be attributed to these particular numbers. The general lesson is that tariff reduction will ultimately benefit the poor; but the trickling down process is uneven and may require some time to work through the socio-economic system.

We look at the poverty gap squared measure next. From the results presented in table 4, it turns out that tariff reduction does lead to a reduction in poverty severity at 18 per cent. However, the change in the national poverty measure is small--- a fall of only one per cent. This is consistent with the observation that trade liberalization may benefit initially those among the poor who are closer to the poverty line than those who are far below. It may leave unchanged the incomes of those who are well below the poverty line. But the good news surely is that when tariffs are sufficiently low, some of the poorest may finally begin to benefit.

Scrutinizing table 4 carefully, it can be seen that for the various household groups the headcount jump is relatively more significant for several of the rural household groups. In particular, both the rural skilled and unskilled household groups experience significant changes in poverty reduction at the lower tariff rates. For urban unskilled the changes are even larger absolutely but are relatively less dramatic and more monotonic over an entire range of gradually declining tariff schedules.. However, for the poverty gap measure, the poverty reduction effects shown are much smaller for this group. By contrast, the urban skilled household group via higher wages and better employment opportunities experiences a further reduction of about 20% when tariff rates are reduced from 20 to 18 per cent. However, this group has fewer poor households to begin with. Hence, the overall impact on national poverty reduction is small.

In terms of the change in poverty severity measure, the urban unskilled show the greatest improvement. This group is followed by rural unskilled, rural skilled and rural smallholders. Thus an overall average tariff rate reduction target all the way down to the range of 10 to 20 per cent range seems a reasonable trade liberalization policy objective for a South Asian economy from a poverty reduction perspective..

However, a cautionary note needs to be sounded so that there is a sense of

realism about the potential of trade liberalization alone to meet the overall poverty reduction targets. Although the positive effect on national poverty is clearly discernible within our model with the results derived from South Asian data, the absolute amount is not as high as it would need to be given the poverty reduction targets of the Millennium Development Goals, for instance. In part this is because of migrations taking place from both high paying to low paying and vice versa. The net effect is smaller than it would have been if only low paying to high paying job migration were taking place. One needs a dynamic model to trace out these movements over time and also to estimate the dynamic benefits of liberalization. This is an important future task although beyond the scope of the present paper.<sup>41</sup>

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<sup>41</sup> For recent work on some of the dynamic connections via productivity increases see Alcalá and Ciccone(2004) and the references therein.

## **8. Conclusions and Prospects for Future Work on Asian Developing Economies**

In this paper, it has been argued that a generic CGE model for analyzing the poverty impact of various economic reforms in South Asia can be built. As a first step, trade liberalization is taken as the specific policy experiment for examination. The specific generic model for South Asia incorporating dualism and rural-urban and urban-rural migration within a Harris-Todaro framework reveals a number of specific features of the connections between trade liberalization and poverty reduction.

Within this particular CGE model, the policy experiments show that in this region trade liberalization can lead to further poverty reduction. This is true at both the national level and at the level of the various household groups. This is indeed good news that conforms to the general prediction of the standard comparative advantage based trade theory.

However, the extent of poverty reduction impact of trade liberalization turns out to be limited. There are several reasons for this. The main reason is that the Harris-Todaro mechanism allows reverse migration to lower paid jobs for the potentially unemployed as protection is removed. Furthermore, the impact of further tariff reductions becomes attenuated for most groups when the tariff levels are lowered sufficiently. On the whole, the high tariff barriers should be dismantled, but beyond a certain point---say about 15 per cent average tariff rate--- the further impacts become negligible.

Several policy conclusions can be reached regarding poverty reduction strategies in South Asia in light of the findings here. Trade liberalization certainly does not conflict with poverty reduction and hence can be pursued without fearing adverse poverty impact. However, the approach may need to be a firm but gradual liberalization with special sensitivity to agriculture and the rural poor. It should also be kept in mind that trade liberalization can certainly help reduce poverty, but by itself it may not be the magic bullet against poverty. The actual poverty reduction impact in South Asia is most likely to remain small for this policy instrument. Hence other growth enhancing reforms need to be pursued simultaneously. Targeted poverty reduction programs may also be needed with emphasis on increasing the efficiency of targeting and improving their cost-effectiveness. Programs such as food-for-work and other employment schemes, microfinance, agricultural credit etc. need to be pursued with a focus on making them more effective in terms of reaching the targeted groups at minimum cost to the programs. Rural industrialization and increase in productivity through investment in social sectors and human capital also remain viable policy options. In terms of Sen's capabilities approach, the capabilities of the poor--- particularly their basic functionings--- need to be enhanced so that they can better participate in income earning



activities.

Turning now to some methodological issues for future work, there are at least four categories of Asian economies--- broadly speaking--- that could be the subject of CGE modeling exercises regarding the poverty reduction implications of trade liberalization. First, we have low income countries of South Asia. Here, a model based on an economy such as India or Bangladesh could offer some insights. This is indeed what has been attempted here. The second category would include middle income Asian Developing countries such as Indonesia. The third and fourth categories will include the transitional low and middle income economies in Asia, for example, Viet Nam and PRC respectively.. As any student of the Asian Developing Economies will quickly point out, the four categories are not exhaustive, but they do cover a large number of country cases including the most populous poor countries with a large number of poor people.

Addressing all the structural and institutional issues even in each of the four categories is beyond the scope of this paper. However, as a beginning, the case of India has been studied here. In Asian economies such as India, the low level of income and pervasive poverty present a *prima facie* case for a policy focus on poverty reduction. However, there has only been mixed success in poverty reduction so far. One reason is that over the past few decades, the growth record has also been somewhat mixed. There have also been macroeconomic imbalances in the form of high fiscal deficit, low domestic savings, and sizable external account deficit. Consequently, both inflation and interest rates were high, making the economic environment unfriendly to adequate and accelerated investment. In the wake of the policy focus on macroeconomic balancing, the growth and poverty impacts of such policies are natural candidates for rigorous investigation within the CGE tradition of modeling.

India is one of the 'big five' in Asia along with PRC, Bangladesh, Pakistan and Indonesia in terms of both population and poverty . These five Asian countries comprise three fifths of the world's population and two fifths of poor people. The next step may be to move to the case of a middle income Asian country such as Thailand or Indonesia with large numbers of poor.

It should be mentioned here that the modeling approach for the middle income countries will need to be an "extended" dual-dual approach. Since these economies are more diversified with relatively more developed financial sectors, the incorporation of these details may take us well beyond the dual-dual model used here. For transitional economies a different set of structural features may need to be considered. For example, the presence of state owned enterprises and financial controls of various sorts will need to be modeled. These are some fruitful directions for future research.

Finally, one important methodological issue is the level of aggregation on the household side. Clearly, the use of a fully disaggregated data set on the household side removes the compulsion of using the always-somewhat-arbitrary classification of households into various socio-economic groups. Although we are still dealing with a sample of households and not the entire population, it can be argued that this "micro" picture is in some sense as accurate as we can get without enlarging the sample. When data are available, undertaking both group level and micro level poverty analysis can offer important insights. Therefore, micro poverty analysis in macromodels is a desirable

direction for research to follow.

.To sum up, within a generic CGE model, the consequences of the trade liberalization part of the adjustment policies for allocation of resources, household income distribution of income and impact on poverty has been examined here in a way similar to the dual-dual approach pioneered by Thorbecke and others. Beginning with a solid understanding of the causality of household income distribution, production structure, migration patterns and factor markets emphasizing both formal and informal sectors, the model incorporates the economy wide causality of income poverty in a transparent manner. Although the first stage of the modelling process has only aimed at comparative statics experiments, an eventual dynamic extension will clearly be desirable and possible. The dynamic gains from trade---with proper redistributive mechanisms--- could indeed lead to a more rapid poverty reduction than the comparative statics exercise would indicate. This remains an urgent task within the CGE framework of analysis for all Asian Developing Economies.

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## Appendix I

A Generic table for representation of poverty dynamics can be formulated as follows with simulation of 10% stepwise tax reduction.

Table: Changes in Poverty

	Base 100%	Chg (%)	SIM_100_90	Chg (%)	SIM_90_80	Chg (%)	SIM_80_70	Chg (%)
<b>National Poverty</b>								
Poverty Headcount (P0)	24.5550		24.4170	-0.562%	24.3090	-0.442%	24.3090	0.000%
Poverty Gap (P1)	5.5970		5.5980	0.018%	5.5940	-0.071%	5.5940	0.000%
Poverty Severity (P2)	2.0890		2.0890	0.000%	2.0880	-0.048%	2.0880	0.000%
<b>Poverty Headcount (P0)</b>								
Rural Small-Holders	90.2040		90.2040	0.000%	90.2040	0.000%	90.2040	0.000%
Rural Unskilled	20.5660		20.5660	0.000%	20.5660	0.000%	20.5660	0.000%
Rural Skilled	21.1780		21.1780	0.000%	20.8180	-1.700%	20.8180	0.000%
Rural Capitalist	0.0000		0.0000		0.0000		0.0000	
Urban Informal	74.7060		74.0140	-0.926%	74.0140	0.000%	74.0140	0.000%
Urban Unskilled	5.3400		4.5770	-14.288%	4.5770	0.000%	4.5770	0.000%
Urban Skilled	1.4900		1.4900	0.000%	1.4900	0.000%	1.4900	0.000%
Urban Capitalist	0.0000		0.0000		0.0000		0.0000	
<b>Poverty Gap (P1)</b>								
Rural Small-Holders	26.9120		26.9200	0.030%	26.9040	-0.059%	26.9030	-0.004%
Rural Unskilled	0.9910		0.9930	0.202%	0.9880	-0.504%	0.9880	0.000%
Rural Skilled	1.9310		1.9340	0.155%	1.9270	-0.362%	1.9270	0.000%
Rural Capitalist	0.0000		0.0000		0.0000		0.0000	
Urban Informal	27.0930		27.0920	-0.004%	27.0860	-0.022%	27.0850	-0.004%
Urban Unskilled	0.1580		0.1580	0.000%	0.1580	0.000%	0.1580	0.000%
Urban Skilled	0.0150		0.0150	0.000%	0.0150	0.000%	0.0150	0.000%
Urban Capitalist	0.0000		0.0000		0.0000		0.0000	
<b>Poverty Severity (P2)</b>								
Rural Small-Holders	10.5090		10.5140	0.048%	10.5050	-0.086%	10.5050	0.000%
Rural Unskilled	0.0740		0.0740	0.000%	0.0740	0.000%	0.0740	0.000%
Rural Skilled	0.2340		0.2350	0.427%	0.2340	-0.426%	0.2340	0.000%
Rural Capitalist	0.0000		0.0000		0.0000		0.0000	
Urban Informal	11.7260		11.7260	0.000%	11.7220	-0.034%	11.7210	-0.009%
Urban Unskilled	0.0080		0.0080	0.000%	0.0080	0.000%	0.0080	0.000%
Urban Skilled	0.0000		0.0000		0.0000		0.0000	
Urban Capitalist	0.0000		0.0000		0.0000		0.0000	

Table: continued

	SIM_70 _60	Chg (%)	SIM_ 60_50	Chg (%)	SIM_50_40	Chg (%)	SIM_40_30	Chg (%)
<b>National Poverty</b>								
Poverty Headcount (P0)	24.3090	0.000%	24.3090	0.000%	24.3090	0.000%	24.3090	0.000%
Poverty Gap (P1)	5.5940	0.000%	5.5930	-0.018%	5.5930	0.000%	5.5930	0.000%
Poverty Severity (P2)	2.0870	-0.048%	2.0870	0.000%	2.0870	0.000%	2.0870	0.000%

**Poverty Headcount (P0)**

Rural Small-Holders	90.2040	0.000%	90.2040	0.000%	90.2040	0.000%	90.2040	0.000%
Rural Unskilled	20.5660	0.000%	20.5660	0.000%	20.5660	0.000%	20.5660	0.000%
Rural Skilled	20.8180	0.000%	20.8180	0.000%	20.8180	0.000%	20.8180	0.000%
Rural Capitalist	0.0000		0.0000		0.0000		0.0000	
Urban Informal	74.0140	0.000%	74.0140	0.000%	74.0140	0.000%	74.0140	0.000%
Urban Unskilled	4.5770	0.000%	4.5770	0.000%	4.5770	0.000%	4.5770	0.000%
Urban Skilled	1.4900	0.000%	1.4900	0.000%	1.4900	0.000%	1.4900	0.000%
Urban Capitalist	0.0000		0.0000		0.0000		0.0000	

**Poverty Gap (P1)**

Rural Small-Holders	26.9030	0.000%	26.9020	-0.004%	26.9020	0.000%	26.9000	-0.007%
Rural Unskilled	0.9880	0.000%	0.9880	0.000%	0.9870	-0.101%	0.9870	0.000%
Rural Skilled	1.9270	0.000%	1.9270	0.000%	1.9270	0.000%	1.9260	-0.052%
Rural Capitalist	0.0000		0.0000		0.0000		0.0000	
Urban Informal	27.0850	0.000%	27.0840	-0.004%	27.0840	0.000%	27.0830	-0.004%
Urban Unskilled	0.1580	0.000%	0.1580	0.000%	0.1580	0.000%	0.1580	0.000%
Urban Skilled	0.0150	0.000%	0.0150	0.000%	0.0150	0.000%	0.0150	0.000%
Urban Capitalist	0.0000		0.0000		0.0000		0.0000	

**Poverty Severity (P2)**

Rural Small-Holders	10.5050	0.000%	10.5040	-0.010%	10.5040	0.000%	10.5040	0.000%
Rural Unskilled	0.0740	0.000%	0.0740	0.000%	0.0740	0.000%	0.0740	0.000%
Rural Skilled	0.2340	0.000%	0.2330	-0.427%	0.2330	0.000%	0.2330	0.000%
Rural Capitalist	0.0000		0.0000		0.0000		0.0000	
Urban Informal	11.7210	0.000%	11.7210	0.000%	11.7200	-0.009%	11.7200	0.000%
Urban Unskilled	0.0080	0.000%	0.0080	0.000%	0.0080	0.000%	0.0080	0.000%
Urban Skilled	0.0000		0.0000		0.0000		0.0000	
Urban Capitalist	0.0000		0.0000		0.0000		0.0000	

Table: continued

	SIM_30 _20	Chg (%)	SIM_ 20_10	Chg (%)	SIM_10_0	Chg (%)
<b>National Poverty</b>						
Poverty Headcount (P0)	24.3090	0.000%	24.3090	0.000%	24.3090	0.000%
Poverty Gap (P1)	5.5930	0.000%	5.5920	-0.018%	5.5920	0.000%
Poverty Severity (P2)	2.0870	0.000%	2.0870	0.000%	2.0870	0.000%
<b>Poverty Headcount (P0)</b>						
Rural Small-Holders	90.2040	0.000%	90.2040	0.000%	90.2040	0.000%
Rural Unskilled	20.5660	0.000%	20.5660	0.000%	20.5660	0.000%
Rural Skilled	20.8180	0.000%	20.8180	0.000%	20.8180	0.000%
Rural Capitalist	0.0000		0.0000		0.0000	
Urban Informal	74.0140	0.000%	74.0140	0.000%	74.0140	0.000%
Urban Unskilled	4.5770	0.000%	4.5770	0.000%	4.5770	0.000%
Urban Skilled	1.4900	0.000%	1.4900	0.000%	1.4900	0.000%
Urban Capitalist	0.0000		0.0000		0.0000	
<b>Poverty Gap (P1)</b>						
Rural Small-Holders	26.9000	0.000%	26.8990	-0.004%	26.8980	-0.004%

Rural Unskilled	0.9870	0.000%	0.9870	0.000%	0.9860	-0.101%
Rural Skilled	1.9260	0.000%	1.9260	0.000%	1.9250	-0.052%
Rural Capitalist	0.0000		0.0000		0.0000	
Urban Informal	27.0820	-0.004%	27.0810	-0.004%	27.0810	0.000%
Urban Unskilled	0.1570	-0.633%	0.1570	0.000%	0.1570	0.000%
Urban Skilled	0.0150	0.000%	0.0150	0.000%	0.0150	0.000%
Urban Capitalist	0.0000		0.0000		0.0000	

**Poverty Severity (P2)**

Rural Small-Holders	10.5030	-0.010%	10.5030	0.000%	10.5030	0.000%
Rural Unskilled	0.0740	0.000%	0.0740	0.000%	0.0740	0.000%
Rural Skilled	0.2330	0.000%	0.2330	0.000%	0.2330	0.000%
Rural Capitalist	0.0000		0.0000		0.0000	
Urban Informal	11.7190	-0.009%	11.7190	0.000%	11.7180	-0.009%
Urban Unskilled	0.0080	0.000%	0.0080	0.000%	0.0080	0.000%
Urban Skilled	0.0000		0.0000		0.0000	
Urban Capitalist	0.0000		0.0000		0.0000	

**Appendix II**

Notation and symbol explanation:

*Production and Labor Market*

$$X_{fc} = A_{fc} \left[ \beta_K^{fc} \overline{K}_{fc}^{\frac{\mu_{fc}-1}{\mu_{fc}}} + \beta_{LS}^{fc} LS_{fc}^{\frac{\mu_{fc}-1}{\mu_{fc}}} \beta_{LU}^{fc} LU_{fc}^{\frac{\mu_{fc}-1}{\mu_{fc}}} \right]^{\frac{\mu_{fc}}{\mu_{fc}-1}} \dots\dots\dots(1) - (2)$$

Eqn 1-2: output of formal sector [superscript/subscript; fc=formal sector commodities]

X=output in formal sector; A=Technology coefficient; K=Fixed capital; β=share of input in output; LS= skilled labor; LU=unskilled labor; μ=elasticity of substitution;

$$X_{ic} = A_{ic} \left[ \beta_K^{ic} \overline{K}_{ic}^{\frac{\mu_{ic}-1}{\mu_{ic}}} + \beta_{LU}^{ic} LU_{ic}^{\frac{\mu_{ic}-1}{\mu_{ic}}} \right]^{\frac{\mu_{ic}}{\mu_{ic}-1}} \dots\dots\dots(3) - (4)$$

Eqn 3-4: output in informal sector [superscript/subscript; ic=informal sector commodities]

X=output in formal sector; A=Technology coefficient; K=Fixed capital; β=share of input in output; LS= skilled labor; LU=unskilled labor; μ=elasticity of substitution;

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

i<sub>ic</sub>=income in informal sector (wage in informal sector is determined)

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

wu<sub>ex</sub>= unskilled labor wage in export sector [subscript ex is used for export sector representation]; β=share of input in output

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

δ= Transaction costs of work in rural formal sector (export) instead of working in food sector (for unskilled labor) ; i<sub>food</sub>=income in food sector

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

i<sub>srvc</sub>=income in service sector of unskilled workers

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

$w_{im}$ = wages in import competing industry;  $\gamma$ =profit share ratio for unskilled labor in import competing sector;  $\Pi$ =profits;

$$\Pi = P_{im} X_{im} - i_{srtc} LU_{im} - ws_{im} LS_{im} \dots \dots \dots (11)$$

$\Pi$ =profits of capitalists;  $ws_{im}$ =skilled labor wage;

$$wu_{ex} = (1 - \frac{hLU_{im}}{LU_{srtc} + LU_{im}})wu_{srtc} + (\frac{hLU_{im}}{LU_{srtc} + LU_{im}})wu_{im} \dots \dots \dots (12)$$

$h$ = scale parameter

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

$ws_{fc}$ = skilled wage in formal sector

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

$ws_{im}$ = skilled wage in import competing sector;  $\theta$ = relative risk aversion of skilled workers

*Disposable income and savings*

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

$I_{rih}$ = disposable income of rural informal household

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

$I_{ruh}$ = disposable income of rural unskilled household

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

$I_{rsh}$ = disposable income of rural skilled household

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

$I_{rlh}$ = disposable income of rural large landholders household

$$I_{uih} = i_{srtc} LU_{srtc} \dots \dots \dots (20)$$

$I_{uih}$ = disposable income of urban informal household

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

$I_{uuh}$ = disposable income of rural unskilled household

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

$I_{ush}$ = disposable income of urban unskilled household

$$I_{ukh} = P_{im} X_{im} - w s_{im} L S_{im} - w u_{im} L U_{im} - S_{im} \dots \dots \dots (23)$$

$I_{ukh}$ = disposable income of urban capitalist household

$$I_{bch} = tM \dots \dots \dots (24)$$

$I_{bch}$ = disposable income of bureaucrat household

$$S_{fc} = \lambda_{fc} [P_{fc} X_{fc} - w s_{fc} L S_{fc} - w u_{fc} L U_{fc}] \dots \dots \dots (25) - (26)$$

S=savings of formal sector employers (urban capitalists and rural large landholders)

*Demand*

$$C_c^h = \frac{\alpha^h I_h}{P_c} \dots \dots \dots (27) - (49)$$

$\alpha$ =budget share of commodities; I=household income; C=consumption of commodities by households; P=price of commodities;

*Foreign Trade*

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

M=import; C= demand for imported commodities; S=savings of capitalists; P=price of imported commodities; X=output in import competing sector;

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

EX=export; X=output in export sector; S=savings of rural capitalists (large landholders); P=price of export commodities;

*Equilibrium Conditions*

$$\sum_c L U_c = L U \dots \dots \dots (52)$$

$$\sum_{fc} L S_{fc} = L S \dots \dots \dots (53)$$

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

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

P=price of imports; t= tariff rate

$$P_{ex} \equiv 1 \dots \dots \dots (57)$$

P=price of exports