# ADDIS ABABA UNIVERSITY
# SCHOOL OF GRADUATE STUDIES

## TRADE LIBERALIZATION, INEQUALITY AND POVERTY IN ETHIOPIA: A DYNAMIC COMPUTABLE GENERAL EQUILIBRIUM MICROSIMULATION ANALYSIS

**By**

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**Approved by:** **Signature**

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# Abstract

This study examines the short run and long run impacts of unilateral trade liberalization, in terms of a complete and instantaneous import tariff removal, on sectors of the Ethiopian economy and household poverty and inequality. The study utilized a dynamic sequential CGE model, employing a 'top-down' approach to carry out the microsimulation analysis of poverty and inequality. We used WB SAM of 1999/2000 and CSA household survey of 1999/2000 that comprises of 17332 households.

The main findings of the analysis are complete and instantaneous tariff removal in the Ethiopian economy would lead to a worsening of poverty in the short run, and contraction of the initially protected industry, particularly industry and services. In the long run, trade liberalization combined with capital accumulation reduces poverty and swells sectors that were contracted in the short run. The growth effect captured by the model contributes to the expansion of all sectors, particularly agriculture and reduces poverty. The decomposition of changes in poverty indicates growth is pro-poor.



**Key words:** Dynamic CGE, Trade Liberalization, Poverty, Inequality, Ethiopia

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# 1. Introduction

Globalization and poverty, together with the issue of climate change, are two of the most critical international development agenda today. Despite the huge potential of globalization in accelerating economic growth and development, its impact in alleviating poverty is uneven and in some regions such as Sub-Saharan Africa (SSA) minimal (Nissanke and Thorbecke, 2008).

International trade is a critical conduit though which global interdependence influences the welfare of Africa. Thus, the thorough analysis of trade liberalization impacts on poverty and inequality on Africa is indispensable (Alemayehu, 2006).

Globalization through trade liberalization brings about new opportunities for accelerating growth and development. But it also poses challenges to policy makers in aligning national policies to the global economic system. Developing countries' economies and the world's poor are easily hurt to the downside of globalization. This situation is noticeable during global financial and economic crisis. In times of significant gains from globalization, however, the benefits are not shared evenly among the global communities (Nissanke and Thorbecke, 2005).

The link between trade liberalization and household welfare is diverse and complex. The effect of trade liberalization on poverty is contentious. Though the dominant view on both theory and empiricism maintain a welfare enhancing effect of liberalization, there are increasing concern that trade liberalization might cause a deteriorating effect on welfare. Such concern is reflected on Ethiopian study conducted by Dejene et al. (2007) examining the impact of unilateral trade liberalization in Ethiopia on poverty and inequality using a CGE Micro simulation analysis.

According to (Winters, 2000), empirical studies broadly accepted that trade liberalization will be poverty alleviating in the long run and on average. Therefore, in this study, we entertain not only the short run impacts of trade liberalization but we also try to capture the long run effects. Then, we assess if trade liberalization is a viable policy instrument in alleviating poverty in both the short and long run.

This study addresses the following research question:

- What is the short run impact of trade liberalization on household poverty and inequality?
- What is the long run impact of trade liberalization on household poverty and inequality?
- How will tariff reduction affects sectoral and macro economic variables both on short and long run?

Empirical studies have used cross-country, time series or general equilibrium approaches to examine the link between trade liberalization and economic growth. There are difficulties in establishing empirical link between a liberal trade regime and income growth when models used linear regression models:

- problem of aggregating and measuring tariffs and quantitative restrictions
- Casualty is difficult to establish because the measure of openness is likely to be endogenous

The majority of the studies found that openness is associated with more rapid growth. However, these studies are subject to criticism. One common drawback of these studies is with the kinds of openness indicators used. The critics argued that "trade policy" measures used are more than just trade policy. The trade measurements are likely to be correlated with other variables/factors (Ravallion, 2004a).

Another limitation of the studies is the models used for estimation omit control variables. Policies correlated with growth, such as trade openness, macro economic stability, rule of law, etc. are highly correlated among themselves. Then, when all of these policies are included in the regression, it is difficult to find the separate effects of different policies (Ravallion, 2004a).

A more robust trade policy analysis could be undertaken within a general equilibrium modeling framework than partial modeling framework. This is because the general modeling measures both the first round effects of simulated changes, and second

round effects on inter-industry and macroeconomic adjustments (Razzaque and Raihan, 2008).

In order to augment the existing research works, and capture the overall effects of trade liberalization on poverty and inequality, this article will utilize a Sequential Dynamic General Equilibrium Model. The model requires data on household income and expenditure, and Social Accounting Matrix (SAM). The study utilized Ethiopian SAM of 1999/2000 constructed by the World Bank, and household survey of 1999/2000, comprises of 17,332 households, collected and organized by Central Statistics Authority (CSA).

## 2. Literature Review

Theoretically, trade liberalization is the reduction of official barriers to trade that distorts the price of tradable and non-tradable goods and services. Its practical overall measurement, however, is difficult. One of the reason, being it is rarely the case that all distortionary policies are identifiable. In addition, it is not well known how the promised policy changes have actually been implemented (Winters, 2000)

Roderik (2000) defined trade liberalization as the reduction of both tariffs and non-tariff barriers to trade. The traditional approach to measure openness is to use imports and exports. Then the increase of the two is considered as the result of the fall of trade barriers. The problem with this method of measurement is both imports and exports are determined simultaneously with other variables (Koujianou et al, 2004).

According to Winters (2000), though there are some critics on policies of trade liberalization/openness in improving wefare, there is a general consensus that in the long run and on average, open economies contributes to long run development. In the short run, trade liberalization might exert pressure on certain sectors, and might even endanger some group of the population by aggravating poverty.

In analyzing the impact of trade policy on poverty, determining poverty threshold/line is important. There are two ways in determining poverty line: relative or absolute line. Relative poverty lines are determined in relation to the overall distribution of incomes or consumption in a country. Absolute poverty bases on some standard that the household must posses to meet their basic needs.Then, any individual or household measured below the poverty line is considered as poor (See Ravallion, 2004b; Boccanfuso, 2004).

Ravallion (2004b) indicated three ways in measuring poverty: head count index, poverty gap index and squared poverty gap index. The head count index is the percentage of household population with income per person below the poverty line. The poverty gap index provides the mean distance below the poverty line as a proportion of the poverty line. In squared poverty gap index, the individual poverty gaps are weighted by the gaps themselves to reflect inequality among the poor.

On the other hand, in explaining growth with inequality, Simon Kuznet (1995, cited in Culpeper, 2002) developed what is called the Kuznet curve. He explained that during industrial development in the long run, income inequality at first rises and then decline, giving an inverted U-shaped curve.

Inequality generally comprises of two components: inequality between country average incomes and inequality within countries. Inequality between nations focuses on the determinants of per capita incomes while inequality within countries looks at the determinants of factor prices and their link to the size distribution of income (Lindert and Williamson, 2001).

There is one common measure of inequality, which is the Gini coefficient. It ranges between zero and one; where zero correspond with perfect equality (everyone has the same income) and one corresponds with perfect inequality (one person has all the income and everyone has zero income). The Gini is derived from the Lorenz curve that ranks the population by income from poorest to richest. The curve displays the cumulative proportion of the population on the horizontal axis and the cumulative proportion of expenditure (or income) on the vertical axis (WB, 2005).

The channel through which trade liberalization affects poverty and inequality is complex and heterogeneous involving manifold channels. Nissanke and Thorbecke (2005: 4) illustrated such complexity through an analogy of lake (as poverty) and its tributaries (as canals) as, "These various channels can be compared to rivers and canals flowing into a common sea or lake. Some of these rivers may be muddy and even polluted, others may be crystal clear. The resulting quality of the lake water depends on these various flows combined."

Likewise, the ultimate net effect of the different linkages of trade liberalization and poverty depends on the sum of the individual effects. The literature attributes the major link between trade liberalization and poverty to growth. Other direct and indirect links between trade liberalization and poverty are change in relative price of factors, technological progress and technological diffusion, and institutions (Winters,

2000). The subsequent discussion follows these causal links between trade liberalization, inequality and poverty.

## Trade Liberalization and Growth

Policies of openness through trade liberalization have been encouraged based on economic growth. The main growth enhancing effects of openness are expected to come from: (1) static efficiency gains arising from improved resource allocation, and (2) dynamic efficiency gains from economies of scale, diffusion of information, technology transfer, knowledge spillover effects and intertemporal trade gains from cross-border borrowing and lending to increase investment and smooth consumption (Nissanke and Thorbecke, 2008).

To understand the impact of openness on poverty, it would be better to decompose the openness-inequality-poverty chain into three: from openness to growth, growth to inequality, and from inequality to poverty (Nissanke and Thorbecke, 2005; 2008).

Trade liberalization is the main manifestation of openness. It affects growth through exports and imports. Liberalization policies encourage exports that benefit the export sector, and contribute to gross domestic product (GDP) growth. However, trade liberalization could expose previously protected domestic industries through import. It could also reduce fiscal revenue because of reduction or removal of import tariff (Nissanke and Thorbecke, 2008).

Many studies used cross-country regression to analyze the trade liberalization-growth-poverty link. According to Winters et al. (2004), there is no a simple empirical linkage between trade liberalization and poverty because trade liberalization and poverty are not easily measured.

Empirical literature widely supports the analysis that openness is good for growth (IMF, 2008). Among the prominently cited literatures in this group are Frankel and Romer (1999), Dollar (2001) and Dollar and Kraay (2001).

Dollar (2001), and Dollar and Kraay (2001) found that openness, measured in terms of trade volume, helps in alleviating poverty. In similar vein, but using geographical

indicators as a proxy for trade, Frankel and Romer (1999) argued that trade raises income through accumulation of physical and human capital.

Though there are no empirical evidence that show a harmful effect of trade liberalization on growth (Winters et al., 2004), there are critics (e.g. Rodriguez and Rodrik (2000), Rodrik (2000b, 2004b) and Nye et al. (2002)) that scrutinize the methodological viability of the above-mentioned growth enhancing effect of openness/trade liberalization.

Nye et al. (2002) argued that the arguments and evidence presented by Dollar and Kraay are erroneous and unconvincing. The criticism focused on the indicator of trade and openness used, the direction of causality and correlation of measures of trade openness with other policy variables that affect growth. Another criticism is on selection bias because Dollar and Kraay only considered successful 'globalizers' from Asia (Nye et al. 2002).

Rodriguez and Rodrik (2000), Rodrik (2000b, 2004b) reasoned that the measure of openness used by Dollar and Kraay are poor. Therefore, they measure openness/trade policies as reduction of tariff and non- tariff barriers, not as trade volume as used by Dollar and Kraay. Then, they found little evidence that support the view that openness promotes economic growth. Rodriguez and Rodrik (2000) cautioned the reader that their intention is not to disapprove of openness; rather, to redirect the too much focus given for trade policies to institutions.

Nissanke and Thorbecke (2005) noted that growth is indispensable for poverty reduction. However, is not the rate of growth *per se* that is important but the pattern and distribution of economic growth.

## Trade Liberalization and Inequality

If trade liberalization influences growth, and growth affects inequality, then trade liberalization has an indirect effect on inequality through the growth channel. The theoretical literature provides two contradictory strands in the link between inequality and growth. The classical approach argues that there is a higher marginal propensity to

save among the rich than among the poor. The implication is that a higher inequality will result in a higher saving. This results in a higher capital accumulation and growth (Nissanke and Thorbecke, 2008).

The opposing view, so called the new political economy, links greater inequality with reduced growth. Such a relation arises due to: (1) the dissemination of political and social instability leading to greater uncertainty and lower investment (2) unproductive rent seeking activities reducing the security of property, and (3) wide income and wealth gap adversely influencing education and health, and widespread crime. The underdevelopment in human capital and malnutrition leads to a lower long term growth. This latter view of the link between growth and inequality is recently gaining momentum as some empirical findings reject the Kuznet's hypothesis of inverted U-shaped relationship between growth and inequality (Nissanke and Thorbecke, 2008).

In the empirical literature, Dollar (2001), and Dollar and Kraay (2001) claimed that there is no clear link between inequality and growth, and growth is distributional neutral. Therefore, they maintained, growth is good for the poor, as the share of income of the poor does not vary on average with growth. The authors further stated that there is no evidence that supports systematic link of trade volume (used as measure of trade policy) with income distribution/inequality. However, Rodriguez and Rodrik (2000), Rodrik (2000b, 2004b) and Nye et al. (2002) criticize the methodology employed by these authors, and thus its outcome.

If inequality influences future growth, it also affects poverty. A pervasive inequality is harmful to the objective of poverty reduction as an increase inequality slows growth. Poverty slows at a lower speed during a more unequal distribution than equitable one. Alemayehu et al. (2009) and Tassew et al. (2008) have confirmed the significance of distribution of income and growth in alleviating poverty, particularly for poor countries like Ethiopia. Tassew et al. (2008) study of poverty in Ethiopia reported that the prevalence of a higher inequality in urban areas increases the incidence of poverty. Having conducted analysis on distributional effect of poverty in Ethiopia, Alemayehu et al. (2009) found that equally distributed income growth would reduce poverty significantly than distributional neutral growth.

## Trade Liberalization and Poverty

Trade liberalization can directly affects poverty through changes in relative price in both factor and product market. According to Stolper-Samuelson theorem, in developing countries, where there is abundant unskilled labor, income inequality would decline as the demand for unskilled labor increases. However, the narrowing gap of wages/income between skilled and unskilled labor is not observed in many developing countries (See Alemayehu, 2006, Nissanke and Thorbecke 2005, and Vos, 2007, among others).

As stated by Winters et al. (2004), the Stolper-Samuelson theorem is insufficient to answer question of trade and poverty in the real world. For instance, though the rise in the prices of unskilled labor-intensive goods raises unskilled wages, poverty will be alleviated only if poor households rely mainly on unskilled wage earners.

Another channel through which trade liberalization affects income distribution and poverty is the nature of technological progress and diffusion. According to Culpeper (2002), technical change is mainly a result of Research and Development in industrial countries. Then, technical change tends to be more labor saving and skilled biased. This would increase inequality in both developed and developing countries alike. The skilled and semi-skilled labor would benefit from opening the economy while the unskilled labor would be continuously marginalized as productions require some minimum level of skill. Alemayehu (2006) observed similar findings in Africa where trade liberalization deteriorates the income distribution by reducing the demand for unskilled labor.

If technological change itself is an outcome of more openness, trade reform could be indirectly responsible for an increase in the skill premium. Among other reasons, intensified competition from abroad may enforce domestic firms to engage in research and development (Vos, 2007).

In Africa, however, trade liberalization exposes many industries to contraction than upgrading. In Lall's (1999) study ( cited in Winters et al., 2004) technological adaptation in the Kenyan, Tanzanian and Zimbabwean engineering and garment

sectors found that the majority of domestic respond to import competition pressure by contracting rather than upgrading.

The other major concern of trade liberalization, especially for developing countries, is that it reduces government revenue. If the compensatory increase in other taxes or decrease in expenditure imposed mainly on the poor, poverty would be exacerbated (Winters, 2000).

Loss of revenue is particularly a potential source of fiscal instability in African countries as these countries mainly rely on trade taxes for government revenue. In ECA publication, Achterbosch et al. (2004) reported that between 1999-2001 import duties constitutes 34% of government revenue in the Least Developed countries of Africa.

Moreover, increased openness incapacitates government in raising revenue because mobile factors can no longer be taxed. In such cases, the social and redistribution expenditure would be under threat (Mamoon, 2007).

The aforementioned empirical evidences are mainly based on cross-country regressions. As the methodological interest of this article is on economy-wide impact of trade liberalization on poverty and inequality in a specific country and its use to study issues of trade liberalization, poverty and inequality, we look very briefly at the empirical literature on Computable General Equilibrium (CGE).

Most of the earlier studies utilized static CGE models to analyze the effect of trade liberalization. A few of these studies are Cororaton (2006) for Philippines; Khondker and Raihan (2004) for Bangladesh; and Cockburn (2001) for Nepal. None of these static studies found that trade liberalization have a significant welfare enhancing effect. On the other hand, dynamic CGE of Annabi et al. (2005) for Senegal and Bhattarai and Okyere (2005) for Ghana reported a better poverty alleviating effect of trade liberalization. Such findings might seem in line with the theoretical literature as gains from trade are usually realized after adjustment/resource reallocation. Thus, in the short run, trade liberalization might worsen welfare while in the medium and long run, after adjustment, trade is expected to increase growth and alleviate poverty.

## Trade Liberalization, Inequality and Poverty in Ethiopia

There is sever poverty and inequality in Ethiopia. Policy makers have undertaken trade reforms to reap the potential benefit associated with trade, and achieve the overarching policy objective of the government - poverty reduction.

Economic growth is expected in the wake of trade liberalization. Tassew et al. (2008) argued that there is 'impressive' growth. However, studies (e.g. Alemayehu and Befekadu ( 2005), Dercon (2003), and Alemayehu et al. (2009)) reported that poor market for products and inputs, and unstable political environment, *inter alia,* have contributed for the limited growth performance of the Ethiopian Economy.

Tassew et al. (2008) argued that although poverty is still pervasive, 27.5 million people were below poverty line in 2004/05, it declines over the period 1995/96 to 2004/05 by 6.7%. The fall of national poverty is attributed to the reduction of poverty in rural areas whose head count index dwindled from 47.5% in 1995/96 to 39.3% in 2004/05 due to increase in consumption. On the other hand, higher inequality in urban areas stifled poverty reducing effect of the higher growth observed in the area. However, Dercon (2003:610), co-author in Tassew et al. (2008), previously reported that the growth in urban areas particularly in Addis Ababa is mainly, "an aid-fuelled real estate expansion of the non-tradable sector."

Rural and urban poverty of Ethiopia possess unique attributes. A persistent poverty is prevalent in urban areas than rural ones. This is explained by the percentage of households staying in the poverty trap which is twice as large as rural households. In rural areas, poverty fluctuates due to lack of consumption smoothing. The possible remedy suggested is availability and access to credit (financial institutions) to ameliorate problem of consumption smoothing and hence poverty (Alemayehu et al., 2006).

Be that as it may, an attempt to link such poverty with trade liberalization is made by Dejene et al. (2007). The study examined the impact of unilateral trade liberalization in Ethiopia on poverty and inequality using a static CGE Micro simulation analysis.

They utilized EXTER CGE model, and DAD software in analyzing poverty and inequality

Dejene et al. (2007) study revealed that full liberalization is likely to reduce domestic production of manufactured goods. The demand for domestic goods would decline due to cheap imported commodities. The micro simulation outcome suggests that the overall outcome after the reform might be an increase in poverty at national level. However, the study did not essentially capture the overall effect of the trade reform as it is a static, one-time policy shock.

In the next section, we will explore the impact of trade liberalization in the form of tariff reduction on poverty and inequality in Ethiopia employing a Dynamic CGE Micro simulation. In the process, we will see how different the dynamic approach will be from that of Dejene et al. (2007). The economic wide simulation will enable us to capture the direct and indirect link in trade liberalization and poverty nexus. Most important, it will incorporate the overall effect of dynamism, and hence broader than the static approach such as Dejene et al. (2007).

# 3. Model Specification and Analysis

## 3.1 Model Specification

In this section, we first look at why a general equilibrium is appropriate for the study of poverty and income distribution. Then, we explore the salient features of the model. The model is called EXTER+SD which is a combination of the static EXTER model and the extended dynamic version. Scholars with French as native language have built EXTER model. Then, the model is named after a French word *Extérieur,* meaning the foreign export sector; as EXTER model is constructed by extending the closed economy into an open economy with government.

As Dejene et al. (2007) used the same static model, the intention of the study is to extend the static model into dynamic one. Having grasped the main characteristics of the computable general equilibrium (CGE) model, we proceed to the household micro-simulation model. The latter incorporates household survey data, which constitutes of 17332 households, undertaken by Central Statistics Authority (CSA) in 1999/2000. This data is consistent with World Bank (WB) social accounting matrix (SAM) that will be used for the analysis. The consistency of the household data with the SAM arises because the SAM is constructed using the same household survey of CSA for the year 1999/2000. Finally, we indicate the poverty indices used and decomposition of change in poverty into growth and distribution effects.

An all-inclusive study of the impact of trade liberalization on poverty and income distribution ideally necessitates for a general equilibrium approach (GEA). It is because the GEA assess both the direct and indirect effects associated with a certain policy reform on household welfare. The direct effect on household real income, among other variables, arises from change in consumer prices while the indirect effect is the result of demand and supply response to the policy reform. The latter effect generates efficiency and revenue impacts (IMF, 2008).

An economy wide model integrates details on how households earn and spend their income. A CGE model, as an economy wide framework, explicitly includes markets

for factors and commodities, and their links to the rest of the economy. Knowledge on household income and expenditure is generated from CGE model that display information on remuneration for factors and expenditure for commodities.

CGE models compare outcomes in the observed (base run) to counterfactual (simulated) situations. Their construction demands a complete list of both the demand and supply side of all relevant markets. The specification of these equations captures all flows in the economy. The CGE includes the first order condition of both producers maximizing profit subject to production technology and consumers maximizing utilities subject to income constraint (Robinson, 2003).

### 3.1.1 The Static Module

The static model is based on EXTER model, which is an open economy with government (Decluwé et al., 2000). The description of the static model follows from Cockburn, Decluwé and Robichaud (2008), unless otherwise stated. The structure of the model is sub-divided into seven parts: production, income and savings, demand, prices, international trade and equilibrium conditions.

The complete list of the equations is provided at the appendix where parameters are indicated in lower cases, exogenous and endogenous variables are represented with and without a bar at the top respectively. As exceptions, returns to factors and exchange rate are in lower case while they are variables.

**Production**

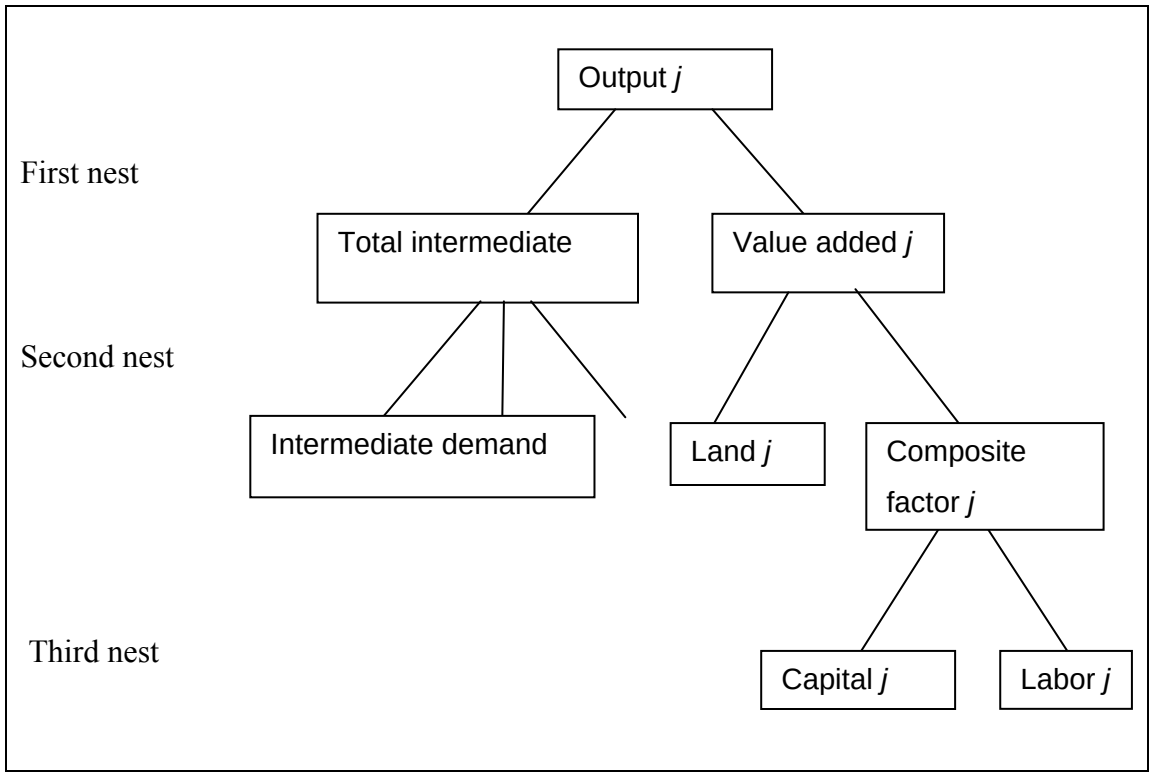
Producers are assumed to maximize profit subject to production technology. The CGE model incorporates the first-order conditions of profit maximization for producers (Lofgren et al., 2002).A multi-stage production function is adopted (figure 1).

In the first stage, each activity j is a combination of value added and total intermediate consumption according to Leontief function. The Leontief function is characterized by zero substitutability. This is because inputs are used in fixed proportions to the level of output (Elsenburg, 2003). Then, value added is represented by constant elasticity of

substitution (CES) for both agriculture and non-agriculture sectors which constitutes industry and service. According to Annabi et al. (2006), "CES function allows for non-unitary but constant price elasticities and non-nil but constant substitution elasticities."

The value added for agricultural and non-agriculture consists of labor and capital while for the agricultural sector it also includes land. Value added for the agricultural sectors is a combination of land and a composite factor which is an optimal mix of labor and capital indicated at the third stage.

Figure 1: Multi-stage production function




Cockburn, Decaluwé and Robichaud (2008)

The basic EXTER model includes both tradable and non-tradable. According to Devarajan et al. (1997), a CGE model should include at least two productive sectors: tradable and non-tradable goods. If an economy only produces traded goods, policy instruments such as devaluation would not have impact because all of the country's

domestic prices are determined by world prices. Moreover, if a country only produces non-tradable goods, it would not be affected by global shocks.

The value added for tradable sectors in the model is an optimal mix of land, labor and capital. For the non-tradable sectors, however, value added is exclusively generated by labor, which is the sole factor of production in this sector. However, as this assumption is not maintained in Ethiopian case, for the non-tradable service sector generates value added from both labor and capital, we aggregated the non-tradable and tradable service sector into one.

In the second stages of production, the individual inputs are combined to form total intermediate consumption according to Leontief function. These are composite of domestic and imported products that are provided for the domestic market.

**Income and Savings**

Agents or institutions in the domestic economy are households, firms and government. For each of these agents, income and savings equations are defined.

Household income constitutes returns to labor, capital and land. It also includes government transfers, which are indexed by the general price index to maintain homogeniety of degree zero, and dividends collected from firms. Household disposable income is given by total income less direct income taxes while household savings are proportionate to its disposable income and adjust to ensure saving-investment balance.

Firms obtain their income from returns to capital and land. Their savings is derived after deducting the following items from their income: payments of dividends to households and to the rest of the world, and direct taxes payment to the governments.

Government revenue is derived from taxes. These includes tariff, export taxes, indirect taxes on goods and direct taxes on households and firms income. Government saving is the residual income after current government consumption and fixed transfer payments to households are deducted.

**Demand**

Households are assumed to maximize a Stone-Geary utility function which is also known as the Linear Expenditure System (LES). This function distinguishes between minimum or subsistence consumption and discretionary consumption. Total consumption is the sum of the two consumption levels. The minimum consumption is the volume of each product a household must consume to meet certain minimal standard of living. Such minimal level of consumption is irrespective of its price or consumers' income (Ramskov and Munksgaard, 2001).

In this static version of the model, investment does not determine capital stock, and hence do not influence production levels. Investment is included only as part of final demand.

**Prices**

The factor returns are assumed to be determined by the equality of marginal costs and marginal revenue for each production factor in both agricultural and non-agricultural sector.

As the result of the presence of indirect taxes, we distinguish prices at factor costs and at market prices. Market price of a product produced and sold locally is equal to price paid to local producers (factor price) plus indirect taxes.

Due to the small country assumption, world prices of imports and exports are determined on the world market. Hence, these prices are fixed for the country. The variation of world prices and domestic prices is attributed to exchange rate and indirect taxation of tariffs and domestic taxes.

The composite consumer price is a weighted average of domestic prices and import prices. It maintains equilibrium between total commodity supply and the sum of its domestic market. Likewise, average producer price represents a weighted average of the local price (at factor cost) and export price.

Finally, the general price index is defined as the sum of value added prices weighted by shares of value added of each activity in total Gross Domestic Product (GDP). This price represents the GDP deflator.

**International Trade**

Local producers allocate total production between export and domestic markets while local consumers chose between locally produced and imported goods. Production allocation and consumption choice are based on constant elasticity of transformation (CET) and constant elasticity of substitution (CES) respectively. CET measures elasticity of transformation for producers between export and domestic sales, while CES measures elasticity of substitution for consumers between imported and locally produced goods. Then, CGE model incorporates the first order conditions for profit maximization of producers when selling between the domestic market and export, and expenditure minimization of consumers when choosing between domestically produced goods or imports.

In contrast with the assumption of perfect substitutability and transformability of the standard neoclassical model, the EXTER model adopts the standard Armington assumption of imperfect substitutability and transformability.

**Equilibrium**

General equilibrium is maintained by the equality between supply and demand of goods and factors as well as the saving-investment identity.

**Limitations of the model**

This article is based on a neoclassical EXTER model. Then, the major drawback of the model is associated with the assumption of neoclassical school of thought. Some of assumptions are equilibrating mechanism of prices in both the goods and factor markets; the use of real value, relative prices, implying absence of a clearly specified monetary sector.

Structuralist Economists such as Taylor (1990) argued that a realistic model that assists policy formulation could be constructed by ameliorating the abovementioned weakness of neoclassical models.

Taylor (1990) maintained that Structuralism is more of a program of research and policy development than a set of prescription for building a model. However complex the structural detail of the economy, Taylor suggested general hypothesis on how economic system functions. These hypotheses underlie the fundamental difference between the neoclassical and structural approaches. Among few of these hypotheses, one deals with the role and function of institutions. Institutions are economically powerful actors. A few of them are the state, corporations and unionized labor. And these groups, according to Taylor (1990), are not price takers as assumed by neoclassical paradigm. Rather, they can influence change in price and/or quantity.

Then, in constructing a model, stucturalist modelers starts in identifying and specifying structure and institutions of the economy. In contrast, the practice in neoclassical school is giving enormous attention in optimization of individual persons or firms. The consideration of institutions comes, if any, as an afterthought in the neoclassical paradigm (Taylor, 1990).

The other distinctive feature of structuralist models is they are not established based on real terms, in relative prices. Structuralist models explicitly incorporate price and income accounts in nominal terms, arguing that the nominal variables can affect the real variables unlike the neoclassical school where nominal variables are not supposed to affect the real variables (Taylor, 1990).

With such vivid weakness of EXTER model, we are compelled to use the model. It is because the main motivation of this article is to add value to the existing literature. Specifically, there is only one published research material on economy wide effect of trade liberalization on poverty and inequality in Ethiopia. The model, that of Dejene et al. (2007), utilized static CGE. As our intention is to examine what will happen if we extend the existing static CGE into a dynamic one, we followed the model used by Dejene et al. (2007), which is the neoclassical EXTER model. The other factor in

utilizing a neoclassical CGE model is that there is no SAM for Ethiopia, to the best of our knowledge, which is built on the structuralist framework. The construction of the available SAM for Ethiopia follows the neoclassical assumptions. Given these factors, we are obliged to base our analysis on neoclassical model.

### 3.1.2 The Dynamic Module

Dynamic analysis for the effect of trade policy reforms are important to study the adjustment period as the effect of the reform is not immediate. For many of the consequences of trade policy shocks are dynamic in nature, static CGEs are not well equipped to analyze the full magnitude of the effects of policy reform. There are mainly two dimensions of dynamism. The first is trade policy may modify capital stocks through impacts on incomes or savings. and the second dimension is that it may influence human capital and technology (Hedi et al., 2002).

When we further extend the welfare analysis of the impacts of trade reform on poverty and inequality, most studies revealed negligible effect for the static analysis. According to Cockburn and Decluwé (2006), this result is not surprising for the static effect comes only from variation in factor and consumer prices. In such models, the allocation of production factors among households is fixed. In order to incorporate the long term factor accumulation and growth effects, a dynamic approach is appropriate (Cockburn and Decluwé, 2006).

Dynamic CGE models are grouped into two categories: intertemporal or sequential (recursive). In the intertemporal models, agents are assumed to have rational expectations and make optimal decisions. In Lofgren and Robinson (2004) words, “everybody knows,” in the intertemporal models, “everything about the future, and they use that information in making decisions.”

In the recursive models on the other hand agents make their decisions on the basis of past and current information with no role for forward looking expectations, i.e. agents have myopic behavior (Lofgren and Robinson, 2004). A recursive dynamic model combines a within-period module and a between-period module. The within-period

model is essentially the static model while the between-period model links the within-periods modules by updating selected parameters (e.g., population) on the basis of exogenous trends and past endogenous variables (e.g. investment) (Lofgren and Robinson , 2004). Then, recursive CGE models are solved sequentially/successively for each period. The time span is usually 15 to 20 years (Hedi et al., 2002).

It is usually impractical or inappropriate to assume perfect foresight, particularly for developing countries. Therefore, in most of empirical studies myopic sequential dynamic model is adopted (Cockburn and Decluwé, 2006). Likewise, we adopt a recursive dynamic CGE model for Ethiopia. Specifically, we follow the EXTER+SD (sequential dynamic) model of Annabi et al. (2004, 2005). It is an extension of the static EXTER model that incorporates dynamic features. These features, which are the attributes of the between model, are increase in work force (labor accumulation), savings (capital accumulation) and redistribution of labor and capital. Economic growth mainly arises from these factors (Cockburn and Decluwé, 2006).

The dynamic model is constructed as a static CGE model that is linked to between periods by exogenous and endogenous variables updating procedures. As the recursive dynamic model is an extension of the static model, it incorporates the static model part, the within model, and the main driver of dynamism, the between model. The variables in the between model could be updated endogenously or exogenously. Capital stock is updated endogenously with capital accumulation equation and population (total labor supply) is updated exogenously between periods. The EXTER+SD model is constructed using the static ETER model, indexing all variables with time (t) and introducing the following equations.

**Dynamic Equations** (the order of numbers is in line with equations in the appendix)

Capital Accumulation: (45) $KD_{i,it+1} = (1-\delta)KD_{i,it} + Ind_{i,it}$

Labor force growth: (46) $LS_{t+1} = (1+ng) * LS_{t,h,t}$

LES minimal consumption: (47) $C^{min}_{i,h,t+1} = (1+ng) * C^{min}_{i,h,t}$

Investment demand: (48) $\frac{Ind_{i,t}}{KD_{i,t}} = \gamma_{1tr}\left(\frac{r_{i,t}}{U_t}\right)^2 + \gamma_{2tr}\left(\frac{r_{i,t}}{U_t}\right)$

Capital user cost: $(49)\ U_t = Pinv_t(ir + \delta)$

Investment equilibrium: $(50)\ IT_t = Pinv_t * \sum_i Ind_{i,t}$

Where,

$KD_{it}$ : Capital stock

$Ind_{it}$ : Investment by destination

$LS_t$ : Total labor supply

$SG_t$ : Government savings

$CAB_t$ : Foreign savings

$r_{it}$ : Return to capital

$PC_{it}$ : Consumption price

$\delta$ : Capital depreciation rate (free parameter)

$ng$ : Population growth rate (free parameter)

$ir$ : Interest rate (free parameter)

$IT_t$ : Nominal total investment

$Pinv$ : Price index of investment

$\mu_i$ : Share parameter (free parameter)

**Capital Accumulation**

Equation (45) describes the law of motion for sectoral capital stock. In each period, capital stock (KD) used in each sector (i) varies with sectoral rate of investment ($IND_i$ ) and the rate of depreciation of the capital stock ($\delta$).

**Growth in Labor Supply**

The introduction of equation (46) endogenizes the total labor supply, $LS_t$, variable. But it increases at the exogenous rate, ng, which is at the same time the population and labor force growth rate. The minimal level of consumption in LES is also assumed to increase at the same rate, ng.

**Investment Demand**

The investment function determines how new investment is distributed among the different sectors. The investment demand function used by Annabi et al. (2004, 2005), equation (48), is identical with the one employed by Bourguignon, Branson and De Melo (1989).

The accumulation rate, which is the ratio of investment (Ind) to capital stock (KD), is an increasing function of the ratio of the rate of return to capital (R) and its user cost (U). The rental cost of capital is in turn equal to the capital good price index multiplied by the sum of the capital stock depreciation rate and an exogenous interest rate (ir) (equation (49)).

Bourguignon et al. (1989) proposed the formulation of a quadratic expression for demand for real investment to avoid extreme fluctuation to the changes in the relative profitability of investment because of interest rate or expectations change. We, therefore, follow such quadratic formulation for demand of real investment.

Total household, firm, government and foreign savings of the previous period determine the total investment budget available at the beginning of the period. The allocation of investment by sectors of destination is determined by return to capital and its user cost.

The investment in the dynamic module is not investment by origin (product) as is in the static model. But it is investment by sectors of destination. In each period, the total of all investments by sectors of destination is set equal to total investment and total savings (equation (50)).

Then, in EXTER+SD model the main determinants of growth, which is endogenously determined in the model, stems from accumulation of capital and its distribution by sectors (Cockburn and Decluwé, 2006).

### 3.1.3 The Household Model (Microsimulation)

There are two approaches in analyzing poverty and income distribution using CGE. The first and earlier one is called the traditional or the representative approach because it uses the representative household rather than the actual household. This approach disaggregates households as much as possible based on socio economic or location criteria. Then, it analyzes the impacts of policies on incomes and welfare. However, the representative approach is not able to provide information on poverty within group (intra-group) distribution. Besides, as the intra household income distribution is assumed to be fixed, this approach could not analyze intra-group income distribution (Decluwé et al., 1999). The main advantage of the representative approach is it is easier to use than the other methods.

CGE models typically include small household categories. This limits them in analyzing poverty and income distribution. This is because indicators used to measure poverty and income distribution (e.g. FGT indices and the Atkinson and Gini inequalities) make use of household or individual data (Fofana and Cockburn, 2003).

Consequently, the second approach in analyzing poverty and inequality came to the scene. It is named as microsimulation analysis. It differs from the representative approach in that it makes explicit use of household survey data. Such method makes it possible to fully grasp the heterogeneity of household income and consumption pattern. There are two strands within the microsimulation analysis: the integrated approach and the layered (or the top-down) approach (Davies, 2004).

The integrated approach includes large or all of the household data into the CGE model. The merit of this approach is the consistency of micro and macro data. In addition, compared to the representative approach, it allows for intra-group distribution variation. However, the approach is not without a taint. First, as the size of the model increases, it would become a constraining factor and data reconciliation between the micro and macro data would be difficult .The other major drawback of the integrated microsimulation approach is that it limits the types of behaviors that will be used in the model. For instance, regime-switching behaviors from employment to

unemployment decisions are difficult to model (Mussard and Savard, 2002). According to Savard (2003), the difficulties arise "as the equation system of the model cannot change as the iteration process moves along." The problem magnifies if the CGE model uses non-linear equation, which is usually the case.

The second approach within the microsimulation analysis is the 'layered' or 'top-down' approach. In this method, there are two layers (stages): first layer and second layer. In the first stage, called the top layer, the CGE model captures change in prices, incomes, exchange rate and macro variables. The second layer is the household micro simulation model incorporating the entire household income and consumption survey data (Davies, 2004). The model simulation is undertaken by taking changes in selected variables from the first layer/stage and feed it into the second layer/stage.

To link the CGE with the household data, first we construct and solve the CGE model. Then we provide the changes of before and after simulation (policy shock), such as change in consumption and income, as an input into the microsimulation household model. This is how we develop a 'top-down' approach of analyzing poverty and inequality using CGE (Davies, 2004).

The gain of utilizing the top-down approach is, as in the case of the integrated approach, it takes into account the variation within the group distribution. But it offers flexibility of modeling household behaviors unlike the integrated approach. The potential pitfall with the layered approach is that it does not take the feedback effect of the household microsimulation back into the CGE model (Davies, 2004).

In this article, we adopt a sequential ('top-down') microsimulation model. We first solve the CGE model, and feed the changes in consumption into the household model. The model utilizes Central Statistics Authority (CSA) household survey of 1999/2000 that is used for the construction of the SAM. The analysis of poverty and income distribution will be analyzed using Distribution Analysis Software .

**Poverty Indices**

The analysis uses the Foster, Greer and Thorbecke (FGT) class of poverty measures that is denoted by $P_\alpha$. It is formulated as (Foster et al., 1984),

$$P\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Yi}{Z}\right)^{\alpha}$$

Where Z is poverty line, n is the size of total population, q is the number of poor household, i is sub-group of individuals with income below the poverty line and α reflects degree of aversion to inequality within the poor.

Alpha (α) allows us to calculate alternative measures of poverty indices. When $\alpha = 0$, the poverty index is called head count index. It measures the percentage of the population below the poverty line. If $\alpha = 1$, the measure is called poverty gap index (depth of poverty). It measures the aggregate deficit of the poor relative to the poverty line. Finally, when $\alpha = 2$, we found squared poverty gap index (poverty severity). This measures not only the deficit that the poor households need to meet the basic need but it also takes into account the inequality among the poor (WB, 2005).

Cockburn and Decluwé (2006), following the work of Datt and Ravallion (1992) and Kawkani, (1997), as cited in their work, formulated decomposition of change in poverty as growth and distribution components. Considering the poverty index as $P_t = P(Z/\mu_t , L_t)$, where Z represents the poverty line, $\mu_t$ defines average incomes and $L_t$ indicates a parameter vector representing income distribution at time t. Then, poverty may change due to income or its distribution.

The growth component measures change in poverty index as a result of change in average income while maintaining the initial distribution. On the other hand, the distribution component measures change in poverty because of variation in distribution while holding average income at initial level. Mathematically, the growth component is given by,

$$G(t, t+n; t) \equiv P(z/\mu_{t+n}, L_t) - P(z/\mu_t, L_t)$$

And the distribution component is,

$$D(t, t+n; t) \equiv P(z/\mu_t, L_{t+n}) - P(z/\mu_t, L_t)$$

In order to capture the full interaction of the growth and distribution component, Cockburn and Decluwé (2006) took simple mean of each component as:

$$\hat{G}(t, t+n) = \frac{1}{2}[P(z/\mu_{t+n}, L_t) - P(z/\mu_t, L_t) + P(z/\mu_{t+n}, L_{t+n}) - P(z/\mu_t, L_{t+n})]$$

$$\hat{D}(t, t+n) = \frac{1}{2}[P(z/\mu_t, L_{t+n}) - P(z/\mu_t, L_t) + P(z/\mu_{t+n}, L_{t+n}) - P(z/\mu_{t+n}, L_t)]$$

The change in the poverty index can then read as follows:

$$P_{t+n} - P_t = \hat{G}(t, t+n) + \hat{D}(t, t+n)$$

*change in poverty* — *growth component* — *redistribution component*

In the forthcoming analysis of the impact of trade liberalization on poverty and inequality, we employ these techniques in attributing change in poverty to either growth effect or distribution effects.

## 3.2 Base-run Statistics and Simulation Results

The original World Bank SAM is a 40 by 40 matrix. But for our analysis, as our focus is on the accounts of households factor remuneration and consumption, we aggregated into a 24 by 24 matrix. The SAM has three accounts for households: farm households, wage earners and entrepreneurs. Consistent with the household grouping in the SAM, we classified the total household survey of 1999/2000, 17,332 households, collected and organized by Central Statistics Authority (CSA), into three accounts based on household occupation: 7200 of farm households, 4308 of wage earners and 5825 of entrepreneurs. The selection of the 1999/2000 household survey data is to make it consistent with the SAM that used for its construction the same household data. Then, the CGE model is solved using GAMS software and MINOS5 solver. The household analysis of poverty and inequality is undertaken through distribution analysis software.

### 3.2.1 Base-run Statistics

#### 3.2.1.1 Macro and Sectoral variables

The SAM represents the initial structure of the Ethiopian economy. Table 1 indicates the share of key macro economic variables. The economy is represented by three sectors: agriculture, industry and services. Protection, through imposition of import tariff, is observed in all the three sectors. But in the industrial sector, there is highest level of protection, 25% import tariff rate. This sector also has highest (78%) import share. However, the sector contributes the least share to total value added (21%) and production (26%). The agriculture and service sectors have the major share of production and export. The agriculture sector also produces the highest (46%) for domestic sales.

The agricultural sector employs 60% of the total labor demand while the industry and service sectors absorbed 15% and 25%, respectively, of total labor demand. On the contrary, the agriculture sector has the lowest capital share, 20%. The major

Table 1: Share of macroeconomic variables in the base-run (percentage)

| | | Sectors | | | |
|---|---|---|---|---|---|
| | | Agriculture | Industry | Services | Total |
| Tariff rate | tm* | 16 | 25 | 13 | 100 |
| Import share | Mi/M | 4 | 78 | 18 | 100 |
| Export share | EXi/EX | 42 | 6 | 52 | 100 |
| Value added share | VAi/VA | 49 | 21 | 30 | 100 |
| Domestic Sales | Di/D | 46 | 32 | 22 | 100 |
| Production share | XSi/XS | 39 | 26 | 35 | 100 |
| Labour share | LDi/LD | 60 | 15 | 25 | 100 |
| Capital share | KDi/KD | 20 | 36 | 44 | 100 |
| **Value added composition** | | | | | |
| Labor | LDi/VAi | 59 | 34 | 41 | 49 |
| Capital | KDi/VAi | 16 | 66 | 59 | 39 |
| Land | Land/VAi | 25 | 0 | 0 | 12 |
| Total | | 100 | 100 | 100 | 100 |

Source: computed from Ethiopian SAM (1999/2000)

* see the appendix for variable notation

shareholders of capita are industry (36%) and service sectors (44%). This figures and the composition of value added in table 1 indicates that the agriculture sector is labor intensive, having 59% of its total value added generated from labor. The industry and service sectors, in contrast, are capital intensive having 66% and 59%, respectively, of their total value added produced from capital.

### 3.2.1.2 Sources and uses of Household Income

The source of household income differs significantly among household groups. The household generate their income mostly from two factors of production, labor and capital, and from transfers. Farm household derive their income mainly from wage (57%) and capital (38%). The wage earners obtain the lion share of their income from wage (88%). Conversely, entrepreneurs receive their income mainly from capital (62%) (See table 2). Then, trade liberalization would exert significant effect on household welfare through factor remuneration. If, for instance, the policy reform shrinks the manufacturing industrial sector, those household who heavily rely on wage

income would hurt most. Alternatively, if trade liberalization induces expansion of the agricultural sector, those households engaged in the sector would benefit most.

Table 2: Sources and uses of Household Income (percentage)

| Household Type | Income Sources | | | | | |
|---|---|---|---|---|---|---|
| | Wage | Capital | Transfer | | | Total |
| | | | Public | Private | Foreign | |
| Farm Households | 57 | 38 | 1 | 3 | 2 | 100 |
| Wage Earners | 88 | 0 | 5 | 0 | 7 | 100 |
| Entrepreneurs | 9 | 62 | 4 | 9 | 17 | 100 |
| | Uses of Income | | | | | |
| | Consumption | | | Direct Tax | Saving | Total |
| | Agriculture | Industry | Service | | | |
| Farm Households | 71 | 18 | 5 | 1 | 6 | 100 |
| Wage Earners | 32 | 37 | 12 | 6 | 12 | 100 |
| Entrepreneurs | 24 | 28 | 9 | 17 | 21 | 100 |

Source: computed from Ethiopian SAM (1999/2000)

The household also differ in how they use their income. The major share of farm household income (71%) is spent on consumption of agricultural products. This household group saves the least share of its total income (6%) to saving. Wage earners and entrepreneurs allocate their highest income share in consumption of industrial goods. These household groups contribute the relative largest share of their income to saving, 12% 1nd 21% respectively. Part of household income also goes to government in the form of direct tax. Government collects direct taxes, as percentage of household income, 17% from entrepreneurs, 6% from wage earners and 1% from farm households. We could draw implication from such structure of direct taxes: if government compensates the loss of import tariff revenue with direct tax, the poor will be affected less, as their share to direct tax is the least (1%). But this assumes that majority of the poor exist in farm households. The assumption is asserted in our later analysis where we find most of the poor (61%) in farm household category.

The difference in consumption pattern, particularly in agricultural and industrial product has considerable effect in distribution of trade liberalization benefits among households. The effect due to consumption of service products is much lower as the

share of household on service consumption is the least, and household consumption do not relatively vary among themselves. Trade liberalization impacts consumption, and hence poverty, through changes to price of imports and domestic sales. In this analysis, changes in consumer price of agricultural products affect most farm household who spend 71% of their income in agricultural products. On the other hand, change in prices of industrial products affects most wage earners and entrepreneurs.

### 3.2.2 Simulation Results

The analysis explores the impact of trade liberalization, in terms of a complete and instantaneous tariff removal, on the economy as a whole and on households' poverty and income distribution in particular. The study captures both short run and long run effects. The period of analysis extends from 2002 to 2017. The short run impact refers to the period 2002 while the long run analysis corresponds to the year 2017.

The removal of domestic distortion, caused by tariff, is expected to bring about a more efficient factor reallocation between sectors. The expected outcome is the highly protected and import competing sector would contract whereas the less protected and export oriented sector would expand. The dynamic model not only grasps the efficiency effects but it also takes into account the capital accumulation effects. In the short run, capital is sector specific while in the long run it is mobile and moves to the expanding sector.

#### 3.2.2.1 Macro and Sectoral Effects

Table 3 presents the outcome of trade liberalization on imports, exports, sectoral outputs and domestic sales. The elimination of tariff induced a fall in import price for all product groups in both the short run and long run except for the service sector where it shows increasing trend in the long run. The highest decline (-17%) is observed for industrial goods in the short run. In the longer period, the industrial product prices still decreases but at a lower rate.

Table 3:Impact of trade liberalization on price of import, domestic sales, export and output (Percentage change from the base-run)

| Sectors | Short Run | | | | Long Run | | | |
|---|---|---|---|---|---|---|---|---|
| | Imports | Domestic sales | Exports | Out put | Imports | Domestic sales | Exports | Out put |
| Agriculture | -11 | -1 | 0 | -3 | -10 | -25 | -18 | -15 |
| Industry | -17 | -7 | 0 | -10 | -5 | -9 | 1 | -22 |
| services | -8 | -28 | 0 | -18 | 8 | -44 | 70 | -25 |

Source: model simulations

In response to the fall in import price, total import demand increases 6% in the short run and 34% in the long run. Consequently, local producers confront with a decline (-2%) in domestic demand in the short run, and hence a fall in domestic sales price (-1%). But the longer period result revealed that domestic sales increases by 52% (see table 4).

Table 4:Impact of trade liberalization on volume of import, domestic sales, export and output (Percentage change from the base-run)

| Sectors | Short Run | | | | Long Run | | | |
|---|---|---|---|---|---|---|---|---|
| | Imports | Domestic Sales | Exports | Output | Imports | Domestic Sales | Exports | Output |
| Agriculture | 23 | 4 | 11 | 5 | 115 | 72 | 1.3 | 66 |
| Industry | 16 | -2 | 12 | -2 | 44 | 11 | 2.1 | 9 |
| services | -43 | -18 | 11 | -7 | -28 | 70 | 1.3 | 3 |
| Total | 6 | -2 | 11 | -1 | 34 | 52 | 1.3 | 29 |

Source: model simulations

The impact of the trade policy reform has generally increased export in both periods. There are two possible explanations for the increase in export. First, following the reduction in producer prices, real exchange rate would depreciate, as the real exchange rate incorporates producer prices as its denominator. The depreciation would create competitiveness in international market by supplying cheaper domestic products. Second, as the increase in import has dwindled domestic sales, domestic producers have to compensate the reduction in domestic sales by looking for market elsewhere.

When we examine the effect of trade liberalization on factor markets, we observe a closer link between output price and factor price. Following the policy shock, we found a fall in output prices that is highest for service sector, -18% for the short run and -25% for the long run. Next to service sector, the industrial output prices are curtailed by -10% in the short run and -22% in the long run (table 3).

The way in which this output price changes into factor price determines the change in household incomes. We anticipate a fall in factor price for factors intensively employed in sectors where value added prices decline following the shock. Like the changes in output prices, value added prices decline for all sectors in both periods. The major reduction is observed for the industrial sector, -7% in the short run and -17% in the long run, and the service sector -21% in the short run and -12% in the long run.

Table 5: Effect of trade liberalization on prices of value-added, factors and consumers (Percentage change from the base-run)

| | Agriculture | | Industry | | Services | |
|---|---|---|---|---|---|---|
| | SR | LR | SR | LR | SR | LR |
| Value added | -3.0 | -9.4 | -7.2 | -17.2 | -20.8 | -12.0 |
| labor | -5.1 | -18.0 | -5.1 | -18.0 | -5.1 | -18.0 |
| capital | 0.3 | 7.9 | -8.2 | -21.6 | -31.1 | -28.1 |
| land | 0.3 | 8.2 | | | | |
| CPI | -0.8 | 5.5 | -11.1 | 3.8 | -25.3 | -11.2 |
| Composite good | -0.8 | 5.7 | -11.1 | 3.5 | -25.3 | -22.8 |

Source: model simulations
SR ≡ short run, LR ≡ long run, CPI ≡ consumer price index

Because of the assumption of labor mobility in both periods, variation of wage rate is uniform across sectors. In contrast, capital is sector specific in the short run, and its returns differ across sectors. Changes to returns capital resembles changes in value added price of the corresponding sector. The decline in returns to capital for industrial and service sectors, -8% & -31% in the short run and -22% & -28% in the long run, respectively, are attributed to the decrease in value added for the same sectors, -7% & 21% in the short run and -17% & -12% in the long run respectively. Return to capital is relatively highest for agricultural sector (0% in the short run and 8% in the long run)

because agriculture has undergone the least decline in prices of value added (-3% in the short run and -9% in the long run) (see table 5).

The policy reform has brought about a change in price of imports and domestically produced goods. And consumer price index (CPI) is a weighted average of the two prices. The impact of changes in consumer price depends on the pattern of consumption by the households. Table 5 shows that the highest decline, short run, in CPI is observed for the industrial products (-11%) next to service products (-25%). The fall in CPI for agriculture is only 1%. Consequently, those households who predominantly consume the industrial products would benefit most. In our case, wage earners and entrepreneurs consume most of the industrial goods. Then, the simulation suggests that the two household groups benefit most from trade liberalization in the short run.

The change in consumer price of service products is not as significant as the other two product groups. It is because household consumption share of service products has smallest share of their income and it does not vary much among the households. In the long run, the change in CPI between agricultural and industrial products does not vary much. Then, highest reduction in CPI enjoyed by wage earners and entrepreneurs in the short run would vanish.

We can explicitly measure variation in poverty following trade liberalization employing the Foster, Greer and Thorbecke (1984) class of poverty measures. The subsequent section presents FGT indices using MOFED (2002) estimation of poverty line, 1075.03 Birr, below which households are deemed poor.

#### 3.2.2.2 Poverty and Inequality Effects

Level of poverty and inequality for the base run is reported on table 6. Farm household group has the highest (61%) concentration of the poor, measured by head count index. On the other hand, the least number of poor households is located in the wage earners group. This group, however, represents the most unequal expenditure distribution, computed by the Gini coefficient as 41%. Uniform expenditure distribution is relatively observed in farm households group with a Gini coefficient of 26%. At the

country level, 56% of the households are below the poverty line while overall inequality is measured as 32%.

Poverty gap index measures the mean proportionate poverty gap in the households where the non-poor have zero poverty gap. It can be considered as the cost of eliminating poverty relative to poverty line . Poverty gap index also indicate how much would have to transfer to bring the poor expenditure (or income) up to the poverty line (WB, 2005). Accordingly, from table 6, we could see that farm households demand higher amount of transfer in both base run and simulation periods where as wage earners need minimum level of transfer in the base run and long run.

The simulation result has revealed that trade liberalization, in the form a complete tariff removal, has an adverse short run effect on household welfare. Table 6 shows that all household groups have undergone through an increase in the number of the poor. The total number of households has increased by 15%.

Table 6: Poverty and inequality in the base run and after simulation

| | Farm Household | | | Wage Earners | | | Entrepreneurs | | | Total Households | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Base | SR | LR | Base | SR | LR | Base | SR | LR | Base | SR | LR |
| Headcount ratio | 61 | 74 | 53 | 31 | 52 | 30 | 44 | 53 | 37 | 56 | 71 | 50 |
| Poverty gap | 18 | 26 | 15 | 9 | 19 | 9 | 14 | 18 | 10 | 17 | 25 | 14 |
| Poverty severity | 7 | 12 | 6 | 4 | 9 | 4 | 6 | 8 | 4 | 7 | 12 | 6 |
| Gini | 26 | 26 | 26 | 41 | 41 | 41 | 39 | 39 | 39 | 32 | 32 | 32 |

Source: model simulations
SR ≡ short run effects, LR ≡ long run

The wage earners are the most adversely affected household groups in the short run. This could be explained by the loss of job attributed to the stiff competition associated with the influx of foreign imported products. The reduction in import price and probably the improved quality of imported products would compel the domestic manufacturing industry to shrink. This, in turn, would reduce labor demand for the

Table 7: Decomposition of poverty changes into growth and redistribution components

| Households | FGT Indices | Components | | | | Residual (Datt & Ravallion) | Difference between long run and base |
|---|---|---|---|---|---|---|---|
| | | Growth | | Distribution | | | |
| | | Datt & Ravallion | Kakwani | Datt & Ravallion | Kakwani | | |
| Farm Households | Headcount ratio | -0.08 | -0.08 | 0.00 | 0.00 | 0.0 | -0.08 |
| | Poverty gap | -39 | -39 | 0 | 0 | 0.0 | -39 |
| | Poverty severity | -20488 | -20488 | 1 | 1 | 0.3 | -20487 |
| Wage Earners | Headcount ratio | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.00 |
| | Poverty gap | -0.70 | -0.70 | 0.01 | 0.01 | 0.0 | -0.68 |
| | Poverty severity | -379 | -379 | 6 | 6 | 0.0 | -373 |
| Entrepreneurs | Headcount ratio | -0.08 | -0.08 | 0.00 | 0.00 | 0.0 | -0.08 |
| | Poverty gap | -37.49 | -37.49 | 0.00 | 0.00 | 0.0 | -37.49 |
| | Poverty severity | -20344 | -20344 | 0 | 0 | -0.1 | -20344 |
| TOTAL | Headcount ratio | -0.06 | -0.06 | 0.00 | 0.00 | 0.0 | -0.06 |
| | Poverty gap | -31 | -31 | 0 | 0 | 0.0 | -31 |
| | Poverty severity | -16250 | -16251 | 0 | 0 | -0.3 | -16250 |

Source: model simulations

sector. Then, wage earners engaged in manufacturing sector would be severely affected by loss of jobs.

In the long run, trade liberalization and capital accumulation effects leads to a fall in poverty across all household groups. The highest reduction in poverty is observed in farm household group (-8%). The decline in the number of the poor in farm household has considerable effect on the overall poverty level. This is because most of the poor (61%) are concentrated in farm household, and farm household constitute 42% of the total households. Then, at the country level, household poverty has fallen by 6%. On the other hand, inequality value has generally remained as the base run value.

As stated in the theoretical literature, we could decompose change in poverty into growth and redistribution effects. We explore if both components, growth and redistribution, work together in alleviating poverty or one, redistribution component, might decrease poverty reducing effect of the other, growth component.

Table 7 presents the change in poverty between the base run values and long run values. The result indicates that growth is the major factor in curtailing poverty. It

implies that the growth component is inversely related to changes in the number of the poor: as growth increase, the number of poor decreases. In farm household groups, growth is the sole factor in lessening poverty. In other household group, wage earners, head count ratio slightly increases due to deterioration of expenditure distribution. In the other FGT measures, poverty gap and poverty severity, there is a smaller adverse effect of the redistribution component in a sense that it increases poverty.

Based on table 7, we could generally say that trade liberalization, coupled and driven by capital accumulation (growth), is pro-poor in the long run.

## 4. Conclusion and Implications

We have attempted to examine the short run and long run impacts of unilateral trade liberalization, in terms of a complete and instantaneous import tariff removal, on sectors of the Ethiopian economy and household poverty and inequality. The study utilized a dynamic sequential CGE model, employing a 'top-down' approach to carry out the microsimulation analysis of poverty and inequality. We used WB SAM of 1999/2000 and CSA household survey of 1999/2000 that comprises of 17332 households.

The main findings of the analysis are complete and instantaneous tariff removal in the Ethiopian economy would lead to a worsening of poverty in the short run, and contraction of the initially protected industry, particularly industry and services. In the long run, trade liberalization combined with capital accumulation reduces poverty and swells sectors that were contracted in the short run. The growth effect captured by the model contributes to the expansion of all sectors, particularly agriculture and reduces poverty.

The decomposition of changes in poverty indicates that the contribution of the redistribution component in alleviating poverty is trivial. This implies that the decrease in poverty observed in the long run is solely attributed to the growth component. Therefore, we could say that growth is pro-poor.

In order to ameliorate the short run negative impacts of trade liberalization, we suggest two possible remedies. First, provisions of temporary transfers to the poor until the long run benefits are realized. As the industrial and service sectors are compelled to shrink and the poor did not benefit from the increased inflow of imported commodities, we suggest a different policy tool as a second solution. Instead of undertaking a complete and instantaneous import tariff removal, it might be appropriate to gradually liberalize and temporarily protect key industries that provided enormous employment. However, this policy is not to encourage inefficiency linked with protectionism. In order to reap the efficiency gain associated with liberalized economy, those temporarily protected industries would be ultimately liberalized. The

necessary time schedule has to be set as to when the protected industry would be liberalized.

Then, as a future research agenda, it would be useful to examine the effect of gradual trade liberalization on household poverty and inequality. Other vital future research agenda would be to incorporate the structural rigidities and institutional constraints inherent in the Ethiopian economy into the model.

Finally, cautions need to be exercised in interpreting and using the model's results as the model assumed market-clearing conditions for all markets.

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**Appendix**: Equations of EXTER + SD

The subscript presenting the time periods is introduced only when necessary.

**Production**

1 $XS_j = min\left[\frac{CI_j}{io_j}, \frac{VA_j}{v_j}\right]$

2 $VA_{nag} = A_{nag}^{kl}\left[\alpha_{nag}^{kl} LD_{nag}^{-\rho_{nag}^{kl}} + (1-\alpha_{nag}^{kl})\ KD_{nag}^{-\rho_{nag}^{kl}}\right]^{\frac{-1}{\rho_{nag}^{kl}}}$

3 $VA_{agr} = A_{tr}^{cl}\left[\alpha^{cl} CF^{-\rho^{cl}} + (1-\alpha^{cl})\ \overline{LAND}^{-\rho^{cl}}\right]^{\frac{-1}{\rho^{cl}}}$

4 $CF = A_{agr}^{kl}\left[\alpha_{nag}^{kl} LD_{agr}^{-\rho_{agr}^{kl}} + (1-\alpha_{agr}^{kl})\ KD_{agr}^{-\rho_{agr}^{kl}}\right]^{\frac{-1}{\rho_{agr}^{kl}}}$

5. $\overline{LAND} = \left(\frac{1-\alpha^{cl}}{\alpha^{cl}}\right)\left(\frac{rc}{rl}\right)^{\sigma^{cl}} CF$

6. $LD_i = \left(\frac{\alpha_i^{kl}}{1-\alpha_i^{kl}}\right)^{\sigma_i^{kl}}\left(\frac{r_{tr}}{w}\right)^{\sigma_i^{kl}} KD_i$

7. $CI_j = io_j XS_j$

8. $DI_{i,j} = aij_{i,j} CI_j$

**Income and savings**

9. $YH_h = \lambda_h^w * w\sum_j LD + \lambda_h^r \sum_j r_i\, KD_i + \lambda_h^l * rl * \overline{LAND} + Pindex * \overline{TG}_h + \overline{DIV}_h$

10. $YDH_h = YH_h - DTH_h$

11. $SH_h = ADJ * \psi_h * YDH_h$

12. $YF = \lambda^{rf}\sum_i r_i\, KD_i + \lambda^{lf} * rl * \overline{LAND}$

13. $SF = YF - \sum_h \overline{DIV}_h - e * \overline{DIV}^{row} - DTF$

14. $YG = \sum_i TI_i + \sum_i TIE_i + \sum_i TIM_i + \sum_h DTH_h + DTF$

15. $TI_i = tx_i(P_i XS_i - PE_i EX_i) + \left[(1+tm_i) * \overline{e} * \overline{PWM}_i M_i\right]$

16. $TIM_i = tm_i * e * \overline{PWM}_i M_i$

17. $TIE_i = te_i Pe_i EX_i$
18. $DTH_h = tyh_h YH_h$
19. $DTF = tyf * YF$
20. $SG = YG - G - Pindex \sum_h \overline{TG}_h$

**Demand**

21. $Pc_i C_{i,h} = Pc_i c_{i,h}^{min} + \gamma_{i,h}\left(CTH_h - \sum_h Pc_i\, c_{i,h}^{min}\right)$

22. $CTH_h = YDH_h - SH_h$
23. $INV_i = \frac{\mu_i IT}{Pc_i}$
24. $DIT_i = \sum_j DI_j$
25. $G = XS_i P_i$

**Prices**

26. $Pv_j = \frac{P_j XS_j - \sum_{tr} Pc_{tr} DI_{tr,j}}{VA_j}$

27. $r_{nag} = \frac{Pv_{nag} VA_{nag} - wLD_{nag}}{KD_{nag}}$

28. $r_{agr} = \frac{rc * CF - wLD_{agr}}{\overline{KD}_{agr}}$

29. $rc = \frac{PV_{agr} VA_{agr} - rl * \overline{LAND}}{CF}$
30. $PD_i = (1 + tx_i) PI_i$
31. $PM_i = (1 + tx_i)(1 + tm_i) * e * \overline{PWM}_i$
32. $PE_i = \frac{e * \overline{PWE}_i}{1 + te_i}$

33. $PC_i Q_i = [Pd_i D_i + PM_i M_i]$

34. $P_i XS_i = PI_i D_i + Pe_i EX_i$

35. $Pinv = \prod_i \left(\frac{Pc_i}{\mu_i}\right)^{\mu_i}$

36. $PINDEX = \sum_j \boldsymbol{\delta}_j PV_j$

**International Trade**

37. $XS_i = B_i^e \left[\beta_i^e EX_i^{k_i^e} + (1 - \beta_i^e) D_i^{k_i^e}\right]^{\frac{1}{k_i^e}}$

38. $EX = \left[\left(\frac{Pe_i}{Pl_i}\right)\left(\frac{1-\beta_i^e}{\beta_i^e}\right)\right]^{\tau_i^e} D_i$

39. $Q_i = A_i^m \left[\alpha_i^m M_i^{-\rho_i^m} + (1-\alpha_i^m) D_i^{-\rho_i^m}\right]^{\frac{1}{-\rho_i^m}}$

40. $M_i = \left[\left(\frac{Pd_i}{Pm_i}\right)\left(\frac{\alpha_i^m}{1-\alpha_i^m}\right)\right]^{\sigma_i^m} D_i$

41. $CAB = \sum_i \overline{PWM}_i M_i + \frac{\lambda^{row} \sum_i r_i KD_i}{\overline{e}} + \frac{\lambda^{lrow} rl * \overline{LAND}}{\overline{e}} + \overline{DIV}^{row} - \sum_i \overline{PWE}_i \, EX_i$

**Equilibrium**

41. $Q_i = DIT_i + \sum_h C_{i,h} + INV_i$
42. $\overline{LS} = \sum_j LD_j$
43. $IT = \sum_h SH_h + SF + SG + e * CAB$
44. $EV_h = \left(CTH_H - \sum_i PC_i \, c_{i,j}^{min}\right) \prod_i \; - \left(CTHO_h - \sum_i PCO_i \, C_{i,j}^{min}\right)$

**Dynamic Equations**

45. $KD_{i,it+1} = (1-\delta) KD_{i,it} + Ind_{i,it}$

46. $LS_{t+1} = (1+ng) * LS_{t,h,t}$

47. $C_{i,h,t+1}^{min} = (1+ng) * C_{i,h,t}^{min}$

48. $\frac{Ind_{i,t}}{KD_{i,t}} = \gamma_{1i} \left(\frac{r_{i,t}}{U_t}\right)^2 + \gamma_{2i} \left(\frac{r_{i,t}}{U_t}\right)$

49. $U_t = Pinv_t (ir + \delta)$

50. $IT_t = Pinv_t * \sum_i Ind_{i,t}$

**Endogenous variables**

$C_{i,h}$： Household *h*'s consumption of good *i* (volume)

$CF$： Composite agricultural capital-labor factor (volume)

$CI_j$： Total intermediate consumption of activity *j* (volume)

$CTH_h$： Household *h*'s total consumption (value)

$D_{tr}$： Demand for domestic good *i* (volume)

$DI_{i,j}$： Intermediate consumption of good *i* in activity *j* (volume)

$DIT_i$： Intermediate demand for good *i* (volume)

$DTF$ ： Receipts from direct taxation on firms' income

$DTH_h$ ： Receipts from direct taxation on household $h$'s income

$e$ : Exchange rate

$EV_h$ ： Equivalent variation for household $h$

$EX_i$ ： Exports in good $i$ (volume)

$G$ : Public expenditures

$INV_i$ ： Investment demand for good $i$ (volume)

$IT$ : Total investment

$LD_j$ ： Activity $j$ demand for labour (volume)

$M_i$ ： Imports in good $i$ (volume)

$P_i$ ： Producer price of good $i$

$PC_i$ : Consumer price of composite good $i$

$PD_i$ : Domestic price of good $i$ including taxes

$PE_i$ : Domestic price of exported good $i$

$PINDEX$ ： GDP deflator

$Pinv$ : Price index of investment

$PL_i$ : Domestic price of good $i$ (excluding taxes)

$PM_i$ : Domestic price of imported good $i$

$PV_j$ : Value added price for activity $j$

$Q_i$ : Demand for composite good $i$ (volume)

$r_i$ : Rate of return to capital in activity $i$

$rl$ : Rate of return to agricultural land

$rc$ : Rate of return to composite factor

$SF$ : Firms' savings

$SG$ : Government's savings

$SH_h$ : Household $h$'s savings

$TI_i$ ： Receipts from indirect tax on $i$

$TIE_i$ : Receipts from tax on export *i*

$TIM_i$ : Receipts from import duties *i*

$VA_j$ : Value added for activity *j* (volume)

$w$ : Wage rate

$XS_i$ : Output of activity *i* (volume)

$YDH_h$ : Household *h*'s disposable income

$YF$ : Firms' income

$YG$ : Government's income

$YH_h$ : Household *h*'s income

$LS$ : Total labour supply (volume)

$KD_i$ : Demand for capital in activity *i* (volume)

$CAB$ : Current account balance

$Ind_{i,t}$ : Demand for capital in activity *i* (volume)

$U_t$ : Capital user cost

$c_{i,h}^{min}$ : Minimum consumption of good *i* by household *h*

**Exogenous variables**

$\overline{DIV}_h$ : Dividends paid to household *h*

$\overline{DIV}^{row}$ : Dividends paid to the rest of the World

$\overline{LAND}$ : Land supply (volume)

$\overline{PWE}_i$ : World price of export *i*

$\overline{PWM}_i$ : World price of import *i*

$\overline{TG}_h$ : Public transfers to household *h*

**Parameters**

**Production functions**

$A_j$ : Scale coefficient (Cobb-Douglas production function)

$aij_{i,j}$ : Input-output coefficient

$\alpha_j$ : Elasticity (Cobb-Douglas production function)

$io_j$ : Technical coefficient (Leontief production function)

$v_j$ : Technical coefficient (Leontief production function)

**CES function between capital and labor**

$A_i^{kl}$ : Scale coefficient

$\alpha_i^{kl}$ : Share parameter

$\rho_i^{kl}$ : Substitution parameter

$\sigma_i^{kl}$ : Substitution elasticity

**CES function between composite factor and land**

$A_i^{cl}$ : Scale coefficient

$\alpha_i^{cl}$ : Share parameter

$\rho_i^{CL}$ : Substitution parameter

$\sigma_i^{CL}$ : Substitution elasticity

**CES function between imports and domestic production**

$A_i^M$ : Scale coefficient

$\alpha_i^m$ : Share parameter

$\rho_i^m$ : Substitution parameter

$\sigma_i^m$ : Substitution elasticity

**CET function between domestic production and exports**

$B_i^e$ : Scale coefficient

$\beta_i^e$ : Share parameter

$k_i^e$ : Transformation parameter

$\tau_i^e$ : Transformation elasticity

**LES consumption function**

$\gamma_{i,}$ : Marginal share of good *i*

**Tax rates**

$te_i$ : Tax on exports *i*

$tm_i$ : Import duties on good *i*

$tx_i$ : Tax rate on good *i*

$tyh_h$ : Direct tax rate on household *h*'s income

$tyf$ : Direct tax rate on firms' income

**Other parameters**

$\boldsymbol{\delta}_j$ : Share of activity *j* in total value added

$\lambda_h^l$ : Share of land income received by household *h*

$\lambda^{lf}$ : Share of land income received by firms

$\lambda^{lrow}$ : Share of land income received by foreigners

$\lambda_h^r$ : Share of capital income received by household *h*

$\lambda^{rf}$ : Share of capital income received by firms

$\lambda^{row}$ : Share of capital income received by foreigners

$\lambda_h^w$ : Share of labor income received by household *h*

$\psi_h$ : Propensity to save

$\mu_i$ : Share of the value of good *i* in total investment

$ng$ : Population growth rate

$\delta$ : Capital depreciation rate

$\gamma_{1i}$ : Parameter in the investment demand function

$\gamma_{2i}$ : Parameter in the investment demand function

$ir$ : Real interest rate

**Sets**

$i, j \in I = \{Agriculture, Industry, Service\}$

$nag \in NAG = \{Industry, Service\}$

$h \in H = \{Farm\ Households, Wage\ Earners, Entrepreneurs\}$

$t \in T = \{2002, 2003, \dots, 2017\}$