Economic Significance of Selective Export Promotion on Poverty Reduction and Inter-Industry Growth of Ethiopia

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ABSTRACT

The purpose of this thesis was to assess the economic implications of an export promotion policy on poverty reduction and inter-industry growth of Ethiopia. The study was conducted in four steps. The first and the second steps involved simulation scenarios. Scenario 1 simulated the change in the incidence of poverty when FDI capital was selectively introduced into non-coffee export agriculture. Scenario 2 simulated a situation in which the coffee industry received the same policy treatment as other export agriculture in accessing FDI capital. Step three analyzed inter-industry growth under the two scenarios. In the fourth step, sensitivity analysis was conducted to assess the possible outcomes of Scenario 1 and 2 under fluctuations in world coffee prices and changes in substitution parameters.

A micro-simulated CGE model was constructed to determine optimum production, income and consumption. A Beta frequency distribution function and FGT poverty measures were used to examine the changes in three household groups' income distribution and prevalence of poverty. For these analyses, the National Accounting Matrix and the Household Income and Expenditure Sample Survey data set were used.

At the macro level, growth in GDP due to expansion of export agriculture was significant. But at a micro level, the magnitude and dimension of economic changes were different with respect to each policy alternative. In the selective export promotion, for instance, only rural households were able to achieve statistically significant income changes. More particularly, about 10 percent of rural households were drawn out of poverty while only 1.7 and 0.5 percent of small and large urban households overcame poverty. When export promotion was assumed to be implemented across the board of all agricultural activities, the welfare gains were extended beyond rural household groups. In this policy alternative, statistically significant mean income changes were observed for both rural and urban household members. Specifically, about 12 percent of rural, 9 percent of small urban and 5 percent of large urban households were able to escape poverty. These achievements were attributed to higher intensification of coffee production and better linkages with other industries to efficiently allocate factors of production where they provided higher rates of return. The increase in income and consumption of millions of coffee dependent households has also stimulated more agricultural and some non-agricultural productions. Simulation results were observed to deteriorate when export promotion was evaluated under world coffee price fluctuation. The negative effect of a price shock, however, was observed to be minimized under alternative an export promotion approach.

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CHAPTER 1

ETHIOPIAN ECONOMIC PERFORMANCE AND EXPORT PROMOTION

A) Background

Based on recent paleoanthropological research Ethiopia is believed to be the original home of humanity (Pankhurst, 2001). Geographically, it is a land locked country surrounded by Eritrea to the north, Sudan to the west, Somalia to the east, Kenya to the south, and Djibouti to the northeast. The economy is predominantly agrarian in which 47 percent of the GDP and 40 percent of the export earnings are generated from agriculture (Economic Intelligent Unit, 2007). The population of Ethiopia is 79 million (World Bank, 2007) which makes it the second most populous country in Africa next to Nigeria.

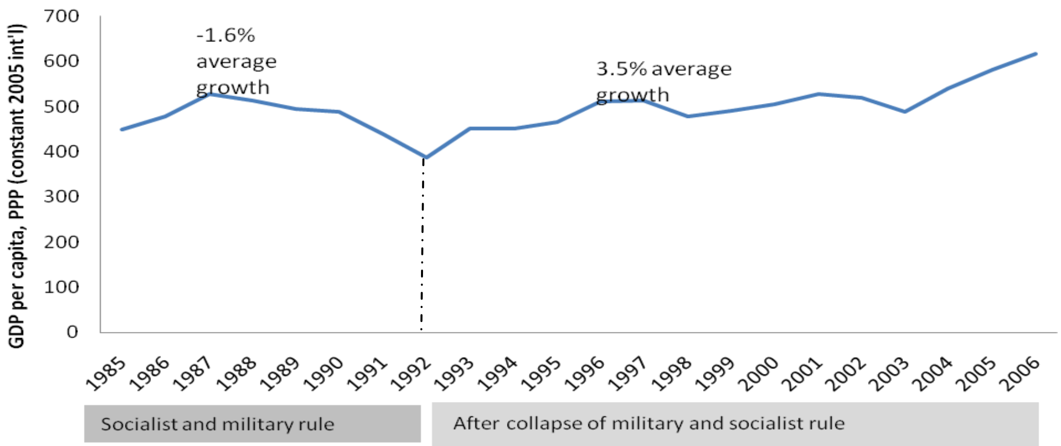
Despite the nation being endowed with natural resources, hard working people and suitable agro-ecology, its history is associated with recurrent famine and poverty. Many reasons have been given for such severe and prevalent poverty, among which the major ones are traditional agricultural practices with high dependence on rain-fed-agriculture, inefficient economic and political systems, regional and domestic conflicts, and frequent drought.

B) Economic Performance

The economic performance of Ethiopia can be reviewed from the perspectives of two major political administrations of recent decades. The military junta in 1974 ousted and killed Emperor Haile Silassie and subsequently the country fell under Soviet socialist ideology. The period immediately after the killing of the emperor was a time of havoc and a closed command economy. People were imprisoned, tortured and killed for their political views. Private farms, industries and properties were confiscated by the government. Medium and large scale private businesses were closed. Small scale private firms were operating under strict government control. Moreover, since the government was involved in every economic activity, it was difficult for small private firms to compete freely in their effort to maximize returns. This turmoil resulted in economic and social deteriorations. As indicated in figure 1, for instance, the real per capita income, which was among the lowest by Sub Saharan standard, had an average rate of decline of

1.6 percent between 1985 and 1992. When the war between the military rule and opposition groups reached its peak (in 1991) and the latter controlled the country (in 1992), the decline in real per capita income reached 10 and 11 percent. Purchasing power at this time was very low because of double digit inflation as high as 35 percent (World Bank, WDI, 2008).

Figure 1: Trend in per capita Income



Source: Personal drawing using World Bank, World Development Indicators WDI, 2008, Ethiopia data.

C) Trade Policy Reforms

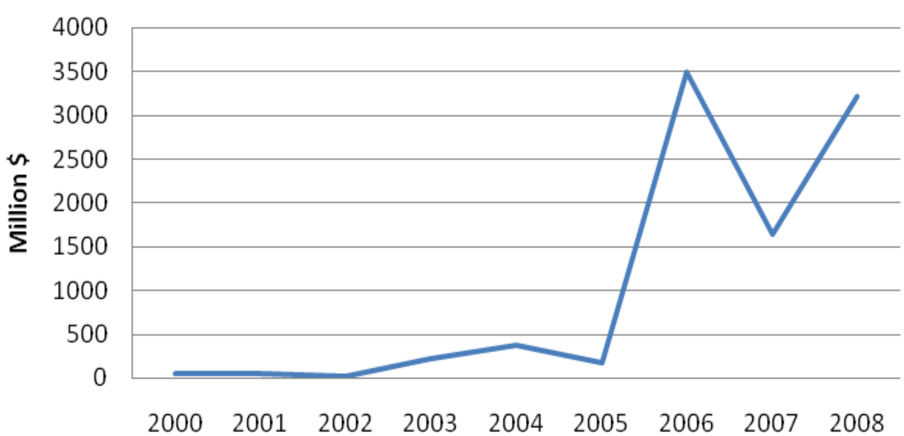
Since 1993, the incumbent new government has undertaken trade policy reforms which deregulated markets and prices, privatized state owned businesses, adjusted fiscal and monitory policies and lifted trade barriers and subsidies (Sustainable Development and Poverty Reduction Program – SDPRP (2002)). A State-led development approach of Import Substitution Industrialization (ISI) has also been replaced by an Agricultural Development- Led Industrialization (ADLI) strategy. Moreover, with the support of the World Bank and other bilateral agencies, the government has embarked on two poverty reduction programs, the SDPRP (2002) for the period of 2002/03-2004/05 and Plan for Accelerated and Sustainable Development to End Poverty PASDEP (2006) for the period of 2005/06-2009/10. In this strategy, the poverty level of the country is planned to be reduced from 39 to 29 percent through a massive investment on human and institutional capacity of the country. Following the ADLI strategy, enhancement of the agricultural sector diversification and commercialization is being given due consideration.

Through exploiting niche markets of horticulture, floriculture, livestock and mining, export earning is planned to reach 20 percent of the GDP.

Implementations of trade policy reforms and development programs have brought about changes in some economic growth indicators. For example, according to the World Bank Development Indicators, the real GDP per capita between 1993 and 2006 grew on average by 3.5 percent (figure 1). Devaluation of the national currency, reduction in income and corporate taxes, new investment code, new labor laws and privatization of public enterprises have started to encourage private businesses and investment. Based on the National Bank of Ethiopia Annual Report 2005/06, between 1992/93 and 2005/06, about 19,363 investment projects worth Ethiopian Birr 229.3 billion (equivalent of 26.7 billion dollars at 2005/06 exchange rate) were approved .

Referring to Weissleder (2009), which used the Ethiopian Investment Authority data, Foreign Direct Investment (FDI) inflow until the year 2005 was under 500 million US dollars. But after 2005, the flow increased sharply and reached to 3.5 billion US dollars in 2006 (Figure 2).

Figure 2: Foreign Direct Investment Inflow in Ethiopia



Source: Personal drawing using the data reported in Weissleder (2009)

But the trend in FDI was not smooth and steady. For example between 2006 and 2007, the FDI declined by 53 percent. And in the next year, the increase was less than the period between 2005 and 2006. According to the Economic Intelligent Unit (EIU) report (2007), the reduction is attributed to the 2005 disputed national parliamentary election and subsequent political crisis which worries the investors.

Encouragement of domestic and foreign investors has contributed to increased export values. As indicated in United Nation Commission for Trade and Development (UNCTAD) Handbook of Statistics (2008), total merchandise exports reached 1.29 billion dollars in 2007, up from just 199 million in 1992. The share of total trade as a percentage of the GDP also grew from 6 percent in 1990 to 16 percent in 2006 (World Bank, WDI, 2008). This share is anticipated to reach 20 percent by the end of 2010 (PASDEP, 2006). Between 2002 and 2006, coffee makes up about 34 percent of the export value (EIU, 2008). Until 2003, leather and leather products and "Kat" were respectively the second and third competing export industries. But the surge of oil seed exports to China since 2004 has brought them down to the third and fourth place as a source of foreign trade earnings (EIU 2008).

Cut-flower commercial farming which began in 1980 has become an attractive industry since 1992 (Belwal and Chala, 2007). But more importantly, the recent economic and trade liberalizations have attracted more foreign and domestic investors into this industry. As a result, the flower exports value which was below half a million US Dollars before 1992 has grown up to 13 million US Dollars in 2004/05 and 23 million US Dollars in 2005/06. After 2007, this export value has shot up above 100 million US Dollars [EIU, 2008 and Ethiopian Horticultural Producers and Exporters Association (EHPEA)].

D) Export Growth versus Poverty Reduction

The major export commodities of Ethiopia are agricultural products. Until now the lion's share (one third) of the country exports is constituted by the coffee industry. The other major agricultural exports are livestock, oil seeds, Kat[1], vegetables and flowers. Though limited in shares, there are also some non-agricultural export commodities such as leather and leather products, textiles and minerals.

Coffee exports are still growing. However, the share of foreign earnings from this traditional crop has declined by an average annual rate of 5.1 percent since 1997. On the other hand, the export share of non-coffee commodities (which include all other agricultural plus non-

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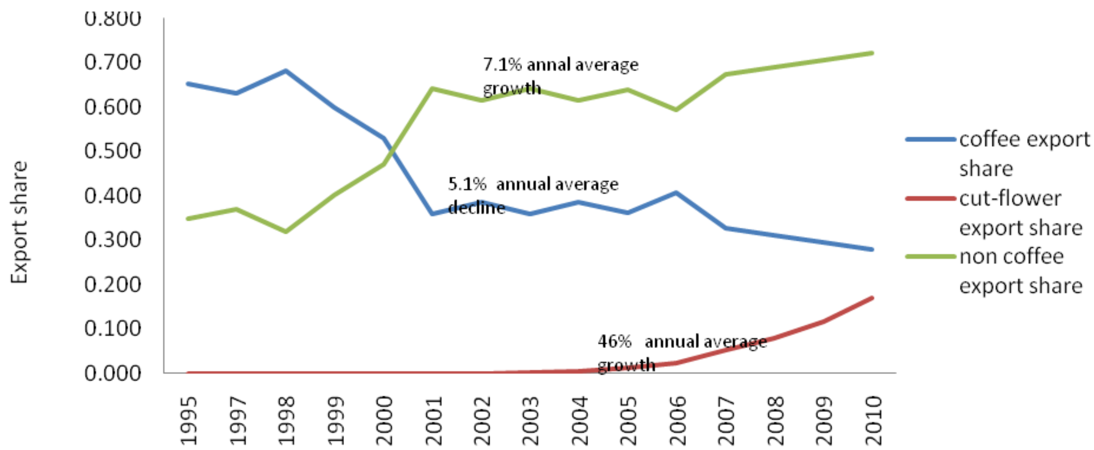
[1] According to the US Department of Justice, Drug Administration (June 2006 DEA/OD/ODE) definition: "Khat" is a flowering shrub native to East Africa and the Arabian-Peninsula. "Khat" refers to the leaves widely used since the thirteenth century as a recreational drug by the indigenous people of East Africa, the Arabian Peninsula and throughout the Middle East".

agricultural exports) has increased at annual average rate of 7.1 percent. More specifically, as compared to all non-coffee export commodities, the share of cut-flower exports, which has a shorter lifespan in the country' export history has shown an annual average growth rate of 46 percent (excluding an outlier[2]) since 1997 (UN COMTRAD, 2008). The cut-flower export share grew by an average of more than 100 percent annually since 2004 (Figure 3).

Figure 3: Trend in Export Share of Coffee and Non-Coffee Industries



Source: Personal drawing using COMTRAD (2008) statistical data and publication

The change in the structure of Ethiopian exports is also documented in the Ethiopian economic report of the Ethiopian Economic Association (2008). As stated in this report, even if the value of coffee and non-coffee exports increased by an annual average of 8 and 18 percent respectively, shares to the total export on average have shown a 5.2 percent decline for coffee and 8.2 percent increase for non-coffee industries. Government officials as well as the EHPEA are even projecting that in the near future, cut-flowers will overtake the country's export share value from coffee industry.

Despite export intensification and diversification, the poverty situation of the country is still high. According to United Nations Human Development Report (HDR 2009), between 2002 and 2007, more than 39 percent of the population was living below a $1.25 poverty line and more

2 The outlier excluded is the 2003 export value of $1,760,000 which took 0.34 percent of the total export. In 2002, the export value was only $270,000 or less than 0.01 percent of the total export. Hence an increase from 0.01 to 0.34 percent is more than a 5000 percent growth rate. For other years, the annual growth rate range between 30 and 200 percent. Hence, it is believed that such a large outlier may exaggerate the average annual growth rate and represent an error in data collection or reporting.

than 77 percent was living below a $2.00 a day income level. Assuming other factors remained constant; the structural shift between coffee and non-coffee exports is believed to have made only a small contribution to economic growth and poverty reduction. Such slow growth and little poverty reduction results can be attributed to a selective export promotion policy which favored certain sectors but restricted other more important ones. The coffee industry, which still supports the livelihood of more than 12 million households, is being replaced by the labor intensive flower and vegetable industries. According to Joosten (2007) and Weissleder (2009), some of the major implemented export promotion policies and regulations in favor of FDI are the following:

- No minimum capital requirement if foreign investors are exporting more than 75 percent of their outputs;
- Foreign investors are permitted to hire expatriate, fully repatriate capital, and remit profit and dividend;
- Foreign investors have full exemption benefit from paying import duties of capital goods and construction materials;
- FDI projects which export at least 50 percent of their production are fully exempted from income tax for 2-6 years;
- Foreign investors have full exemption from paying sales and excise tax for export commodities.

Foreign investors in horticulture and floriculture have benefited from the aforementioned export promotion policies. But the coffee industry, which is mainly operating with unskilled labor, scarce capital and technology, is not getting all of these special policy treatments. Coffee production and marketing activities are restricted to domestic investors and the export policy in this sector is limited to exemption of customs duties and import tariffs.

Until 2008, the total land used for the flower industry was less than 2400 hectares and the employed labor ranges between 50,000 and140, 000 in slack and pick seasons (Demeke et al 2007 and Ethiopian Horticulture Producers and Exporters Association - EHPEA[3] profile 2010). On the other hand, the Ethiopian coffee which constitutes about 3.6 percent of the world production (Bastin and Matteucci, 2007) was produced on more than 500,000 hectares of land by more than 1.2 million small holder farmers (Bastin and Matteucci, 2007). More than 95 percent of

[3] www.ehpea.org.et - the Ethiopian Horticultural Producers and Exporters Association web page

the country's coffee is produced by these subsistence farmers in which each household is cultivating less than 0.5 hectares of land and earning less than a one US dollar per day income (Oxfam, 2002).

Had the flower and horticulture industries reallocated large scale unemployed and under-employed labor from the traditional coffee and subsistence agricultures, it would have been a plus to the country's poverty reduction endeavor. But, as described above, they are expanding on less intensive cultivable land. Their capacity to absorb a large amount of labor, therefore, is very minimal and hence their contribution to poverty reduction is trivial. Due to its nature and scale of operation, expansion of coffee industry, on the contrary, requires a large farm area, capital, and substantial labor. Hence, investment in this industry might provide more employment opportunities and welfare gains to the society than its counterparts. Furthermore, the supply side constraints of the existing coffee industry might have been improved if it had benefited from external capital flows and technology transfers. Under the present conditions in which many countries in these markets have greater capital and innovative capabilities, the competitiveness of Ethiopia is limited. Unless the coffee industry becomes competitive in the world market soon, its economic contribution could further deteriorate.

E) Purpose and Objectives of the Study

Several studies have been made to assess the impacts of exports, trade liberalization, and other policies on economic growth and development. To date, however, there has been limited quantitative evidence in favor of or against industry- specific export promotion as currently being implemented in Ethiopia. This study, therefore, assesses the economic significance of an already-implemented export promotion policy on poverty reduction and economic growth of the country. Specific objectives are to:

(1) Measure the change in the prevalence of poverty at the household level with increased FDI inflows and subsequent growth of non-coffee agricultural exports as a result of special treatment they receive from the export promotion;

(2) Compare the change in poverty that would have occurred had FDI also increased in the coffee sector as a result of receiving the same export policy treatment as other sectors; and

(3) Analyze the extent of inter-industry and overall growth that could be achieved under the above two scenarios.

Organization of the Remaining Chapters

This thesis is organized into seven chapters. Chapter two presents a case study of coffee and cut-flower export performances and trends. This review is mainly done to distinguish major internal and external factors that impede agricultural exports' contribution to poverty reduction. This chapter concludes by recommending an empirical study to substantiate its literature review findings.

Chapter three reviews literature which has studied the impacts of exports, trade liberalization, and other policy interventions on economic growth and poverty reduction. It begins by explaining different econometric studies and their findings. It then proceeds by pointing out two limitations of the econometric approach. The first limitation is the fact that the presence of endogeniety among explanatory variables makes it difficult to statistically establish causality. The second drawback is the restriction the approach has on assessing impacts at household level. This chapter ends by highlighting how the Computable General Equilibrium (CGE) Model is a sound alternative to deal with household level poverty analysis.

Chapter four addresses the methodology of this study. It starts by defining the Social Accounting Matrix (SAM) and by developing the CGE model. The model explains economic behaviors of all accounts in the SAM and it defines the supply and demand equilibrium and closure conditions. It shows how price and resource allocations are changed with exogenous shocks and their subsequent effect on economic growth and poverty reduction.

Chapter five presents the data and procedures employed in the thesis. The contents and sources of the data sets and how they are linked together to be used in the CGE model are explained. Model simulation procedures are also discussed in this chapter.

In chapter six, the impact of changes in FDI-endowed capital on poverty reduction is evaluated. The evaluation is made in two scenarios. The first scenario simulates the effect of capital factor changes on agricultural activities excluding coffee. The second scenario repeats the first experiment but includes capital change for the coffee activity. Finally, chapter seven summarizes the findings and concludes with recommendations for future research.

CHAPTER 2

BACKGROUND: ETHIOPIAN AGRICULTURAL EXPORTS

Agricultural exports in Ethiopia can be viewed from two angles. The first one is traditional coffee exports which for decades render the lion's share of the country's foreign currency earnings but its production and marketing operation is still controlled by the government. And the second one is exports of vegetables, flowers and other cash crop commodities in which their share in total exports value are still very low. But the production and marketing activities of these commodities are open to foreign investors. To understand achievements, trends, and issues observed in current agricultural exports, a case study of two representative commodities is presented as follows:

A) The coffee Industry

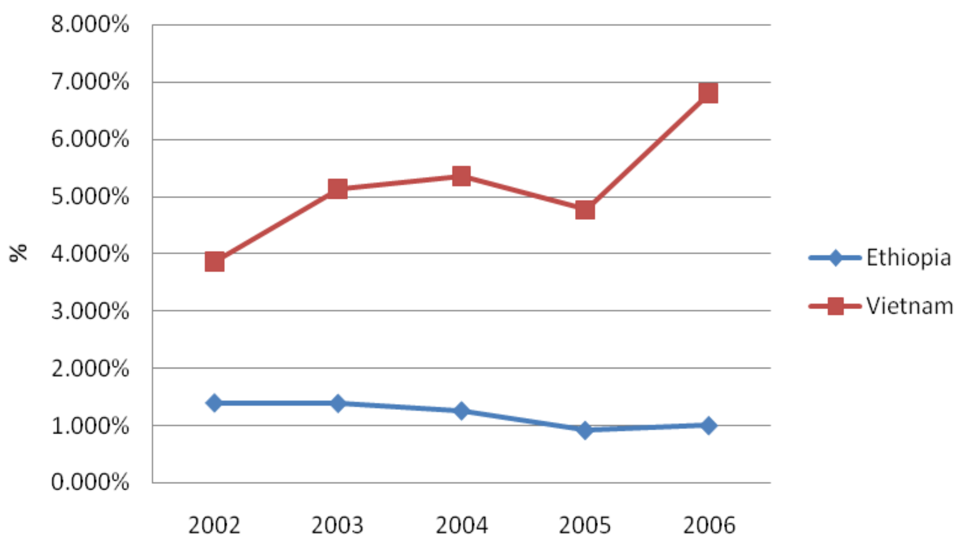
Coffee exports in Ethiopia dates back to the eighteenth century, but trade in an organized and coordinated manners began in 1960. The crop is largely produced by subsistence farmers using labor-intensive agricultural practices. Until the end of the 1990s, coffee was contributing 60 percent of the country's foreign currency earnings and supporting about 12 million rural livelihoods[4].

But in recent years, the coffee share to the total exports value has declined because of the fall in the world price and Ethiopia's weak competitiveness in the world market. As is common for other primary commodities, the terms of trade for coffee are declining because it is an income and price inelastic commodity (Prebisch, 1984 and Grynberg & Newton, 2007). As Tauer (2006) explains it, with new entrants like Vietnam since 1989, the world market has flooded with a large coffee supply leading to the coffee price crisis in 2001. According to Osorio (2002), the 2001 coffee price crises was caused by more than 3.6 percent increase in worldwide coffee production while global demand increased only by 1.5 percent. This supply and demand imbalance was created mainly due to the rapid expansion of production in Vietnam and establishment of new plantations in Brazil.

[4] www.treecrops.org – Sustainable Tree Growing Program

The effect of the price reduction has been pronounced in Ethiopia where the supply side of the sub-sector is characterized by low productivity of labor and capital. With current agricultural practices and limited fertilizer use, average coffee yield in Ethiopia is 600 kg/hectare compared to 2000 kg/hectare in Vietnam (Ethiopian Economics Association, 2008). Based on the UN COMTRADE database (2008), the share of Vietnam coffee to the world export value increased from 3.8 to 6.8 percent, while the same share for Ethiopia coffee exports declined from 1.39 to 0.99 percent between 2002 and 2006 (Figure 4).

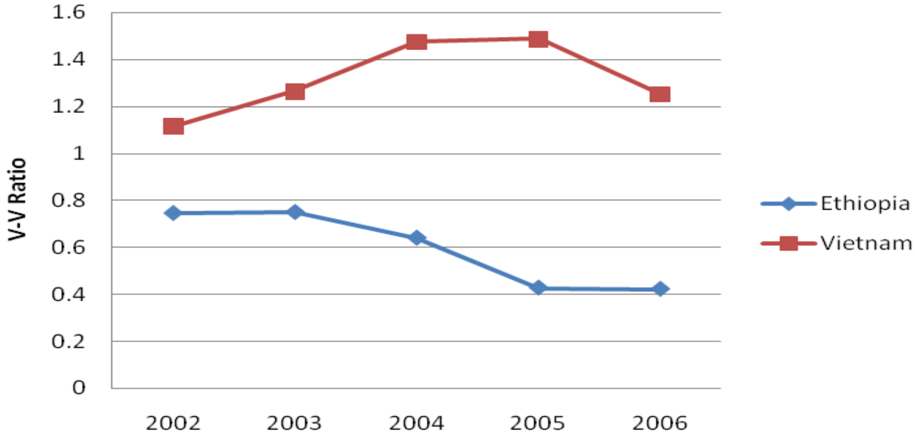
Figure 4: Trend in the Share of World Coffee Export Value



Source: Personal Drawing Usng COMTRADE Data (2008)

The World Bank (2004) used the Value-Volume (V-V) ratio to analyze the trend in export shares of traditional and high value commodities. According to this report, V-V shows whether a product is going in a positive or negative direction with respect to the world price and whether the product is becoming more differentiated. Using UN COMTRADE data of the coffee exports of Ethiopia between 2002 and 2007, the V-V ratio was estimated. The results of this estimation for Ethiopia coffee show a decline in V-V ratio from 0.75 to 0.38, whereas for Vietnam the ratio for the same period shows a positive trend from 1.11 to 1.25 (Figure 5).

Figure 5: Trend in V-V Ratio of Coffee Export in Ethiopia and Vietnam



Source: Personal Drawing Usng COMTRADE Data (2008)

In addition to an increasing trend in the V-V ratio, coffee exported from Vietnam obtained a higher price premium than that of Ethiopia. Based on the same data, the price premium of Vietnam coffee over Ethiopia was 0.36 US Dollar per Kilo Gram in 2002 but it rose up to 0.86 US Dollar per Kilo Gram in 2006. This increase in price premium implies that Vietnam is shipping a value-added coffee product, whereas Ethiopia is shipping more of the same types of washed and unwashed coffee beans. Extensive margin of trade, as defined by Hummels and Klenox (2002), is the additional return from trade by expanding the number of export product categories, whereas the intensive margin of trade is the incremental return generated by exporting more of the same product category. Based on this definition, Vietnam is gaining relatively at the extensive margin of trade, while Ethiopia is losing market share at the intensive margin of trade.

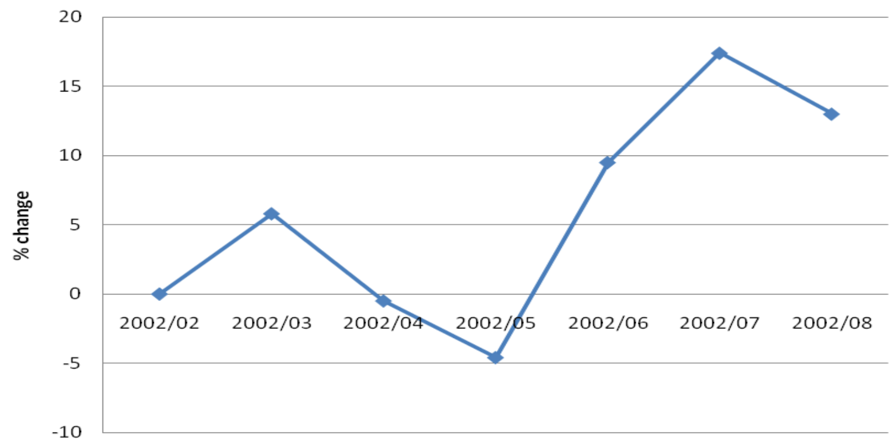
Trade policy, infrastructure, macroeconomic stability and the existence of Trade Support Service (TSS) institutions are also important for attaining sustainable export growth (Bonagali and Fukasaku, 2003). Although coffee production and marketing activities in Ethiopia have been liberalized, there are many areas where government is still imposing its control. For instance, the auction market is still controlled by the government, the licensing procedure is prohibiting private firms from vertical integration, and multinational corporations are not allowed to be involved in an export venture (Petit, 2007). Petit (2007), as cited in Davion and Ponte (2005, 108), suggests that “as a result of the absence of multilateral corporation (MNC) competition at the auction level, the industry is much more locally controlled than elsewhere in Africa ”.

Government restriction of MNCs is not because domestic exporters are competitive with technology and capital, but rather for the political purpose of controlling the flow and collection of foreign currency to stay in power (Petit, 2007; Love, 2002). If local exporters had a comparative advantage in capital, technology, management skill and market information, the country coffee export, operating only by domestic exporters, should have had larger world market share.

A case study in Ethiopia and Kenya indicates that trade support services are mostly public owned promotion services which are politically biased and have inadequate staffs and resources (Bonagali and Fukasaku, 2003). There are some well staffed and resourceful private business services, but most of them have minimum recognition by the government (Bonagali and Fukasaku, 2003). These institutions could not have sufficient capacity to provide up-to-date and effective market information and trade negotiations services for their members. With such constrained arrangement, the management decisions of domestic exporters were depended on the asymmetric information obtained from their importing companies or foreign trading brokers. Therefore, management decisions made in this situation could not put them at a competitive position in the world market. Being a major exportable commodity, coffee exports also share this problem.

As shown in Figure 6, with an inflation rate increased from 18 percent in 2003 to 44 percent in 2008 (WDI, 2010), the real effective exchange rate of Ethiopian Birr to the US Dollar has appreciated from 5.3 percent in 2002/03 to 13 percent in 2007/08 (National Bank of Ethiopia, 2007).

Figure 6: Trend in Real Effective Exchange Rate of Ethiopia



Source: Personal Drawing using the data in the National Bank of Ethiopia Report (2007)

Due to a year to year appreciation of the Ethiopia Birr exchange rates, the exports of coffee and other commodities could not become competitive because prices are higher than other exporting countries.

Therefore, external factors such as declining world prices and fierce competition and internal factors such as less productivity, weak TSS institutions and unstable macroeconomic conditions are still the major hurdle of the coffee industry. With these limitations, the coffee sector which used to account for about 3 percent of the world market, generates more than 60 percent of foreign earnings, and continues to support more than 12 million people, appears to be headed into a long-term decline.

B) The Cut-flower Industry

Exports of cut-flowers have grown dramatically from less than half a million dollars in 1995 to 69 million dollars in 2007 (COMTRADE, 2008). In this production period, more than 139,000 jobs were created by the industry, of which 70 percent were women (Demeke et al 2007 and Melese, 2007). Currently, more than 100 private firms are involved in cut-flower production and export operations of which 55 percent are owned by foreign investors[5]. At present, cut-flower is the sixth largest exportable commodity of the country. And its share in Ethiopian export earnings has increased from less than 0.04 percent in 2001 to 5.39 percent in 2007(COMTRADE,

[5] http://www.ehpea.org

2008). In 2008, exports to Europe, Asia and the Middle East were reported to reach 111 million (EIU Country report, 2009). Ethiopia is now Africa's second largest flower exporter after Kenya.

Unlike coffee, cut-flower is a luxury good and hence it is more income and price elastic. Its demand in the world market is still growing. That is why world-leading cut-flower producing countries such as the Netherlands, Germany, Italy, United States, United Kingdom and Switzerland are importing more flowers from Asia, Latin America and Africa (Belwal & Chala, 2007). For instance, based on COMTRADE data, the V-V ratio of cut-flower exports from Ethiopia has increased from 1.5 to 3.9. But the rise in the V-V ratio is not attributed to product diversification but rather is a response to prevailing higher demand in the world market. Ethiopia is not exporting diversified flower varieties as more than 80 percent of the exports are a single rose variety (Melese, 2007).

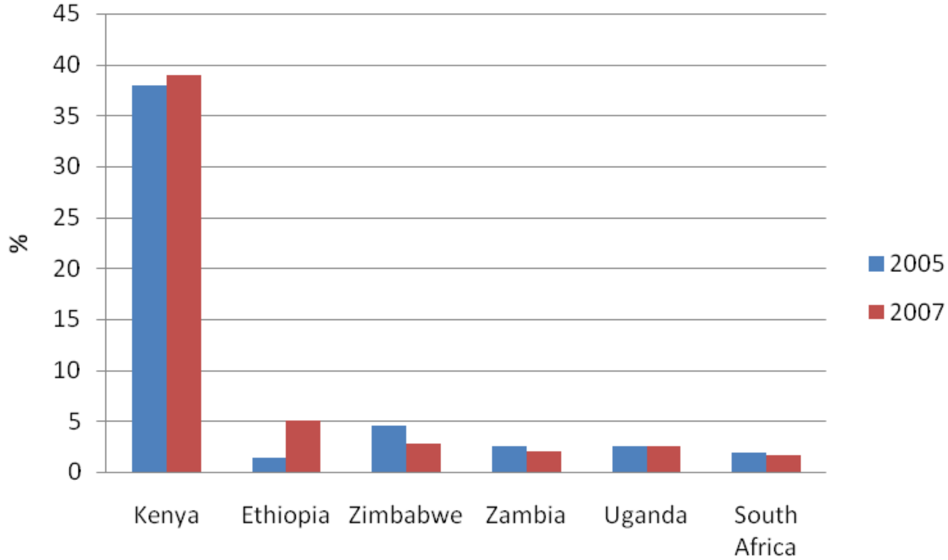
From the estimated V-V ratio for cut-flower exports, two conclusions are drawn:

(1) Ethiopia may continue to benefit from high cut-flower prices until the market is flooded by a large supply of new entrants. Many countries have recently been attracted to this lucrative market. In Africa in addition to Kenya, neighboring countries such as Tanzania, Uganda, Malawi, Zambia, and Namibia are working vigorously to expand market share (Belwal & Chala, 2007). China is intensifying production to obtain a larger share of the European market by investing more in the industry, using a relatively cheap labor force, and applying more competent business and management skills than African exporters. According to the New York Times September 25, 2006 article "… There is the issue of China's immense productivity. Growers in many countries worry that China may ship so many flowers, especially low-quality ones, that wholesale prices could plunge". This article also indicates that China may quadruple its exports to $200 million by 2010, becoming a threat to established producers such as Colombia, Ecuador, Kenya, Malaysia, and Thailand.

(2) A long term strategy to stay in the industry and benefit from its returns is to foster world market competitiveness. Even though the sub-sector in Ethiopia is showing dramatic growth and still has potential to grow more, its contribution to the national economy is only 0.12 percent of the GDP (at purchasing parity price) (C.I.A. World Fact book, 2007). Moreover, its competitiveness compared to related industries in sub-Saharan Africa is still very low. Based on a UNCTAD/WTO report (2008), Ethiopia's export share from the 2006 world market was less than 0.25 percent, whereas Kenya accounted for 3.18 percent of the world exports. Moreover,

according to Gebreeyesus (2008), the export share of Kenya in 2005 European flower market (EU25) was 38 percent while Ethiopia's share was only 1.4 percent (Figure 7). In 2007, the export share of Ethiopia in the same market has increased to 5 percent but the competitiveness gap with Kenya is still so wide.

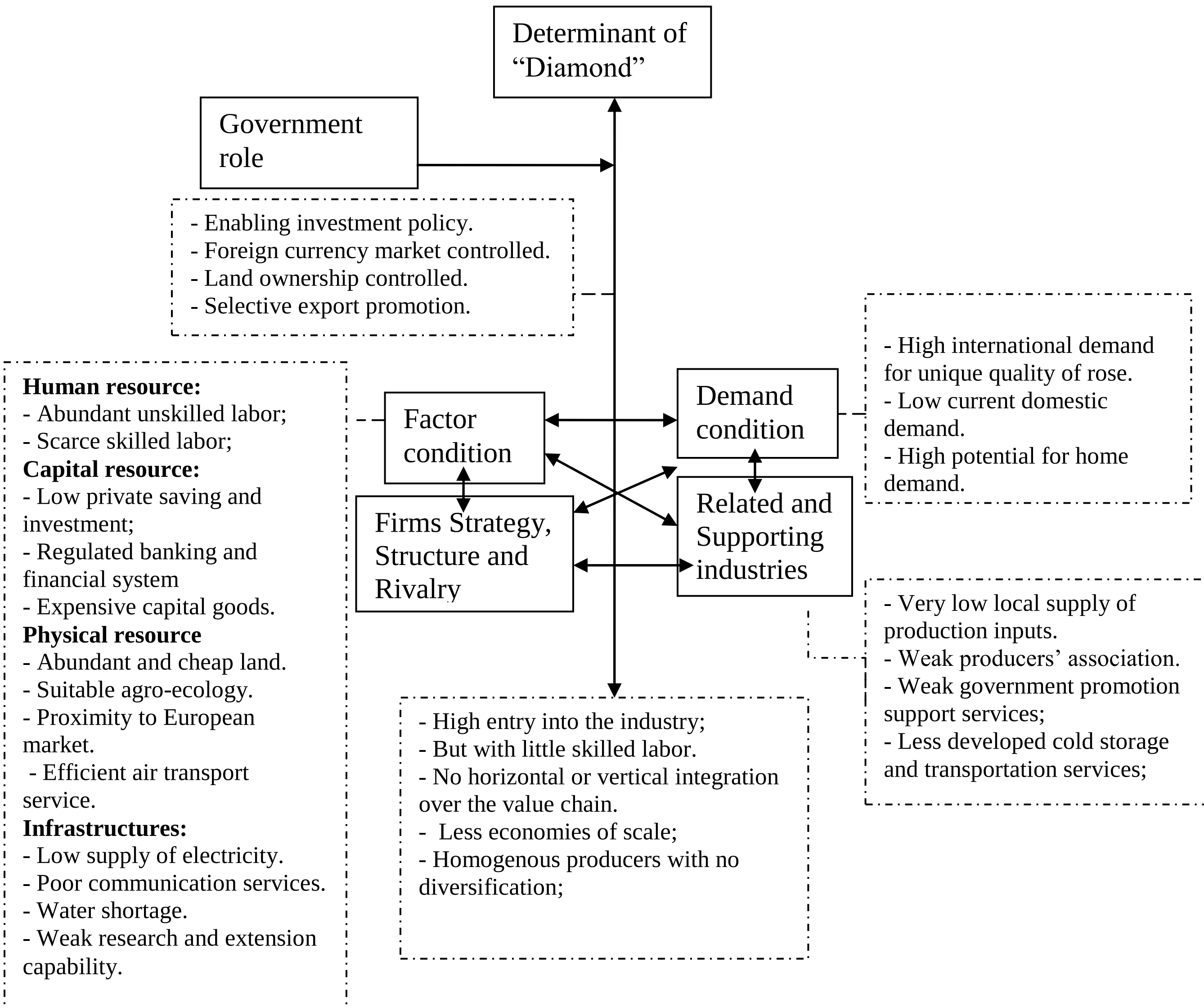
Figure 7: Sub-Saharan Africa Market Share in the EU Flower Market



Source: Personal drawing using data obtained from Gebreeyesus (2008)

Following Chobanyan and Liegh (2006), determinant factors of competitiveness of Ethiopia's cut-flower industry is evaluated using Porter's (1990) Diamond framework as shown in Figure 8:

Figure 8: Porter's Diamond Framework for Ethiopia Cut-flower Industry



Source: Adopted f rom Chobanyan and Liegh (2006) and Porter (1990)

As illustrated in figure 5, by deregulating the flower industry and revitalizing the investment code, the government has been able to attract both domestic and FDI growers. But still, the government is controlling the financial system which constrains firms' ability to make decisions in their import and export activities.

To date, only some elements of the factor conditions such as unskilled labor, land and suitable agro-ecology are being exploited by the domestic and FDI firms. Many of the determinant variables of "Porter's diamond" are either not or minimally initiated towards attaining competitiveness of the flower industry. For example, access to electricity, telecommunication and internet connection are limited to only big cities. That is why most of the flower farms are concentrated in a 200 kilometer radius to the capital Addis Ababa (Melese, 2007).

Even if there is abundant potential to grow more flowers in many parts of the country, expansion is limited due to high fixed and variable costs of production. According to the World Bank (2004), rose flower farming in Ethiopia needs considerably high establishment and post harvest fixed costs. The major pre-harvest fixed assets include seedling propagation houses with drip irrigation system, green house, agricultural equipment, machineries, electricity infrastructure, and planting materials. And the post-harvest fixed costs include establishment of warehouse, cold rooms, packing units, refrigerated trucks, and storages. In general for start-up and operation of a cut-flower farm, about one to two million U.S. Dollar is required (Table 1).

Table 1: Investment Cost of Commercial Flower Farming in Ethiopia (Eth Birr)

Investment items	Farm1	Investment items	Farm 2
Greenhouses (6 ha)	5,257,376	Greenhouses (10 ha)	13,626,648
Irrigation Scheme	255,452	irrigation system	1,057,777
machinery and vehicles	1,257,782	Vehicles	921,784
Rose plants	2,180,420	Cooling units	781,862
Agricultural equipment	223,095	Equipment	2,895,721
Operating equipment	157,429	Building/infrastructure	3,963,005
Infrastructure	315,145	Propagation units	424,969
Warehouse (1200m2)	1,145,000		
Other buildings	630,576		
Electric installation lines	430,000		
Power supply	153,000		
TOTAL	12,005,275		23,671,766

Source: World Bank (2004)

Costs are high because there are no forward and backward linkages between the flower and other related industries. Referring to Hirschman (1958) and Powers (2004), forward linkages are a positive pecuniary externality imposed on downstream firms as a result of increased production of an upstream firm. In the presence of such externality, downstream firms will get an opportunity to buy output from upstream firms at a low cost for their intermediate use. On the other hand, backward linkages are positive pecuniary externality created to the upstream firm as a result of increased production by downstream firms.

At present, there is little upstream and downstream industrial linkage in relation to the cut-flower business. There are no many industries in Ethiopia which can locally produce drip irrigation equipment and pumps, greenhouse gasses, agricultural equipment and machineries. The electric infrastructure is not well developed to supply sufficient electricity at minimum cost. Moreover, there are very few local industries which need cut-flower output as an intermediate good and which, on the other hand, supply inputs like fertilizers, herbicides, to the flower industry. There are only a few cold-chain and transportation firms. But they are not growing at equal pace with cut-flower output growth and hence they have caused high variable costs of cold storage and transportation facilities.

The large population size of the country is a potential for domestic demand and a subsequent push factor for competition among flower firms. But under the circumstances where more than 55 percent of household income is spent on food consumption, flower will still be considered as a luxury item. So until the consumption structure of the country is changed, the only potential destination of cut-flowers will remain to be the global market. Moreover, most firms are organized with limited skilled manpower and supported with weak research and extension capabilities. Hence with much of unskilled manpower and less innovative production system, competition and rivalry among firms to develop diversified marketing institutions are absent.

As has been true in the coffee industry, the TSS is not efficient enough to provide accurate trade related information to flower exporters. The industry is supported by the EHPEA which is organized with weak man power and technical capabilities. Its capacity to collect, analyze and speculate future market demand and trend in international auctions is limited. With this constraint, exporters are frequently exposed to higher airfreight costs. As explained in Belwal and Chala (2007), since exporters are reserving space for export packages below or above anticipated demand, they are either not meeting importers' demand or paying extra unanticipated air transport costs.

Even though government deregulated entry and exit of foreign firms in the flower industry, there are many areas where producers find it difficult to do business in the country. For instance, it is cumbersome to access finance for further expansion and foreign exchange to import capital goods (Belwal and Chala, 2007). Moreover, the Index of Economic Freedom Report (2008) of the Heritage Foundation indicates that Ethiopia’s overall rank in business, trade, fiscal, monetary, financial and labor freedoms and freedom from corruption is lower than most of its competitors such as Kenya, Tanzania, Uganda, Malawi, Zambia and Namibia.

Therefore, under the condition in which both industries have their own and cross cutting internal and external limiting factors, their contribution to economic growth and poverty reduction is small.

Since this conclusion is made based on a literature review, it is imperative to substantiate it with scientific findings. A careful empirical analysis is therefore initiated by this study to assess the impact of export promotion on poverty reduction in the country.

CHAPTER 3

LITERATURE REVIEW

There are many previous studies which have assessed the likely impacts of exports, trade liberalization, and other policies on economic growth and poverty reduction. The impact of both industrial and agricultural exports on economic growth, for instance, is evaluated in many empirical works. Referring to the works of Balassa (1985), Jung & Marshall (1985), Fosu (1990), Lusier (1998), Lee & Cole (1994), Al-Yousif(1997), Isam (1998) and others, Madina-Smith (2001) reported mixed results about the influence of exports on economic growth. While some of these studies support positive causality of exports on economic growth, others find a negative relationship.

There are also other empirical studies which have incorporated various measures such as trade openness and convergence among countries with and without trade liberalization [Sachs and Warner (1995), Edwards (1995) and Ben-David (1993)]. All these studies agree on the positive role of openness to trade on economic growth. But many of them are criticized by other researchers. Rodriguez and Rodik (2000) for example argues that explanatory variables of openness are also correlated with unobserved variables such as lack of better health, education and institutional set up, as well as historic experiences of colonialism, migration, war and poor natural endowment. Hence, estimation in this situation could result in the problem of endogeniety. Moreover, policy variables such as the degree of openness, tariffs, terms of trade and export performance used by Edward (1998) to compare closed versus liberalized economies are criticized in Winters et al (2004) as being highly correlated. When all these variables are included in the empirical analysis, it may be difficult to identify their separate effects.

Some econometric studies have analyzed the impact of FDI on economic growth. Terry and Hans (2009) used an endogenous model to prove the hypothesis that the effect of FDI inflows is stronger for those countries with higher level of economic development. The result of this study indicated that only those host countries with better absorptive capacity were directly impacted in economic growth and indirectly impacted with human capital development. A review of many empirical studies by Narula and Portili (2004) also questioned the positive contribution of FDI to economic growth and factors productivity mainly because many host countries do not have enough absorptive capacities to capture the bulk of benefits FDI can provide. Not much empirical work related to causality of FDI and poverty reduction was encountered by this study.

Very few econometric studies have analyzed the contribution of export promotion to poverty reduction. The most widely known study in this respect is Dollar and Draay (2001a) which found that trade liberalization could lead to economic growth and poverty reduction in developing countries. But this study did not escape criticism because it used trade openness variables which happen to correlate with other trade policy variables. Many studies are also criticized for their use of a head count index (proportion of the poor over the population) to measure the direct effect (through employment and wage) and indirect effect (through spill over from overall economic growth) of exports on improving household income. As explained by Ravallion (1996), this choice variable neglects inter-household income inequality. For example, certain export commodities might employ only semi-skilled households, excluding the large number of unskilled households found in many rural areas of developing countries. Exports promoted under such circumstances might worsen poverty rather than reduce it. The head count index cannot identify this specific poverty effect because it aggregates all households with homogenous socioeconomic characteristics.

To empirically analyze the direct effects of trade liberalization in developing countries, it is crucial to assess whether it encourages more labor intensive output; whether it creates a relative wage gap between demographically varying labor forces and whether the export industry is dominated by primary products or not (Winters et al, 2004).The same study pointed out that such complexity of econometric prediction has forced many researchers to prefer a Computable General Equilibrium (CGE) approach.

Being the basic data of the CGE model, clear understanding about the concept and organization of the Social Accounting Matrix (SAM) is necessary. A Social Accounting Matrix (SAM) is a square matrix which depicts inter-sectoral linkages and economic interdependence of industries at national, regional or village levels for one accounting period. The seminal work of SAM dates back to Richard Stone’s social account work (Decaluwe et al, 1999) and its formalization as an economy wide database goes back to Pyatt and Thobecke (1976). A SAM fixed multiplier, for instance, has been used for counterfactual experiments of government budget retrenchment programs and their effects on income distribution in Indonesia (Keuning and Thorbecke, 1989). In this study, the effect of cutting government current and capital expenditures in relation to the 1980 base year and other alternative scenarios was examined. The 1980 base year was the period when an unexpected oil shock affected Indonesia's oil revenue and hence a high level of government public expenditures was maintained through a large scale increase in external debt. The result of the experiment was that the incomes of different households would have been increased in the long term, had more current expenditures (than capital expenditures) been reduced by the government instead of mitigating a short term income loss through external borrowing.

In Thorbecke (2002), the SAM analysis was done based on a Keynesian assumption that there is always excess capacity and unused resources in the economy, hence any exogenous increase in resource demand could be satisfied by increased supply of unused resources without any change in factors prices. This paper argues that the above assumption is restrictive because in the real world there are some economic sectors which operate with fully employed factors. Hence under this situation, it is only an endogenously determined price which could equilibrate supply and demand factors of different sectors of the economy. Use of the SAM multiplier is also criticized in Adelman and Taylor (1996) as being limited to its assumptions of fixed-price, perfectly elastic input supply, linear and fixed-proportion productivity of inputs. Theoretically, output production and consumption decisions are determined by endogenous domestic and exogenous world market prices, constrained input demand and marginal productivity of inputs. Therefore, in order to incorporate such economic sectors, institutions and behavioral interactions, a Computable General Equilibrium (CGE) approach is widely preferred. In this approach, when an exogenous shock is introduced into an economy, a new vector of prices will be obtained, so that it will bring about changes in factors payment, household income and aggregate production and consumption decisions.

CGE models are used to assess the impacts of conservative and voluntary monetary, fiscal, and expenditure reforms on income distribution in Indonesia (Thorbecke, 1991). The model in this study was built by incorporating a previously established SAM. Moreover, parameters and coefficients of the model equations for production and consumption were calibrated from it. Simulation experiments in this study explored the impact of six alternative scenarios of expenditure adjustment on income distribution, macroeconomic variables and other sectors of the economy. Specifically, the income effect was evaluated by looking into the change in employment and farm household returns from domestic and exportable production. A similar approach to Thorbecke's was used by de Janvry, Sadoulet and Fargeix (1991) and Morrison (1991) to analyze the effect of adjustment on equity for Ecuador and Morocco respectively.

A CGE model is also used in the Global Trade Analysis Project (GTAP) Model. The GTAP model is developed to analyze the impact of bilateral and multilateral trade reforms, through General Agreement for Trade and Tariff (GATT) and the World Trade organization (WTO), on multi-countries' economic growth and welfare (Hertel, 1997). This model uses Input-Output (IO) Tables of 37 traded and intermediate outputs, factor prices, and support and protection data collected from 37 countries by UN COMTRADE. The GTAP model has been used by many researchers in estimating the impact of unilateral and multilateral, preferential and non-preferential (most favored nation (MSN)) agricultural liberalization; the impact of reforming the Multi-Fiber Arrangement (MFA) on the level of bilateral quota rent; and the outcome of climate change on worldwide production, consumption and trade patterns (Hertel, 1997). While this model is applicable and efficient in assessing intraregional trade and its impact on welfare gain, it cannot incorporate these same interconnections and implications on non-traded domestic commodities. Moreover, the impacts of reforms on individual welfare in the GTAP are evaluated only at the per capita consumption level.

Rutherford, Tarr, and Shepotylo (2005) analyzed the impacts of WTO accession, global free trade, and the Doha Development Agenda on growth and poverty reduction in Russia. The study used a CGE model to assess possible gains: (1) if Russia lifted export subsidies and reduced import tariffs; (2) if all other countries lifted tariffs and subsidies to Russian trade and (3) if Russia removed barriers to FDI on service sectors. The base data source for this model was the IO table developed by the Russian Statistics Authority and vectors of price changes simulated from GTAP. The results of this study showed that overall household consumption on average would increase by 7.3 percent if the country undertook its own trade liberalization through lifting barriers to FDI inflow in the service sectors, while the same gain from completion of global free trade and the Doha agenda was only 0.2 and -0.3 percent respectively.

All of the above CGE models made a representative household assumption when they measured changes in income distribution. But within a representative household setting, all rich and poor households were aggregated as one entity. This approach cannot provide explicit and sufficient information about the role of policy interventions on reducing the magnitude and dimensions of poverty. Therefore, if we need to evaluate policy reforms and external shocks at the micro level, we have to identify different categories of households living with different income levels. The first effort in this respect is disaggregating of households depending on different socio-economic or geographic settings [Adelman and Robinson (1979), Dervis, de Melo and Robinson (1982) and de Janvry, Sadoulet and Fargeix (1991)]. In this approach, household survey data are linked with the CGE model after they are adjusted with their sample weight and aggregated by household groups. By this aggregation, the variance of income and expenditures within each group are fixed, therefore the CGE model is used to estimate a change in average income of each household group. Hence it still retains a representative household assumption with intra-household groups. This method may provide misleading poverty results given that there is quantifiable variation within each socioeconomic group (Decaluwe et al., 1999). There is much evidence to substantiate variation in income and expenditure within each demographic group. For example, educated and uneducated or skilled and unskilled household heads may not have identical level of income and expenditure.

In order to avoid the above mentioned ambiguity, a micro simulated CGE model was introduced (Decaluwe et al., 1999). In most cases, this model is similar to a standard CGE model but (1) it directly incorporates disaggregated household income and expenditure data from the sample survey by replacing the value of the representative household in the national SAM, and (2) during this process, intra group socio-economic variations are endogenized by introducing flexible income distribution functions for each household group.

Decaluwe et al. (1999) was one of the few works to use the micro-simulated CGE model. In this approach, using household income and expenditure survey data, six intra-group income distribution households were specified and linked to the CGE model. To accommodate flexibility, a Beta type functional form of income distribution was chosen. The model defined the poverty line and converted it into a monetary value using endogenously determined prices. Then it simulated the effects of a fall in export price and import tariff reform on household groups' average income. Finally, using the average income of household groups and endogenously derived poverty line, incidences of poverty at head count, poverty-gap and severity levels were estimated using the Foster, Greer and Thorbecke (1984) additively decomposable class of poverty measures. This estimation was finally used to compare the extent of poverty before and after policy interventions.

Decaluwe et al. (1999) concluded that even though its development and implementation is relatively complex, the micro-simulation CGE model is more justifiable for capturing micro data and heterogeneity in its efforts to assess policy impacts on poverty and inequality. Another limitation of the CGE mode is its inability to account for a long-term growth or cumulative effective of exogenous shocks or policy interventions (Annabi et al, 2005).

The impact of eliminating all import tariffs on poverty reduction and inter and intra-household inequality was also evaluated with a micro-simulation CGE model for Nepal (Cockburn, 2002). This model used a previously developed standard CGE model and national survey data representing 3,373 households. A Log-Normal type of intra-group income distribution was assumed to analyze poverty. According to the results of this study, trade liberalization favors urban more than rural households, mainly because the latter were previously benefiting from the protection policy. While urban poverty fell, it is worsened in the rural areas. Moreover, the reform favored higher income household categories more than lower income counterparts and hence inequality was exacerbated.

A similar approach was used by Chitiga et al (2005) to study the impact of total removal of an import tariff on income distribution, poverty, and sectoral growth in Zimbabwe. By lifting tariffs, more capital and manufactured goods were imported. Exports increased and domestically produced manufactured goods declined. Outputs of domestic manufacturing decreased because the country lost price competitiveness compared to imported goods. These lose led to a high demand for unskilled labor in the primary sectors and low demand for skilled labor in the manufacturing sectors. It consequently resulted in increased wages for the former and decreased wages for the latter. From this policy, more poor people benefited than rich capital owners and skilled laborers. But the poverty level fell more in urban than rural areas since unskilled workers in the primary sectors are urban dwellers and the majority of food producing farmers are rural dwellers.

According to Fekadu (2007) there are some studies that have assessed the likely impacts of trade liberalization in the Ethiopian economy, but very few of them have addressed policy impacts on poverty and inequality. In this work, the impacts of an import tariff reduction on incidence of poverty and on the structure of domestic and export production were evaluated. The study used a micro-simulated CGE model by taking the 2001/2002 SAM and Household Income and Expenditure Survey of 1999/2000 as bench mark data sets. To consider heterogeneity, households were grouped into farm, entrepreneur, and wage household categories. When the change in import tariff was simulated in the CGE model, new prices were generated to give new consumption and income data for about 17,332 households. These new intra-group income distributions were used to determine a poverty line which was incorporated into the Foster, Greer, and Thorbecke class of additively decomposable poverty measure. The results of this study indicated that if the government implemented a 100 percent tariff removal, imports of capital goods would increase and exports of primary products would also increase. On the other hand, due to increased imports of cheap manufactured goods, the competitive position of domestic industries would decline. Hence, the study concluded that, as a result of complete tariff removal, the welfare of farm households would improve, but that of wage workers in the industrial areas would decline.

Among different household categories analyzed in this thesis, the agricultural household of the rural Ethiopia is one of the most important groups. Hence it is crucial to review some theory and empirical facts related to the agricultural household model and its application in the micro-simulated CGE model. The following review is obtained from Singh, Squire and Strauss (1986) and (de Janvry, Fafchamp and Sadoulet, 1991).

In a competitive market where farmers are price takers, the framework of an agricultural household model is operating in a separable production and consumption decision mechanism. In this model, household decision in production is explained within a profit function where the agricultural household requires information about output and factor prices. Hence household decisions are independent (separate) from consumption decisions and labor supply. But, household behavior for consumption and labor supply is dependent on production choice. For instance, with increased price of a normal agricultural good, the household would obtain higher income (from profit), and hence consumption would be increased but labor supply would decrease (due to allocation of more leisure time). This one way influence of production creates a profit effect. As explained in Singh, Squire and Strauss (1986), seven studies based on the theoretical foundation of agricultural household model and data from Korea, Nigeria, Taiwan, Malaysia, Thailand, Japan and Sierra Leon obtained mixed results. Four of the studies reported positive own-price elasticity while three of them showed negative outcome. The positive response was reported to be due to the profit effect of household production which offset the negative effect of the standard demand theory.

Separable production and consumption decision of a household, however, would disappear if there is a market failure. As discussed in de Janvry, Fafchamp and Sadoulet (1991), if the price band between sale and purchase of labor is wide; household utility gain from hiring labor is less than the disutility this market produces; hence a household would decide to use its own labor rather than hiring from the market. This is a market failure situation where there is no market wage; hence a household labor demand and supply imbalance caused by external shock is adjusted through an endogenously determined shadow labor price. With increased crop price, for instance, output volume and labor demand would increase but labor supply would decrease due to a profit effect. More consumption of labor time for leisure would create a labor demand and supply gap. In order to balance such a labor gap, the household would increase the shadow wage rate which finally causes a decline in the crop supply elasticity in response to the increased price incentive. Nonseparability of production and consumption decisions under a failed market situation is demonstrated in de Janvry, Fafchamp and Sadoulet (1991). According to this study, peasants are unresponsive to price incentives or technological changes not because they are less of utility maximizers but because selective input and/or output market failures constrain them from responding to those incentives. Consistent with this theory, simulation of a 10 percent increase in cash crop price under failed labor and output markets ended up with a decline of cash crop supply elasticity from 0.99 to 0.18.

A general equilibrium approach has also been applied in analyzing the effect of price or technological change within the agricultural household model framework. Micro-simulation of Smith and Strauss with Sierra Leon data is one of the few works cited in Singh, Squire and Strauss (1986). This study used a static and separable farm-household model with price taking behavior. Household demand in this model is estimated using Quadratic Expenditure System (QES) equation. In the production side, outputs are specified using a Constant Elasticity of Transformation (CET) function and inputs are specified using Cobb-Douglas function. The data are from cross-sectional rural household survey which divided households into low, medium, and high expenditure groups. In this study, the partial equilibrium effect of price and income on food consumption and nutrition was evaluated. As results in this study show, the share of expenditures on rice declined from low to high-income household groups whereas the opposite trend was observed in root crops, cereals, oils and fat consumption. Price elasticity of demand for all groups was negative when profit was set constant. The same measure under varying profit remained negative except for root crops and other cereals of low-expenditure groups. Overall results of this study indicate negligible nutritional benefit of increased rice price on low-income households but the larger marketed surplus of rice and the subsequent profit effect was found to significantly offset the direct impact of traditional substitution and income effects.

From the above literature review, the micro simulation CGE model appears to be the most accepted and effective method of assessing the impacts of an exogenous shock on economic growth, income distribution, and poverty reduction. More specifically, the micro-simulated CGE model has become a common technique for studying the effects of policy changes or trade shocks on poverty reduction at a heterogeneous micro level. But to the best of my knowledge, not much work has been completed to analyze the impacts of FDI inflows and subsequent growth in exports of primary commodities on rural and urban households' poverty and their multiplier effects on other sectors of the economy. There are only a few econometric studies which analyzed FDI inflow in industrial and service sectors. In these studies, changes in the economy or outputs were analyzed by introducing FDI capital as an exogenous variable along with domestic capital and labor (Ramirez, 2006; Contessi and Weinberger, 2009). Therefore, my study will extend this experiment with a micro simulation CGE approach.

The novelty of this study is the way it fills a knowledge gap that exists between export promotion of primary commodities and its subsequent contribution to economic growth and poverty reduction in Ethiopia. This study specifically concentrates on assessing household level economic impacts of policy stimulated FDI capital changes on export agriculture (with and without inclusion of the coffee industry). It is an *ex-ante* policy evaluation which will provide information to policy makers for reviewing achievements of their interventions. Furthermore, the results of this study could provide new information about the effects of trade on growth and development. Because the role of trade in economic growth is under scrutiny and the impacts of primary exports on poverty reduction are still being debated, this study will shed light on these debates.

CHAPTER 4

METHODOLOGY

This chapter constructs a quantitative CGE model that explains the economic behaviors of households, production factors and activities contained in the national SAM of Ethiopia. Specifically, it explains how factor inputs are combined in the production process, how commodities are exchanged domestically and internationally, and how households and government generate their income and pay for their expenditures. Finally Chapter 4 introduces how FDI inflows under different policy experiments can affect the economic growth and household poverty situation of Ethiopia.

The CGE model is a conceptual framework designed to explain the impact of exogenous shocks on outputs, factor payments, income and consumption of an economy. Economic behaviors of the SAM accounts are explained through a number of simultaneous and non-linear equations developed based on the theory of firms and consumers and the macroeconomics of saving, investment, fiscal and current accounts. Once the consistency of the formulated CGE model is validated through calibration, it will be used as a simulation tool to assess the impacts of exogenous interventions on output, factorial and income distribution in general and poverty reduction in particular. Before describing the theory behind the CGE model, it is important to understand the Ethiopian Social Accounting Matrix (SAM).

A) The SAM

In the Ethiopian national SAM, there are a number of accounts situated in rows and columns of a given matrix. The row of a given account contains income received from other accounts, whereas its corresponding column consists of expenditures it makes to others. Therefore, each account will have receipt and expenditure flows in its corresponding cells. Based on the double entry accounting principle, the sum of income received and expenditures paid by each account should be equal.

As a small open economy, the SAM contains all income and expenditures of different institutions (households, government, the Rest of the World (ROW)), activities, commodities, and capital account. In the production process, a household receives income from being hired or self-employed and from rent of capital allocated in agricultural and/ or non-agricultural activities. Moreover, household income accrues from transfers of household, government and the ROW. The household makes expenditure for consumption of domestic and imported agricultural and non-agricultural commodities; for transfers to other households and government direct taxes and residual savings.

Production activities receive income from selling primary and finished products to domestic and export markets. In order to produce these commodities, these activities incur costs for intermediate goods and value-added factors. Intermediate outputs are obtained from the commodity markets and the value-added factors are obtained from the households.

Commodities are outputs produced by production activities. While output markets for each activity represent producer sales at the industry or farm gate levels, output markets for each commodity represent consumer purchases after the product passes through transaction chains. Hence a commodity income account in the SAM includes receipt from purchase of intermediate goods by activities, final consumption goods purchased by households and government, other commodities payment made to cover transaction costs, and from goods reserved for investment and stock changes. Its expenditures, on the other hand, are payments made for purchase of commodities from producers, and payments made to cover transport margins, indirect taxes, import and export duties and imported commodities from the ROW.

Factors of production receipts include value-added payments (wage and capital rent) for the labor and capital services provided to the producers (activities) and net capital factor income received from abroad. And its expenditure is factors payment distributed as an income to households.

Government obtains income from direct taxes received from households and indirect taxes and trade tariffs collected from commodities. Its expenditure, conversely, represents payments made for public consumption (health, education, and social services), transfers made to households and saving.

A capital account receives income from households and government savings and balance of payment from the ROW trade. Its expenditure is commodities reserved for gross capital formation and capital stock changes.

The ROW is an account for external trade which is income from commodities and capital goods imported by the country and its expenditure is payment made to the country's export, capital factor rent, remittances to households and government and current account balance from trade.

The Ethiopian economy in this study is classified into two categories: agricultural and non-agricultural. The agricultural activity includes production of (1) food crop, (2) cash crop, (3) coffee, (4) oil seeds, (5) livestock (cattle, sheep and goat) and fish and the non-agricultural sector includes (6) minerals (which contains coal and natural gas), (7) food & beverages, (8) textiles, papers and woods, (9) leather and leather products, (10) fertilizers, chemicals, machineries and equipments, (11) service 1, (12) service 2, and (13) service 3. Corresponding to each activity variable, these are the commodities purchased by households for consumption and by activities for intermediate use.

For convenience of this study, some activities were put in aggregate forms. The food crop activity, for instance, included production of 'Teff'[6], wheat, maize, barley, sorghum, pulses and 'enset'[7]. In the industry sector, food & beverage activity comprised processed and manufactured meat, vegetables, dairy products, sugar, tobacco, beverages, teas and flour grains. In the service sector, service 1 combined utility services like electricity, water, constructions; whereas service 2 included distributive services such as hotels, transport & communication and financial services; and service 3 incorporated public services like education, health and social works.

The data of other activities, conversely, were presented in disaggregated form; hence depending on their importance for this study, they were organized as separate accounts in the SAM. In line with the objective of this study, for example, coffee activity is set as a separate account. On the contrary, data like flower activity, which is essential for this study, was not available as a separate commodity, hence it was aggregated within cash crop activity including vegetables, fruits, 'Kat", cotton, sugar canes and tea.

The fertilizer, chemical and equipment account is also a highly aggregated variable. This variable when analyzed from the consumption side included data related to manufactured household cleaning staffs such as laundry soaps, detergents, body wash soaps and fluids, floor waxes, household and office appliances such as furniture, refrigerators, cooling and heating appliances. In the production side, this variable included the above listed consumption data plus intermediate inputs such as fertilizers, pesticides, machinery and equipments.

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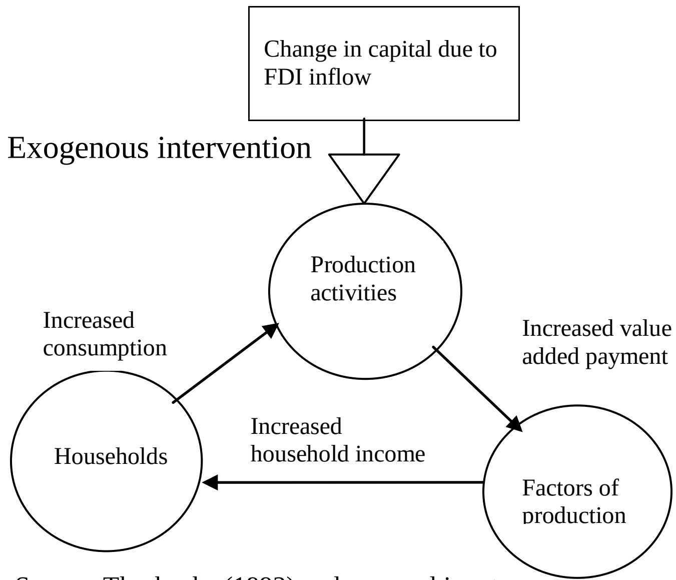
[6] 'Teff' is a staple cereal crop growing only in Ethiopia. It is widely used to make spongy bread called "Injera".
[7] 'enset' is the most important root crop in Ethiopia which is a traditional staple food for southern and southwestern part of the country. It resembles local banana plant.

Primary factors used by the agricultural activities are (1) skilled labor, (2) unskilled labor, and (3) composite capital (include land and farm tools) and those used by non-agricultural activities are (1) skilled labor, (2) unskilled labor, and (3) capital. According to EDRI, household income by factors and transfers in the SAM were allocated by deriving corresponding shares from the household survey (2007) of the Central Statistics Authority (CSA) and Welfare Monitoring Survey 2004/05 of the Ministry of Finance and Economic Development.

Following the CSA classification, households were categorized into (1) rural (2) small urban and (3) large urban households. In the CSA (2007) classification, people living in the capital city-Addis Ababa, the chartered city-Dire Dawa and eight regional administrative cities were grouped under large urban households. On the other hand, more than 1000 inhabitants living in one locality (district and zonal towns) and primarily engaged in non-agricultural activities were grouped as small urban households. Finally, those households dispersedly situated in rural areas and mainly engaged in agricultural activities were grouped as rural households.

Besides being a base data for the CGE model, the SAM is a framework to explain the inter-sector linkages of an economy. To this end, its accounts are divided into endogenous and exogenous variables. The exogenous accounts are those variables like government expenditures, investment-saving, ROW and capital factor which are influenced by external intervention and the endogenous accounts are those variables which are determined inside the matrix such as households, firms, labor factors and outputs. The interaction of these accounts and subsequent changes in production, factor and household income and consumption is presented in the following figure:

Figure 9: Interaction between Sam Exogenous and Endogenous Accounts



Source: Thorbecke (1992) and personal input

As demonstrated in the above figure, with economic liberalization policy reforms, FDI could flow into a country and when invested in expansion of the capital factors of the agricultural activities, it could contribute to increased output of export commodities. Increase in exports could foster domestic production activities which as a result make more value-added payments and increased use of factors of production. With increased factor payments (wages and rate of capital return), households income will increase to stimulate more domestic consumptions. Furthermore, with increased FDI inflow, technological and marketing knowledge and best management practices could be transferred to domestic firms to make them more competitive (Melese, 2007). Furthermore, with increased FDI, more capital stocks will be available for further investments. Consequently, with competitive business and increased investment, outputs production and consumption will be maximized. A stable and consistent increase in aggregate demand and supply in the long run will bring about economy wide growth.

B) The CGE model

The CGE model demonstrates the logical picture of an economy through defining the theory behind payments and expenditures made in the SAM. It contains a set of non-linear simultaneous equations developed after the behavioral definition of different accounts in the SAM. The equations also have a set of constraints that satisfy aggregate supply and demand market clearing conditions. The model used in this study is built on a framework developed by Cockburn, Decaluwe and Robichaud (2008) and Decaluwe et al (2009) for an archetype small open economy.

i. Production Behavior

Base on the structure of the SAM, outputs are reported both at the activity and commodity level. At the activity level, outputs are recorded as products for domestic sales and exports. Commodity level outputs are those domestic products recorded as being sold for households and government consumption, for investment and for trade margin expenses. Behavioral relationships of outputs in this CGE model are represented based on the above definitions.

At the top level of the production process, outputs are produced by combining complementary inputs of primary factors and intermediate outputs in fixed proportions. Hence to produce output $QX(I)$ (where I stands for a vector of activities), factors of production $VA(I)$ and intermediate input $\mathrm{TINTRM(I)}$ are combined with Leontief Production Function (LF).

$$VA(I) = v(I) * QX(I) \tag{1}$$

$$TINTMR(I) = io(I) * QX(I) \tag{2}$$

$v(I)$ is the cents worth of value-added used in producing per Ethiopian Birr worth of output $QX(I)$ at the activity level and $io(I)$ is an Input-Output coefficient in which a total intermediate goods I used to produce an output $QX(I)$. The variable $\mathrm{TINTRM(I)}$ stands for the sum of different intermediate inputs used to produce an output $QX(I)$.

Each output used in combination with other output as intermediate inputs to produce a finished output J is represented in the following equation:

$$INTRM(TR, J) = a_{IJ}(TR, J) * TINTRM(J) \tag{3}$$

Where $INTRM(TR, J)$ is a single intermediate traded good TR used by an activity J. Here a variable TR is used to represent the vector of outputs produced at commodity level. The variable $a_{IJ}(TR, J)$ is the cents worth of a traded intermediate output TR used as an input in production of one Ethiopian Birr worth of output QX at the activity level J. For mathematical convenience, the vector of activity originally represented by a symbol I as horizontal coordinate is alternatively represented by a symbol J when it is analyzed as a vertical coordinate in relation to a vector of traded commodity TR . The value of $v(I)$ and a_{IJ} are constants derived from average value-added and intermediate expenditure matrices of the SAM. Producers combine VA and $TINTRM$ based on the assumption of separability in production in which firms choose an optimal mix of primary factors and intermediate outputs in fixed proportions and independent of their relative prices (Hertel 1997, Dervis, De Melo and Robinson, 1982). For example, we do not combine more than a certain volume of fertilizer and improved seeds to produce a bushel of wheat. Likewise we do not increase more fertilizer or chemicals and decrease improved seeds depending on the decrease and increase of their respective prices, respectively.

As a small open economy, each producer (represented as an activity in the SAM) is assumed to operate in a competitive environment. Hence, each activity maximizes profit subject to available production technology constraints with given prices of outputs and inputs. At the next lower level of production, primary factors of composite labor LLD and capital KKD in agricultural activity; and composite labor LD and capital KD in non agricultural activities are combined in a constant elasticity of substitution (CES) technology:

$$VA_{agr} = A_{agr}^{kkl}[\alpha_{agr}^{kkl} LLD_{agr}^{-\rho^{agr}} + (1-\alpha_{agr}^{kkl}) KKD_{agr}^{-\rho^{kkl}}]^{-1/\rho_{agr}^{kkl}} \quad (4)$$

$$VA_{nagr} = A_{nagr}^{kl}[\alpha_{nagr}^{kl} LD_{nagr}^{-\rho^{kl}} + (1-\alpha_{nagr}^{kl}) KKD_{nagr}^{-\rho^{kl}}]^{-1/\rho_{nagr}^{kl}} \quad (5)$$

Where α_{agr}^{kkl} and α_{nagr}^{kl} are the share parameters for CES between labor and capital in AGR and NAGR activities, A_{agr}^{kkl} and A_{nagr}^{kl} are scale parameters, and ρ_{agr}^{kkl} and ρ_{nagr}^{kl} are substitution parameters between capital and labor in agricultural and non-agriculture sectors. Superscripts kkl and kl represent substitution between AGR capital and labor and NAGR capital and labor respectively. The substitution parameter is derived from the the elasticity of substitution parameter $\sigma_I = \dfrac{1}{\rho_I + 1}$ with a given value between 0 and infinity. The CES technology is chosen in this model because it accommodates flexibility depending on the value of elasticity of substitution parameters $\rho_i = \dfrac{1-\sigma_i}{\sigma_i}$ used during substitution. For instance, when σ_i is equal to infinity, we have a linear (perfect substitute) function; when σ_i is equal to zero, a Leontief (perfect complement) technology is used and when σ_i is between the two extreme cases, the production function takes the CES functional form. The Cobb Douglas function is a special case of CES when the value of σ_i is equal to 1.

The first order condition of minimized producers' inputs cost $wa * LLD_{agr} + ra_{agr} * KKD$ (where ra_{agr} and r_{nagr} are rates of return to agricultural and non-agricultural capitals respectively) subject to equation 4 and 5:

$$\frac{\partial VA_{agr}}{\partial LLD_{agr}} = A^{kkl}_{agr}\left[\alpha^{kkl}_{agr} LLD_{agr}^{-\rho^{agr}} + (1-\alpha^{kkl}_{agr}) KKD_{agr}^{-\rho^{kkl}}\right]^{\frac{-1}{\rho^{kkl}_{agr}}-1}\left(\alpha^{kkl}_{agr} LLD_{agr}^{-\rho^{kkl}-1}\right) \qquad (6)$$

and,

$$\frac{\partial VA_{agr}}{\partial KKD_{agr}} = A^{kkl}_{agr}\left[\alpha^{kkl}_{agr} LLD_{agr}^{-\rho^{agr}} + (1-\alpha^{kkl}_{agr}) KKD_{agr}^{-\rho^{kkl}}\right]^{\frac{-1}{\rho^{kkl}_{agr}}-1}\left((1-\alpha^{kkl}_{agr}) KKD_{agr}^{-\rho^{kkl}-1}\right), \qquad (7)$$

plus equality of equation 6 and 7 with factor prices,

$$\frac{\partial VA_{agr}}{\partial LLD_{agr}} = wa \qquad (8)$$

and,

$$\frac{\partial VA_{agr}}{\partial KKD_{agr}} = ra_{agr} \qquad (9)$$

and,

Setting equality between the ratio of the first order derivatives in equation 6 and 7 and the ratio of agricultural labor and capital of equation 8 and 9; and doing some arithmetic rearrangements, the following labor demand LLD equation is derived:

$$LLD_{agr} = \left[\frac{\alpha^{kkl}_{agr}}{1-\alpha^{kkl}_{agr}}\right]^{\sigma^{kkl}_{agr}} \left[\frac{ra_{agr}}{wa}\right]^{\sigma^{kkl}_{agr}} KKD \qquad (10)$$

Following the same procedure as above, the demand equation LD for non-agricultural labor is derived:

$$LD_{nagr} = \left[\frac{\alpha_{nagr}^{kl}}{1-\alpha_{nagr}^{kl}}\right]^{\sigma_{agr}^{kkl}} \left[\frac{r_{nagr}}{w}\right]^{\sigma_{agr}^{kkl}} KD \qquad (11)$$

Capital is assumed to be sector specific hence ra_{agr} and r_{nagr} vary from one activity to another. As capital is activity specific, it cannot be reallocated from one activity to another. Conversely, labor is assumed to be mobile from one activity to another hence variation in wa and w is uniform. Under this assumption, labor could be reallocated from one activity to another with an endogenous change of its rate.

In the original SAM, the data for land was obtained within composite capital (including draft animals and farm tools) hence it could not be programmed as a separate capital account. But composite labor, which is available in the original SAM as skilled and unskilled labor, is programmed to be combined with CES technology for both agricultural and non agricultural activities (equation 12 and 13):

$$LLD_{agr} = A_{agr}^{LL}[\alpha_{agr}^{LL} LLQ_{agr}^{-\rho^{LL}} + (1-\alpha_{agr}^{LL}) LLNQ_{agr}^{-\rho^{LL}}]^{-1/\rho_{agr}^{LLl}} \qquad (12)$$

$$LD_{nagr} = A_{nagr}^{L}[\alpha_{nagr}^{L} LQ_{nagr}^{-\rho^{L}} + (1-\alpha_{nagr}^{L}) LNQ_{nagr}^{-\rho^{L}}]^{-1/\rho_{nagr}^{L}} \qquad (13)$$

LLQ and $LLNQ$ respectively are skilled and non-skilled labor of agricultural activities, LNQ and LQ respectively are non-skilled and skilled labor of non-agricultural activities,

A_{agr}^{LL} and A_{nagr}^{L} are scale parameters, α_{agr}^{LL} and α_{nagr}^{L} are share parameters and ρ^{LL} and ρ^{L} are substitution parameters for both categories of labor in each sector.

Following similar procedures as depicted from equation 6 to 9, the first order condition of input cost minimization with technology constraints of equation 12 and 13 provided the following demand equations of skilled and unskilled labor :

$$LLQ_{agr} = \left[\frac{\alpha_{agr}^{LL}}{1-\alpha_{agr}^{LL}}\right]^{\sigma_{agr}^{LL}} \left[\frac{wnq1}{wq1}\right]^{\sigma_{agr}^{LL}} LLQ_{agr} \qquad (14)$$

$$LQ_{nagr} = \left[\frac{\alpha^L_{nagr}}{1-\alpha^L_{nagr}} \right]^{\sigma^L_{Nagr}} \left[\frac{wnq2}{wq2} \right]^{\sigma^L_{Nagr}} LNQ_{nagr} \tag{15}$$

Where $wnq1$ and $wq1$ are uniform wages for non-skilled and skilled agricultural labor. Variables $wnq2$ and $wq2$ are non-skilled and skilled uniform wage rates for non-agricultural labors. The elasticity of substitution at all levels of aggregation in the above equations indicates the ability of producers to mix primary factors in response to their relative prices (Hertel, 1997).

ii. Household Behavior

Income

Household income in the economy is generated from factor payments, transfers from households, government and the ROW. Hence:

$$YH(H) = YHL(H) + YHK(H) + TRH(H) + TRG(H) + TRROW(H) \tag{16}$$

$YH(H)$ is household total income, $YHL(H)$ is income from labor, $YHK(H)$ is income from capital, $TRH(H)$ is transfer from other households, $TRG(H)$ is transfer from the government and $TRROW(H)$ is transfer from the ROW. Income from labor includes wage income received from four types of labor in the economy:

$$\begin{aligned} YHL(H) = {} & flab1(H) * wa * \sum_{AGR} LLD(AGR) + flab2(H) * wa * \sum_{AGR} LLD(AGR) \\ & flab3(H) * w * \sum_{NAGR} LD(NAGR) + flab4(H) * w * \sum_{NAGR} LD(NAGR) \end{aligned} \tag{17}$$

$flab1(H)$ and $flab2(H)$ are the shares of each household income from unskilled and skilled agricultural labor income and $flab3(H)$ and $flab4(H)$ are shares of each household income from non-agricultural unskilled and skilled labor income. Income from capital is the sum received from agricultural and non-agricultural capitals:

$$\begin{aligned} YHK(H) = {} & \lambda_{ra}(H) * \sum_{AGR} ra(AGR) * KKD(AGR) \\ & + \lambda_r(H) * (\sum_{NAGR} KD(NAGR) * r(NAGR) + KDROW) \end{aligned} \tag{18}$$

$\lambda_{ra}(H)$ and $\lambda_r(H)$ are the shares of income each household gets from the total agricultural and non agricultural capital incomes. $KDROW$ is the capital demand from the rest of the world.

In the model, government is the other institution which receives income YG. Government receives income from households' direct taxes, indirect taxes from domestic commodity sales and import tariffs. In addition, the government generates income from the ROW in the form of financial aid and loans:

$$YG = \sum_{TR} INDTAX(TR) + \sum_{H} DIRTAX(H) + \sum_{TR} IMDUTY(TR) + TRROWG * e \qquad (19)$$

where, $INDTAX(TR)$ is an indirect tax paid by each traded commodity, $DIRTAX(TR)$ is the direct tax each household is paying from its total income $YH(H)$, $IMDUTY(TR)$ is an import duty paid by each imported commodity, and $TRROWG$ is an aggregate transfer from the ROW to the government.

Government income, on the other hand, is allocated to expenditures for public consumption $G(TR)$, aggregate imports from ROW and to household transfers:

$$GOV = G(TR) * PC(TR) + GMROW + \sum_{H} TRG(H) * PINDEX \qquad (20)$$

$GMROW$ is government aggregate imports from the ROW, $TRG(H)$ is government transfers to households, $PINDEX$ is a price index and $PC(TR)$ is the composite commodity TR price.

Demand

In this model, there are three household groups. These groups are (1) rural, (2) small urban and (3) large urban households. In these categories households are involved in different economic activities. Rural people are largely involved with agricultural activities whereas urban people are mostly involved in industrial and service economic activities. The livelihood of small urban households, on the other hand, depends on both agricultural and non-agricultural activities. Under such classification, each household group is living with a different income level and hence assumed to have different minimum consumption requirements. With different minimum requirements, consumption demand for each household is derived from maximizing the Stone-Geary Utility function $\prod_{TR} \left(CONSMK(H,TR) - CMIN(H,TR) \right)^{\alpha(H,TR)}$ with a budget constraint of $\sum_{TR} PC(TR) * CONSMK(H,TR)$ to arrive at the following Linear Expenditure System (LES) equation:

$CONSMK(H,TR) = CMIN(H,TR)$

$$+\frac{\gamma(H,TR)*(YHD_h-\sum_i CMIN(H,TR)*PC(TR))}{PC(TR)} \qquad (21)$$

$CONSMK(H,TR)$ is demand for consumption of good TR by each household H and $CMIN(H,TR)$ is the minimum good requirements or subsistence expenditure of TR goods committed by household H; $YHD(H)$ is household disposal income, $\gamma(H,TR)$ is household H marginal budget share for consumption of commodity TR above the subsistence level $(YHD_h-\sum_i CMIN(H,TR)*PC(TR))$. Consumption above the subsistence level is also called discretionary income. If a household does not have discretionary income, the second term of equation (21) will be zero so that the household will consume only its minimum requirement. Hence, each household has its own minimum basket of good requirements depending on its standard of living.

The marginal budget share in the model is estimated using the base year data of composite price, $TCONSHO(H)$ and the elasticity of income $YELAS(H,TR)$ for commodity TR:

$$\gamma(H,TR)=\frac{PCO(TR)*CONSMKO(H,TR)*YELAS(H,TR)}{TCONSHO(H)} \qquad (22)$$

$TCONSHO(H)$ is the base year total household consumption which is the difference of household saving from its disposable income and $CONSMKO(H,TR)$ is the household consumption at the base period.

The minimum good requirement $CMIN(H,TR)$ is a parameter that is estimated for each household member in the sample. Following Dervis, De Melo and Robinson (1982), the value of the minimum subsistence consumption $V\_MIN(H,TR)$ is estimated using the following equation:

$$V\_MIN(H,TR)=\left(\sum_{TR} CONSMK(H,TR)*PC(TR)\right)\left(1+\frac{1}{\phi}\right) \qquad (23)$$

The Frisch parameter ϕ is a constant value which measures the elasticity of marginal utility of income. Therefore, the minimum consumption requirement in volume term is estimated as:

$$C\_MIN(H,TR) = CONSMKO(H,TR) - \gamma(H,TR) * \left[\frac{TCONSHO(H) - V\_MIN(H)}{PCO(TR)} \right] \quad (24)$$

iii. Other Demand

At each activity level, domestic demand $DD(TR)$ is total produced outputs $QX(TR)$ less exports $EX(TR)$. At the commodity level, besides households, outputs are domestically demanded by the government, by activities, for investments and transaction margins. Activities demand commodities for intermediate use $INTRM(TR, J)$ in their production process. Government consumption $G(TR)$ is allocated for public services such as education, health services, construction, defense, etc. Total commodities needed for investment $INV(TR)$ are the fixed capital formation FCF created after production. Margins are commodities put aside to pay transport and transaction expenses. Therefore, overall composite domestic goods are the aggregates of household and government consumption, intermediates, investments and trade margins. Activities, households and government also demand imported commodities $M(TR)$ from the ROW. Hence the total composite commodities supplied for domestic use $QQ(TR)$ is the sum of domestic $DD(TR)$ and imported $M(TR)$ demand.

iv. Prices

In a competitive market, both activities and institutions are price takers. Markets for goods and factors are assumed to respond to changing demand and supply conditions which in turn are affected by government policies and external shocks. Hence in a general equilibrium condition, these prices are endogenously determined from the simulation. On the other hand, due to the small country assumption, the world price of imports $PWM(TR)$ and exports $PWE(TR)$ are exogenously determined. Domestic prices of imports $PM(TR)$ and exports $PE(TR)$ are derived through conversion with exchange rate e and tariff rates:

$$\mathrm{PM(TR)} = (1 + \mathrm{tm(TR)}) * \mathrm{e} * \mathrm{PWM(TR)} \quad (25)$$

$$\mathrm{PE(TR)} = \mathrm{PWE(TR)} * \mathrm{e}/(1 + \mathrm{te(TR)}) \quad (26)$$

Where $tm(TR)$ and $te(TR)$ are import and export tariff rates and e is foreign currency exchange rate. To encourage exports, the government has fixed the export tax rate close to zero.
With $PL(TR)$ as an output price excluding tax, the domestic price $PD(TR)$ is:

$$PD(TR) = PL(TR)*(1+tax(TR)) \qquad (27)$$

Here $tax(TR)$ is a rate derived from a ratio of the base year indirect tax and composite demand of a commodity as follows:

$$tax(TR) = \frac{INDTAXO(TR)}{DDO(TR)+MO(TR)+IMDUTYO(TR)} \qquad (28)$$

All the prices and price indexes in this model are relative prices generated by weighting the value of aggregates with the sum of their components (Decaluwe et al, 2009). Producer price of each traded commodities $P(TR)$, for instance, is the ratio of the sum of the value of domestic and export commodities over total output value:

$$P(TR) = \frac{PL(TR)*DD(TR)+PE(TR)*EX(TR)}{QX(TR)} \qquad (29)$$

The composite price $PC(TR)$ is also the ratio of the sum of the value of domestic and imported commodities over total composite goods:

$$PC(TR) = \frac{PL(TR)*DD(TR)+PM(TR)*M(TR)}{QQ(TR)} \qquad (30)$$

The total value added $VA(I)$ has its own price which is endogenously determined from the ratio of the difference of the value of outputs and intermediates weighted over its total value of the VA(I):

$$PV(I) = \frac{P(I)*QX(I)-\sum_{TR} INTRM(TR,I)*PC(TR)}{VA(I)} \qquad (31)$$

The values of wages and capital are determined in the same manner as above. Wage rates of both activities, for instance, are derived from the ratio of the sum of their respective skilled and unskilled labor values over their total values:

$$wa = \frac{\sum_{AGR}(wnq1*LLNQ(AGR)+wq1*LLQ(AGR))}{LLD(AGR)} \qquad (32)$$

$$\text{w} = \frac{\sum_{NAGR}(wnq2 * LNQ(NAGR) + wq2 * LQ(NAGR))}{\text{LD(NAGR)}} \quad (33)$$

Where $wnq1, wq1, wnq2$ and $wq2$ are non qualified and qualified wage rates for agricultural and non agricultural labors respectively. These rates, at the initial model calibration stage are normalized as unitary values. Wage rates wa and w are constants over sectors, and hence, labor is mobile from one activity to the other depending on the higher rate it receives.

The rate of return to capital likewise is determined from the ratio of the difference of value added with labor cost weighted at total capital value:

$$\text{ra(AGR)} = \frac{\text{PV(AGR)} * \text{VA(AGR)} - wa * LLD(AGR)}{\text{KKD(AGR)}} \quad (34)$$

$$\text{r(NAGR)} = \frac{\text{PV(NAGR)} * \text{VA(NAGR)} - w * LD(NAGR)}{\text{KD(AGR)}} \quad (35)$$

The rate of return to agricultural capital ra(AGR) and non agricultural capital r(AGR) are fixed prices for each activity. Hence, with a specific price for each activity, capital is not flexible to be allocated from one activity to another.

Values of transfers from households and government are assessed using a producer price index $PINDEX$ derived from value added as follows:

$$\text{PINDEX} = \sum_{\text{I}} PV(I) * \delta(I) \quad (36)$$

In which $\delta(I)$ is the share of an activity I over the total value added for all activities.

v. Agricultural Household Model

Due to the scope of this thesis, an agricultural household model is not explicitly specified. The intention of this study is not to assess the impact of a price policy change on agricultural household consumption. Rather, it is designed to measure the impact of selective export promotion policies on poverty reduction of all rural and urban household categories. But as has been observed in the production and consumption equations of this study, all assumptions of agricultural household behavior under competitive market condition are implicitly incorporated.

The assumption of separability in production and consumption decision, for instance, is clearly demonstrated in equation 12, 13 and 21. As shown in the value-added equations 12 and 13, a household did not need to know its consumption demand or labor supply to decide on how much to produce. For its production choice, it only required information about output and factor prices and the technological relationship between inputs and outputs. But as equation 21 indicates, household decisions on consumption are largely dependent on income received from factor payments from production activities. Moreover, the institutions' price taking behavior assumption made in this model assumed no market failure, which is a precursor for nonseparability of production and consumption decisions such as the missing market for labor (de Janvry, Fafchamp and Sadoulet,1991).

vi. Domestic and Foreign Trade

In an open economy, aggregate domestic outputs $QX(TR)$ are traded by activities as domestic $DD(TR)$ and export $XE(TR)$ commodities with an assumption that firms maximize their revenue subject to a constant elasticity of transformation (CET) function. This is based on the Armington (1969) assumption that producers imperfectly substitute their output sales between domestic and export markets depending on the respective relative prices they received. Mathematically, this relationship is represented by the following functional form:

$$QX(TR) = B^E_{TR}[\beta^E_{TR} XE_{TR}^{\kappa^E_{TR}} + (1-\beta^E_{TR})DD_{TR}^{\kappa^E_{TR}}]^{\frac{1}{\kappa^E_{TR}}} \qquad (37)$$

Where B^E_{TR} is a scale parameter; β^E_{TR} is a share parameter and κ^E_{TR} is a CET parameter for domestic and exported goods imperfect substitution. The parameter κ^E_{TR} is derived from a given elasticity transformation parameter $\rho = 1/(\kappa - 1)$. As shown in Decaluwe et al (2009), from the minimization problem of the costs of production of domestic and export commodities, $PE(TR)*XE(TR) + PL(TR)*DD(TR)$, subject to CES technology in equation 37, the following equality condition of marginal value products with exports price is derived:

$$\frac{\partial QX(TR)}{\partial XE(TR)} = PE(TR) \qquad (38)$$

and,

$$\frac{\partial QX(TR)}{\partial DD(TR)} = PL(TR) \qquad (39)$$

The first derivatives of equation 37 with respect to $XE(TR)$ and $DD(TR)$ are:

$$\frac{\partial QX(TR)}{\partial XE(TR)} = B_{TR}^{E}(\frac{1}{\kappa_{TR}^{E}})[\beta_{TR}^{E} XE_{TR}^{\kappa_{TR}^{E}} + (1-\beta_{TR}^{E})DD_{TR}^{\kappa_{TR}^{E}}]^{\frac{1}{\kappa_{TR}^{E}}-1}$$

$$*(\kappa_{TR}^{E}\beta_{TR}^{\kappa_{TR}^{E}} XE^{\kappa_{TR}^{E}-1}) \quad (40)$$

and,

$$\frac{\partial QX(TR)}{\partial DD(TR)} = B_{TR}^{E}(\frac{1}{\kappa_{TR}^{E}})[\beta_{TR}^{E} XE_{TR}^{\kappa_{TR}^{E}} + (1-\beta_{TR}^{E})DD_{TR}^{\kappa_{TR}^{E}}]^{\frac{1}{\kappa_{TR}^{E}}-1}$$

$$*(\kappa_{TR}^{E}(1-\beta_{TR}^{\kappa_{TR}^{E}})DD^{\kappa_{TR}^{E}-1}) \quad (41)$$

Taking the ratios of the first order conditions of equation 40 and 41, setting them equal to the ratio of domestic and export prices, and doing some arithmetic rearrangements, the following exports supply equation is derived:

$$EX(TR) = \left[\frac{1-\beta_e(TR)}{\beta_e(TR)}\right]^{\kappa^E(TR)} \left[\frac{PE(TR)}{PL(TR)}\right]^{\kappa^E(TR)} DD(TR) \quad (42)$$

As $QX(TR)$ pays for factors and intermediate inputs, it also receives income through selling commodity outputs for domestic demand $DD(TR)$ and exports supply $EX(TR)$. In this equilibrium, any changes in one of the variables due to external shock will be adjusted through changes in input or output prices.

On the consumption side, composite commodities $QQ(TR)$ demand is domestically satisfied through purchases from domestic sales $DD(TR)$ and imported commodities $M(TR)$. This behavior also follows the Armington assumption that domestic consumers minimize their costs subject to imperfect substitutability of domestic and imported goods expressed by the following CES function:

$$QQ(TR) = A_{TR}^{M}[\alpha_{TR}^{M} DD_{TR}^{-\rho_{TR_i}^{M}} + (1-\alpha_{TR}^{M})M_{TR}^{-\rho_{TR}^{M}}]^{-\frac{1}{\rho_{TR}^{M}}} \quad (43)$$

Where A_{TR}^{M} is a scale parameter; α_{TR}^{M} is a share parameter and ρ_{TR}^{M} is a CES parameter for domestic and imported goods imperfect substitution. Parameter ρ_{TR}^{M} will be derived from a given elasticity transformation parameter $\sigma = 1/(\rho + 1)$ which is a constant value between 0 and infinity. With similar mathematical procedures shown from equation 38 to 41, the first order condition of minimized consumer expenditure to purchase domestic and imported commodities subject to CES equation 43, the following import demand equation is derived:

$$M(TR) = \left[\frac{\alpha_m(TR)}{1-\alpha_m(TR)}\right]^{\sigma_m(TR)} \left[\frac{PD(TR)}{PM(TR)}\right]^{\sigma_m(TR)} DD(TR) \qquad (44)$$

The CES and CET are the most widely used functional forms in analysis of international trade in the CGE model. These functions are chosen because they can entertain flexibility between Linear (perfect substitutes) and Leontief functional forms (perfect complements) depending on the extreme value of zero or infinity the elasticity of substitution parameter takes.

The Rest of the World (ROW) in the model receives income from domestic imports and Foreign Direct Investment (FDI) payments:

$$ROWY = \sum_{TR} PWM(TR) * M(TR) + HMROW + GMROW + \varphi FDI(TR) \qquad (45)$$

Where $ROWY$ is ROW income, φ is the share of income received from FDI in particular commodity, $HMROW$ is the household consumption of aggregate imports, and $GMROW$ is the consumption of aggregate imports. As an incentive to attract more investment into the country, the government has allowed the whole share of FDI income to be paid to foreign investors, hence φ in this model is assumed to be a constant value of one. The ROW, on the other hand, is paying to local institutions in the form of exports, factors payment and transfers:

$$ROWE = \sum_{TR} PWE(TR) * EX(TR) + \sum_{H} TRROW(H)$$

$$+ TRROWG + \lambda_{ROW} (\sum_{NAGR} w * KD(NAGR) + KDROW) \qquad (46)$$

Where $ROWE$ is ROW expenditure, $TRROW(H)$ is transfer payment from the ROW to each household, $TRROWG$ is the aggregate transfer from the ROW to the government in the form of relief, development aid and long term loans. $KDROW$ is an aggregate capital payment from the ROW which when summed up with KD makes up the total capital demand of the non-agricultural sector. Hence λ_{ROW} is the share of $KDROW$ over the total non agricultural capital used in the economic process. Therefore, the difference in aggregate value from ROW income and expenditure in foreign currency unit (FCU) gives us the current account balance (CAB) of the country.

$$CAB = YROW - EROW \tag{47}$$

vii. Gross Domestic Product

In order to measure the contribution of the shock to the economy and to compare the same at each industry level, Gross Domestic Product (GDP) at factor price and net final demand levels are endogenously estimated in the model. GDP at factors prices $GDPfp$ is the total payments made to all factors used in the economy:

$$GDPfp = \sum_{I} PV(I) * VA(I) \tag{48}$$

And GDP at market prices ($GDPmp$) is the GDP at factor prices plus indirect taxes and import duties paid by traded commodities:

$$GDPmp = GDPfp + \sum_{I} PC(TR) * INDTAX(TR) + \sum_{TR} PC(TR) * IMDUTY(TR) \tag{49}$$

GDP at final demand is the sum of all domestic goods consumed and invested plus the trade balance:

$$\mathrm{GDPfd} = \sum_{\mathrm{TR}} \mathrm{PC(TR)} * (\sum_{\mathrm{H}} \mathrm{CONSMK(H,TR)} + INV(TR) + DSTK(TR) + G(TR))$$

$$+ \sum_{TR} PE(TR) * EX(TR) - \sum_{TR} PM(TR) * M(TR) \tag{50}$$

$DSTK(TR)$ is change in capital stock.

viii. Welfare Analysis

Welfare effects of interventions at the macro level are evaluated by estimating Equivalent Variation (EV). According to Robichaud (2001), EV is derived from the money metric of the indirect utility function. When the LES of equation 22 is used in the Stone-Geary Utility function $\prod_{TR} \left(CONSMK(H,TR) - CMIN(H,TR)\right)^{\gamma(H,TR)}$, the following indirect utility function V^{LES} is obtained:

$$V^{LES}(PC,YH) = \left[YH(H) - \sum_{TR} CMIN(TR)PC(TR) \right] \prod_{TR} \frac{\gamma(TR)}{PC(TR)}. \tag{51}$$

Solving equation 51 for $YH(H)$ gives use the money metric indirect utility function which is the amount of income household H needs to attain utility V at composite price level $PC(TR)$:

$$m^{LES}(PC,V) = \prod_{TR} \left[\frac{PC(TR)}{\gamma(TR)} \right]^{\gamma(TR)} V + \sum_{TR} PC(TR) * CMIN(TR) \tag{52}$$

EV measures the changes in utility of a household as a result of changes in commodity prices and income due to increased agricultural exports production caused by FDI injection in the economy. If $YHO(H)$ and $PCO(TR)$ are household income and composite prices before external shock, whereas $YH(H)$ and $PC(TR)$ are household optimum incomes and composite price after the simulation, EV is therefore:

$$EV = m^{LES} \left(PCO(TR), V^{LES}(PC(TR), YH(H)) \right) - YHO(H) \tag{53}$$

Which when equation 51 and 52 are replaced into equation 53 yields:

$$EV(H) = YH(H) * \prod_{TR} \left[\frac{PCO(TR)}{PC(TR)} \right]^{\gamma(TR)} - YHO(H) \tag{54}$$

The household utility will gain both from an income effect (IE) and substitution effect (SE) with increased income and decrease in composite price. But the gain will be limited to the IE if composite price is still increasing while income is increased.

ix. Equilibrium, Exogenous variables and Closures

In order to ensure supply and demand equilibrium at market clearing condition, macroeconomic closures are specified in the model. There are six equilibrium conditions defined in this model. They are: (1) domestic composite goods balances, (2) labor demand and supply balance, (3) Fiscal account balance, (4) saving-investment balance, (5) Current account balance (CAB) and (6) GDP balance.

Traded composite goods supplied at the commodity level should be at equilibrium with the amount consumed by households, government, intermediates, investments and trade margins. Equilibrating variables in this equation are composite prices:

$$\mathrm{QQ(TR)} = \sum_{\mathrm{H}} \mathrm{CONSMK(H,TR)} + \mathrm{G(TR)} + \mathrm{TMARGIN(TR)}$$

$$+ \text{ INTRMD(TR)} + \text{INV(TR)} + \text{DSTK(TR)} \quad (55)$$

Agricultural and non agricultural labors are assumed to relocate within each activity depending on wage rate changes. Hence the aggregate supply of agricultural and non agricultural labor LLS and LS are fixed variables that will be balanced with the aggregate sum of labor demand in each sector:

$$LLS = \sum_{AGR} wa * LLD(AGR) \quad (56)$$

$$LS = \sum_{NAGR} w * LD(NAGR) \quad (57)$$

The government saving SG is the difference between government revenue GY and government expenditures GE. Saving is a flexible residual which depends on flexible government income and fixed public expenditures and transfers to households. Flexible government income is adjusted through the fixed rate of saving.

In this model the current account balance CAB is a net capital received from imports, exports and transfers from ROW to household and government in FCU. In the base period, transfer from the ROW in the form of FDI is assumed to be zero. The model assumes that FDI inflow, particularly for flower and other cash crop farms increases over time through government selective policy interventions. Due to a small country assumption, demand for exports and supply for imports are flexible depending on fixed world prices. Hence under fixed world prices, exogenous change in exchange rate (e) is the equilibrating variable to achieve at least a positive CAB. For example, if a country faces a negative CAB, devaluation of the e can encourage more exports and discourage more imports hence attaining a positive current account balance.

Under saving-investment balance, total investment volume is equal to the aggregate of household and government savings and current account balances.

$$\text{TINV} = \sum_{\text{H}} \text{SH(H)} + \text{SG} + \text{CAB} * \text{e} \quad (58)$$

This model adopts savings driven “neoclassical closure” rule, explained in Lofgren et al (2002), in which fixed investment (fixed capital formation) is balanced through adjusting private, government, and foreign savings. Private and government savings are adjusted through fixed capital formation and fixed Marginal Propensity to Save (MPS) of private institutions. Foreign saving are assumed to be adjusted through a changing exchange rate (e) regime,

Except that GDP at market price is analyzed at activity level and GDP at final demand is computed at commodity level, both value should be balanced:

$$GDP_{MP} = GDP_{FD} \quad (59)$$

x. Other Closures

Being a small country, both world price of exports (Pwe) and imports (Pwe) are exogenous to the model. CAB, FDI and exchange rate e are also exogenous to the model. Moreover, government consumption and transfer payments to households are exogenous. This study assumes that unskilled labors in coffee and food crop activities are under- employed. For instance, in the coffee industry, there are millions of farmers who are working on their subsistence farms with traditional technologies. With increased investment in this or other sector, many of these under-employed farmers could be absorbed to obtain higher income than they are getting from their traditional farms. Hence labor supply for these activities is not fully employed. But full resource employment assumption is applied to other agricultural sectors. Land and industrial capital are fixed and exogenous to the model. The effect of FDI inflow in the economy is evaluated by introducing it as an exogenous capital endowment. The conceptual flow of the CGE model explained above from production to consumption is presented in Annex I.

CHAPTER 5

DATA AND PROCEDURES

This chapter introduces different data used in the study. Three types of data sets were used in this study namely the national SAM, Households Income and Expenditure Sample Survey (HIES) data and behavioral parameters. This chapter also demonstrates the procedures and methods followed to organize the data sets and use them for calibration and simulation experiments.

A) The SAM Data

The 2006 SAM data set of Ethiopia is obtained from Ethiopian Development Research Institute (EDRI). The original data consisted of 253X253 accounts out of which 98 were activities, 69 marketed commodities, 25 home commodities, one trade margin, four labor accounts, 20 land-capital accounts, one non-agricultural capital, one government, ten rural household accounts, four small and large urban households, eight indirect tax, 14 direct and indirect taxes, one stock changes, one saving and investment and one ROW account. Such a large SAM is created by EDRI to explain social-economic interactions at five agro-ecological zones of the country.

Since this study is specifically interested in exports of primary commodities, household incomes and expenditures at rural and urban categories, labor and capital factors used in production process and aggregate government income from taxes and tariffs, many of the accounts are not necessary in their original form. To meet the objective of this study, therefore, the original SAM was aggregated into 44 accounts, of which 13 are activities, 13 commodities, one trade margin, four labor accounts, two capital accounts, one government, three household groups, four tax and tariff accounts, one investment and saving, one capital stock change and one ROW account. Activities, commodities and their corresponding value added shares, export intensity and import penetration rate of an adjusted and balanced SAM are presented in Annex II.

According to this table, cash crop and livestock activities use about 17 and 24 percent of the total value added, whereas coffee and food crops share 12 and 13 percent of the value-added. With respect to export share, coffee takes a larger share (37 percent) followed by cash crops (26 percent) and livestock (20 percent).

In the non-agricultural sector, service 2 takes about 11 percent of the total value-added followed by service 3 (8 percent) and service1 (6 percent).With regard to exports, distributive service, especially transport and communication (three percent) is the most important. Import penetration rates of fertilizers, oils, machinery and equipment in the domestic market is the highest (88 percent), followed by textile, wood and paper production (70 percent) and food and beverage industries (25 percent). Export intensity of oil seed is the highest (60 percent) followed by coffee (54 percent) and cash crops (28 percent).

B) The Household Data set

The second data set used in this study is the 2004/05 the Household Income and Expenditure Survey (HIES) data. This data was obtained from the Ethiopian Central Statistics Authority (CSA) Office. The survey data contains income and expenditure information of 21,600 household samples selected from all regions of the country at the district, zone, region and national level. It was organized into two sets: (1) demographic and (2) economic. In the demographic data set, household demographic characteristics such as age, sex, family heads and nationalities were grouped. In the economic data set, employment type classified as self-employed, wage workers or family workers were recorded, and source of expenditures were categorized into agricultural enterprises, non-agricultural enterprises, wage and salaries, and remittances. Moreover the economic data contained thousands of agricultural and non-agricultural commodities consumed by the sample in the year under review. From this large pool of information, important data related to household consumption and incomes were extracted. Out of 21,600 household samples in the data set, 17,761 observations consistent with the 2006 SAM were selected for the analysis. Household data which did not have information about the sources of income and expenditures information, for instance, are excluded for this study.

In this dataset, household expenditures included all payments made for both agricultural and non-agricultural commodities. They comprised consumption of own and purchased goods from agriculture, industry and service sectors. The corresponding income for consumption of these commodities was derived from the sources of expenditure information recorded in the survey. The samples of questionnaires used to collect information about the sources of expenditures are presented in Annex III. According to this survey, about 15 sources of expenditures were identified, among which income from agricultural enterprise, non-agricultural enterprise, wages and salaries, house rent, remittance and transfers from households, government, and the ROW were the major ones. Aggregation of the household income in the above listed income categories corresponds to a similar endowment allocated in the SAM. The only income source which did not map from the SAM was house rent. House constructed for rent is a fixed asset, hence in this study it was aggregated within the non-agricultural capital category.

In the survey, an enterprise was defined as an economic entity run by the household to produce agricultural and non-agricultural commodities for own consumption and market sales. Economic enterprises used to produce crops and livestock are land, draft animals and agricultural tools, which in this study were categorized into aggregate agricultural capital. On the other hand, non-agricultural enterprises are machineries and equipment used to produce industrial goods and services, which in this study are categorized as non-agricultural capital.

Based on this data, households are grouped into rural, small urban and large urban households. Rural households are making their income largely from agricultural activities. As they are predominantly small holder farmers, the major capital they use is a composite of land and livestock. In this group there are also households involved in non- agricultural activities. Some of them are involved in off-farm activities such as blacksmith, wholesale and retail trades, and others are government employed teachers, agricultural experts and medical doctors. Hence, these households make their income from non-agricultural capital and labor.

Households in small urban categories receive their income from being employed in non-agricultural activities and from owning non-agricultural capital. As small urban areas are very close to rural areas, there are some households in this category that own agricultural capital and are employed on farms. Likewise, for large urban households, the major source of income is non-agricultural labor and owning of non-agricultural firms. But since there are agricultural activities (especially horticulture and livestock farms) in the town areas, household earning from this sector is also common.

Demographic description of household income data by the sample weight is presented in Table 2:

Table 2: Income and Demographic Characteristics of Households

Household group	Sample	Mean(Birr)	Min	Max	% below poverty[8]
Rural	8733	1606.47	36.31	18839.5	38.5
Small Urban	3584	2016.01	97.19	67851.3	38.6
Large urban	5444	2399.12	118.65	81095.4	34.3

As can been seen in the above table, the mean income of rural and large urban household is about 1600.00 and 2399.00 Ethiopian Birr respectively. The sizeable range of income variation in each category indicates the presence of a high level of inter-household income variance within the group. Many people in all groups are living below poverty line, but the incidence of poverty is higher in rural and small urban areas.

The distribution of income for household groups by source, as presented in Table 3, is related to their geographic locations and types of economic activities they are involved in. For rural households, which are predominantly involved in agricultural activities, more than 76 percent of their income comes from agricultural capital source (which largely includes land and draft animals) and 12 percent from non-agricultural capital source. Transfers from households represent about 8 percent of the group's income. Only 4 percent of the income comes from wages. For large urban households, more than 56 percent of the income is received from employment and 29 percent from non-agricultural capital. In small urban areas, wage and non-agricultural capital represent the largest proportion of household income. While a higher government and ROW transfer goes to the large urban households, rural households receive the highest household transfers.

[8] According to Decaluwe et al (1999) the poverty line (Z) is defined in Ravllion (1994) as a basket of basic commodities needed by an individual to fulfill his food and non-food requirements.

Table 3: Factorial Source of Household Income

Household Group	KKD	KD	TRG	TRROW	TRH	Wage
Rural HH*	0.76	0.12	0.00	0.06	0.01	0.04
Small Urban	0.09	0.50	0.01	0.05	0.01	0.34
Large urban	0.02	0.29	0.01	0.10	0.01	0.57
All households	0.63	0.18	0.01	0.07	0.01	0.11

Variable (KKD) is agricultural capital; (KD) is non - agricultural capital; (TRG) is government transfers to households; (TRROW) is transfer from the rest of the world to households and (TRH) is transfers between households.
*The horizontal share values of each household group are summed up to a rounded value of 1.

The source of income by employment is further disaggregated by skill-type in the following table:

Table 4: Household Wage Income by Skill Differences

	LLNQ	LLQ	LNQ	LQ
Rural	0.57	0.00	0.14	0.29
Small urban	0.03	0.01	0.31	0.64
Large urban	0.00	0.00	0.36	0.63

Variable (LLNQ) is non-qualified agricultural labor; (LLQ) is qualified agricultural labor; (LNQ) is non-qualified non -agricultural labor and (LQ) is qualified non agricultural labor.

As we can observe in the above table, more than 63 percent of wages for small and large urban households is obtained from skilled non-agricultural labor (LQ) and above 31 percent of wages are obtained from unskilled non-agricultural labor (LNQ). About 57 percent of rural households' wages come from unskilled agricultural labor (LLNQ) and about 29 percent from skilled non-agricultural labor (LQ). Higher non-agricultural wage income in the rural households is remuneration paid to government employed doctors, teachers, agricultural experts and technical workers in private businesses in the rural areas.

In the following two tables, the share of primary factors in value added of each activity of the SAM is presented:

Table 5: Share of Primary Factors in Agricultural Value Added

	foodcrp	cashcrp	coff	oils	livfshfor
LLNQ	0.25	0.26	0.08	0.08	0.33
LLQ	0.22	0.23	0.14	0.14	0.27
KKD	0.19	0.25	0.18	0.05	0.34

Variable (foodcrp) is food crop; (cashcrp) is cash crop; (coff) is coffee, (oils) is oilseed and (livfshfor) is livestock, fish and forest.

Table 5 shows that about 84 percent of unskilled and 73 percent of skilled labors are used in the food, cash crop, and livestock activities, and only 16 percent unskilled and 27 percent skilled labor shares are in the coffee and oil seed industries. The capital factor share is also high in livestock (34 percent) and cash crop (25 percent) activities than coffee (18 percent) and oil seed production (5 percent). Labor (skilled and unskilled) and capital, therefore, are more intensively used in the cash and livestock production enterprises than in coffee and oil agriculture. Such a low value added share of the coffee sector while there is excess labor force engaged in traditional farming practices strengthens the argument that there is resource under employment.

Table 6: Share of Primary Factors in Non-Agricultural Value Added

	mining	foodbev	txwdpp	leath	fertchemceq	serv1	serv2	serv3
LNQ	0.02	0.08	0.03	0.00	0.04	0.45	0.03	0.36
LQ	0.01	0.07	0.09	0.01	0.05	0.13	0.25	0.40
KD	0.01	0.05	0.02	0.01	0.03	0.19	0.48	0.21

Variable (mining) is mineral and quarrying, (foodbev) is food and beverage; (txtwdpp) is textile, wood and wood; (leath) is leather and leather products; (fertchemceq) is fertilizer, chemical, petroleum, machine and equipments; (serv1) is service 1; (serv2) is service 2 and (serv3) is service 3.

According to table 6, industrial activities use about 17 percent of unskilled labor, 23 percent of skilled labor, and less than 8 percent of total capital. The majority of the value-added in non-agricultural categories are used in distribution, utility and social service activities. From this information one can see the limited industrialization of the Ethiopian economy.

By studying tables 4 and 5, one can deduce that most of the trade and export promotion policies (discussed in section C and D of Chapter I) introduced in the country to date have benefitted only those rural households employed in the cash crop activities and those urban households employed in the service sectors (mostly hotels and restaurants). The very low share of employed labor and capital in the coffee industry shows the extent in which it is predominantly operating under subsistence agricultural practices. This data is consistent with Oxfam (2002) report that ninety five percent of the country's coffees are produced by small holder farmers who cultivate on less than 0.5 hectares of land. These farmers are living below the one dollar a day income level which is not even enough to feed them let alone investing on increased productivity. Therefore, had the existing coffee sector been transformed from subsistence to commercial farming practices, millions of people depended on this industry would have a larger share of value added in the economy. More coffee-dependent families would have owned capital assets and been employed as unskilled and skilled labor forces. Transformation of the existing coffee operation would have generated surplus current account balance that could be used to expand the industry sector.

C) Behavioral parameters

The third major data set contained behavioral parameters and constants to be used in calibrating and simulating of the CGE model. These constants are shares of value-added, I-O coefficients and share parameters, scale parameters and elasticities of substitution parameters used in the CES equations of factors and outputs. The shares of value added $v(I)$ in total output and I-O coefficients $io(I)$ and a_{IJ} were derived from dividing each value-added and intermediate product by their respective total values in the SAM. Constant elasticity of substitution parameters (ρ_{agr}^{kkl}, ρ_{nagr}^{kkl}, ρ_{agr}^{LLl}, ρ_{nagr}^{Ll}, κ_{TR}^{E} and ρ_{TR}^{M}), share parameters (α_{agr}^{kkl} , α_{nagr}^{kkl}, α_{agr}^{LLl}, α_{nagr}^{LLl}, β_{TR}^{E} and α_{TR}^{M}) and scale parameters ($A_{agr}^{kkl}, A_{nagr}^{kkl}, A_{agr}^{LL}, A_{nagr}^{L}, B_{TR}^{E}$ and A_{TR}^{M}) were derived through model calibration. Tax rates were also estimated during the calibration process. The model calibration was initialized by introducing a given value of free parameters for substitution between capital and labor factors and that of domestic and traded commodities. Due to limitation of time series input, output and price data, the elasticity of substitution free parameters were borrowed from econometric estimates used in GTAP, Lofgren (2001) and Decaluwe et al (2009) for sub-Saharan countries. The free parameters used for initializing the calibration process were $\sigma^{kkl} = 0.8$, $\sigma^{LL} = 0.8$ κ_{TR}^{E} =1.5 and σ_{TR}^{M} =2. The mathematic calibration procedures used to derive the CES, share and scale parameters are demonstrated as follows:

First, the elasticity of substitution free parameter formula was defined as $\sigma_I = \frac{1}{\rho_I + 1}$. Since the value of the free parameter was given as indicated above, it was easy to calculate the CES parameter ρ_I using the rearranged formula of $\rho_I = \frac{1-\sigma_I}{\sigma_I}$. Next, by substituting the given value of σ_I into equation 10 of the CGE model, the value of the share parameter was calculated in the following derived equation:

$$\alpha_I = \left[\frac{wa}{ra(I)}\right]^{\frac{1}{\sigma_I}} \left[\frac{LLD}{KKD}\right]^{\frac{1}{\sigma_I}} \tag{60}$$

Then, by replacing the value of α_I and ρ_I into the equation 4 of the CGE model, the scale parameter A_I value was computed in the following derived equation:

$$A_I = \left[\frac{VA(I)}{[\alpha_I LLD_I^{-\rho} + (1-\alpha_I)KKD_I^{-\rho_I}]^{-1/\rho_I}}\right] \tag{61}$$

The same procedures were followed to calibrate related parameters of skilled and unskilled labors, exports and imports.

Parameters governing the elasticity of income for each commodity were obtained from USDA study document (WRS-01-11) on cross country analysis of food consumption Pattern and Ethiopian Economics Association (2008). These parameters are presented in the following table 7:

Table 7: Income Elasticity of Demand for Commodities

Commodity	Income elasticity	Commodity	Income elasticity	Commodity	Income elasticity
foodcrp	0.89	mineral*	0.94	serv1	1.4
cashcrp	0.89	foodbev	0.85	serv2	1.4
coff	0.60	txwdpp	0.94	serv3	1.4
oils	0.97	leath	0.94		
livfshfor	1.64	fertchemcheq**	0.94		

Source: 1) Ethiopian Economics Association (2008); 2) Regmi, A. et al (2001).
*Income elasticity for mineral is for consumption of coal and natural gas.
**Income elasticity of ferchemequ is for consumption of manufactured house appliances, cleaning soaps, detergents, wax and polish staffs. It does not contain fertilizers, chemicals and production equipment.

As shown in the above table, the income elasticity of demand for food and cash crops and industrial outputs are less than one implying that these commodities are normal goods and elasticity of livestock (meat) and services are above one entailing that these commodities are luxury commodities.

The Frisch parameter value (-5.8) for sub Saharan Africa used in calibrating households' minimum consumption requirement is obtained from an econometric estimate used in Hertel et al. (1997). According to its definition, the Frisch parameter is the ratio of household per capita income over the amount of discretionary expenditures. In this ratio, the larger the discretionary expenditure the household has, the lower the Frisch value will be. For poor countries (like sub Saharans) expenditure above subsistence level is very low, hence, using higher Frisch parameter value (-5.8) for this model seems plausible.

D) SAM Balancing and Model Validation

Before the actual simulation, the micro data of 17,761 observations was directly integrated into the national SAM by replacing the representative household income and expenditure data. During the integration process, discrepancies in income and expenditure balance of SAM accounts were created. These discrepancies were corrected through undertaking a re-balancing procedure. This procedure was carried out using a SAM balancing GAMS program developed in Fofan, Lemlin, and Cockburn (2005). In this program, given AO_{ij} is the original SAM matrix where i and j stand for rows and columns values; $A1_{ij}$ is the new SAM matrix, AO_{hj} and $A1_{hj}$ are the original and the new SAM household accounts, the sum of the square of the variations between the original and the new SAM matrices was minimized:

$$Minimize \sum_i \sum_j \left(\frac{(A1_{ij} - AO_{ij})}{AO_{ij}} \right)^2 \quad (62)$$

Subject to:

Equality of the sum of the rows and the columns of the new SAM accounts:

$$\sum_i A1_{ij} = \sum_j A1_{ij}$$

and,

Fixed value of the household accounts in both the original and the new SAM matrices:

$$AO_{hj} = A1_{hj}$$

Once the CGE model was defined and the household data were integrated into the balanced SAM, parameters were derived through calibration. The calibration process was also used to check the validity of the CGE model. Model validity was ascertained through testing its capacity to replicate the base year data. A step by step procedure for organizing the household and SAM data sets, tables for calibration, and simulation is presented in Annex IV. Moreover, the mathematical program used for balancing and the CGE model is presented in Annex VI and VII.

E) Income Distribution and Poverty Incidences

The CGE model in this study was formulated to evaluate the impacts of an export promotion policy on poverty reduction and inter-industry growth. Changes on poverty were evaluated by analyzing the change in income of each household found in rural, small urban and large urban areas in the country. In this classification, households are living with different levels of income. In the rural area there are landless and land owners, skilled and unskilled wage receivers; in small urban areas, there are small business owners, as well as skilled and unskilled workers; in big cities, there are poor unskilled workers, business owners and industrialists, as well as educated and skilled workers. The model assumes that with the introduction of FDI capital into the agricultural activities of the country, all households are not affected by the same dimension and magnitude. With increased capital, for instance, there will be further agricultural expansion and hence demand for labors could be increased. But not all skilled $LLQ(AGR)$ and unskilled labors $LLNQ(AGR)$ are demanded in equal proportion. Currently in Ethiopia, there is abundant cheap labor and hence economic expansions are mostly implemented in ways to exploit abundant unskilled labor resources.

Following Decaluwe et al (1999), Boccanfuso et al (2003) and Cockburn (2004), this model has postulated intra-group income distributions for three household groups. The equation of the Beta Distribution Function is:

$$P(Y,a,b)=\frac{1}{B(p,q)}\frac{(Y-\min)^{a-1}(Y-\max)^{b-1}}{(\max-\min)^{a+b-1}} \qquad (63)$$

Where, $B(a,b)=\int_{\min}^{\max}\frac{(Y-\min)^{a-1}(\max-y)^{b-1}}{(mx-mn)^{a+b-1}}dy$

In which $B(a,b)$ is a Beta distribution function created based on the shape (a) and skewness(b) parameters and; $\min$ and $\max$ are minimum and maximum values of household income Y. According to Decaluwe et al (1999) the poverty line (Z) is a benchmark value introduced in the income distribution curves as a vertical line. From Poverty Profile of Ethiopia (MOFED, 2002) and PASDEP (2006), Z is 141.00 US Dollar per annum at 1995/96 prices which is equivalent to 1226 Ethiopian Birr per annum. Taking a single poverty line as representative of all household groups could be questionable. But as explained in World Bank (2005), it is a widely used approach provided that per capital income is adjusted for differences in prices and household composition. Household income, in this data set, was adjusted for differences in household composition. Moreover, taking an absolute poverty line, which is a fixed benchmark value of USD 141.00 over the course of different experiments, is consistent with many studies measuring government policies in combating poverty (World Bank, 2005).

The shape and skewness parameters are derived using a Method of Moments (MOM) estimator as follows:

$$a=\bar{X}\left(\frac{\bar{X}(1-\bar{X})}{S^2}-1\right) \qquad (64)$$

$$b = (1-\bar{X})\left(\frac{\bar{X}(1-\bar{X})}{S^2} - 1\right) \tag{65}$$

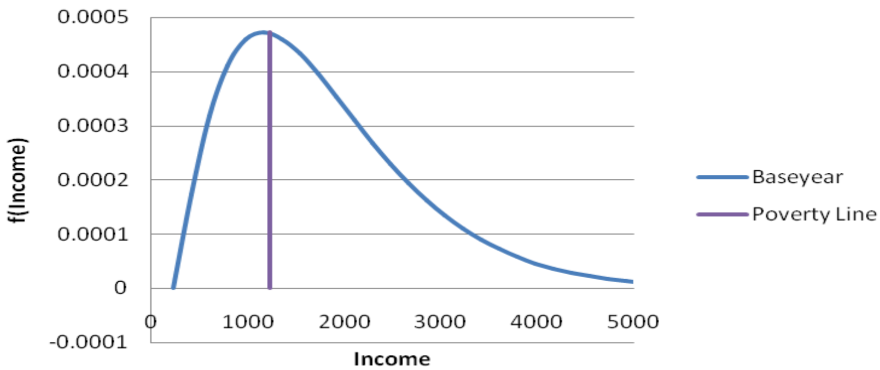
In the above equation $\bar{X}$ is the sample mean and S^2 is the sample variance for household income with $\min$ and $\max$ values between 0 and 1. But the min and max values in our data are not between 0 and 1, hence $\bar{X}$ is replaced by $\left(\frac{YH - \min}{\max - \min}\right)$ in the above equations. The base year a, b, min and max values estimated with this procedure in SAS are presented in Table 8:

Table 8: Parameters Used in the Beta Distribution at the Base Year Period

Households	a	b	Min	Max	Poverty line Ethiopian Birr
Rural	2.22	24.42	36.31	18,839.49	1226.00
Small Urban	0.60	20.72	97.19	67851.26	1226.00
Large urban	0.40	13.91	118.66	81095.39	1226.00

As can be seen in table 8, the a value for rural households is much less than the b value. In this situation, the beta distribution has an asymmetrical and positively skewed tail hence the variance of income to the right of the mean is very high. This indicates that there are few higher income observations situated far from the mean value. Moreover, the distribution is leptokurtic hence many of the observations are concentrated around the mean value leaving some infrequent extreme deviations to the far right of the mean (Figure 10).

Figure 10: Income Distribution of Rural Households in the Base Year



In Table 8, the a values for small and large urban households are not only much less than the b value but also are below the value of 1. In this situation, the beta distributions for both groups have taken strictly decreasing curves. These indicate that there are only few observations concentrated around the mean and at higher income level, leaving the majority of the observations at close distance around the poverty line. In these distributions, infrequent observations of extreme lowest and highest values are excluded because it is difficult to show significant changes (Figure 11 and 12):

Figure 11: Income Distribution of Small Urban Households in the Base Year

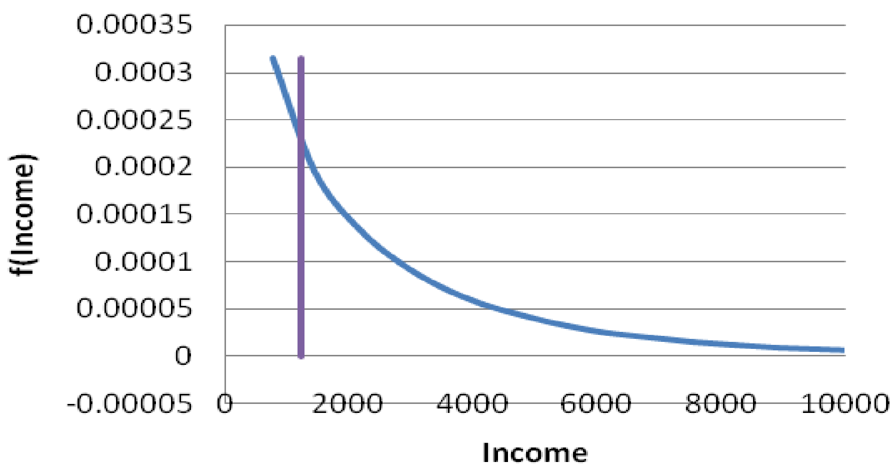
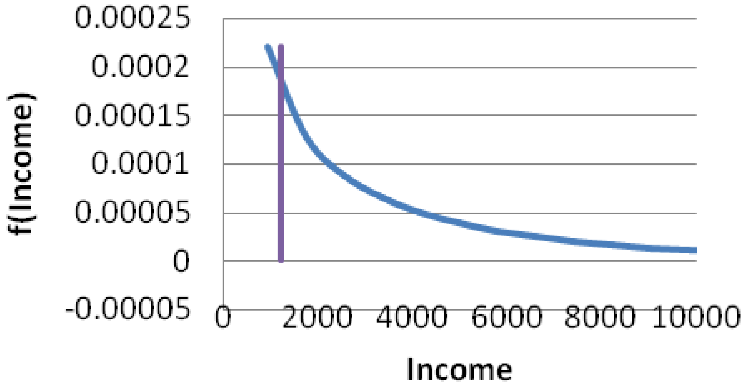


Figure 12: Income Distribution of Large Urban Households in the Base Year



The income distributions obtained before and after model simulations are used to compare incidence of poverty within each group of the households. Following simulation, new mean incomes were obtained for each group and hence the distribution curves were shifted proportionally to the right or left of the base period. Such distributional shift showed the gainers and losers of the policy intervention. Moreover, the shift also indicated the magnitude of gain or loss in relation to the yardstick of the poverty line. The SAS code used to draw the Beta Distribution curves is presented in Annex VIII.

Further statistical analysis has also been made to test whether or not the means of three household groups' income were the same following the two experiments. This analysis has been made using an ANOVA test in two steps. The first step has tested if the mean income within all groups was the same and the second tested if the mean income between groups was the same after the two experiments. In the first test, the explanatory variables were household groups, the two experiment scenarios, and their interactions. The response variable was the nominal income. In the second test, the two experiments were the explanatory variables, whereas income was the response variable. The null hypotheses for these tests were having the same mean income within and between groups after simulation experiments. The significance of these statistics was tested using a Tukey's Studentized Range (HSD) Test. The basic idea of this test is that if there is more difference between group variations than within group variation, we can conclude that the intervention has brought about changes in the mean income of each household group. The SAS code used to do the ANOVA test is attached in Annex IX.

Income distribution analysis is limited to assessing changes in income within groups. Hence, intra group income changes after the experiment were evaluated through examining incidence of poverty measures. These measures were empirically made using Foster Greer

Thorbecke (FGT) additively decomposable class of poverty measures. According to FGT (1984), and the World Bank (2005), the class of poverty measures is defined as:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{N_p}\left[\frac{Z-y_i}{Z}\right]^\alpha I(y,Z) \qquad (66)$$

Where P_α is the poverty level at a risk aversion parameter α, N is the total number of households included in the model, N_p is the total number of poor households, Z is the poverty line, and y_i is a vector of households income estimated in the simulation. $I(y,Z)$ is the distribution function which is equal to 1 when $y < Z$ or zero otherwise, such that only the poor households are selected for such analysis. Estimation was made by using the Distributive Analysis Software developed by Jean -Yves Duclos, Abdelkerem Araar and Carl Fortin **(**2004).

The incidence of poverty is measured based on the difference in the poverty aversion parameter α. When the value of $\alpha = 0$, $P_0 = \frac{N_p}{N}$ is a *head count ratio* which gives us the proportion of poor households within each group. Since this measure could not indicate how poor people below poverty line are becoming more or less poorer, further measurement is introduced. This measure is the poverty *gap index (* P_1). In this index the value of $\alpha = 1$ in which the measure adds up the extent of each household falls under the poverty threshold estimated as a percentage of poverty line $P_1 = \frac{1}{N}\sum_{i=1}^{N_p}\left[\frac{Z-y_i}{Z}\right]$. The gap index is helpful to measure the total resources needed to be transferred to those groups below poverty line to bring them above the poverty thresh hold. When $\alpha = 2$, P_1 is *poverty severity*, which assigns a weight to each household's gap to the poverty line, hence $P_2 = \frac{1}{N}\sum_{i=1}^{N_p}\left[\frac{Z-y_i}{Z}\right]^2$. P_2 measures the extent of vulnerability of certain households to sever poverty risk in each group. It gives a higher weight to those households far away from the poverty line.

Impact on household consumption and welfare was also evaluated by looking into changes in income, cost of living, and prices. Since households are consuming composite goods of domestic and imported commodities, effects on household consumption were analyzed by estimating Consumer Price Laspeyres Index Variation (CPI):

$$CPI = \left[\left(\frac{\sum_{TR} PC(TR) * QQO(TR)}{\sum_{TR} PCO(TR) * QQO(TR)} \right) - 1 \right] * 100 \qquad (67)$$

$PCO(TR)$ is the base year composite price for traded commodity TR, $PC(TR)$ is the optimum price after the simulation, and the numeraire $QQO(TR)$ is the composite commodity at the base period.

F) Model Simulation

Analysis of the impacts of new economic policies or external shocks can be ex-ante or ex-post. The former is made to provide information to policy makers who are trying to decide on whether to implement the policy. The latter is made to measure achievements of implemented interventions and to draw lessons learned for policy amendments and better planning.

In Ethiopia, trade policies which encourage private businessmen and foreigners have been introduced since the early 1990s and were vigorously implemented during the first phase of the poverty reduction program SDPRP (2002/03-2004/05). More specifically, in the second national plan PASDEP (2005/06-2009/10), cut-flowers, vegetables and other high value products have been selectively promoted to contribute to accelerated market-based economic growth. This national program which planned an 11.5 percent annual GDP growth rate is based on the assumption that development of these selective industries could create more employment opportunities and additional capital stocks for further expansion of other sectors of the economy.

Entrepreneurs from Europe, India, Israel, USA and Saudi Arabia are encouraged to invest in production and export of floriculture, horticulture, livestock and food crop products because the government has relaxed its previous policies and regulations on trade and investment. Between 2000 and 2005, FDI inflows in Ethiopia were below 500 million US dollars. But after the above reforms, external financial flows proliferated. In 2006 alone, about 3.49 billion US dollars flowed into the country of which 11.168 billion Ethiopian Birr were invested in land development and capital goods of floriculture, horticulture, livestock and food crop production activities (Weissleder, 2009). According to this study calculation, 11.2 billion Ethiopian Birr FDI inflows is a 15 percent additional capital endowment made on the 2005 capital factors of exportable agricultural activities.

The coffee industry did not benefit from this external intervention because it is protected for domestic investors. This study, therefore, hypothesized a minimum economic impact of the selective export promotion policy. Significant economic growth and poverty reduction is hypothesized to be achieved if the coffee sector becomes part of the reform. To test these hypotheses, ex-post policy simulations are undertaken in two scenarios:

1) A 15 percent increase in capital endowment used in exportable agricultural activities excluding coffee;
2) A 15 percent increase in capital endowment used in exportable agricultural activities including coffee;

G) Sensitivity Analysis

Ethiopian coffee has been affected predominantly by world price fluctuations. According to the International Coffee Organization's report cited in Osorio (2002), the average coffee price of 120 US cents/ LB in the 1980s fell to 50 US cents/ LB in 2002. This amount of fall in price accounts more than 50 percent but for this study a 40 percent fall in price was assumed. As coffee is still the main stay of millions of small holder farmers and urban dwellers directly and indirectly involved in the coffee value chain, its price fall had a direct impact on income and poverty. Moreover, since it still represents the largest share of foreign currency earnings in Ethiopia, its export fall affected the country's terms of trade which led to less access to intermediate inputs and machinery needed by the manufacturing and service sectors. Lack of intermediate and capital goods therefore hampered the production capacity of industries and hence employment opportunities. Moreover, the decline in aggregate production and income indirectly affected government revenue from direct and indirect taxes.

In this study, the impact of FDI capital with and with-out favoring the coffee sector is evaluated. But since world price fluctuation is a frequent exogenous shock, evaluating the effect of alternative export promotion efforts under such an economic phenomenon is important. Moreover the structural change of the economy due to policy and a world price shock depends on the size of the elasticity of substitution and transformation parameters (cited by Essama-Nssah (2004) from Devarajan and Lewis (1990: 633-638)). According to this paper, when the elasticity of substitution parameters (ρ_{agr}^{kkl}, ρ_{nagr}^{kkl}, ρ_{agr}^{LLl}, ρ_{nagr}^{Ll}, κ_{TR}^{E}) are close to infinity, domestic goods, imports and exports are near perfect substitutes. On the other hand, when the free parameter value is approaching zero, domestic and tradable goods are perfect complements. Similar substitution is also expected to happen between capital and labor at the composite level and skilled and unskilled level at the disaggregated level. The consistency of this theory is evaluated in this study by undertaking sensitivity analysis for increased and decreased free parameter values over the base period.

CHAPTER 6

STUDY RESULTS

As discussed in the previous chapters, foreign capital has been attracted to Ethiopia since the investment-friendly export promotion policy was introduced in the agricultural sector. Such an attractive policy and the comparative advantage of the country in cheap labor and cultivable land have encouraged many foreign firms to invest in export agriculture. However, land development and capital goods investments are limited on cash crops, oilseeds, livestock and food crops agriculture since the export promotion policy did not permit foreign capital flow in the coffee industry[Petit (2007) and Love, 2002]. This chapter will present the results from simulating the impacts of such a selective export promotion on poverty reduction and inter-industry growth.

Results are presented in the following three steps. First, the impact of capital change on non-coffee agricultural export activities is reported. Then the outcome of an experiment when both the coffee and non-coffee activities are treated equally with an external capital shock is presented. Finally, overall economic change and inter-industry growth achieved under the two scenarios are reported.

A) Scenario 1: Capital Changes in Non-Coffee Agricultural Export Industries

In this scenario, additional endowment of the FDI capital on non-coffee agriculture was experimented. The simulation was done by increasing 15 percent more capital on non-coffee agricultural capital while the same capital remained constant for coffee sector. Simulation results with respect to impacts on outputs volume and price of outputs, volume and price of factors, households' income and consumption, and incidences of poverty are reported as follows:

i. Impacts on Outputs, Prices and International Trade

As shown in Table 9, with expansion of agricultural production due to increased capital outlay, increased outputs of food and cash crops (14 percent) and livestock (23 percent) have been observed. With excess supply of these crops over domestic demand, producers and domestic prices (prices after tax) for these crops have fallen by 1 to 3 percent. Lower domestic price levels in turn have enhanced domestic market sales by a range of 14 to 33 percent. Excess supply from expansion has also boosted exports of food crops and cash crops by 12 and 20 percent respectively. Oilseeds trade has grown up by 12 and livestock by 58 percent. On the other hand, due to more competitive domestic prices for agricultural outputs, the volume of imports of food and cash crops has declined by 67 and 40 respectively. As has been true in the base year, no imports occurred for oilseeds and livestock (live cattle, sheep and goat). Details are presented in Table 9.

Table 9: Change in Outputs, Domestic and Foreign Trade and Prices in Simulation 1

	Total output	Producer price	Domestic sale	Domestic price	Export volume	Import price	Import volume
foodcrp	0.145	-0.013	0.146	-0.013	0.126	0.000	-0.667
cashcrp	0.145	-0.012	0.199	-0.012	0.200	0.000	-0.400
coff	0.081	0.000	-0.008	0.000	0.157	0.000	0.000
oils	0.141	-0.002	0.333	-0.002	0.116	0.000	0.000
livfshfor	0.237	-0.025	0.172	-0.025	0.577	0.000	0.000
mining	-0.019	0.016	-0.019	0.026	0.000	0.000	0.051
foodbev	0.156	0.099	0.154	0.083	0.333	-0.001	0.554
txwdpp	-0.055	0.096	-0.054	0.097	-0.300	-0.023	0.026
leath	0.177	0.115	0.177	0.110	0.500	-0.002	-0.101
fertchemcheq	0.071	0.007	0.001	0.003	0.031	-0.004	0.055
serv1	0.200	0.128	0.200	0.031	0.200	0.000	-0.891
serv2	0.034	-0.011	0.016	-0.011	0.050	0.000	0.059
serv3	-0.166	-0.114	0.167	-0.115	0.001	0.000	-0.563

Increased agricultural outputs have also provided more and cheaper intermediates to food & beverage and leather product industries and they achieved output increases of 16 and 18 percent respectively. With expanded production process, utilization of service 1 utilities (water, electricity, and other infrastructures) has risen up by 20 percent. Service 2 activity has also increased by 3.4 percent due to a rise of demand for transporting agricultural products from the farm gate to domestic and international markets. Due to less price competitiveness in non-agricultural products, most of the domestic demand of food & beverages, textiles, fertilizers/ chemicals, machineries, transportation and communication facilities is satisfied through imports.

ii. Impacts on Primary Factors and Their Prices

With growth of export agriculture, there has been more demand for primary factors. The minimum wage rate in Ethiopia is very low. Hence, a slight increase above this minimum level has attracted large volume of labor into these activities. The wage rate paid by these export farms, for instance, has increased by 18 percent compared to the base year rate. Wage rate increase in export agriculture has attracted more unemployed and less paid laborers living in the rural and small town areas. Such attractive wage rate, therefore, reallocated 16 percent more composite labor (mostly unskilled labor) in food crop, 31 percent more in cash crop and 2 percent more in livestock from coffee and mining activities. Furthermore, growth in export due to intensification of the agricultural sectors has also increased the rate of return of agricultural capital by 7 to 20 percent while it reduced for non-agricultural and coffee activities by 2 to 11 percent (Table 10).

Table 10: Change in Volume and Remuneration of Primary Factors in Simulation 1

	Labor demand		Factor price			
	LLD	LD	ra	r	wa	w
foodcrp	0.164		0.195		0.180	
cashcrp	0.312		0.198		0.180	
coff	-0.221		-0.005		0.180	
oils	0.000		0.075		0.180	
livfshfor	0.024		0.135		0.180	
mining		-0.157		-0.027		-0.050
foodbev		-0.004		-0.089		-0.050
txwdpp		-0.021		-0.047		-0.050
leath		-0.011		0.091		-0.050
fertchemcheq		-0.140		0.010		-0.050
serv1		-0.003		-0.115		-0.050
serv2		-0.069		0.097		-0.050
serv3		-0.156		-0.002		-0.050

(LLD) is volume agricultural labor demanded, (LD) is volume of non-agricultural labor demand, ra and r are the rates of return of LLD and LD respectively.

The rate of return for capital in some of the non-agricultural activities was influenced by forward and backward linkages with agricultural activities. For instance, increased output of livestock provided cheaper intermediates to the leather industries; hence the rate of return of capital of this industry has increased by 9 percent over the base year. With increased demand of transporting agricultural outputs from the farm gate to the market place, the rate of capital return for service 2 has increased by 10 percent. But wage rate in non-agricultural activities has declined by 5 percent since the overall sector is deteriorating due to relatively lower investment in this sector. Consequently, demand for labor in these activities has dropped by 1 to15 percent.

iii. Impacts on Household Income

In this experiment, average income for all households has increased by 6.6 percent compared to the base year, but when this change is viewed by household groups different outcomes are observed. While average rural household income increased by 14 percent, only marginal increase of 1.5 and 0.4 percent are registered for small and large urban households respectively. These aggregate income changes were analyzed by examining changes in income from each factor as well as changes in their shares of overall household income.

As can be seen in Table 9, after simulation, rural household income from agricultural capital (KKD) and wage has increased by 18 and 24 percents respectively; and income from non-agricultural capital (KD) has declined by 13 percent. This change in income from each factor has led to an increased income share of both for KKD and for wage by 1.5 and 42 percent respectively. For small and large urban households, on the other hand, income from KKD increased by 15 and 17 percent, but income from wage decreased by 0.4 and 0.9 percent. As a result, the shares of wages in these households' incomes have declined to 9 and 10 percent, while the KKD share increased between 8 and 10 percent (Table 11).

Table 11: Changes in Factorial Source of Income in Simulation 1

	Change in share of factors to total income			Change in factors income		
	KKD	KD	Wage	KKD	KD	Wage
Rural HH	0.015	-0.132	0.422	0.175	-0.05	0.238
Small Urban HH	0.147	-0.019	-0.004	0.096	-0.11	-0.089
Large urban HH	0.175	0.008	-0.009	0.075	-0.139	-0.095

Based on the base year data, agricultural capital (KKD), non-agricultural capital (KD) and wages respectively constituted 76, 12 and 4 percent of rural household income. Therefore, the rises of remuneration from these major sources, as observed in Table 9, have contributed to higher aggregate income increases for this household group.

For small urban households, on the other hand, the major income sources originated from non-agricultural capital (50 percent) and wages (34 percent). For large urban household as well, the larger income shares came from wages (57 percent) and non- agricultural capital (29 percent). Therefore, a very low or negative rise in remuneration from these major income sources, as observed table 9, has contributed to marginal aggregate income increases for these groups.

iv. Impact on Household Consumption

It is assumed that, in an open economy, households that allocate their larger income share for imported consumer commodities are the ones who are more likely to be affected by a high cost of living. As observed in table 10, rural households were spending more than 58 percent of their income on agricultural commodities, out of which food makes up the lion's share. Forty two percent of their income was spent on industrial and service goods of which fertilizer makes up the bigger share. On the other hand, urban households spend about 49 percent of their income on agricultural products while 51 percent is allocated to non-agricultural goods. As the import penetration ratio (M/QQ) in table 10 indicates, most of non-agricultural goods were largely imported.

Table 12: Changes in Consumer Prices and Consumption Share of Income in Simulation 1

	M/QQ	dDP	dPM	dPC	Consumption share of Income		
					rural	small urban	Large urban
foodcrp	0.000	-0.013	0.000	-0.012	0.450	0.380	0.250
cashcrp	0.000	-0.012	0.000	-0.011	0.050	0.070	0.090
coff	0.000	0.000	0.000	0.000	0.020	0.040	0.040
oils	0.000	-0.002	0.000	-0.002	0.030	0.030	0.040
livfshfor	0.000	-0.025	0.000	-0.025	0.030	0.050	0.070
mining	0.004	0.026	0.000	0.020	0.010	0.020	0.040
foodbev	0.379	0.083	-0.001	0.071	0.020	0.050	0.080
txwdpp	0.804	0.097	-0.023	0.040	0.040	0.050	0.070
leath	0.178	0.110	-0.002	0.041	0.040	0.030	0.060
fertchemcheq	0.890	0.003	-0.004	0.031	0.250	0.150	0.050
serv1	0.000	0.031	0.000	0.030	0.010	0.040	0.060
serv2	0.149	-0.011	0.000	-0.011	0.020	0.040	0.070
serv3	0.003	-0.115	0.000	-0.115	0.030	0.050	0.080

(M/QQ) stands for import/ composite domestic demand ratio; (dDP) change in Domestic Price; (dPM) change in import price; (dPC) change in composite price.

In this experiment, due to an increase in aggregate supply, domestic prices of agricultural goods have declined, whereas prices of non-agricultural commodities have increased. Therefore, constant import prices and lower domestic prices have pulled down composite prices of agricultural goods, which in turn has lowered the cost of living CPI(-1.5) for food consumption. Very low rates of decline in import prices of industrial goods could not offset the higher rates of domestic price increases, which as a result, kept the composite prices at a higher level than those of the base period. This resulted in a higher cost of living CPI (0.59) of non-agricultural commodities.

Equivalent Variation (EV) of rural households was observed to increase by 12 percent, whereas it rose by only 0.52 percent and fell by 0.62 percent for small and large urban households respectively. This suggests that rural households earn more income to pay for their consumption needs than do their two counterparts. With higher EV, rural households have achieved both substitution and income effects. The higher substitution effect for rural household was attributed to the reduction in composite price of agricultural outputs. Very low EV for urban households, on the other hand, is attributed to increased composite prices of non-agricultural outputs but insignificant raise in income.

Consumer welfare analysis based on aggregate consumption and prices was limited to a representative household assumption. Therefore, substantiating the accuracy of the aggregate estimation by doing household-level analysis was necessitated.

v. Impacts on Income Distribution and Poverty Incidence

Income Distribution

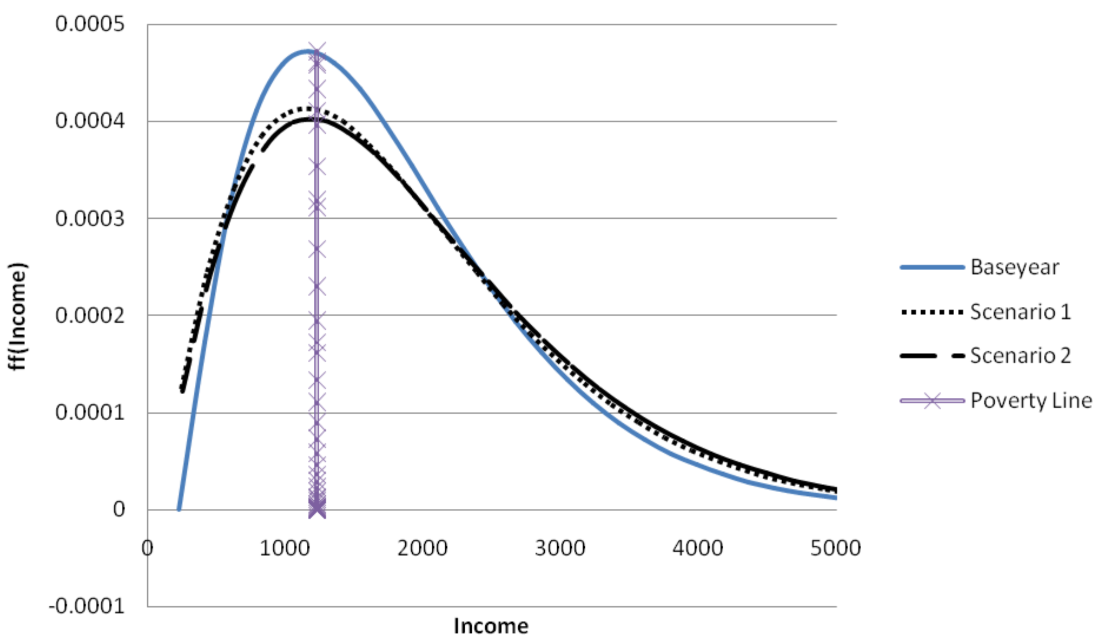
In the first simulation experiment, rural households' mean income increased by 14 percent compared to the base year, while income grew by 1.5 and 0.4 percent for small and large urban households respectively. Parallel with increased mean income, the minimum and maximum values of households' income distributions have been changed to give different shape and skewness parameters (Table 13):

Table 13: Parameters of the Beta Distribution after Simulation 1

	a	b	Min	Max	change in Income %
Rural HH	2.29	22.49	41.66	19559.47	14.8
Small Urban	0.62	20.81	102.22	67851.26	1.9
Large urban	0.41	14.41	125.83	81949.02	0.4

Parameters in table 13 have been used to plot the Beta Distribution curves of three household groups. As shown in Figure 13, the solid line represents the situation in the base year, whereas the dotted lines represent situation in the first simulation experiment. Based on the new parameters values in Table 13, the distribution of rural households (dotted line) has proportionally moved to the right of the base year. Moreover, with decrease in b value, the peak of the distribution has declined which implies that the variance of income due to infrequent higher extreme values has been reduced.

Figure 13: Changes in the Rural Households Income Distribution in Simulation 1 and 2



Figures 14 and 15 illustrate changes in income distribution of small and large urban households following the first experiment. In these plots, the dotted lines of the curve depicting income distribution in the first experiment were superimposed on the solid lines of the base year curve, implying that no visible intra-group distributional shift was observed with a change of mean incomes.

Figure 14: Changes in Small Urban Households Income Distribution in Simulation 1and 2

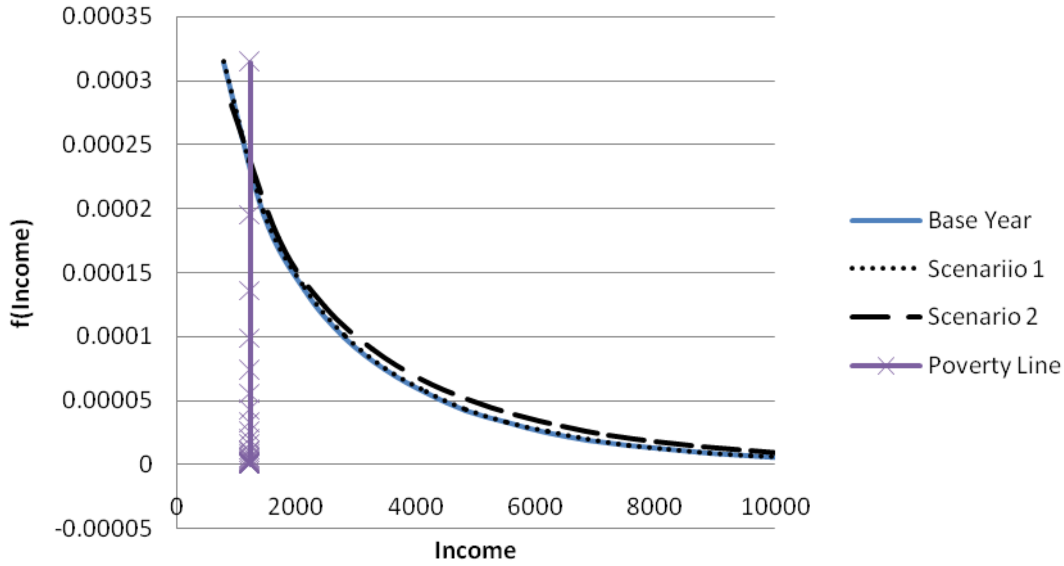
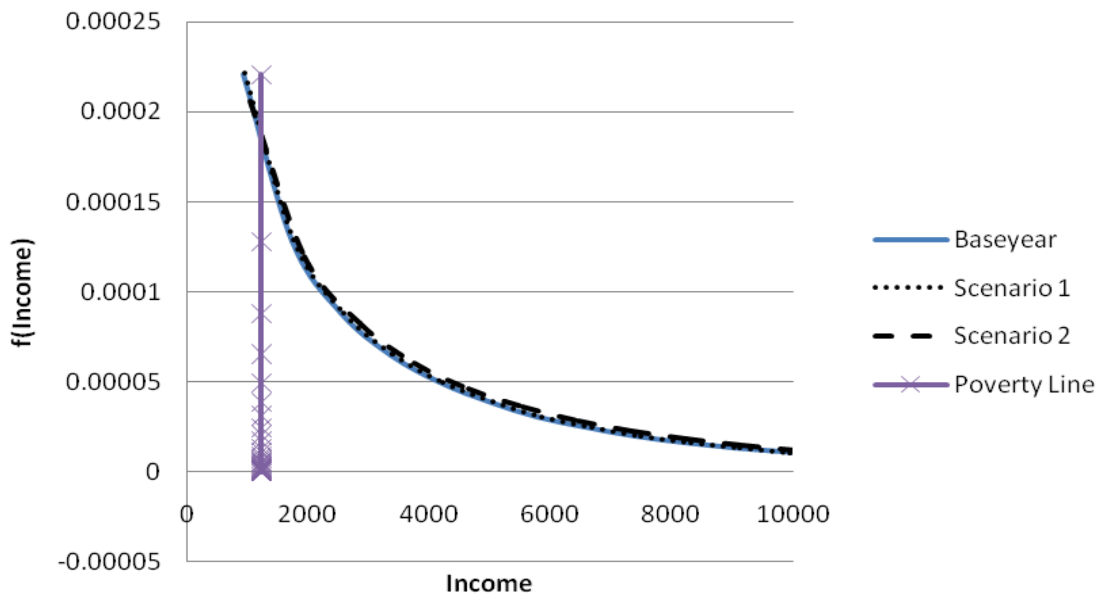


Figure 15: Changes in Large Urban Households Income Distribution in Simulation1 and 2



In numerical terms, the mean incomes for the small and large urban households were observed to increase by 1.5 and 0.4 percent, but no visible or pronounced changes were seen in their respective distributions. Hence an ANOVA test was made to check if these results were statistical significant.

The null hypothesis of the ANOVA test was no variation in the mean income of households after simulation experiments. The result of the test for within all household mean income variations was found to be significant (p<0.001 at $\alpha = 0.05$ confidence interval). For multiple comparisons of this experiment, the Tukey's Studentized Range Test (HSD) was made as the results are presented in Table 14.

Table 14: Results of the Tukey's Studentized Range Test for Within and Between Group Income Variations

	Tukey Grouping*	Mean	N	Treatment
------------------Within households(HH)------------------				
	A	2200.69	17761	Scenario2
	B	2059.99	17761	Scenario1
	C	1932.07	17761	Base Year
------------------Between HH groups ------------------				
	A	1897.35	8733	Scenario2
Rural Households	B	1844.7	8733	Scenario1
	C	1606.46	8733	Base Year
	A	2316.61	3584	Scenario2
Small urban households	B	2054.43	3584	Scenario1
	B	2016.01	3584	Base Year
	A	2610.96	5444	Scenario 2
Large urban households	B	2409.02	5444	Scenario 1
	B	2399.12	5444	Base Year

* A, B and C are letters in Turkey grouping where similar letters in scenario 1 and 2 implying no significant difference in the mean income value.
* Comparison is made at 0.05 significant levels.

As HSD test indicates, mean incomes of households within all groups has been changed in the first simulation experiment. This implies that with increased agricultural exports, the mean income of households in any of the three groups was changed. The ANOVA test for between groups variations was also made as presented at the same Table 14. Based on this result, the rural household group obtained statistically significant different mean with the treatment, whereas small and large urban household groups have no significantly different mean incomes in the same experiment.

Incidence of Poverty

Inter-household group income variation, following the external intervention was analyzed by calculating the FGT poverty measures. As Table 15 shows, in the base year the incidence of poverty using the *head count ratio* level was 38.5 percent for rural households, 38.6 percent for small urban households and 34.4 percent for large urban households. After simulation 1, the head count poverty index for rural households has declined by 10 percent. This implies that 10 percent of the rural populations have risen out of poverty due to the change in capital used for export agriculture production. Despite being low in magnitude, 1.7 and 0.5 percent of households from small and large urban populations have also risen out of poverty.

The extent of poverty compared to the poverty line was also measured with a *poverty gap index*. Simulation 1 results indicate that on average 3.4 percent of rural households' income gap from the poverty line has been removed, but only 0.6 and 0.2 percent has been removed for small and large urban households. This implies that more poor households in the rural group benefitted from being closer to the poverty line than the other two groups.

The extent of poverty among poor households was further evaluated by a *poverty severity index.* According to the experiment, the vulnerability of 1.4 percent of rural households to severe poverty risk was minimized, but only 0.2 and 0.1 percent of small and large urban households.

Table 15: Percentage Changes in Incidence of Poverty in Simulation 1

	Simulation1			Changes		
	α=0	α=1	α=2	α=0	α=1	α=2
Rural HH	0.284	0.074	0.030	-0.101	-0.034	-0.014
Small Urban HH	0.369	0.122	0.057	-0.017	-0.006	-0.002
Large urban HH	0.339	0.097	0.041	-0.005	-0.002	-0.001

The above results suggest how much the rural households benefited from the selective intervention compared to urban households. In all three poverty measures, the magnitude of change was more pronounced in rural households than in small and large urban household groups. These households benefited the most because the intervention has intensified export agriculture in their area, which provides a higher rate of capital and labor return than was found in the base year period. For urban households, the impact of the intervention was insignificant.

B) Scenario 2: Capital Changes in Agricultural Export Industries Including Coffee

vi. Impacts on Output, Prices and International Trade

Simulation 2 was made by providing equal policy treatment to the coffee industry and other agricultural export activities. In this approach, 15 percent more capital endowment obtained from FDI was introduced to the coffee and other agricultural activities in equal proportions. Due to its higher export share and intensity, expanding this industry has translated in to a larger increase in output (50 percent), domestic sales (50 percent), and exports (49 percent) compared to the base period. An increase in the output of coffee has exerted a second round effect on the production and consumption of other agricultural outputs. With the increase in coffee output, coffee farmers have received more income (profit effect an agricultural household model) which has encouraged them to consume more food and cash crops. This increased demand for food consumption has encouraged food and cash crop farmers to produce more output than they were able to produce from capita-induced productivity change. More food and cash crops were consumed by the same producers because they benefited from income and substitution effects from the fall in crop price. As a result, food and cash crop outputs, in the second simulation, rose 18 to 25 percent more than the base period which was 3 to 11 percent more than in the first simulation. Moreover, food & beverages and leather product industries have obtained cheaper intermediates to intensify their outputs above 20 percent. A larger increase in agriculture has also stimulated the service 2 activity to transport 9 percent more outputs than in simulation 1.

With increased consumption, expanded domestic markets of food crops (24 percent), cash crops (34 percent), coffee (50 percent) and livestock (18 percent) were registered. The domestic market of food & beverages, leather products and chemical fertilizers were also improved by 7 to 20 percent. With more internationally competitive prices, imports for some of these products increased compared to the first simulation. In general, FDI capital for the coffee industry raised the volume of many agricultural and non-agricultural outputs and their respective domestic and international markets compared to the first simulation. Increased supply of cheap agricultural output has also suppressed import volume by 17 to 20 percent. Moreover, relatively higher domestic production of food & beverages and leather products than the first simulation has reduced the level of non-agricultural import volume (Table 16).

Table 16: Changes in Outputs, Domestic and Foreign Trade and Prices in Simulation 2

	Total output	Producer price	Domestic sale	Domestic price	Export volume	Import price	Import volume
foodcrp	0.239	-0.014	0.240	-0.014	0.135	0.000	-0.833
cashcrp	0.247	-0.012	0.336	-0.012	0.229	0.000	-0.600
coff	0.497	-0.001	0.500	-0.001	0.494	0.000	0.000
oils	0.175	-0.001	0.418	-0.001	0.151	0.000	0.000
livfshfor	0.254	-0.024	0.180	-0.024	0.648	0.000	0.000
mining	-0.026	0.023	-0.026	0.027	0.000	0.000	0.081
foodbev	0.211	0.033	0.209	0.011	0.386	-0.013	0.512
txwdpp	-0.086	0.097	-0.086	0.097	-0.367	-0.026	0.056
leath	0.201	0.054	0.176	0.051	0.567	-0.011	-0.259
fertchemcheq	0.156	0.003	0.002	-0.001	0.010	-0.008	0.168
serv1	0.202	0.130	0.202	0.032	0.200	0.000	-0.891
serv2	0.13	-0.011	-0.018	-0.011	0.031	0.000	0.289
serv3	-0.181	-0.125	-0.183	-0.126	0.001	0.000	-0.563

vii. Impacts on Primary Factors and Their Prices

With the protected coffee industry open to the FDI, capital intensification was able to attract more labor. Part of the coffee expansion also included establishment of coffee processing plants and marketing facilities which demanded more labor. Higher labor demand brought about a higher wage rate of 19.5 and 1.5 percent more than in the base period and simulation 1 respectively. Consequently more under and unemployed unskilled labor forces from subsistence agriculture and small urban areas were reallocated to this industry. With increased production of exportable products, the rate of return to agricultural capital also increased 12 to 21 percent over the base year, which was even higher than in scenario 1 (Table 17):

Table 17: Changes in Factors Demand and Remuneration in Simulation 2

	Labor demand		Factor price			
	LLD	LD	ra	r	wa	w
foodcrp	0.764		0.214		0.195	
cashcrp	0.876		0.121		0.195	
coff	0.327		0.074		0.195	
oils	0.186		0.168		0.195	
livfshfor	0.879		0.154		0.195	
mining		-0.343		-0.035		0.120
foodbev		0.147		0.336		0.120
txwdpp		-0.036		-0.051		0.120
leath		0.058		0.096		0.120
fertchemcheq		0.012		0.136		0.120
serv1		-0.002		0.364		0.120
serv2		-0.039		0.100		0.120
serv3		-0.060		-0.033		0.120

(LLD) is volume agricultural labor demanded, (LD) is volume of non-agricultural labor demand, ra and r are the rates of return of LLD and LD respectively.

A higher volume of non-agricultural outputs for the domestic and international markets was transmitted to a higher labor demand in food & beverages (15 percent) and leather (6 percent) as well as increased wage (12 percent) and capital return (9-33 percent) rates. Moreover the transportation and communication services (service 2) also experienced similar improvements. The growth was due to the establishment of coffee- related subsidiary facilities (processing, financial and communication services).

viii. Impacts on Household Income

Unlike the first simulation, impacts on household incomes in this scenario moved beyond rural households. Nominal incomes for rural households increased by 18 percent; and small and large urban households also gained income increase of 14 and 8 percent. An income boost, especially to the urban households, can be attributed to more efficient resource reallocation in the coffee industry and in its interactions with urban based industries and services.

As can be seen in Table 18, rural household income from KKD and WAGE was increased by 19 and 26 percent which led to increase in total income shares of 1.5 and 63 percent respectively. The labor share of total income, in this experiment, grew even two percent more than in simulation 1. Unlike simulation 1, small and large urban households also benefited from this intervention. For small urban households, income from KKD and WAGE increased by 12 and 16 percent and for large urban household by 8 percent. As a result, the share of wage to the total income, which was the major source of income for these household groups, rose up by 11 to 16 percent (Table 18).

Table 18: Changes in Factorial Source of Income in Simulation 2

	Change in share of factors to total income			Change in factors income		
Households	KKD	KD	Wage	KKD	KD	Wage
Rural	0.015	-0.178	0.628	0.189	-0.063	0.255
Small Urban	0.099	-0.110	0.159	0.115	-0.125	0.156
Large urban	0.046	-0.150	0.105	0.084	-0.156	0.079

In this scenario, urban households benefitted from the increased income because their dominant income source (i.e. wages) was utilized efficiently. Increased use of agricultural capital in the rural areas has contributed to a higher income level than in the base period and in scenario 1.

ix. Impact on Household Consumption

Because the prices of food items further declined, the cost of rural households major consumption decreased (CPI=-1.59). Their income level increased even more and they were able to benefit both from income and substitution effects. Due to higher domestic prices for non-agricultural outputs, on the other hand, the cost of living for urban households increased (CPI=0.52) but the extent was much less than in simulation 1. Comparatively lower cost of living in simulation 2 was due to a relative fall in composite prices (Table 19).

Table 19: Changes in Consumer Prices in Simulation 2

	M/QQ	dDP	dPM	dPC	Consumption share of Income		
					rural	small urban	Large urban
foodcrp	0.000	-0.014	0.000	0.000	0.450	0.380	0.250
cashcrp	0.000	-0.012	0.000	0.000	0.050	0.070	0.090
coff	0.000	-0.001	0.000	0.000	0.020	0.040	0.040
oils	0.000	-0.001	0.000	0.000	0.030	0.030	0.040
livfshfor	0.000	-0.024	0.000	0.000	0.030	0.050	0.070
mining	0.004	0.027	0.000	0.000	0.010	0.020	0.040
foodbev	0.315	0.011	-0.013	-0.013	0.020	0.050	0.080
txwdpp	0.818	0.097	-0.026	-0.026	0.040	0.050	0.070
leath	0.145	0.051	-0.011	-0.011	0.040	0.030	0.060
fertchemcheq	0.896	0.008	-0.008	-0.008	0.250	0.150	0.050
serv1	0.000	0.032	0.000	0.000	0.010	0.040	0.060
serv2	0.174	-0.011	0.000	0.000	0.020	0.040	0.070
serv3	0.003	-0.126	0.000	0.000	0.030	0.050	0.080

(M/QQ) stands for import versus composite domestic demand ratio; (dDP) change in Domestic Price; (dPM) change in import price; (dPC) change in composite price.

In this experiment, EV for the rural group rose by 14 percent whereas it rose by 4.2 and 2.6 percent for small and large urban households respectively. Even if the cost of industrial goods was still high, these households were able to earn more income than in simulation 1 and they were better able to cope with the higher cost of living.

x. Impacts on Income Distribution and Poverty Incidence

Income Distribution

In this experiment, rural household mean income increased by 18 percent whereas small and large urban groups' mean incomes increased by 15 and 9 percent respectively. Parallel with a change in mean income, the min and the max values of the income distribution of all households were changed to provide different shape and skewness values (Table 20).

Table 20: Parameters of the Beta Distribution after Simulation 2

Households	p	q	Min	Max	Change in income %
Rural	2.32	20.74	42.81	20273.31	18.1
Small Urban	0.65	21.81	115.74	75993.41	14.9
Large urban	0.44	15.43	136.27	88504.94	8.8

Using these parameters new distribution curves were drawn for the three household groups. As shown in Figures 14, 15 and 16, the dashed lines illustrate changes in the distribution of rural, small and large urban households following simulation 2. In this experiment, all households' income distribution curves were visibly shifted to the right, indicting a significant change in mean incomes after the intervention. More importantly, a pronounced shift in the income distribution curves of urban households indicates the significant impact of the alternative export promotion approach adopted.

The consistency of these results was established by doing an ANOVA test for which the results were presented in Table 14. As shown in this table, under the scenario where the coffee industry is benefit from the FDI capital, statistically significant mean income differences were observed both within and between household groups. These results imply that the alternative export promotion approach was successful in significantly improving the income of all household groups than the selective approach.

Incidence of Poverty

The FGT additive poverty measure estimated for the three household groups is presented in Table 21. As this table indicates, compared to the base period, the head count poverty index for the rural household group declined by 12 percent. This implies about 12 percent of the rural population has risen out of poverty as a result of the agricultural capital change under the alternative policy scenario. Also, about 9 and 5 percent of small urban and large urban populations have been drawn out a poverty situation.

Table 21: Changes in Incidence of Poverty in Simulation 2

	Sim 2			**Changes**		
Households	α=0	α=1	α=2	α=0	α=1	α=2
Rural	0.266	0.069	0.028	-0.119	-0.039	-0.016
Small Urban	0.301	0.095	0.043	-0.085	-0.033	-0.016
Large urban	0.292	0.079	0.033	-0.052	-0.020	-0.009

As this experiment indicates, rural households' income gap from poverty line decreased by 4 percent compared to the base year. Moreover 3 and 2 percent decreases were recorded for small and urban households. This implies that an increasing number of poor households from all three household groups are getting closer to the poverty line compared to the first experiment. The vulnerability to severe poverty was reduced for about 2 percent of rural households as well as 2 and 1 percent of small and large urban households respectively.

The above results suggest a significant improvement for all household groups in the second compared to the first experiment. In all three measures, the magnitude of change was considerable for all groups. This intervention changed the poverty incidences for all groups because the intensification of coffee together with other activities created a suitable condition to efficiently allocate domestic resources to where they provided higher rates of return for both rural and urban households.

C) Inter-Industry Growth

FDI capital inflows for export agriculture caused changes to certain macro- economic indicators. Compared to the base year, for example, the Gross Domestic Product (GDP) at market prices grew by 8 and 11 percent for first and second experiments respectively. This growth rate is consistent with the World Bank Data Statistics (2008) [9]Intensities of exports to the GDP rose by 3 and 5 percent and that of imports by 0.3 and 2 percent compared to the base period.

The fairness of the estimated growth trend at the aggregate level can be rationalized by comparing it with trends at the disaggregated level. Trends at the disaggregated level were

9 http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/ETHIOPIAEXTN/0,,menuPK:295955~pagePK:141132~piPK:141109~theSitePK:295930,00.html

rationalized by reviewing input-output linkages and import and export intensity between industries.

i. Industrial Linkages

Since value-added and intermediate inputs are complementary in the production process, they were combined in fixed proportions. Therefore, with increased agricultural capital in simulation 1, the proportions of intermediate inputs used by agricultural and non-agricultural activities grew.

In these input-output exchanges, two-way industrial linkages were created. With provision of more intermediate inputs from agricultural activities to non-agricultural sectors, forward linkages were established. Due to these linkages, food & beverages, leather products, service 1 and service 2 activities obtained cheaper intermediate inputs for their production processes. The lower cost of production consequently assisted these industries to attain 3 to 20 percent output growth compared to the base period. Output growth, particularly in fertilizer and chemical industries service 1 and service 2, in turn created backward linkages with the agricultural activities. With backward linkages, the agricultural activities obtained more access to trade, transport and communication services which contributed to a 14 to 23 percent output growth compared to the base period (Table 22).

Table 22: Growth in Outputs and Intermediate Inputs in simulation 1 and 2

	Output Sim 1	Output Sim 2	*TINTRM sim1	TINTRM sim2
foodcrp	0.145	0.239	0.132	0.302
cashcrp	0.145	0.247	0.145	0.158
coff	0.081	0.497	-0.003	0.148
oils	0.141	0.175	0.142	0.163
livfshfor	0.237	0.254	0.144	0.182
mining	-0.019	-0.026	-0.020	-0.026
foodbev	0.156	0.211	0.152	0.207
txwdpp	-0.055	-0.086	-0.041	-0.040
leath	0.177	0.201	0.177	0.186
fertchemcheq	0.071	0.156	0.005	0.049
serv1	0.200	0.202	0.200	0.203
serv2	0.034	0.127	0.052	0.249
serv3	-0.166	-0.181	-0.168	-0.183

*TINTRM stands for total intermediate inputs used

The extent of forward and backward linkages in the second experiment was more pronounced than in the first experiment. Exchange of intermediate inputs between food crops and food & beverages, for example, increased by 5 percent over simulation 1. Livestock and leather industries also grew by 1 to 4 percent. Moreover, access to fertilizer/ chemicals for agricultural production grew by more than 4 percent and service 2 by more than 20 percent over simulation 1.

Generally, improved linkages among industries in simulation 2 paved the way for a higher output level of all agricultural and some non-agricultural sectors (such as food & beverage, leather, service 1 and service 2).

ii. Export and Import Intensity

The levels of export expansion and import substitution were analyzed through reviewing export and import intensity in relation to the GDP. As shown in Table 21, increase in export intensity in the first experiment was more prominent in cash crops, coffee, oilseeds, livestock and food & beverages. Compared to the base year, export intensity for these activities grew by 0.6, 0.5, 0.1, 1.8 and 0.02 percent respectively. Similar increases were observed in the second experiment, but at a lower rate (0.2 percent) than the first experiment for cash crops whereas it was more pronounced (2 percent) for coffee. The higher export intensity of coffee in the second experiment was attributed to a larger ratio of output growth in the industry, while other primary exports attained less output increases than in the first experiment. This happened so because labor was reallocated to the coffee industry (Table 23).

Table 23: Changes in Export and Import Intensity in Simulation 1 and 2

Export intensity=Export/GDP			Import intensity=Import/GDP	
	Sim1	Sim 2	sim1	sim2
foodcrp	0.0000	0.0000	0.0000	0.0000
cashcrp	0.0057	0.0055	0.0000	0.0000
coff	0.0054	0.0251	0.0000	0.0000
oils	0.0008	0.0009	0.0000	0.0000
livfshfor	0.0179	0.0188	0.0000	0.0000
mining	0.0000	0.0000	-0.0002	-0.0002
foodbev	0.0002	0.0003	0.0119	0.0113
txwdpp	0.0000	0.0000	-0.0040	-0.0038
leath	0.0000	0.0000	-0.0011	-0.0021
fertchemcheq	0.0000	-0.0001	-0.0025	0.0072
serv1	0.0000	0.0000	-0.0001	-0.0001
serv2	-0.0002	-0.0004	-0.0004	0.0045
serv3	0.0000	0.0000	-0.0003	-0.0003
Total	0.0298	0.0502	0.0032	0.0164

Table 23 demonstrates changes in export and import intensities for each activity. Both in the base year and the two experiments, import intensity for agricultural commodities was low and hence the change in import intensity in relation to the GDP was close to zero. This is due to the fact that with increased output and subsequent competitive domestic prices, demand for food is satisfied locally hence import from the rest of the world was much lower. On the other hand, the import intensity of non- agricultural activities in the base year was higher. During the two consecutive experiments, only a minimal (0.02 to 0.4 percent) decline of import intensities were achieved in textile, leather, and service activities. Upward trends of 0.7 to 1 percent were observed in the food & beverage and fertilizer/ chemical/ machinery import ratios in both experiments. These results indicate that there are weak input-output linkages within these industries. Because of underinvestment and reallocation of labor from these sectors, they are not competitive enough to supply intermediate inputs to each other and hence their production process has remained largely dependent on imported intermediate inputs from the rest of the world.

Based on the above results, an exogenous shock in agricultural capital was observed to considerably enhance primary exports but minimal effects on import substitution of non-agricultural commodities. More specifically, impacts were found more momentous in experiment 2 than experiment 1.

The structure of exports was similar to the base year situation in the first experiment. Under the selective policy scenario, the coffee industry did not benefit from the external capital flow and hence its export share declined by 5 percent while the non-coffee export share rose by 5 percent. But in the alternative policy scenario, the export share of coffee was augmented by 3 percent where as the non-coffee export share declined by 3 percent. It was in the later alternative that many rural and urban households were drawn out of absolute poverty. Coffee still represents the largest export share and supports millions of people, and its growth was proven to benefit the country the most.

D) Sensitivity Analysis

As shown in Annex V a, b and c, experiment 3 and 4 depict the response of alternative export promotions to a 40 percent fall in the world coffee price. The coffee price fall in Scenario 1 wa**s** observed to show various structural changes both in the agricultural and non-agricultural sectors. The price shock primarily caused a 24 percent decline in coffee exports and consequently it brought about a 9 percent fall in coffee output level. The drop in coffee production ended up with a 23 percent reduction in labor demand, 22 percent fall in agricultural wage rate and 23 percent decrease in agricultural capital return. The fall in factor demand and price has directly affected the average household income level, causing it to fall by 11 percent compared to the base period. With a fall in income for millions of coffee dependent households, demand for consumption of agricultural and non-agricultural outputs has declined. The decrease in aggregate demand transmitted to a 10 to 14 falls in crop and livestock products. Moreover, the decline in agricultural output resulted in weak forward and backward linkages among the industrial and service sectors. In Scenario 1, food and beverages, leather and leather products, service 1 and 2 activities were showing positive responses to selective export promotion interventions but with the coffee price fall, all non-agricultural sectors were observed to show an output decline of 8 to 14 percent. As a result of changes in the terms-of-trade, the country's capacity to import more intermediate and capital goods for non-agricultural activities has fallen by 25 to 50 percent. The price shock has also affected the producers' sales and consumers' purchasing price level. Due to decline in aggregate agricultural and non-agricultural output supply, producers' and consumers' prices have fall by 3 to 15 percent. The effect of a coffee price shock was found out to be less pronounced under an alternative policy scenario (experiment 4). Detail in Annex IV a-d.

The sensitivity of the price shock under Scenario 1 was also evaluated by changing the base period value of the elasticity of substitution parameters. With a 30 percent increase in elasticity of substitution (experiment 5), the decrease in coffee exports volume fell from 24 to 16 percent and coffee output declined by 6 percent. Moreover, the decrease in labor demand was 22 to 13 percent and wage rate 23 to 18. Consistent with economic theory, such improvement was attributed to a higher export volume due to a higher elasticity of substitution than in the base period. A higher elasticity of substitution also enabled more imports for non-agricultural production. As a result, an 11 percent decline of average household income that was registered under a coffee price shock was reduced to 9 percent. Improvement in income also encouraged more agricultural and non-agricultural production with the overall effect of absorbing the economic shock of coffee price fluctuations. The outcome of this analysis is consistent with economic theory suggesting more exports and imports with respect to a higher elasticity of substitution. More agricultural exports encourage higher factor demand and price and larger aggregate output. The increase in exports improves the terms-of-trade and hence the non-agricultural sectors are able to get more imported intermediate and capital goods for increased production. The positive outcome of an increased substitution parameter was more prominent under experiment 6 than Experiment 5 (Annex IV a-d).

The effect of a coffee price shock was greater when it is evaluated at a lower substitution parameter value. With a 30 percent decrease in elasticity of substitution (experiment 7), the decrease in coffee export volume was 24 to 27 percent and coffee output declined by 12 percent than 10 percent. Moreover, the extent of decrease in labor demand was from 23 to 26 percent and the wage rate fell18 to 26 percent. Consistent with economic theory, such reductions can be attributed to a lower export volume due to the elasticity of substitution being lower than in the base period. The lower elasticity of substitution has also discouraged imports and hence reduced non-agricultural production capacity. Accordingly, an 11 percent decline of average household income registered under the coffee price shock was reduced to 13 percent. The lower household income for coffee dependent households has also discouraged agricultural and non-agricultural production. The outcome of our analysis is consistent with economic theory which suggests less exports and imports at a lower elasticity of substitution. As less and less agricultural goods are exported, lower factor demand and prices reduce aggregate output. The decrease in exports widens the terms-of-trade gap and hence the non-agricultural sectors cannot obtain additional imported intermediate and capital goods to increase production. The negative outcome of the decrease in substitution parameter was less prominent under Experiment 8 than 7 (Annex V a-d).

CHAPTER 7

SUMMARY, CONCLUSION AND RECOMMENDATION

Export oriented development requires all nations to specialize in economic activities in which they have a comparative advantage. But for those countries with a small economy and few comparative advantages, specialization and trade could result in an uneven and less-self-sustaining growth and development. This is particularly true for exports which are exposed to high volatility and/or long-term decline in price and/or volume. Such characteristics perfectly describe primary products which make up a dominant share of the exports of many Third World countries, including Ethiopia.

In order to overcome the drawbacks of specialization and continue garnering stable economic benefit of agricultural trade, many developing nations have diversified their export bases. Instead of relying on a few relatively homogenous goods, they have introduced value-added commodities that could penetrate global niche markets. Moreover, in order to foster market competitiveness, they have reformed their trade policies. Trade liberalization policy, for instance, has helped many nations to attract external capital and technical capabilities to efficiently produce competitive exports.

Ethiopia has followed suit of this development strategy. Since 1990s, it has diversified its export bases. Instead of relying on coffee, the country has introduced the exports of vegetables, oilseeds, flowers, leather and leather products. With these reforms, positive macro-economic performances have been achieved. The GDP has grown and the share of export in the economy has increased. But these macro-economic achievements have not been transmitted towards curbing the prevalence of poverty of the country.

According to this study, the implemented export promotion policy which encouraged FDI flows in selected agricultural activities could not transform the livelihood of many poor people. According to the model results, investment in flowers, vegetables and other cash crops could not reallocate many underemployed or unemployed labors still held in the subsistent coffee and food agriculture sectors. Simulation results indicate that with the introduction of FDI capital into the coffee industry, productivity improved, factors payments increased and accordingly underemployed and/or unemployed labor were efficiently utilized. With better employments and factors payments in the expanded coffee sector, the poverty situation of millions of rural and urban households was reduced. Moreover, due to increased income in the coffee sector, consumptions of agricultural and non-agricultural outputs were enhanced. Demand for outputs among sectors has encouraged inter-industrial linkages. Overall, the cumulative effect of export promotion across the board of all agriculture, in poverty reduction and inter-industrial growth was found more pronounced than the selective export promotion. With coffee world price fluctuation, economic achievements in agricultural and non-agricultural sectors were hampered but the extent of negative outcome was less severe under Scenario 2 than 1. Moreover, as the value of the substitution parameter increased from the base period, the effect of the coffee price shock was cushioned. On the other hand, the negative effect of the price shock was increased when the value of the substitution parameter was decreased.

Due to data constraints, FDI in this study was directly incorporated into the domestic capital as an endowment. This approach did not consider other important features of the FDI. First, coming from foreign owned firms, FDI has distinct production and demand characteristics, which need to be assigned as a separate activity in the CGE model. Income and expenditures of the FDI were not available in the 2006 SAM of Ethiopia. Thus, this study could not explicitly show the amount of outputs, income, and consumption that should have been accounted for in the rest of the world. Second, labor and capital of the FDI were not available in the SAM, and hence technological spillover effects could not be captured in this study. With this limitation, it was not possible to show the magnitude of new technical and managerial skills transferred into the host country. Future research should consider incorporating the above mentioned FDI features.

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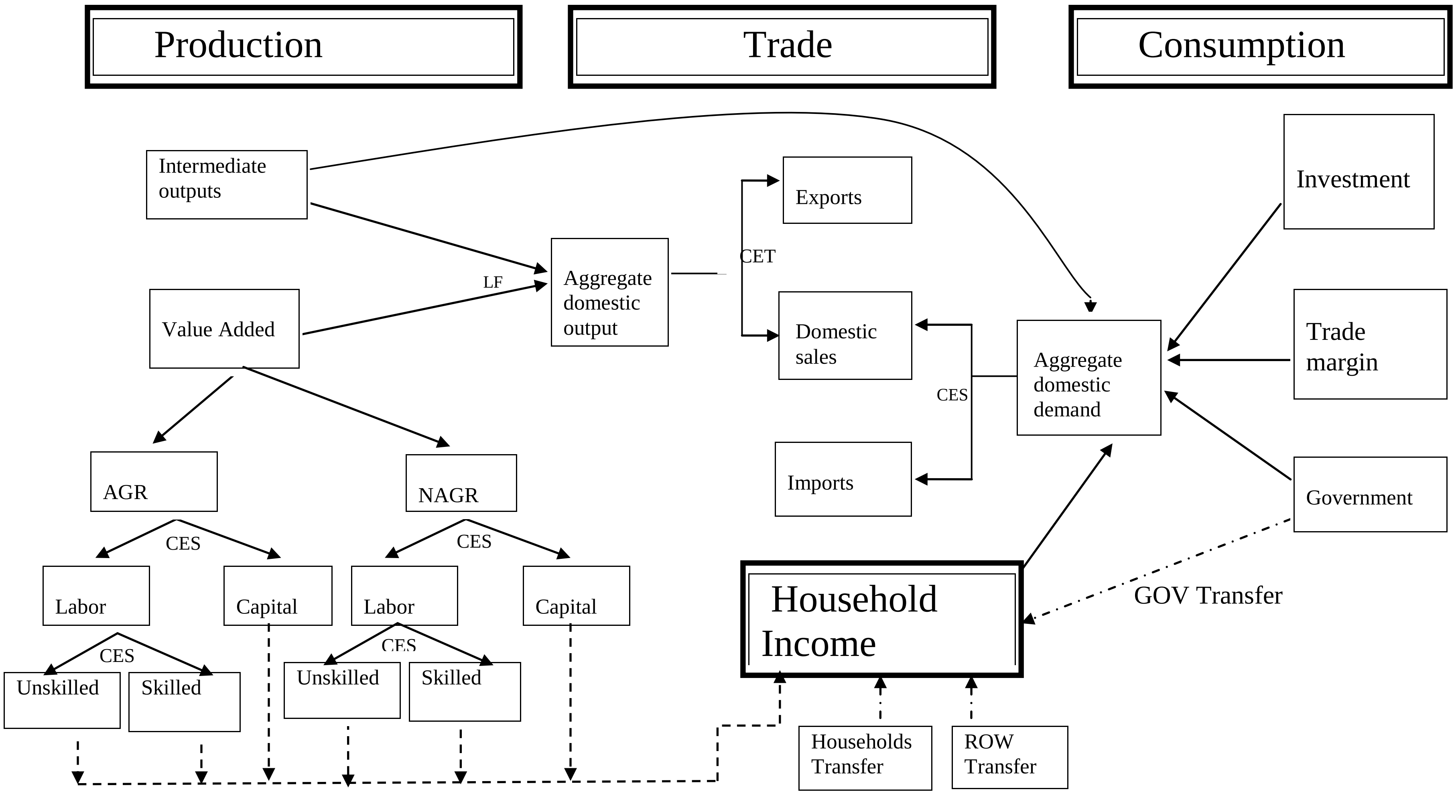
Annex I: CGE Model Flow from Production to Consumption



Annex II: Value Added, Domestic and International Outputs Shares in the SAM data (%)

Activity	Total Output	Value Added	Total Intermediates	Export Share	Domestic Sale	Import Share	Export Intensity	Import Penetration
foodcrp	10.17	13.28	0.15	0.51	11.85	0.02	0.74	0.04
cashcrp	13.73	17.5	1.61	25.74	11.64	0.02	27.82	0.03
coff	10.31	12.47	3.36	37.33	5.6	0	53.77	0.00
oils	2.95	3.48	1.22	11.83	1.4	0	59.57	0.00
livfshfor	18.74	24.23	1.06	20.04	18.51	0	15.87	0.00
mining	0.18	0.24	0	0.01	0.21	0.08	0.44	8.09
foodbev	6.45	1.68	21.79	0.52	7.48	10.9	1.21	25.40
txwdpp	2.07	1	5.49	0.02	2.42	33.44	0.11	76.31
leath	2.96	0.21	11.81	0.03	3.47	2.52	0.13	14.49
fertchemcheq	1.26	1.02	2	0.44	1.4	42.1	5.24	87.55
serv1	12.58	6.04	33.61	0.01	14.77	0.04	0.01	0.06
serv2	12.22	10.99	16.18	3.44	13.75	10.66	4.18	15.32
serv3	6.4	7.85	1.71	0.09	7.5	0.23	0.21	0.70

Annex III. Central Statistics Authority

Household Income, Consumption and Expenditure Survey questionnaires (2004/05)

FORM 2A: QUANTITY AND VALUE OF FOOD, DRINKS AND TOBACCO CONSUMPTION WITHIN 3 AND 4 DAYS /Including purchased, own produced, obtained free, etc./ FORM 2A

SECTION 1 : AREA IDENTIFICATION

1 Round	2 Killil	3 Zone	4 Wereda	5 Town	6 Higher/Wereda	7 Kebele/FA	8 EA Code	9 Household ser NO.	10 Household Size	11 Agr. Holding	12 Head of Household
	2 3	4 5	6 7	8	9 10	11 12 13		16 17	18 19	Yes =1 NO =2 20	

SECTION 2: QUANTITY AND VALUE OF FOOD, DRINKS AND TOBACCO CONSUMPTION WITHIN 3 AND 4 DAYS /Including purchased, own produced, obtained free, etc./

1 3	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	List of Food, Drinks and Tobacco	Food, Drinks and Tobacco code	EXPEN-DITURE Type CASH =1 KIND =2	source	Units of mesurement Name	Code	Day____ Month____ Year______		Day____ Month____ Year______		Day____ Month____ Year______		Day____ Month____ Year______		1st and 2nd Week code
							FIRST WEEK				SECOND WEEK				
							First visit		Second visit		First visit		Second visit		
							Quantity	Value Birr Cents	Quantity	Value Birr Cents	Quantity	Value Birr Cents	Quantity	Value Birr Cents	
21 22		23 24 25 26 27	28	29 30		31 32	33 34 35 36 37	38 39 40 41 42	43 44 45 46 47	48 49 50 51 52	53 54 55 56 57	58 59 60 61 62	63 64 65 66 67	68 69 70 71 72	73
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Code for column 17:

From own agricultural enterprise	=01	Collected free (wood,Water, ...etc)	=07	Income from house rent	=13
From household enterprise other than agriculture	=02	Wages salaries,bounes,overtime and allowances	=08	Income from rent other	
Gift and remittance received from gov. organizatioi	=03	Pension and other social security benefits received	=09	than house rent	=14
Gift and remittance received from NGOs	=04	From saving (Bank and other, saving account)	=10	From Sale of Household fixed	
Gift and remittance received from Households	=05	Interests and royalties received	=11	asset and personal care goods	=15
Gift and remittance received from abroad	=06	Dividends(Profit share)	=12	Other current transfers	=16

FORM 2B: QUANTITY AND VALUE OF FOOD, DRINKS AND TOBACCO CONSUMPTION WITHIN 3 AND 4 DAYS /Including purchased, own produced, obtained free, etc./

FORM 2B

SECTION 1 : AREA IDENTIFICATION

1 Round	2 Killil	3 Zone	4 Wereda	5 Town	6 Higher/Wereda	7 Kebele/FA	8 EA Code	9 Household ser NO.	10 Household Size	11 Agr. Holding	12 Head of Household
	2 3	4 5	6 7	8	9 10	11 12 13		16 17	18 19	Yes =1 NO =2 20	

SECTION 2: QUANTITY AND VALUE OF FOOD, DRINKS AND TOBACCO CONSUMPTION WITHIN 3 AND 4 DAYS /Including purchased, own produced, obtained free, etc./

1 3	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	List of Food, Drinks and Tobacco	Food, Drinks and Tobacco code	EXPEN-DITURE		Units of mesurement		Day___ Month___ Year___		Day___ Month___ Year___		Day___ Month___ Year___		Day___ Month___ Year___		1st and 2nd Week code
							THIRD WEEK				FOURTH WEEK				
			Type CASH =1 KIND =2	source			First visit		Second visit		First visit		Second visit		
							Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
					Name	Code		Birr Cents		Birr Cents		Birr Cents		Birr Cents	
21 22		23 24 25 26 27	28	29 30		31 32	33 34 35 36 37	38 39 40 41 42	43 44 45 46 47	48 49 50 51 52	53 54 55 56 57	58 59 60 61 62	63 64 65 66 67	68 69 70 71 72	73
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Code for column 17:

From own agricultural enterprise	=01	Collected free (wood,Water, ...etc)	=07	Income from house rent	=13
From household enterprise other than agriculture	=02	Wages salaries,bounes,overtime and allowances	=08	Income from rent other than house rent	=14
Gift and remittance received from gov. organization	=03	Pension and other social security benefits received	=09		
Gift and remittance received from NGOs	=04	From saving (Bank and other, saving account)	=10	From Sale of Household fixed asset and personal care goods	=15
Gift and remittance received from Households	=05	Interests and royalties received	=11		
Gift and remittance received from abroad	=06	Dividends(Profit share)	=12	Other current transfers	=16

FORM 3A : NON DURABLE GOODS EXPENDITURE (ACTUAL AND IMPUTED)

FORM 3A

SECTION 1 : AREA IDENTIFICATION

1	2	3	4	5	6	7	8	9	10	11	12
Round	Killil	Zone	Wereda	Town	Higher/Wereda	Kebele/FA	EA Code	Household ser NO.	Household Size	AGR. Holding	Head of Household
	2 3	4 5	6 7	8	9 10	11 12 13		16 17	18 19	Yes =1 NO =2 20	

SECTION 2: NON DURABLE GOODS EXPENDITURE (ACTUAL AND IMPUTED)

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	List of all payments excluding food, drinks and tobaccos collected in form 2A and 2B	Item code	Payment		Units of mesurement		FIRST WEEK Day____ Month____Year______				SECOND WEEK Day____ Month____Year______				1st & 2nd Week Code
			Type CASH =1 KIND =2	source			First visit		Second visit Day____ Month____Year______		First visit		Second visit Day____ Month____Year______		
					Name	Code	Quantity	Value Birr Cents	Quantity	Value Birr Cents	Quantity	Value Birr Cents	Quantity	Value Birr Cents	
21 22		23 24 25 26 27	28	29 30		31 32	33 34 35 36 37 38 39	40 41 42 43 44	45 46 47 48 49 50 51	52 53 54 55 56	57 58 59 60 61 62 63	64 65 66 67 68	69 70 71 72 73 74 75	76 77 78 79 80	81
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Code for column 17:

From own agricultural enterprise	=01	Collected free (wood,Water, ...etc)	=07	Income from house rent	=13
From household enterprise other than agriculture	=02	Wages salaries,bounes,overtime and allowances	=08	Income from rent other than house rent	=14
Gift and remittance received from gov. organization	=03	Pension and other social security benefits received	=09	From Sale of Household fixed asset and personal care goods	=15
Gift and remittance received from NGOs	=04	From saving (Bank and other, saving account)	=10	Other current transfers	=16
Gift and remittance received from Households	=05	Interests and royalties received	=11		
Gift and remittance received from abroad	=06	Dividends(Profit share)	=12		

FORM 3B : NON DURABLE GOODS EXPENDITURE (ACTUAL AND IMPUTED)

FORM 3B

SECTION 1 : AREA IDENTIFICATION

1	2	3	4	5	6	7	8	9	10	11	12
Round	Killil	Zone	Wereda	Town	Higher/Wereda	Kebele/FA	EA Code	Household ser NO.	Household Size	AGR. Holding	Head of Household
	2 3	4 5	6 7	8	9 10	11 12 13		16 17	18 19	Yes =1 NO =2 20	

SECTION 2: NON DURABLE GOODS EXPENDITURE (ACTUAL AND IMPUTED)

1 3	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
			Payment				Day____ Month____ Year______		Day____ Month____ Year______		Day____ Month____ Year______		Day____ Month____ Year______		1st & 2nd Week Code
	List of all payments excluding food, drinks and tobaccos collected in form 2A and 2B	Item code	Type CASH =1 KIND =2	source	Units of mesurement		THIRD WEEK				FOURTH WEEK				
							First visit		Second visit		First visit		Second visit		
							Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
					Name	Code		Birr Cents		Birr Cents		Birr Cents		Birr Cents	
21 22		23 24 25 26 27	28	29 30		31 32	33 34 35 36 37 38 39	40 41 42 43 44	45 46 47 48 49 50 51	52 53 54 55 56	57 58 59 60 61 62 63	64 65 66 67 68	69 70 71 72 73 74 75	76 77 78 79 80	81
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Code for column 17:

From own agricultural enterprise	=01	Collected free (wood,Water, ...etc)	=07	Income from house rent	=13
From household enterprise other than agriculture	=02	Wages salaries,bounes,overtime and allowances	=08	Income from rent other than house rent	=14
Gift and remittance received from gov. organization	=03	Pension and other social security benefits received	=09	From Sale of Household fixed asset and personal care goods	=15
Gift and remittance received from NGOs	=04	From saving (Bank and other, saving account)	=10	Other current transfers	=16
Gift and remittance received from Households	=05	Interests and royalties received	=11		
Gift and remittance received from abroad	=06	Dividends(Profit share)	=12		

FORM 4: LAST 3 AND 6 MONTHS EXPENDITURE ON DURABLE GOODS(ACTUAL AND IMPUTED)

FORM 4

SECTION 1 : AREA IDENTIFICATION

1 Round	2	3 Zone	4 Wereda	5	6 Kifleketema Higher/ Wereda	7 Kebele/FA	8 EA Code	9 Household Serial NO.	10 Household Size	11 Agricultural Holding	12 Head of Household
	2 3	4 5	6 7	8	9 10	11 12 13		16 17	18 19	Yes =1 NO =2 20	

Section 2: LAST 3 AND 6 MONTHS EXPENDITURE ON DURABLE GOODS(ACTUAL AND IMPUTED)

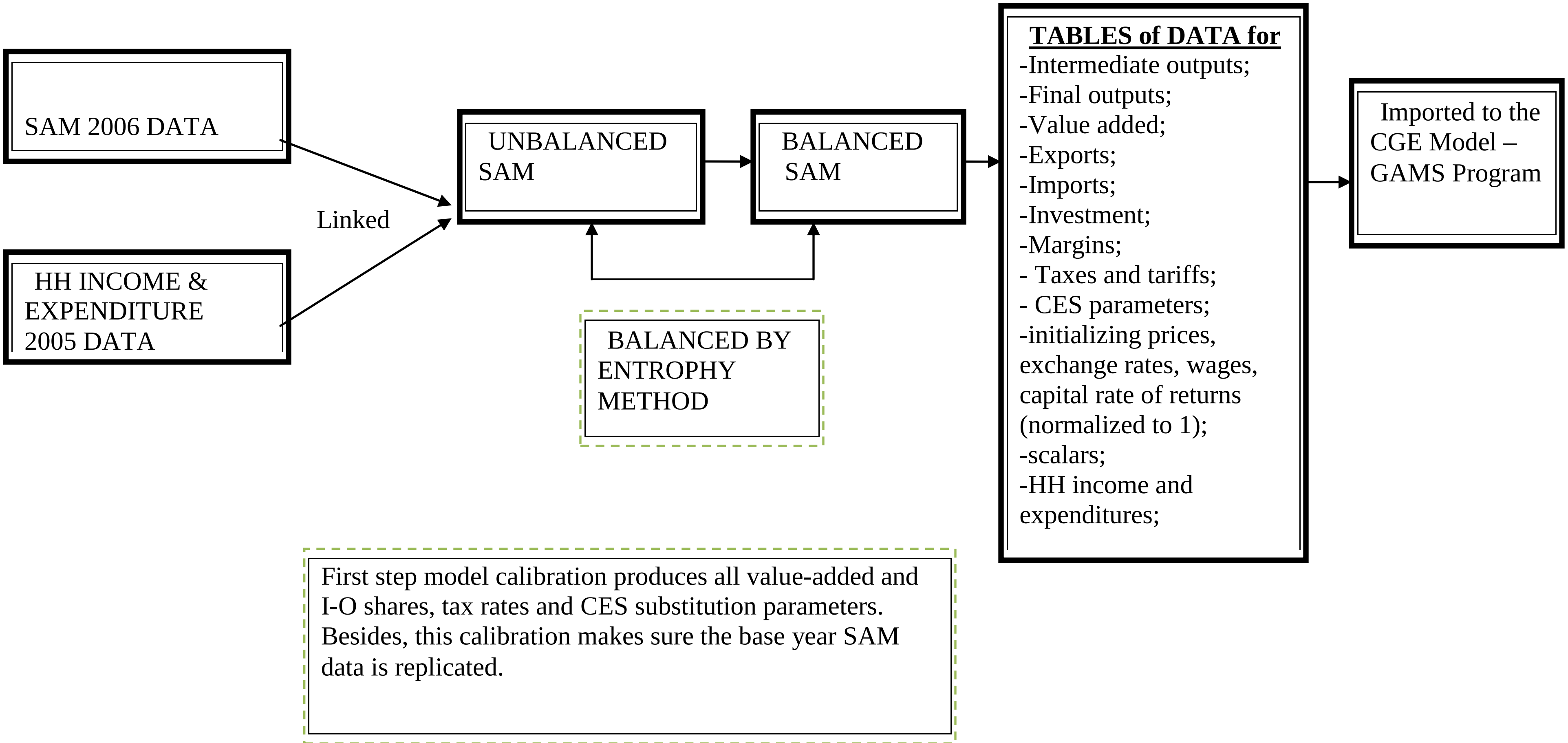
13	14	15	16	17	18	19	20	21	22	23
			Expense		Unit of Mesurement		Day____ Month____ Year ________ LAST 3 MONTHS		Day____ Month____ Year ________ LAST 6 MONTHS	
	List of all payments EXCLUDING food, drinks and tobbaco collected in Forms 2A and 2B	Item code	Type	source	Name	Code	Quantity	Value Birr	Quantity	Value Birr
21 22		23 24 25 26 27	28	29 30		31 32	33 34 35 36 37 38 39	40 41 42 43 44	45 46 47 48 49 50 51	52 53 54 55 56

IN CASH =1
IN KIND =2

Code for column 17:

From own agricultural enterprise	=01	Collected free (wood,Water, ...etc)	=07	Income from house rent	=13
From household enterprise other than agriculture	=02	Wages salaries,bounes,overtime and allowances	=08	Income from rent other than house rent	=14
Gift & remittance received from gov. organization	=03	Pension & other social security benefits received	=09	From Sale of Household fixed asset & personal care goods	=15
Gift and remittance received from NGOs	=04	From saving (Bank and other, saving account)	=10	Other current transfers	=16
Gift and remittance received from Households	=05	Interests and royalties received	=11		
Gift and remittance received from abroad	=06	Dividends(Profit share)	=12		

Annex IV: Procedures of Using the SAM, Household Survey and Parameters data in CGE Model



Annex V-a: Sensitivity Analysis Result

	Experiment 3	Experiment 4	Experiment 5	Experiment 6	Experiment 7	Experiment8
Household Income	-0.116	-0.103	-0.087	-0.072	-0.133	-0.129
<u>OUTPUT</u>						
foodcrp	-0.103	-0.065	-0.080	-0.048	-0.120	-0.081
cashcrp	-0.116	-0.055	-0.101	-0.038	-0.154	-0.097
coff	-0.092	-0.065	-0.068	-0.037	-0.120	-0.845
oils	-0.047	-0.032	-0.033	-0.019	-0.083	-0.063
livfshfor	-0.141	-0.077	-0.116	-0.055	-0.137	-0.091
mining	-0.129	-0.073	-0.087	-0.042	-0.103	-0.103
foodbev	-0.116	-0.048	-0.091	-0.037	-0.129	-0.066
txwdpp	-0.125	-0.039	-0.087	-0.001	-0.149	-0.042
leath	-0.103	-0.095	-0.076	-0.045	-0.121	-0.105
fertchemcheq	-0.108	-0.083	-0.051	-0.032	-0.095	-0.053
serv1	-0.092	-0.053	-0.087	-0.075	-0.139	-0.060
serv2	-0.075	-0.056	-0.035	-0.042	-0.090	-0.068
serv3	-0.144	-0.052	-0.108	-0.042	-0.150	-0.063

Experiment 3: 40% fall in world coffee price under Simulation 1;
Experiment 4 40% fall in world coffee price under Simulation 1;
Experiment 5: 50% increase in substitution parameter over experiment 3;
Experiment 6: 50% increase in substitution parameter over experiment 4;
Experiment 8: 50% fall in substitution parameter over experiment 4.

Annex V-b: Sensitivity Analysis Result

	Experiment 3	Experiment 4	Experiment 5	Experiment 6	Experiment 7	Experiment8
Export						
foodcrp	-0.080	-0.056	-0.064	-0.032	-0.120	-0.095
cashcrp	-0.106	-0.034	-0.084	-0.029	-0.145	-0.063
coff	-0.235	-0.161	-0.163	-0.094	-0.265	-0.187
oils	-0.030	-0.020	-0.026	-0.017	-0.071	-0.060
livfshfor	-0.062	-0.038	-0.063	-0.023	-0.087	-0.069
mining	0.000	0.000	0.000	0.000	0.000	0.000
foodbev	-0.095	-0.055	-0.067	-0.046	-0.124	-0.073
txwdpp	-0.190	-0.158	-0.095	-0.053	-0.143	-0.105
leath	-0.140	-0.075	-0.100	-0.050	-0.120	-0.075
fertchemcheq	-0.117	-0.087	-0.064	-0.033	-0.096	-0.043
serv1	-0.111	-0.071	-0.056	-0.057	-0.089	-0.071
serv2	-0.084	-0.050	-0.036	-0.038	-0.049	-0.040
serv3	-0.125	-0.071	-0.063	-0.021	-0.069	-0.036

Annex V-c: Sensitivity Analysis Result

	Experiment 3	Experiment 4	Experiment 5	Experiment 6	Experiment 7	Experiment8
Import						
foodcrp	-0.150	-0.100	-0.064	-0.032	-0.200	-0.150
cashcrp	-0.333	-0.250	-0.084	-0.029	-0.367	-0.310
coff	0.000	0.000	-0.163	-0.094	0.000	0.000
oils	0.000	0.000	-0.026	-0.017	0.833	0.781
livfshfor	0.000	0.000	-0.063	-0.023	0.000	0.000
mining	-0.500	-0.200	0.000	0.000	-0.600	-0.250
foodbev	-0.037	-0.051	-0.067	-0.046	-0.042	-0.075
txwdpp	-0.175	-0.144	-0.095	-0.053	-0.185	-0.160
leath	0.063	0.088	-0.100	-0.050	0.075	0.092
fertchemcheq	0.011	0.033	-0.064	-0.033	0.011	0.033
serv1	-0.083	-0.150	-0.056	-0.057	-0.083	-0.150
serv2	-0.037	-0.025	-0.036	-0.038	-0.053	-0.041
serv3	-0.250	-0.107	-0.063	-0.021	-0.321	-0.214

Annex V-d: Sensitivity Analysis Result

	Experiment 3	Experiment 4	Experiment 5	Experiment 6	Experiment 7	Experiment8
w	0.062	0.018	0.060	0.009	0.075	0.037
wa	-0.224	-0.209	-0.179	-0.167	-0.258	-0.234
r						
mining	-0.051	-0.025	-0.031	-0.021	-0.077	-0.036
foodbev	0.039	0.046	0.069	0.113	0.014	0.013
txwdpp	-0.069	-0.024	0.014	0.058	-0.079	-0.028
leath	-0.097	-0.036	-0.076	-0.027	-0.101	-0.039
fertchemcheq	-0.160	-0.127	-0.040	-0.017	-0.230	-0.137
serv1	-0.143	0.078	-0.056	0.057	-0.151	0.070
serv2	0.053	0.014	0.055	0.025	0.050	0.012
serv3	-0.091	-0.036	-0.427	0.012	-0.102	-0.042
ra						
foodcrp	-0.033	-0.024	-0.006	0.014	-0.061	-0.042
cashcrp	-0.041	-0.026	-0.002	0.025	-0.055	-0.049
coff	-0.228	-0.139	-0.096	-0.046	-0.270	-0.162
oils	-0.125	-0.122	-0.113	-0.071	-0.147	-0.142
livfshfor	-0.150	-0.114	-0.906	-0.071	-0.168	-0.140

Annex VI: GAMS Code Used to Balance the SAM

```
option limrow=2, limcol=2;
option iterlim = 99999;
option reslim = 99999;

*1. Input names of matrix accounts

set I MATRIX ACCOUNTS
/afoodcrp, acashcrp, acoff, aoils, alivfshfor, amining, afoodbev,
atxwdpp, aleath, aoilmachequ, aserv1, aserv2, aserv3, cfoodcrp,
ccashcrp, cchat,
ccoff, coils, clivfshfor, cflower, cminerals, cfoodbev, ctxtwdpp,
cleath, cfertchem, coilmachequ, cserv1, cserv2, cserv3, TMargin, LLNQ,
LLQ, LNQ,
LQ, KKD, KD, GOV, H1, INDTAX, IMDUTY, EXDUTY, DIRTAX, DSTK , SI, RoW,
TOT/

NHH(I) All accounts except households and total
 /afoodcrp, acashcrp, acoff, aoils, alivfshfor, amining, afoodbev,
atxwdpp, aleath, aoilmachequ, aserv1, aserv2, aserv3, cfoodcrp,
ccashcrp, cchat,
ccoff, coils, clivfshfor, cflower, cminerals, cfoodbev, ctxtwdpp,
cleath, cfertchem, coilmachequ, cserv1, cserv2, cserv3, TMargin, LLNQ,
LLQ, LNQ,
LQ, KKD, KD, GOV, INDTAX, IMDUTY, EXDUTY, DIRTAX, DSTK , SI, RoW/
INT(I) All accounts except total

ALIAS(I,J);
ALIAS(INT,JNT);
ALIAS(NHH,NHH2);
INT(I) = YES;
INT('TOT') = NO;

*2. Input initial matrix

parameter SAMA(I,J) Initial unbalanced matrix;

$libinclude xlimport SAMA unbalncedSAM.xls A2:AU48/m
*If xlimport does not work, put asterisks in front of the preceding
two lines and remove asterisk in front of following line:
*Initial unbalanced SAM

*$INCLUDE unbalanced.prn;

PARAMETER SAMAT(I,J) Initial matrix with transposed negative values
and any new values (coefficients);

*display SAMAT;
```

```
*Initial matrix copied
SAMAT(I,J)=SAMA(I,J);

*Position of negative values in unbalanced matrix are noted
PARAMETER neg(I,J) Matrix of negative values;
neg(INT,JNT)$(SAMAT(INT,JNT) LT 0)=1;

*Negative matrix values are transposed
SAMAT(INT,JNT)$(SAMAT(JNT,INT) LT 0)=SAMAT(INT,JNT)-SAMAT(JNT,INT);
SAMAT(JNT,INT)$(SAMAT(JNT,INT) LT 0)=0;

*Row and column sums are calculated
SAMAT("TOT",JNT)=sum(INT,SAMAT(INT,JNT));
SAMAT(INT,"TOT")=sum(JNT,SAMAT(INT,JNT));

SCALARS
delta      Added small constant (to avoid logs of zeros)
scale      Scaling factor (to ease resolution);
delta=.0001;

*3. Choose NO scaling factor since SAM values are not large
scale=1;

*Values scaled
SAMAT(I,J)=SAMAT(I,J)/scale;

VARIABLES
NSAMT(I,J)     New SAM with transposed negative values
OPT            Distance variable;

*Initialisation of variables
NSAMT.L(I,J) = SAMAT(I,J);
OPT.L           = 0;

*Program equations
EQUATIONS
OPTIMIZE      Optimization criterion
CONSTRAINT(I) Equality between matrix and row sums;
*CONSTRAINT1  Proportions sum equal one ;

*EQUATIONS

*Least squares (in percentage form) optimization criterion
*OPTIMIZE..  OPT =E=
SUM((NHH,NHH2)$SAMAT(NHH,NHH2),(((NSAMT(NHH,NHH2)-
SAMAT(NHH,NHH2))**2)/SAMAT(NHH,NHH2)));


*Entropy optimization criterion
OPTIMIZE..    OPT =E= SUM((NHH,NHH2)$(SAMAT(NHH,NHH2) NE
0),(NSAMT(NHH,NHH2))
```

```
                     *(LOG(NSAMT(NHH,NHH2)+delta)-
LOG(SAMAT(NHH,NHH2)+delta)));


*Equality between row and column sums
CONSTRAINT(INT).. SUM(JNT,NSAMT(INT,JNT))=E=SUM(JNT,NSAMT(JNT,INT));


*Definition of limits

*Cell values between 0 and infinity and empty cells remain empty
NSAMT.LO(INT,JNT)                      = 0 ;
NSAMT.UP(INT,JNT)                      = +INF ;
NSAMT.FX(INT,JNT)$(NOT SAMAT(INT,JNT)) = 0 ;

*4. Fix any values as desired
NSAMT.FX("H1",I)=SAMAT("H1",I);
NSAMT.FX(I,"H1")=SAMAT(I,"H1");

*Model
MODEL BALENTROP / ALL /;
BALENTROP.workspace = 10;
BALENTROP.optfile = 1;
*BALENTROP.holdfixed =1;

*5. Choose solver
*OPTION NLP             = MINOS;
*OPTION NLP             = MINOS5;
*OPTION NLP             = CONOPT;
OPTION NLP             = CONOPT2;

option iterlim = 99999;

SOLVE BALENTROP using nlp minimizing opt;

*Results copied into new matrix

Parameters
NSAM(I,J) New (balanced) matrix;
NSAM(INT,JNT)=NSAMT.L(INT,JNT)*scale;

*Negative values retransposed to original position
NSAM(INT,JNT)$(neg(INT,JNT)=1)=-NSAM(JNT,INT);
NSAM(JNT,INT)$(neg(INT,JNT)=1)=0;

*New row and column totals calculated
NSAM("TOT",JNT)= SUM(INT, NSAM(INT,JNT));
NSAM(INT,"TOT")= SUM(JNT, NSAM(INT,JNT));

Parameter
PROBS(I,J);
PROBS(I,J)=0;
```

```
PROBS(I,J)$(NSAM(I,J) EQ 0 AND SAMA(I,J) NE 0)=SAMA(I,J);

option
limrow=2,
limcol=2;

DISPLAY PROBS, NSAM;

*6. Provide name and range of Excel file for exporting new matrix
*Notes: A file with this name must exist. It will remain intact except
the range of the SAM.
$libinclude xlexport NSAM balanced.xls A2:AU48/m
*If xlimport does not work, put an asterisk in front of the preceding
line

file tabs /

   balanced.xls/;
   tabs.pc=6;
   tabs.pw=32767;
*tabs.pw=100000;
   tabs.ps=100;
   tabs.nd=4;

put tabs;
put '' loop(I, put I.TL); put /;
loop(I, put I.TL
  loop(J, put nsam(I,J) :15 :6); put /;
    );

*put '' loop(J, put J.TL:15); put/;
*loop(I$nsam(I,J), put I.tl
*loop(J,nsam(I,J) :15 :6);put /;or *put nsam(I,J):10:6/; put/;
*put /;
*);
```

Annex VII. GAMS Code Used to Program the CGE Model

```
$TITLE                  RESEARCH MODEL
$STITLE                 SMALL OPEN ECONOMY FOR ETHIOPIA

*Model of a small open economy producing 2 goods using 2 factors owned
by 3 household categories.




*--------------------------------Sets definition----------------*

SET
I Sectors
  /foodcrp, cashcrp, coff, oils, livfshfor, mining, foodbev, txwdpp, leath,
fertchemcheq, serv1, serv2, serv3/


TR(I) tradables

/foodcrp, cashcrp, coff, oils, livfshfor, mining, foodbev, txwdpp, leath,
fertchemcheq, serv1, serv2, serv3/

AGR(TR) Agriculture tradables including coffee

/foodcrp, cashcrp, coff, oils, livfshfor/

AGRCSH(TR)  Agriculture CSH CROPS LESS coffee

/cashcrp, oils, livfshfor/

NAGR(TR) Non AGR tradables

/mining, foodbev, txwdpp, leath, fertchemcheq, serv1, serv2, serv3/

GOOD(TR) Goods

 /foodcrp, cashcrp, coff, oils, livfshfor, mining, foodbev, txwdpp, leath,
fertchemcheq, serv1, serv2, serv3/

H   Household institutions   /H1/

ALIAS (I,J)
ALIAS (TR,TRJ)
ALIAS (AGR, AGRJ)
ALIAS (NAGR,NAGRJ)
```

```
*------------------------------Parameters definition-------------*

PARAMETER

A_KKL(AGR)Scale parameter for CES of capital and labor of AGR activity
A_KL(NAGR)Scale parameter for CES of capital and labor of NAGR activ
A_LL(AGR) Scale parameter for CES of skilled and unskilled labor of AGR
A_L(NAGR) Scale parameter for CES of skilled & unskilled labor of NAGR
alpha_KKL(AGR)Share parameter for CES between labor & capital in AGR
alpha_KL(NAGR)Share parameter for CES between labor &capital in NAGR
alpha_LL(AGR) Share parameter for CES skilled & unskilled labor of AGR
alpha_L(NAGR) Share parameter for CES skilled & unskilled labor of NAGR
sigma_KKL(AGR)Elasticity of transformation between capital and labor in AGR
activity (0<sigma<infinity)
sigma_KL(NAGR) Elasticity of transformation(CES) between capital and labor in
NAGR activity (0<sigma<infinity)
sigma_LL(AGR) Substitution elasticity (CES skilled & unskilled ARG labor)
sigma_L(NAGR) Substitution elasticity (CES skilled and unskilled NAGR labor)
rho_KKL(AGR) Substitution parameter (CES in agri capital and labor)
rho_KL(NAGR) Substitution parameter (CES in non agri capital labor)
rho_LL(AGR)  Substitution parameter (CES for skilled and unskilled agri
labor)
rho_L(NAGR) Substitution parameter (CES skilled and unskilled non agri labor)
io(I)   Coefficient at aggregate intermediate(Leontief total intermediate
consumption)
v(I)  Coefficient at aggregate value added(Leontief value added)
aij(TR,J) Input output coefficient (intermediate input TR in production of
output A)
gamma(H,TR) Marginal share of marketed goods in LES consumption function
YELAS(H,TR) Household H Income elasticity for MARKETED good TR
V_MIN(H)    Household minimum consumption of marketed goods value (temp
variable)
C_MIN(H,TR) Minimum consumption of marketed good TR (LES consumption
function)
FRISCH(H) Frisch parameter (LES consumption function)
psi(H)    Propensity to save for household H
psio(H)   Propensity to  save for HH intercept
mu(TR)    Share of the value of good TR in total investment
zeta(TR)  Share of commodity TR in total government consumption expenditure
lambda_r(H)  Share of NAGR capital income received by household H
lambda_ra(H) Share of AGR capital income received by household H
lambda_row   Share of NAGR capital received from the ROW
flab1(H)   Share of unskilled agri labor wage income received by household H
flab2(H) Share of skilled AGR labor wage income received by household H
flab3(H) Share of unskilled NAGR labor wage income received by household H
flab4(H) Share of skilled NAGR labor wage income received by household H
tmarg(TR)  Rate of margin applied to commodity TR
tm(TR)     Import duties on good(TR)

te(TR)    Export duty on good C
tyh(H)    Direct income tax rate for household H
B_E(TR)   Scale parameter (CET between domestic and exported commodities)
beta_e(TR) Share parameter (CET between domestic and exported commodities)
kappa_e(TR) Transformation parameter (CET function for domestic and export)
tau_e(TR) Transformation elasticity (CET function domestic and exp)
A_M(TR)   Scale parameter (CES between domestic and imported commodities)
rho_m(TR) Substitution parameter (CES function for domestic and imported)
```

```
alpha_m(TR) Share parameter (CES function  for domestic and imported)
sigma_m(TR) Substitution elasticity (CES function for domestic and imported)
delta(I)    Share of sector A in total value added
exshare(TR) Export share of commodity TR
dk          Change in KKD due to FDI


*Bench mark variables
*1. Prices

wao     Composite wage rate for agricultural labor
wo      Composite wage rate for non agricultural labor
wnq1o   Unskilled agri labor wage rate
wq1o    Skilled agri labor wage rate
wnq2o   Unskilled nag labor wage rate
wq2o    Skilled nag labor wage rate
ro(NAGR)  Rate of return to non agri capital
rao(AGR)  Rate of return to agri capital
*rro      Rate of return to NAGR capital to ROW

PO(I)    Producer price of good TR at activity level
PVO(I)   Value added price for sector A
PDO(TR)  Domestic price of good TR including tax
PLO(TR)  Domestic price of good TR excluding tax
PCO(TR)  Price of composite good TR

PWMO(TR)  World price of import TC (foreign currency)
PWEO(TR)  World price of export TR (foreign currency)
Pfobo(TR) Boarder price of C effectively paid by foreign customers on foreign
market
PEO(TR)   Domestic price of exported TR
PMO(TR)   Domestic price of imported TR
PINDEXO   Producer price index
PINVO     Investment price index
eo        Exchange rate

*Production – volume

QXO(I)    Aggregate supply of commodity C by activity A
VAO(I)    Value added of Activity A
INTRMO(TR,J) Intermediate consumption of good TR by activity A
TINTRMO(J)   Total intermediate consumption by activity A

  NNAO     Sample size of NAGR activities A

*Factors - volume

KSO        Total NAGR capital supply
KKSO       Total AGR capital supply
KDROWO     Non AGR capital demanded by ROW
KDO(NAGR)  Activity A demand for NAGR capital
KKDO(AGR)  Activity A demand for composite AGR capital
LLQO(AGR)  Industry A demand for Skilled agri labor demand
LLNQO(AGR) Industry A demand for Unskilled agr labor demand
LQO(NAGR)  Industry A demand for Skilled NAGR labor demand
LNQO(NAGR) Industry A demand for Unskilled NAGR labor demand
LLSO       Total AGR labor supply for activities
```

```
LSO          Total NAGR labor supply for all activities
LDO(NAGR)    Sector A demand for NAGR labor
LLDO(AGR)    Sector A demand for AGR labor
TKDO         Total NAGR capital demand (including K demanded by the row)

*Demand - volume

CONSMKO(H,TR)Consumption of marketed good TR by household H
TCONSHO(H)    Household H total consumption
INVO(TR)      Investment in good TR (volume)
TINVO         Total investment (value)
INVOLO        Total investment (volume)
INTRMDO(TR)   Intermediate demand of commodity TR by different activities
TINTRMO(I)    Total intermediate
GOVO          Total public consumption (government expenditure) (value)
ROWYO         Total receipt by the ROW
GO(TR)        Public consumption of commodity TR
DDO(TR)       Domestic demand for commodity TR
QQO(TR)       Total Demand of composite good TR
DMRKO(TR)     Domestic good supplied by each TR
MARGINO(TR)   Demand for commodity TR as a trade or transport margin
TMARGINO(TR)  Total trade margin received by commodity TR
DSTKO(TR)     Demand of commodity TR for inventory stock change
PPWGTO        Weighted sample size
HHCMROWO(H)   Household H demand for imported composite commodity

*International trade - volume

 MO(TR)       Imports of good TR
 EXO(TR)      Exports of good TR
 GMROWO       Imported composite good by gov
 HMROWO       Imported composite goods by H
 CABO         Current account balance
 ROWYO        Total receipt by ROW
 FDIYO        FDI income

*Income and savings - nominal values

 YHTO        Total household income base year
 YHO(H)      Household H income
 YDHO(H)     Household H disposable income
 YGO         Government income
 SHO(H)      Household H savings
 SGO         Government savings
 TRHO(H)     Transfer between households
 TRGO(H)     Public transfers to households
 TRROWO(H)   Transfer from ROW to household(in FCU)
 TRROWGO     Transfer from ROW to G(in FCU)
 INDTAXO(TR) Receipts from indirect tax
 IMDUTYO(TR) Receipts from indirect tax on imports
 DIRTAXTO    Total indirect tax received at base year
 DIRTAXO(H) Receipts from direct taxation on household H income
 EXDUTYO(TR)  Receipt from indirect tax on EXPORT

* GDP Gross Domestic product

 GDPfpO    GDP at factor price
```

```
 GDPmpO    GDP at market price
 GDPfdO    GDP at final demand at purchases price;

*-------------------------------Benchmark data----------------------*

parameter INTRMO(TR,J)  Intermediate TR consumed by activities (A)
Parameter DPA(*,I)  Output and input parameter values at activity level
Parameter scal(*,*) Scalar values
Parameter HOUSEHOLDS(H,*) Consumed commodity TR direct tax and sources of
income of household H
Parameter VAD(*,I)  value added
Parameter DMX(I,J)  Each domestic commodity TR produced by A;

$libinclude xlimport INTRMO MODELSAM21.xls A3:N16/m
$libinclude xlimport DPA MODELSAM21.xls A21:N60/m
$libinclude xlimport scal MODELSAM21.xls A63:B89/m
$libinclude xlimport VAD MODELSAM21.xls A93:N99/m
$libinclude xlimport DMX MODELSAM21.xls A105:N118/m
$libinclude xlimport HOUSEHOLDS MODELSAM21.xls A123:X124/m
*$libinclude xlimport HOUSEHOLDS MODELSAM21.xls A128:X17889/m
;
*-----------------------------Variable assignment--------------------*

QXO(I)          = DPA("QXO",I);
VAO(I)          = DPA("VAO",I);
TINTRMO(I)      = DPA("TINTRMO",I);
LLNQO(AGR)      = DPA("LLNQO",AGR);
LLQO(AGR)       = DPA("LLQO",AGR);
LNQO(NAGR)      = DPA("LNQO",NAGR);
LQO(NAGR)       = DPA("LQO",NAGR);
LLDO(AGR)       = DPA("LLDO",AGR);
LDO(NAGR)       = DPA("LDO",NAGR);
KKDO(AGR)       = DPA("KKDO",AGR);
KDO(NAGR)       = DPA("KDO",NAGR);
PO(I)           = DPA("PO",I);
sigma_KL(NAGR) = DPA("sigma_KL",NAGR);
sigma_KKL(AGR) = DPA("sigma_KKL",AGR);
sigma_L(NAGR)  = DPA("sigma_L",NAGR);
sigma_LL(AGR)  = DPA("sigma_LL",AGR);
ro(NAGR)        = DPA("ro",NAGR);
rao(AGR)        = DPA("rao",AGR);

INVO(TR)         = DPA("INVO",TR);
EXO(TR)          = DPA("EXO",TR);
DDO(TR)          = DPA("DDO",TR);
MO(TR)           = DPA("MO",TR);
QQO(TR)          = DPA("QQO",TR);
PCO(TR)          = DPA("PCO",TR);
PLO(TR)          = DPA("PLO",TR);
PWMO(TR)         = DPA("PWMO",TR);
*Pfobo(TR)        = DPA("Pfobo",TR);
PEO(TR)          = DPA("PEO",TR);
PWMO(TR)         = DPA("PWMO",TR);
INDTAXO(TR)      = DPA("INDTAXO",TR);
IMDUTYO(TR)      = DPA("IMDUTYO",TR);
EXDUTYO(TR)      = DPA("EXDUTYO",TR);
TMARGINO(TR)     = DPA("TMARGINO",TR);
```

```
MARGINO(TR)      = DPA("MARGINO",TR);
DSTKO(TR)        = DPA("DSTKO",TR);
GO(TR)           = DPA("GO", TR);
sigma_m(TR)      = DPA("sigma_m",TR);
tau_e(TR)        = DPA("tau_e",TR);
exshare(TR)      = DPA("exshare",TR);
YHTO             = scal("YHTO","temp");
YGO              = scal("YGO","temp");
SGO              = scal("SGO","temp");
GOVO             = scal("GOVO","temp");
TINVO            = scal("TINVO","temp");
CABO             = scal("CABO","temp");
ROWYO            = scal("ROWYO","temp");
HMROWO           = scal("HMROWO","temp");
GMROWO           = scal("GMROWO","temp");
TRROWGO          = scal("TRROWGO","temp");
KDROWO           = scal("KDROWO","temp");
FDIYO            = scal("FDIYO","temp");
PINVO            = scal("PINVO","temp");
DIRTAXTO         = scal("DIRTAXTO","temp");
eo               = scal("eo","temp");
PPWGTO           = scal("PPWGTO","temp");
NNAO             = scal("NNAO","temp");
*rro             = scal("rro","temp");
wnq1o            = scal("wnq1o","temp");
wq1o             = scal("wq1o","temp");
wnq2o            = scal("wnq2o","temp");
wq2o             = scal("wq2o","temp");
wao              = scal("wao","temp");
wo               = scal("wo","temp");
flab1(H)         = HOUSEHOLDS(H,"flab1");
flab2(H)         = HOUSEHOLDS(H,"flab2");
flab3(H)         = HOUSEHOLDS(H,"flab3");
flab4(H)         = HOUSEHOLDS(H,"flab4");
lambda_ra(H)     = HOUSEHOLDS(H,"lambda_ra");
lambda_r(H)      = HOUSEHOLDS(H,"lambda_r");
TRGO(H)          = HOUSEHOLDS(H,"TRGO");
TRHO(H)          = HOUSEHOLDS(H,"TRHO");
TRROWO(H)        = HOUSEHOLDS(H,"TRROWO");
CONSMKO(H,TR)    = HOUSEHOLDS(H,TR);
CONSMKO(H,TR)    = HOUSEHOLDS(H,TR);
DIRTAXO(H)       = HOUSEHOLDS(H,"DIRTAXO");
YHO(H)        =
flab1(H)+flab2(H)+flab3(H)+flab4(H)+lambda_ra(H)+lambda_r(H)+TRGO(H)+TRHO(H)+
TRROWO(H);
HHCMROWO(H)    = HMROWO/PPWGTO;
tyh(H)         = DIRTAXO(H)/YHO(H);
DIRTAXO(H)     =  tyh(H)*YHO(H);
TCONSHO(H)     = SUM(TR,CONSMKO(H,TR))+TRHO(H)+HHCMROWO(H);
SHO(H)         = YHO(H)-DIRTAXO(H)-TCONSHO(H);
YDHO(H)        = YHO(H) - DIRTAXO(H);


*Frisch parameter for sub-Saharan Africa
FRISCH(H)       = -5.8;

*Propensity to save intercept
```

```
psio(H)        = 0;

*the rate of capital change

*dk          = 0.15;
dk          = 0;

*income elasticity for commodities

*Fertchemcheq- contained industry produced laundry and body cleaning staffs,
house and office equipments and appliances, cars, motorcycles, bicyles
*textwdpp – industry produced clothing and plastic footwear’s
*leath - industrial leather shoes and wearing
*minerals – gas and charcoals


Table YELASTAB(*,TR)
       foodcrp  cashcrp    coff     oils    livfshfor  mining  foodbev
temp    0.89      0.89      0.60    0.97    1.65        0.94      0.85

      txwdpp   leath  fertchemcheq   serv1   serv2  serv3

      0.94     0.94      0.94          1.4     1.4   1.4;


YELAS(H,TR)   = YELASTAB("temp",TR);



*-------------------------Calibration of parameters-------------------*

*Production (CES and Leontief)

io(I)          = TINTRMO(I)/QXO(I);
v(I)           = VAO(I)/QXO(I);

**CES between capital-labor
*From elasticity of substitution sigma=1/(rho+1

rho_KL(NAGR)     = (1-sigma_KL(NAGR))/sigma_KL(NAGR);
rho_KKL(AGR)     =(1-sigma_KKL(AGR))/sigma_KKL(AGR);
alpha_KL(NAGR)   =  (wo/ro(NAGR))*(LDO(NAGR)/KDO(NAGR))**(1/sigma_KL(NAGR));
alpha_KL(NAGR)   =   alpha_KL(NAGR)/(1+alpha_KL(NAGR));
alpha_KKL(AGR)   =  (wao/rao(AGR))*(LLDO(AGR)/KKDO(AGR))**(1/sigma_KKL(AGR));
alpha_KKL(AGR)   = alpha_KKL(AGR)/(1+alpha_KKL(AGR));

A_KL(NAGR)      = VAO(NAGR)/(alpha_KL(NAGR)*LDO(NAGR)**(-rho_KL(NAGR))
                 +(1-alpha_KL(NAGR))*KDO(NAGR)**(-rho_KL(NAGR)))
                 **(-1/rho_KL(NAGR));
A_KKL(AGR)     = VAO(AGR)/(alpha_KKL(AGR)*LLDO(AGR)**(-rho_KKL(AGR))
                 +(1-alpha_KKL(AGR))*KKDO(AGR)**(-rho_KKL(AGR)))
                 **(-1/rho_KKL(AGR));
* CES between skilled and unskilled labor

rho_L(NAGR)   = (1-sigma_L(NAGR))/sigma_L(NAGR);
rho_LL(AGR)   = (1-sigma_LL(AGR))/sigma_LL(AGR);
alpha_L(NAGR) = (wq2o/wnq2o)*(LQO(NAGR)/LNQO(NAGR))**(1/sigma_L(NAGR));
```

```
alpha_LL(AGR) = (wq1o/wnq1o)*(LLQO(AGR)/LLNQO(AGR))**(1/sigma_LL(AGR));
alpha_LL(AGR)   = alpha_LL(AGR)/(1+alpha_LL(AGR));
alpha_L(NAGR)    = alpha_L(NAGR)/(1+alpha_L(NAGR));
A_L(NAGR)       = LDO(NAGR)/(alpha_L(NAGR)*LQO(NAGR)**(-rho_L(NAGR))
                  +(1-alpha_L(NAGR))*LNQO(NAGR)**(-rho_L(NAGR)))
                  **(-1/rho_L(NAGR)) ;

A_LL(AGR)      = LLDO(AGR)/(alpha_LL(AGR)*LLQO(AGR)**(-rho_LL(AGR))
                 +(1-alpha_LL(AGR))*LLNQO(AGR)**(-rho_LL(AGR)))
                 **(-1/rho_LL(AGR)) ;

*Value added price

PVO(I)      = (PO(I)*QXO(I) - SUM(TRJ,PCO(TRJ)*INTRMO(TRJ,I)) )/VAO(I) ;
delta(I)    = PVO(I)*VAO(I)/SUM(J,PVO(J)*VAO(J));

*wages and rate of return to capitals: wage is sector specific (fixed in
capital) but capital is activity specific

*wao         = sum(AGR,(wnq1o*LLNQO(AGR)+wq1o*LLQO(AGR)))/LLDO(AGR);
*wo          = SUM(NAGR,(wnq2o*LNQO(NAGR)+wq2o*LQO(NAGR)))/LDO(NAGR);
rao(AGR)     = (PVO(AGR)*VAO(AGR) - wao*LLDO(AGR))/KKDO(AGR) ;
ro(NAGR)     = (PVO(NAGR)*VAO(NAGR) - wo*LDO(NAGR))/KDO(NAGR) ;
*rro         = sum(A,ro(A))/NNAO;


*Share parameters and margin rate
*pshio is introduced as saving intercept to control the undesirable
* Consequence of negative saving

psi(H)         = (SHO(H)-psio(H))/YDHO(H);
mu(TR)         = (PCO(TR)*INVO(TR))/TINVO;
zeta(TR)       = (PCO(TR)*GO(TR))/GOVO;
aij(TR,J)      = INTRMO(TR,J)/TINTRMO(J);
flab1(H)       = flab1(H)/SUM(AGR,wao*LLDO(AGR));
flab2(H)       = flab2(H)/sum(AGR, wao*LLDO(AGR));
flab3(H)       = flab3(H)/sum(NAGR,wo*LDO(NAGR));
flab4(H)       = flab4(H)/sum(NAGR,wo*LDO(NAGR));
lambda_r(H)    = lambda_r(H)/(SUM(NAGR,ro(NAGR)*KDO(NAGR))+KDROWO);
lambda_ra(H)   = lambda_ra(H)/sum(AGR,rao(AGR)*KKDO(AGR));
lambda_row     = KDROWO/(sum(NAGR,ro(NAGR)*KDO(NAGR))+KDROWO*eo);

tmarg(TR)      =   MARGINO(TR)/TMARGINO("serv2");


* LES Linear Expenditure System equation parameters
**Adjustment of the elasticity in order to respect Engel aggregation

TCONSHO(H)  = YDHO(H)-SHO(H);

*YELAS(H,TR)=
YELAS(H,TR)/(SUM(TRJ,YELAS(H,TR)*PCO(TR)*LOG(CONSMKO(H,TR)+0.0001))/TCONSHO(H
));

**Other parameters
** gamma is the marginal budget shares available to spend on above the
minimum requirement
```

```
gamma(H,TR)    = PCO(TR)*CONSMKO(H,TR)*YELAS(H,TR)/TCONSHO(H);


*TCONSHO(H)    = CONSMKO(H,TR)*PCO(TR)+DIRTAXHO(H)+HHCMROWO(H)*PHMROWO*eo;

*Following Dervis, De Melo and Robinson
*FRISCH(H)    = -TCONSHO(H)/(TCONSHO(H)-SUM(C,C_MIN(C,H)*PC0(C))

V_MIN(H)      = (SUM(TR,PCO(TR)*CONSMKO(H,TR)))*(1+1/FRISCH(H));
C_MIN(H,TR)   = CONSMKO(H,TR)-gamma(H,TR)*(TCONSHO(H)-V_MIN(H))/PCO(TR);


*-----------------------Calculations of other variables---------------*

*Tax rates

tx(TR)       = INDTAXO(TR)/(DDO(TR)+MO(TR)+IMDUTYO(TR));
tm(TR)       = IMDUTYO(TR)/MO(TR);
te(TR)       = EXDUTYO(TR)/EXO(TR);
tyh(H)       = DIRTAXO(H)/YHO(H);


*Prices

PDO(TR)        = ((1+tx(TR))*(PO(TR)*QXO(TR)- EXO(TR)*PEO(TR)))/DDO(TR) ;
PMO(TR)        = PWMO(TR)*(1+tx(TR))*(1+tm(TR))*eo;
PWEO(TR)       = PEO(TR)*(1+te(TR))/eo;
PCO(TR)        = (PDO(TR)*DDO(TR) + PMO(TR)*MO(TR) )/QQO(TR) ;


*Other prices
PINDEXO        = SUM(I,PVO(I)*delta(I));
PO(TR)         = (PDO(TR)*DDO(TR)/(1+tx(TR))+PEO(TR)*EXO(TR))/QXO(TR);




*International trade

*Exports (CET) elasticity transformation from tau=1/(kappa-1)

kappa_e(TR)     = (1+tau_e(TR))/tau_e(TR);
beta_e(TR)      = 1/(1+(PLO(TR))/PEO(TR)*(EXO(TR)/DDO(TR))
                     **(kappa_e(TR)-1));
B_E(TR)         = QXO(TR)/(beta_e(TR)*EXO(TR)**kappa_e(TR)
                  +(1-beta_e(TR))*DDO(TR)**kappa_e(TR))**(1/kappa_e(TR));

*Imports (CES)from elasticity of substitution sigma=1/(rho+1)
rho_m(TR)       = (1-sigma_m(TR))/sigma_m(TR);
alpha_m(TR)     = (PMO(TR)/PDO(TR))*(MO(TR)/DDO(TR))**(1/sigma_m(TR));
alpha_m(TR)     = alpha_m(TR)/(1+alpha_m(TR));
A_M(TR)         = QQO(TR)/(alpha_m(TR)*MO(TR)**(-rho_m(TR))
                +(1-alpha_m(TR))*DDO(TR)**(-rho_m(TR)))**(-1/rho_m(TR));

ROWYO  =  eo*SUM(TR,MO(TR)*PWMO(TR))+HMROWO+GMROWO+FDIYO;
```

```
CABO    =    ROWYO-SUM(H,TRROWO(H))-TRROWGO-SUM(TR,PWEO(TR)*EXO(TR))
             -lambda_row*(sum(NAGR,ro(NAGR)*KDO(NAGR))+KDROWO/eo);


*PINVO        = PROD(TR$(INVO(TR) NE 0),(PCO(TR)/mu(TR))**mu(TR));

*Volume calculations

LLDO(AGR)      = LLDO(AGR)/wao;
LDO(NAGR)      = LDO(NAGR)/wo;
LLNQO(AGR)     = LLNQO(AGR)/wnq1o;
LLQO(AGR)      = LLQO(AGR)/wq1o;
LNQO(NAGR)     = LNQO(NAGR)/wnq2o;
LQO(NAGR)      = LQO(NAGR)/wq2o;
LLDO(AGR)      = LLNQO(AGR)+LLQO(AGR);
LDO(NAGR)      = LNQO(NAGR)+LQO(NAGR);
KDO(NAGR)      = KDO(NAGR)/ro(NAGR);
KKDO(AGR)      = KKDO(AGR)/rao(AGR);
*KDROWO        = KDROWO/rro;
INTRMO(TR,J)   = INTRMO(TR,J)/PCO(TR);
CONSMKO(H,TR)  = CONSMKO(H,TR)/PCO(TR);
INVO(TR)       = INVO(TR)/PCO(TR);
INVOLO         = TINVO/PINVO;


*Total of a give commodity used as intermediate by all activities
INTRMDO(TR)     =  SUM(J, INTRMO(TR,J));

*Total intermediate goods C used by an activity A
TINTRMO(J)      =  SUM(TR,INTRMO(TR,J));

*KSO            = SUM(NAGR,KDO(NAGR));
*KKSO           = SUM(AGR,KKDO(AGR));
LSO             = SUM(NAGR,LDO(NAGR));
LLSO            = SUM(AGR,LLDO(AGR));
YDHO(H)        = YHO(H)-DIRTAXO(H);
EXO(TR)        = EXO(TR)/PEO(TR);
DSTKO(TR)      = DSTKO(TR)/PCO(TR);
MO(TR)         = MO(TR)/PMO(TR);
QXO(I)         = QXO(I)/PO(I);
QQO(TR)        = QQO(TR)/PCO(TR);
QXO(TR)        = DDO(TR)+EXO(TR);
QQO(TR)        = DDO(TR)+MO(TR);


*Gross Domestic product at various levels
*GDP at factor price

GDPfpO   =   SUM(I,VAO(I)*PVO(I));

*GDP at market price

GDPmpO   =  GDPfpO + SUM(TR,INDTAXO(TR)*PCO(TR))+SUM(TR,IMDUTYO(TR))
         +SUM(TR,EXDUTYO(TR));

*GDP at final demand
```

```
GDPfdO  = SUM((TR,H),CONSMKO(H,TR)*PCO(TR))+SUM(TR,INVO(TR)*PCO(TR))
         +SUM(TR,DSTKO(TR)*PCO(TR))+SUM(TR,GO(TR)*PCO(TR))
         +SUM(TR,EXO(TR)*PEO(TR))-SUM(TR,MO(TR)*PMO(TR));



*======================END OF CALIBRATION============================*


*==================================MODEL============================*

*-----------------------------Variables definition--------------------*


VARIABLES

*Prices
* wage is flexible over activities but r/ra fixed over activities

w    Wage rate for composite NAGR labor
wa   Wage rate for composite AGR labor
r(NAGR)  Rate of return (rental rate) of capital in NAGR activity
ra(AGR)  Rate of return of capital in AGR activity
*rr      Rate of return to NAGR capital demanded by ROW
rf     Uniform return to NAGR capital
raf    Uniform return to AGR capital
wnq1   Wage rate for non qualified AGR labor
wq1    Wage rate for qualified AGR labor
wnq2   Wage rate for non qualified NAGR labor
wq2    Wage rate for qualified NAGR labor
P(I)   Producer price of TR at activity level
PD(TR) Domestic price of good TR including tax
PV(I)  Value added price for activity A
PL(TR) Domestic price of good TR excluding tax
PC(TR) Price of composite good TR

PM(TR)       Domestic price of imported good TR
PE(TR)       Domestic price of exported good TR
PWM(TR)      World price of imported TR (foreign currency)
PWE(TR)      World price of exported TR (foreign currency)
*Pfob(TR)     Boarder price of C effectively paid by foreign customers on
foreign market
PINDEX        Producer price index
PINV          Price index of investment
e             Exchange rate

*Production

QX(I)         Aggregate outpt of activity A
VA(I)         Value added of activity A (volume)
INTRM(TR,J)   Intermediate consumption of commodity TR in activity A
TINTRM(I)     Total intermediate consumptions sector A


*Factors
```

```
KS            Total NAGR capital supply
KKS           Total AGR capital supply
KDROW         NAGR capital demand by ROW
KD(NAGR)      Industry A demand for NAGR capital
KKD(AGR)      Industry A demand for composite AGR capital
LLQ(AGR)      Industry A demand for Skilled agri labor
LLNQ(AGR)     Industry A demand for Unskilled labor demand
LQ(NAGR)      Industry A demand for Skilled NAG labor demand
LNQ(NAGR)     Industry A demand for Unskilled NAG labor demand
LLS           Total AGR labor supply
LS            Total NAGR labor supply
LD(NAGR)      Sector A demand for composite NAGR labor
LLD(AGR)      Sector A demand for composite AGR labor
LLNQS         Total Non-qualified AGR labor supply
LLQS          Total qualified AGR labor supply
LNQS          Total Non-qualified NAGR labor supply
LQS           Total qualified NAGR labor supply

*Demand

CONSMK(H,TR) Household H consumption of market good TR (volume)
TCONSH(H)     Household H total consumption (value)
INV(TR)       Final demand of commodity TR for investment(volume)
GCF           Gross capital formation
INTRMD(TR)    Total intermediate demand of commodity TR by different
activities
GOV           Total public consumption (government expenditure) (value)
ROWY          Total receipt by the ROW
DD(TR)        Demand for domestic good TR
G(TR)         Government consumption of domestic commodity
QQ(TR)        Demand for composite good TR (dd+m)
MARGIN(TR)    Demand for commodity TR as trade or transport margin
TMARGIN(TR)   Total trade margin received by commodity TR
DSTK(TR)        Demand of commodity TR for inventory stock change
INVOL         Total investment volume
TINV          Total investment value
*DMRK(TR)     Domestic market of commodity TR
*International trade
 M(TR)          Imports of good TR
 EX(TR)         Exports of good TR (supply)
 EXD(TR)        Export demand
 CAB            Current account balance
 GMROW          Government import from the ROW
 HMROW          All Households import from ROW
 HHCMROW(H)     Each HH imported good demand
 ROWY           Total receipt by ROW
 SROW           Saving of the ROW
 FDIY           Income of FDI

*Income and savings

*TYH            Total HH income
 YH(H)         Household H income
 YDH(H)        Household H disposable income
 YG            Government income
 SH(H)         Household H savings
```

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 SG           Government savings
 TRG(H)       Government transfers to households
 TRH(H)       Household transfers to other households
 TRROW(H)     Foreign transfer payments to household (FCU)
 TRROWG       Foreign transfer payments to government (FCU)
 INDTAX(TR)   Receipts from indirect tax of commodity TR
 IMDUTY(TR)   Receipts from import duties of commodity TR
 EXDUTY(TR)   Receipts from tax on exports
 DIRTAX(H)    Receipts from direct taxation on household H income
 POVLN(H)     Poverty line
 nu           Adjustment variable for household savings
 adj          Adjustment variable for indirect taxes


*Others
 GDPfp        GDP at factor price
 GDPmp        GDP at market price
 GDPfd        GDP at final demand
 EV(H)        Equivalent variation for household H
 LEON         Walras law verification variable
 OMEGA        Objective variable;


*--------------------------------Equations definition-----------------*

EQUATIONS

*Production

VADQ(I)      Total value added
SUPPLYQ(I)   Aggregate production of commodity TR by activity A
VAD1(AGR)    Value added in non-agricultural activities
VAD2(NAGR)   Value added in agricultural activities
TINTMQ(I)    Total intermediate consumptions a set of commodities by activity
A
INTMQ(TR,J)  Intermediate consumption of a good TR by activity A
LDEM1(AGR)   Labor demand for agricultural activity
LDEM2(NAGR)     Labor demand for non agriculture activity
 LQDEM1(AGR)    Labor demand fn for skilled and unskilled agri labor CES
 LQDEM2(NAGR)   Labor demand fn for skilled and unskilled non agr labor  CES
 LQD1(AGR)      skilled labor demand for agri activity
 LQD2(NAGR)     Skilled labor demand for non agri activity


*Income and savings

 INCH(H)      Household income (workers)
 INCDH(H)     Household H disposable income
 INCG         Government income
 SAVH(H)      Household H savings
 SAVG         Government savings


*Taxes

 INDTX(TR)    Receipts from indirect taxes on TR
 IMPDUTY(TR)  Receipts from import duties
```

```
 DIRTXH(H)    Receipts from household H taxation
 EXPDUTY(TR)  Receipt from export duty

*Demand

 TCONSHQ(H)    Household H total consumption
 CONSHMK(H,TR) Household H consumption of marketed commodity TR
*PUBLICCONS(TR)Public consumption of commodity TR
 TOTGOVC       Total government consumption
*CONSTOT       Total consumption
 TINVVOL       Total investment volume
 TINVVAL       Total investment value
 GROSSCAP      Gross fixed capital formation
 DINVEST       Final demand of commodity TR for Investment
 TINTDEM(TR)   Intermediate demand
 DMARGIN(TR)   Commodity TR demand for trade margin


*Prices

 PRVA(I)      Value added price of activity A
 RETK1(AGR)   Rate of return to capital from non-agricultural activities
 RETK2(NAGR)  Rate of return to capital from agricultural sectors
*RETK3        rate of return of NAGR capital from ROW
*WAGE1        Wage rate on agricultural activity
*WAGE2        Wage rate on non agri activity
 PDOMST(TR)   Price of domestic commodities
 PRM(TR)      Price of Imported commodities
 PRE(TR)      Price of exported commodities
 PRC(TR)      Composite price (commodities)
 PRP(TR)      Producer price (commodities)
*PINDXINV     Price index for investment
 PINDXPRD     Producer price index



*International trade

CET(TR)      Relation between DD and EX
EXPORTS(TR)  Export supply
*EXPORTD(TR) Finite elastic export demand
ARMING(TR)   CES between imports and domestic good
IMPORT(TR)   Import demand
ROWINCOME    Income of the ROW
ROWFDIY      Income of FDI
CURACC       Current account balance

*GDP at various measures
GDPFACTORP    GDP at factor price
GDPMARKETP    GDP at market price
GDPFINALD     GDP at final demand
POVERTYLINE(H)Poverty line

*Equilibrium

DOMABS(GOOD)  Domestic absorption (goods)
*KEQUI1       Agri Capital market equilibrium
```

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*KEQUI2         NAGR Capital market equilibrium
*REQUI1(TR)     Uniform return to AGR capital
*REQUI2(TR)     Uniform return to NAGR capital
LEQUI1          AGR Labor market equilibrium
LEQUI2          NAGR labor market equilibrium
*EXEQUI(TR)     Equilibrium between export demand and supply
INVEQUI         Investment-savings equilibrium
*GOVEQUI        Government current account balance
GDPEQUI         GDP equilibrium at final price and final demand
*TMARGEQUI      TMARGIN is the sum of margin paid by each commodity
*OUTPUTEQU(TR)Output AGR equilibrium

*Others
 EVEQ(H)         Calculation of EV
 WALRAS          Verification of the Walras law
 OBJ             Objective function;


*Production

*at the top of the production technology nest there is a Leontief technology
for fixed level (complementary)
*combination of VA and intermediate consumption of inputs


VADQ(I)..         VA(I)   =E=  v(I)*QX(I);

TINTMQ(I) ..    TINTRM(I) =E=  io(I)*QX(I);

SUPPLYQ(I)..    QX(I)   =E= VA(I)+TINTRM(I);


*Intermediate consumption of commodity TR by activity A from the total
intermediate consumption of activity A
INTMQ(TR,J)..    INTRM(TR,J) =E=  aij(TR,J)*TINTRM(J);

* At the next lower level of the nest value added are combined at CES
function

VAD1(AGR)..       VA(AGR) =E= A_KKL(AGR)*(alpha_KKL(AGR)*LLD(AGR)**(-
rho_KKL(AGR))+(1-alpha_KKL(AGR))*KKD(AGR)**(-rho_KKL(AGR)))
                               **(-1/rho_KKL(AGR));

VAD2(NAGR)..      VA(NAGR)  =E= A_KL(NAGR)*(alpha_KL(NAGR)*LD(NAGR)**(-
rho_KL(NAGR))+(1-alpha_KL(NAGR))*KD(NAGR)**(-rho_KL(NAGR)))**(-
1/rho_KL(NAGR));


*Labor demand for all tradable commodities (TR)derived from minimizing the
cost of production subject to a CES production functions. Here KK is
agricultural composite capital and K is non agricultural capital
* Hence firms are using their KK and K to the point where the value of their
marginal product equal to their respective price (wa and ra)

LDEM1(AGR)..  LLD(AGR)   =E= ((alpha_KKL(AGR)/(1-
alpha_KKL(AGR))*(ra(AGR)/wa))**(sigma_KKL(AGR)))*KKD(AGR);
```

```
LDEM2(NAGR)..  LD(NAGR)   =E=((alpha_KL(NAGR)/(1-
alpha_KL(NAGR))*(r(NAGR)/w))**(sigma_KL(NAGR)))*KD(NAGR);

* At a lower nest of the production function the composite labor is
disaggregated into CES skilled and unskilled labor categories, hence:

LQDEM1(AGR)..  LLD(AGR)   =E= A_LL(AGR)*(alpha_LL(AGR)*LLQ(AGR)**(-
rho_LL(AGR))+(1-alpha_LL(AGR))*LLNQ(AGR)**(-rho_LL(AGR)))**(-1/rho_LL(AGR));

LQDEM2(NAGR)..  LD(NAGR)  =E=  A_L(NAGR)*(alpha_L(NAGR)*LQ(NAGR)**(-
rho_L(NAGR))+(1-alpha_L(NAGR))*LNQ(NAGR)**(-rho_L(NAGR)))**(-1/rho_L(NAGR)) ;

* Hence the labor demand for skilled and unskilled workers in both
agricultural and non agricultural activities are derived from minimizing the
cost of labor s.t. a CES function of skilled and unskilled labor


LQD1(AGR)..    LLQ(AGR)   =E= ((alpha_LL(AGR)/(1-
alpha_LL(AGR))*(wnq1/wq1))**(sigma_LL(AGR)))*LLNQ(AGR);


LQD2(NAGR)..    LQ(NAGR)   =E= ((alpha_L(NAGR)/(1-
alpha_L(NAGR))*(wnq2/wq2))**(sigma_L(NAGR)))*LNQ(NAGR);


*Income and savings
* Household income is the sum of agr and nagr labor and capital income,
transfer from gov, HH an ROW
* Each household receives a fixed share of total and capital income in each
sectors and transfers obtained

INCH(H)..   YH(H)   =E=
flab1(H)*wa*SUM(AGR,LLD(AGR))+flab2(H)*wa*SUM(AGR,LLD(AGR))
                +flab3(H)*w*sum(NAGR,LD(NAGR))+flab4(H)*w*SUM(NAGR,LD(NAGR))+

lambda_ra(H)*SUM(AGR,KKD(AGR)*ra(AGR))+lambda_r(H)*(SUM(NAGR,r(NAGR)*KD(NAGR)
)+KDROW*e)+PINDEX*TRG(H)+PINDEX*TRH(H)+e*TRROW(H);


INCDH(H)..     YDH(H)   =E=  YH(H) - DIRTAX(H);


* nu is adjustment variable for household saving

SAVH(H)..     SH(H)    =E=  psio(H)+nu*psi(H)*YDH(H) ;


*Government Income

INCG..     YG   =E=  SUM(TR,INDTAX(TR))+SUM(H,DIRTAX(H))+SUM(TR,IMDUTY(TR))
                    +e*TRROWG;


* Government consumption, transfer are fixed (exogenous) and hence is
flexible by adjusting tax rates
SAVG..           SG   =E=  YG - GOV;
```

```
*Taxes
* Adjustment factors are used to consider cases when taxes are not the same
for all commodities and savings are not the same for households

*Government income

IMPDUTY(TR)..      IMDUTY(TR)  =E=  tm(TR)*PWM(TR)*e*M(TR);

EXPDUTY(TR)..      EXDUTY(TR)  =E=  te(TR)*PE(TR)*EX(TR);

DIRTXH(H)..        DIRTAX(H)   =E=  tyh(H)*YH(H);

*INDTX(C)..        INDTAX(C)   =E=  tx(C)*(DD(C)+M(C)+IMDUTY(C));


INDTX(TR)..       INDTAX(TR)   =E=(adj+tx(TR)*(1+adj))*(P(TR)*QX(TR)-
PE(TR)*EX(TR))+
                        (adj+tx(TR)*(1+adj))*(1+tm(TR))*PWM(TR)*e*M(TR);

*Demand
*Demand includes HH consumption demand, government consumption for public
admin, investment demand, intermediate demand and transport margin

TCONSHQ(H)..      TCONSH(H) =E= YDH(H)-SH(H);




*Household consumption of marketed commodity

CONSHMK(H,TR)..      CONSMK(H,TR)*PC(TR) =E=
C_MIN(H,TR)*PC(TR)+gamma(H,TR)*(TCONSH(H)-SUM(TRJ,C_MIN(H,TRJ)*PC(TRJ)));

*PUBLICCONS(TR)..      G(TR)   =E=  GOV*zeta(TR)/PC(TR);

*Government expenditure


TOTGOVC..            GOV       =E=
SUM(TR,G(TR)*PC(TR))+GMROW*e+SUM(H,TRG(H))*PINDEX;

DINVEST(TR)..      INV(TR)     =E= mu(TR)*TINV/PC(TR);

TINVVOL..          INVOL       =E= SUM(TR,INV(TR))+SUM(TR,DSTK(TR));

TINVVAL..          TINV        =E=  INVOL*PINV;


GROSSCAP..         GCF         =E= TINV-SUM(TR,PC(TR)*DSTK(TR));

TINTDEM(TR)..       INTRMD(TR)  =E=  SUM(J, INTRM(TR,J)) ;

*For Ethiopian SAM the TMargin (trade margin) is recorded only for
transporting and transaction cost of domestic good, hence similar margin for
exported and imported goods is not included in this model.
Hence demand for commodity C as a trade margin
```

```
DMARGIN(TR)..    MARGIN(TR)   =E= tmarg(TR)*TMARGIN("serv2");

*Prices
*PV(A) Price of value added, P(A) is producer price at activity level and
PC(TR) composite price of TR
PRVA(I)..         PV(I)   =E= (P(I)*QX(I)-SUM(TR,INTRM(TR,I)*PC(TR)))/VA(I);

*PRPROD(A)..       P(A)   =E= (VA(A)+TINTRM(A))/QX(A);

*w wage rates of AGR and NAGR activities

*WAGE1..      wa  =E= sum(AGR,(wnq1*LLNQ(AGR)+wq1*LLQ(AGR)))/LLD(AGR);
*WAGE2..      w   =E= SUM(AGR,(wnq2*LNQ(NAGR)+wq2*LQ(NAGR)))/LD(NAGR);


*ra and r are rate of return to AGR capital (KK) and NAGR capital (K);
*Equally they are prices of their respective capital

RETK1(AGR)..      ra(AGR)   =E= (PV(AGR)*VA(AGR) - wa*LLD(AGR))/KKD(AGR);
RETK2(NAGR)..     r(NAGR)   =E= (PV(NAGR)*VA(NAGR) - w*LD(NAGR) )/KD(NAGR) ;
*RETK3..              rr      =E= sum(a,r(A))/NNAO;

*PL is domestic price of C excluding tax and PD price of domestic commodity
TR including tax

PDOMST(TR)..       PD(TR)   =E=  PL(TR)*(1+tx(TR))*(1+adj);

*PM Price of imported commodities C

PRM(TR)..          PM(TR)   =E=  (1+tx(TR))*(1+adj)*(1+tm(TR))*e*PWM(TR);

*PE price of exported commodities TR. PE id different from Pfob b/c the later
includes export margin.
* But in Eth case the export margin is not provided hence in this case PE and
Pfob are equal

PRE(TR)..          PE(TR)   =E=  PWE(TR)*e/(1+te(TR));

*PC Price of composite commodity TR and QQ(TR) composite commodity demand

PRC(TR)..          PC(TR)   =E=  (PD(TR)*DD(TR)+PM(TR)*M(TR))/QQ(TR);

*P(TR) producer price

PRP(TR)..          P(TR)    =E=  (PL(TR)*DD(TR) + PE(TR)*EX(TR))/QX(TR);


*Producer price index where delta(A) is the share of activity A in total
production

PINDXPRD..       PINDEX   =E=  SUM(I,PV(I)*delta(I));

*Price index of investment where mu(TR) is the share of traded commodities in
total investment
```

```
*PINDXINV..        PINV     =E=  PROD(TR$(INV(TR) NE 0),
(PC(TR)/mu(TR))**mu(TR));

*consumers price index

*CONSPINDX..     PINXCON..    =E=  (SUM(TR,PC(TR)*SUM(H,CONSMKO(H,TR)))
*                                   /(SUM(TR,PCO(TR))*SUM(H,CONSMKO(H,TR)))



*International trade
* Domestic marketed output QX is traded to satisfy domestic demand (DD) and
export (EX) commodities with CET production function

CET(TR)..          QX(TR)   =E=  B_E(TR)*(beta_e(TR)*EX(TR)**kappa_e(TR)
                               +(1-beta_e(TR))*DD(TR)**kappa_e(TR))
                               **(1/kappa_e(TR));

*From maximizing consumer demand from CET exported and domestic traded
commodity s.t. constant budget the following derived:

EXPORTS(TR)..      EX(TR)   =E=  ((PE(TR)/PL(TR))**tau_e(TR)
                                 *((1-
beta_e(TR))/beta_e(TR))**tau_e(TR))*DD(TR);

* in order to include a finite elastic export demand function

*EXPORTD(TR)..      EXD(TR)  =E= EXO(TR)*(PWE(TR)/Pfob(TR))**eta;


* Composite goods QQ(TR) are commodities demanded domestically with Armington
law of CES between domestic and imported goods.

ARMING(TR)..       QQ(TR)    =E=  A_M(TR)*(alpha_m(TR)*M(TR)**(-rho_m(TR))
                                 +(1-alpha_m(TR))*DD(TR)**(-rho_m(TR)))
                                 **(-1/rho_m(TR));

IMPORT(TR)..       M(TR)    =E=  ((alpha_m(TR)/(1-
alpha_m(TR)))**(sigma_m(TR))*(PD(TR)/PM(TR))**sigma_m(TR))*DD(TR);

ROWFDIY..          FDIY     =E= dk*(sum(AGR,KKD(AGR)));

*ROW income
ROWINCOME..        ROWY     =E=   SUM(TR,M(TR)*PWM(TR))+HMROW+GMROW+FDIY;


*ROW saving

CURACC..         CAB    =E=  ROWY-SUM(H,TRROW(H))-TRROWG -
SUM(TR,PWE(TR)*EX(TR))
                               lambda_row*(sum(NAGR,r(NAGR)*KD(NAGR))+KDROW);



* Gross Domestic product
*GDP at factor price
```

```
GDPFACTORP..     GDPfp  =E=   SUM(I,VA(I)*PV(I));

*GDP at final price

GDPMARKETP..     GDPmp  =E=  GDPfp +
SUM(TR,INDTAX(TR)*PC(TR))+SUM(TR,IMDUTY(TR))
                         +SUM(TR,EXDUTY(TR));

*GDP net final demand

GDPFINALD..     GDPfd  =E=
SUM(TR,PC(TR)*(SUM(H,CONSMK(H,TR))+INV(TR)+DSTK(TR)+G(TR)))
                    +SUM(TR,EX(TR)*PE(TR))-SUM(TR,M(TR)*PM(TR));

POVERTYLINE(H)..   POVLN(H)   =E=  SUM(TRJ,C_MIN(H,TRJ)*PC(TRJ));



*=========Equilibriumconiditons========================================

*Income received from domestic Commodity is equal to expenditure made by the
SAME
DOMABS(GOOD)..    QQ(GOOD) =E=
SUM(H,CONSMK(H,GOOD))+G(GOOD)+TMARGIN(GOOD)+INTRMD(GOOD)+INV(GOOD)+DSTK(GOOD)
;

*DOMABS(TR)..     DMRK(TR) =E= SUM(H,CONSMK(H,TR))+G(TR)+TMARGIN("serv2")+
INTRMD(TR)+INV(TR)+DSTK(TR);

*OUTPUTEQU(TR)..    QX(TR)   =E= DD(TR)*PD(TR)+PE(TR)*EX(TR);


*In the model labor demand is flexible over sectors but capital (land,
capital) are fixed or sector specific hence fixed labor supply is used with
flexible labor demand

LEQUI1..          LLS =E=  SUM(AGR,LLD(AGR));
LEQUI2..           LS =E=  SUM(NAGR,LD(NAGR));

* Export demand volume equals initial export demand/supply
*EXEQUI(TR)..           EX(TR)  =E= EXD(TR);


*KEQUI1..           KKS  =E=  SUM(AGR,KKD(AGR));
*KEQUI2..           KS   =E=   SUM(NAGR,KD(NAGR));

*Rate of return to capital in activity A is equivalent with uniform return
rate to capital. This will be introduced if we assume KD/KKD are flexible
over sector
*REQUI1(NAGR)..      r(NAGR)   =E=   rf;
*REQUI2(AGR)..       ra(AGR)   =E=  raf;

*TMARGEQUI(TR)..        TMARGIN(TR)   =E= SUM(TRJ,MARGIN(TRJ));

*Fixed Investment and stock change is equal to the sum of household and
government savings and CAB
```

```
INVEQUI..  TINV =E= SUM(H,SH(H)) + SG + CAB*e;

*Equilibrium condition between GDP at factor market price and GDP final
demand

GDPEQUI..           GDPmp    =E=   GDPfd;

*Current government balance

*GOVEQUI..           YG   =E=   GOV + SG;





*=============Others==========================================================
*Equivalent variation (EV(H)) is how much money a household would pay for a
commodity before the price change
EVEQ(H)..          EV(H)   =E=   YH(H)*
PROD(TR,((PCO(TR)/PC(TR))**gamma(H,TR)))-YHO(H);

*EVEQ(H)..          EV(H)   =E=  PROD(TR,(PCO(TR)/PC(TR))**gamma(H,TR)
*                         *(TCONSH(H)-SUM(TRJ,C_MIN(H,TRJ)*PC(TRJ))));

*In order to make the model square matrix, the number of equation should be
equal to the number of variables. This is satisfied by a variable called LEON

WALRAS..   LEON  =E=   QQ("serv3")-SUM(H,CONSMK(H,"serv3"))-G("serv3")-
TMARGIN("serv3")
                 -INTRMD("serv3")-INV("serv3")-DSTK("serv3");



*WALRAS..        LEON      =E= QQ("cserv1")- DD("cserv1")-M("cserv1");



OBJ..              OMEGA   =E=   1;



*----------------------------------Initialization---------------------*


w.L         =  wo;
wa.L        =  wao;
wnq1.L         =  wnq1o;
wq1.L       =  wq1o;
wnq2.L      =  wnq2o;
wq2.L       =  wq2o;
r.L(NAGR)   =  ro(NAGR);
ra.L(AGR)   =  rao(AGR);
*rr.L       =  rro;
*rf.L       =  1.0;
*raf.L      =  1.0;
```

```
P.L(I)        =  PO(I);
PD.L(TR)      =  PDO(TR);
PV.L(I)       =  PVO(I);
PL.L(TR)      =  PLO(TR);
PC.L(TR)      =  PCO(TR);
PM.L(TR)      =  PMO(TR);
PE.L(TR)      =  PEO(TR);
PWM.L(TR)     =  PWMO(TR);
PWE.L(TR)     =  PWEO(TR);
Pfob.L(TR)    =  Pfobo(TR);
PINDEX.L      =  PINDEXO;
PINV.L        =  PINVO;
INVOL.L       =   INVOLO;
TINV.L        =   TINVO;
e.L           =  eo;
QX.L(I)       =  QXO(I);
VA.L(I)         =  VAO(I);
INTRM.L(TR,J)  = INTRMO(TR,J);
TINTRM.L(I)    = TINTRMO(I);
KD.L(NAGR)     = KDO(NAGR);
KKD.L(AGR)     = KKDO(AGR);
KDROW.L        = KDROWO;
*KS.L          =  KSO;
*KKS.L         =  KKSO;
LD.L(NAGR)     =  LDO(NAGR);
LS.L           =  LSO;
LLD.L(AGR)     =  LLDO(AGR);
LLS.L          =  LLSO;
LLNQ.L(AGR)    =  LLNQO(AGR);
LLQ.L(AGR)     =  LLQO(AGR);
LQ.L(NAGR)     =  LQO(NAGR);
LNQ.L(NAGR)    =  LNQO(NAGR);
CONSMK.L(H,TR)= CONSMKO(H,TR);
TCONSH.L(H)    =  TCONSHO(H);
INV.L(TR)      =  INVO(TR);
TMARGIN.L("serv2") =  TMARGINO("serv2");
MARGIN.L(TR)   =  MARGINO(TR);
DSTK.L(TR)     =  DSTKO(TR);
INTRMD.L(TR)   =  INTRMDO(TR);
GOV.L          =  GOVO;
G.L(TR)        =  GO(TR);
DD.L(TR)       =  DDO(TR);
QQ.L(TR)       =  QQO(TR);
*DMRK.l(TR)    =  DMRKO(TR);
M.L(TR)        =  MO(TR);
EX.L(TR)       =  EXO(TR);
FDIY.L         = FDIYO;
CAB.L          =  CABO;
GMROW.L        = GMROWO;
HMROW.L        = HMROWO;
HHCMROW.L(H)   = HHCMROWO(H);
YH.L(H)        =  YHO(H);
YDH.L(H)       =  YDHO(H);
YG.L           =  YGO ;
SH.L(H)        =  SHO(H);
SG.L           =  SGO;
TRH.L(H)       = TRHO(H);
```

```
TRG.L(H)        = TRGO(H);
TRROW.L(H)      = TRROWO(H);
TRROWG.L        = TRROWGO;
INDTAX.L(TR)    = INDTAXO(TR);
IMDUTY.L(TR)    = IMDUTYO(TR);
EXDUTY.L(TR)    = EXDUTYO(TR);
DIRTAX.L(H)     =  DIRTAXO(H);
GDPfp.l         = GDPfpO;
GDPmp.L         = GDPmpO;
GDPfd.L         = GDPfdO;
*nu.L           =  1;
*adj.L          =  0;
*LEON.L         =  0;
*OMEGA.L        =  1;
LD.LO(NAGR)     = LDO(NAGR)*0.001;
LLD.LO(AGR)     = LLDO(AGR)*0.001;
KKD.LO(AGR)      = KKDO(AGR)*0.001;
KD.LO(NAGR)      = KDO(NAGR)*0.001;
*r.lo(NAGR)      = ro(NAGR)*0.001;
*ra.lo(AGR)      = rao(AGR)*0.001;
*P.LO(TR)        = PO(TR)*0.1;
LLQ.LO(AGR)      = LLQO(AGR)*0.001;
LQ.LO(NAGR)      = LQO(NAGR)*0.001;
*do not give any lower bound in the following two variables
LLNQ.LO(AGR)     = LLNQO(AGR)*0.001;
LNQ.LO(NAGR)     = LNQO(NAGR)*0.001;
DD.LO(TR)        = DDO(TR)*0.001;
M.LO(TR)         = MO(TR)*0.001;
EX.LO(TR)        = EXO(TR)*0.001;

*------------------------------------Closure-------------------------*

* Supply of capital and labor are fixed; capital is sector specific; fixed
public expenditure (in volume); fixed investment (in volume) and CAB fixed.
Due to small country assumption both import and export price is fixed.
Exchange rate is a numeraire.


LS.FX           = LSO;
LLS.FX          = LLSO;
*KS.FX           = KSO;
*KKS.FX          = KKSO;
KDROW.FX        = KDROWO;

* Case 1 Base SAM reproduction
KKD.FX(AGR)      = KKDO(AGR);
KD.FX(NAGR)      = KDO(NAGR);


*Case 2 Simulation in selective policy scenario


*KKD.FX(AGR)      = (1+dk)*KKDO(AGR);
*KD.FX(NAGR)      =  KDO(NAGR);
*KKD.FX("coff") = KKDO("coff");
```

```
*Case 3 Simulation with equal policy treatment of cash crops and coffee
industry

*KKD.FX(AGR)    = (1+dk)*KKDO(AGR);
*KD.FX(NAGR)    = KDO(NAGR);


*Case 4 policy which introduced FDI for all sector

*KKD.FX(AGR)    = (1+dk)*KKDO(AGR);
*KD.FX(NAGR)    = (1+dk)*KDO(NAGR);


INVOL.FX  = TINVO/PINVO;

TRG.FX(H)    = TRGO(H);
TRH.FX(H)    = TRHO(H);
TRROW.FX(H)   = TRROWO(H);
TRROWG.FX     = TRROWGO;
*GOV.FX       = GOVO;
G.FX(TR)      = GO(TR);
PWM.FX(TR)    = PWMO(TR);
PWE.FX(TR)    = PWEO(TR);

*coffee price fall during 2002 crisis was about 50% but for this study 40%
declined assumed

*PWE.FX("coff") = 0.4*PWEO("coff");
PWE.FX(TR)       = PWEO(TR);

e.FX         = 1;
CAB.FX       = CABO;
DSTK.FX(TR)   = DSTKO(TR);
*SG.FX        = SGO;
*YG.FX        = YGO;
adj.FX        = 0;
*tm.FX(C)      = 0;
*tx.FX(C)      = 0;
*te.FX(C)      = 0;

*----------------------------------Model execution--------------------*

OPTION NLP=conopt2;
option limrow=1;
OPTION work = 30;
OPTION ITERLIM = 100000;
OPTION RESLIM = 50000;
MODEL EXTER SAMLL OPEN ECONOMY FOR ETHIOPIA /ALL/;
EXTER.HOLDFIXED=1;
EXTER.optcr=0.02;
EXTER.optca=12;
EXTER.workfactor=3.0;
EXTER.workspace= 300.0;
SOLVE EXTER MAXIMIZING OMEGA USING NLP;
*$libinclude xlexport outSAM SAMtables1.xls A2:FA158/m
DISPLAY C_MIN, gamma;
DISPLAY QXO, VAO, INTRMO, TINTRMO, LLDO, LDO, KKDO, KDO, INVO, EXO,
```

```
        DDO, MO, QQO, ro, rao, wnq1o, wq1o, wnq2o, wq2o, PO, PLO,PWMO,
        PWEO, PINVO, INDTAXO, IMDUTYO, EXDUTYO, DIRTAXO,TMARGINO,DSTKO,   wo,
wao, ro,rao, YHO, SHO, YGO, SGO, GO, INVO, TINVO, INVOLO, CABO, ROWYO,GDPfpO,
GDPmpO, GDPfdO, HMROWO, GMROWO, TRROWGO, eo, CONSMKO, TCONSHO,TRGO, TRHO,
TRROWO;


display A_KKL, A_KL,  A_LL, A_L,  alpha_KKL, alpha_KL, alpha_LL,
alpha_L,sigma_KKL, sigma_KL, sigma_LL, sigma_L, rho_KKL, rho_KL, rho_LL,
rho_L,io, v, aij,mu,delta, tyh, zeta, KKD.L, tmarg;
```

Annex VIII: SAS code used to plot the Beta Distribution

```
/*Plotting Beta Distribution*/

proc sort data=income; by hhgroup; run;
proc means data=income;
      var baseyear scenario1 scenario2;
      by hhgroup;
      output out=minmax_income min= max=/autoname;
run;

data income1;
      merge income minmax_income;
      by hhgroup;
      x_baseyear=(baseyear-baseyear_min)/(baseyear_max-baseyear_min);
      x_scenario1=(scenario1-scenario1_min)/(scenario1_max-
scenario1_min);
      x_scenario2=(scenario2-scenario2_min)/(scenario2_max-
scenario2_min);
run;

proc means data=income1;
      var x_baseyear x_scenario1 x_scenario2;
      by hhgroup;
      output out=xbarstd_xincome mean= std=/autoname;
run;

data xbarstd_xincome1;
      set xbarstd_xincome;
      by hhgroup;
      phat_baseyear=x_baseyear_mean*((x_baseyear_mean*(1-
x_baseyear_mean)/(x_baseyear_stddev**2))-1);
      qhat_baseyear=(1-x_baseyear_mean)*((x_baseyear_mean*(1-
x_baseyear_mean)/(x_baseyear_stddev**2))-1);

      phat_scenario1=x_scenario1_mean*((x_scenario1_mean*(1-
x_scenario1_mean)/(x_scenario1_stddev**2))-1);
      qhat_scenario1=(1-x_scenario1_mean)*((x_scenario1_mean*(1-
x_scenario1_mean)/(x_scenario1_stddev**2))-1);

      phat_scenario2=x_scenario2_mean*((x_scenario2_mean*(1-
x_scenario2_mean)/(x_scenario2_stddev**2))-1);
      qhat_scenario2=(1-x_scenario2_mean)*((x_scenario2_mean*(1-
x_scenario2_mean)/(x_scenario2_stddev**2))-1);
run;


data income3;
      do i=1 to 3;
```

```
          do j=.01 to .99 by .01;
               hhgroup=i;
               x_plot=j;
               output;
          end;
     end;
run;

data income4;
     merge income3 xbarstd_xincome1 minmax_income;
     by hhgroup;
     x_pdf_baseyear=pdf('beta',x_plot,phat_baseyear,qhat_baseyear);
     x_pdf_scenario1=pdf('beta',x_plot,phat_scenario1,qhat_scenario1);
     x_pdf_scenario2=pdf('beta',x_plot,phat_scenario2,qhat_scenario2);

     y_pdf_baseyear=x_pdf_baseyear*(1/(baseyear_max-baseyear_min));
     y_pdf_scenario1=x_pdf_scenario1*(1/(scenario1_max-
scenario1_min));
     y_pdf_scenario2=x_pdf_scenario2*(1/(scenario2_max-
scenario2_min));

     y_baseyear=x_plot*(baseyear_max-baseyear_min)+baseyear_min;
     y_scenario1=x_plot*(scenario1_max-scenario1_min)+scenario1_min;
     y_scenario2=x_plot*(scenario2_max-scenario2_min)+scenario2_min;

run;
```

ANNEX IX: SAS Code used for ANOVA Test

```
/*ANOVA Test*/
/*HISTOGRAM*/
proc univariate data=income;
      var baseyear scenario1 scenario2;
      histogram baseyear scenario1 scenario2;
      by hhgroup;

data income;
set income;

run;

proc sort data=income; by hhgroup;run;
proc univariate data=income;
      var baseyear scenario1 scenario2;
      histogram baseyear scenario1 scenario2;
      by hhgroup;
run;

proc sort data=income; by hhgroup household_num;run;
proc transpose data=income(keep=hhgroup household_num baseyear
scenario1 scenario2) out=income_trans;
by hhgroup household_num;
run;
/* COMPARISON OF POLICY EFFECT on each HOUSEHOLDS*/
proc anova data=income_trans;
class hhgroup _name_;
model col1=hhgroup _name_ hhgroup*_name_;
means hhgroup _name_ hhgroup*_name_/tukey;
run;
/* COMPARISON OF POLICY EFFECT between groups of HOUSEHOLDS*/

proc sort data=income_trans; by hhgroup; run;
proc anova data=income_trans;
class _name_;
model col1= _name_ ;
means _name_ /tukey;
by hhgroup;
run;
```