ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

Prospect and Retrospect of Exchange Rate Shocks on Manufacturing and Exports of Ethiopia:

CGE Model Analysis

By
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(Applied Trade Policy Analysis)

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Acronyms

CGE	Computable General Equilibrium
CPI	Consumer Price Index
EDRI	Ethiopian Development Research Institute
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GAMS	The General Algebraic Modeling System
IFPRI	International Food policy Research Institute
IMF	International Monetary Fund
NBE	National Bank of Ethiopia
NER	Nominal Exchange Rate
ONER	Overall Nominal Exchange Rate
REERI	Real Effective Exchange Rate Index
SAM	Social Accounting Matrix

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Abstract

In this study, the positive and negative consequences of deliberate shocks to Ethiopian Birr have been examined. The focus areas of the analysis includes: domestic production, real consumption, welfare, export, import, trade balance, and current account. It also addresses impacts on employment, investment, government revenue and economic growth.

A static CGE model is employed so as to observe the multi sectors and multi activities effects of the shocks. The outcomes of the simulations are checked for their robustness through sensitivity test. They have been also interpreted counterfactually for the short run to medium term effects.

The findings of the analysis reveal that the productions of agricultural and service sectors expand where as that of the industrial sector shrinks. Particularly, exportable agricultural products and non tradable service sector derive more returns. Even if the light and some heavy manufacturing are benefited, the significant and adverse effect on construction sub sectors largely outweighs. Besides, exports grow faster than imports. On the other hand, trade balance continuous to increase negatively whereas current account partly improves and partly deteriorates under different shock levels.

By and large, real consumption, welfare, GDP, investment and government revenue are all adversely affected. And, thus, the economy of the country would have been restrained in the short run had the exchange rate been shocked in line with the scenarios.

Key words: Exchange rate shocks, exports, manufacturing, Ethiopia, and CGE model

Chapter one: Introduction

1.1 Background

Less developed countries (LDCs) in general and that of African countries in particular have experienced poor macroeconomic performances (in terms of output growth, inflation, current account balance, etc) since the 1970s. One of the main factors is the inappropriate domestic macroeconomic policies (such as high fiscal deficits, misalignment of real exchange rate, etc) (Khan *et al.,* 1993) cited in (Haile, 1999).

Moving from overvalued to equilibrium real exchange rates or devaluation is generally regarded as one of the most important policy instruments in developing countries. Devaluation is primarily aimed at improving international competitiveness or the incentive to produce exportable, particularly agricultural exportable. The international Monetary Fund (IMF) and World Bank (WB) advocate substantial initial devaluations to regain some historical level of real exchange rate, and recommend a transition from a pegged regime (pegged to a single or a basket of currencies) to flexible exchange rate arrangements (Mulat,1992).

The currency Proclamation of 1945 defined the monetary unit of Ethiopia as the Ethiopian dollar (hereafter Ethiopian birr as it replaced the Ethiopian dollar in September 1976) with a value of 0.355745 grams of fine gold. The linkage with fine gold, which was in accord with Bretton Woods Agreement of 1994, automatically established the exchange rate between the national currency and other currencies with the same arrangement. In line with this, the official exchange rate of Ethiopian currency with US dollar was created on July 23, 1945. Accordingly, the official exchange rate of 2.48 birr per US dollar was set. After almost two

decades, that is, on 1 January1964, the Ethiopian birr was slightly devalued to 2.50 birr per US dollar (Derrese, 2001).

Following the collapse of the Bretton Woods System in 1971, the birr was revalued to 2.30 birr per US dollar on 21 December1971. The subsequent 10% devaluation of the US dollar had temporarily brought about undervaluation of the birr. To realign the Ethiopian birr, it was again revalued to 2.07 birr per US dollar in February 1973. From then on, the Ethiopian currency was pegged to the US dollar at the rate of 2.07 birr per dollar until massive devaluation of October 1992. This shows that for nearly half a century, the exchange rate of Ethiopian currency against its reference or reserve currency, the US dollar, was determined by government decree. Moreover, this fixed official exchange rate was left unaltered for two decades despite the floating of the major world currencies including the US dollar. In effect the birr became over-valued in terms of the US dollar as well as many other foreign currencies (Ibid).

Though Ethiopian governments resisted the pressure to devalue the currency over the years, there is the consensus that the Birr had been overvalued since 1970s. Later, change in government led to the devaluation of the Ethiopian currency in September 1992 (Haile, 1999). Since then, the value of the currency has been frequently downsized under managed floating exchange rate regime (specifically a quasi market[1] determined exchange rate) as opposed to previously fixed exchange rate regime (Derrese, 2001).

[1] A quasi-market determined exchange rate is an exchange rate determined through the auction system.

The stabilization packages, which have been undertaken by Ethiopian government in the post 1992, have contributed to the improved economic performance. Accordingly, Ethiopia's economy grew at an annual average of about 11% during 2005/06-2007/08. Contributing close to half of the GDP of the country, agriculture was the driving force behind the earlier growth takeoff. Agriculture grew at 13.5% in 2004/05 and 10.9% in 2005/06, contributing 50% and 44% to overall growth (Getnet, 2010).

Recently, the contribution to growth has been overtaken by the services sector. The growth performance of services has consistently improved over the years to a stage where it contributed 60% of annual economic growth in 2007/08. The industrial sector contributed about 10% to overall growth during 2004/05 to 2008/09 and remained unchanged in its GDP share over these years, at about 13% (Ibid).

1.2. Conceptual Issues

Derrese (2001) reviewed the works of (Gashaw, 1992; Asmerom, 1994; Haile, 1994; Befekadu and Kebre, 1994; Alem ,1995) and concluded that among the significant factors that underlie the poor performance of the Ethiopian economy in general and that of the export sector in particular is the over-valued exchange rate of the birr. He further noted that over valuation of the exchange rate causes misallocation of resources in production and promotes investment of resources in rent-seeking and socially unproductive but privately profitable activities and, hence, reduces the growth rate of output.

In line with this argument, Dercon and Ayalew (1994) quoted in Derrese (2001) attested that

over-valuation of Ethiopian birr also reduced the competitiveness of legal exports and led to significant smuggling.

The government of Ethiopia has been facing foreign exchange shortages and is unable to meet the lowest required foreign exchange reserves (which is supposed to be not less than a 3-month import coverage, but with actual coverage at times being less than six weeks of import coverage).These shortages have led the National Bank of Ethiopia to ration foreign exchange to both importers (and foreign investors who are unable to repatriate some of their profits back home as a result of the foreign exchange shortages). These also indicate a non-market clearing foreign exchange market. The fact that the IMF has also been warning the government that it would face financial difficulties implies that the birr could collapse, sooner or later. Moreover, some domestic firms were suspending their operations and were unable to import the necessary intermediate inputs from overseas due to the lack of foreign exchange also indicate a disequilibrium in the exchange rate market (that is, the exchange rate between the birr and other currencies has become untenable) (Seid, 2010)[2].

Besides, Dorosh *et al.* (2009) underscored that real exchange rate appreciated by 14 percent from July 2004 to January 2007, as nominal exchange rates were kept almost constant while domestic inflation increased, even if there is a remarkable economic growth from 2004/05 to 2008/09.Their analysis further noted that when major external shocks (including increases in world prices of fuel and reduced private transfers) hit the economy, a foreign exchange shortage resulted.

[2] On line from allAfrica.com, Seid Hassan, 30 September 2010.

Since March 2008, access to foreign exchange for imports was restricted (rationed) to avoid excessive drawdown of foreign exchange reserves, and by July 2008, the real exchange rate appreciation had increased by a further 20 percent(from 86.1 to 66.2) to a total of 34 percent(relative to July 2004).

Table 1-1: Ethiopian Nominal and Real Exchange Rates, 2004-2009

Months	Nominal Exchange (Birr/$)	Nominal Exchange Rate(Birr/$) (Index)	World Price Index($)	World Price Index(Birr)	CPI	Real Exchange Rate Index
Jul-04	8.8	100	100	100	100	100
Jan-05	8.83	100.3	102.7	103	102.9	100.1
Jul-05	8.84	100.5	101.4	101.9	111.5	91.3
Jan-06	8.86	100.6	104.1	104.7	112.8	92.8
Jul-06	8.87	100.8	108.7	109.6	125.7	87.2
Jan-07	8.99	102.1	110.4	112.7	131.6	85.7
Jul-07	9.21	104.7	116.8	122.3	143.6	85.1
Jan-08	9.4	106.9	127	135.7	157.5	86.1
Jul-08	9.83	111.7	139.6	156	235.8	66.2
Jan-09	11.06	125.7	120	150.8	217	69.5
Jun-09	12	136.4	121.3	165.4	224.4	73.7
July2004 -June2009 (% Ch)	36.40%	36.40%	21.30%	65.40%	124.40%	-26.30%

Source: Dorosh *et al*., 2009

As it can be observed from Table 1-1, real exchange rate was roughly appreciating, which in turn inculcates loss of international competitiveness and shrinks the incentives for producing tradable goods. It was only for the last period that it commenced to reverse the appreciation. The counteracting was mainly induced by the significant nominal depreciation of Birr (from 9.83 to 12.0 Birr/$) between July 2008 and June 2009. All the fore mentioned issues call up on further readjustment of exchange rate (exchange rate shock[3]). Accordingly, its realignments have been operational zed though its optimality and timing is somewhat questionable.

[3]In this paper, the term "exchange rate shock" is employed rather than "devaluation" since exchange rate in Ethiopia is currently determined through a quasi-market.

On 1 September 2010, the National Bank of Ethiopia announced a devaluation of the birr by 20 per cent. With this devaluation measure, the value of the birr has declined by at least 45 per cent since 2008. It is to be recalled that the birr was devalued by at least 10 per cent in October 2008, by 9.9 per cent in July 2009, and by at least 5 per cent in early May/late April 2010 (Seid, 2010). Based on the data from EDRI (Appendex:7), Ethiopian nominal exchange rate is partly devalued and partly depreciated all together by approximately 90% over the period 2006 to 2010.

According to access Capital (2010) ‘‘there is apparently little justification for a large recent devaluation (20%) from a short-term macroeconomic perspective, rather longer- term and structural motives for the authorities' actions. More specifically, there is now a conscious effort to experiment with a deliberately undervalued exchange rate (the "China Model" one might call it) and to pursue a more aggressive strategy of import substitution. Both these efforts can be seen as being in line with the main objectives of the authorities' recently released draft Five-Year Growth and Transformation Plan".

Theoretically, it is expected that a decline in the value of birr induces supply of tradable goods (exports) to increase. This is due to the fact that they become competitive in world market and cheaper in foreign currencies. In the case of Ethiopian economy, however, there is supply rigidity because of technological backwardness so as to sufficiently respond to the change of the policy.

On the other hand, the cost of imported raw materials, which are inevitable components of domestic manufacturing, rises and leads to the increase in cost of production of domestic. Ultimately, this results in contractionary production in domestic manufacturing unless and

other wise tariffs on imported intermediate inputs are exempted. Similarly, there are import substitution trends for expensive imported commodities and increased employments due to the decline in real wages. The demand side effects (such as expenditure reducing and switching) have also their own crucial implications on export, import, production and employment. The central issue of the paper is, therefore, to realize the impact of exchange rate adjustments based on these broad prospective.

Actually, there are no studies which reveals the effects of these exchange realignments on export, import, consumption, employment, domestic production, sectoral outputs and household incomes relying up on general equilibrium analysis even if there could be little studies using partial equilibrium analysis.

The central objective of the study is to address the impacts of exchange rate shocks on domestic production and employment.

The specific objectives are to:

- explore the short run to medium term impacts of exchange rate shocks on export, import, trade balance and current accounts
- examine the short run to the medium term industrial(manufacturing) output growth in response to the shocks
- analyze the real household consumption, income and welfare effects of the shocks

By incorporating recent shocks and employing general equilibrium analysis, this study fills some gap and, in turn, be a bench mark and used as inputs in formulating optimum Ethiopia's exchange rate policies. Overall, it is intended to make empirical contributions to ongoing and unsettled debate over exchange rate realignment.

Computable general equilibrium model, which is developed by Lofgren *et al*. (2002) and used by International Food Policy Research Institute (IFPRI), is adopted in this study. The intension is to examine what the Ethiopian economy would have been looked like had exchange rate shock been undertaken to the benchmark year data.

The Social Accounting Matrix (SAM) developed by EDRI for the year 2005/06 is employed as a benchmark data. So as to reduce the complication of CGE which is emanated from the full and detail SAM, aggregation in to 15 sectors is developed by EDRI. Among the 99 production activities in the full SAM, 66 of them are agricultural activities, 24 of them are industrial activities and 9 of them are service activities. The first one is aggregated in to 5 major agricultural sub sectors. The second one is aggregated in to 7 major industrial subsectors. And the third one is aggregated in to 3 major service sub sectors. Then, application of the CGE on 15 –sectors aggregation is performed using GAMS software. Lastly, simulation results are checked using sensitivity analysis (i.e. robustness of results to parametric changes).

The scope of this study confines to the interaction between the nominal exchange rate realignments of Ethiopia and associated macroeconomic performances.

It is obvious that the exchange rate adjustment is one of the many components of stabilization package. Under general equilibrium modeling, the effects of this specific policy shock could be isolated from impacts of other policies since it is possible to explicitly specify the nexus and causal mechanisms through which this shocked exchange rate influences the economy.

Whereas, data based econometric analysis method needs reliable data and encounters difficulties in identifying individual policy effects.

Besides, disaggregation of sectors and details of institutions in CGE Model allow in-depth analysis of policies which make CGE preferred to macro econometrics model. Overall, CGE model has advantage over the partial analysis models in that it provides Economy - wide impacts of policy changes.

Even if the computable general equilibrium model captures the largest proportion of inter linkages and reveals the multi sect oral impacts, it is neoclassical in sprit. And, thus, it disregards nominal variables and institutional power of influencing price. The model also ignores financial sectors and considers only real values. Besides, the model is highly based up on theory, which is an abstraction of the real economy. And this calls for individual country – individual treatment approach.

CGE model has two main categories .These are static and dynamic. In this study, the former one is employed. It describes the economy in detail only with-in a single period. As a result, its capacity to evaluate the full effect of policy and non-policy changes is restrained. There are also changes in the amount of capital stock, labor supply, etc…. across period. But it is unable to capture such momentum.

This study is structured in to six chapters. The first chapter is introductory .The second chapter reviews both theoretical and empirical literatures. The third chapter presents a brief review of

the Ethiopian economy. The fourth chapter is devoted to discuss methodology and benchmark year data. Simulation results are analyzed and their robust nesses are checked in the fifth chapter. Finally, conclusions and Policy Implications are presented in the sixth chapter.

Chapter two: Review of Literatures

2.1 Theoretical Literature Review

Devaluation has theoretically both demand and supply effects. On the demand side, it can have both an expenditure- reducing and expenditure-switching effects. The expenditure-reducing effect of devaluation is associated with the rise in prices which reduces private sector financial wealth and expenditure. Since nominal values may not rise proportionally with devaluation, real wages and other factor incomes also tend to fall. The effect of devaluation on domestic absorption can, thus, be contractionary, i.e. reducing expenditure on all goods (Lizondo *et al.*, 1989).

But the expenditure-switching effect of devaluation works in the opposite direction for non tradable. By altering the relative prices of tradable and non tradable, devaluation promotes substitution away from tradable. Consequently, devaluation reduces domestic demand for tradable, while the total (domestic and foreign) demand for domestically produced traded goods is perfectly elastic and ,therefore, is not affected by devaluation. In Mulat (1992), it has further noted that the effect on the demand of non tradable can be positive if the expenditure-switching effect dominates the expenditure- reducing effect.

On the other hand, the supply of traded and non traded goods is affected positively and adversely respectively. Thus, the oversupply (traded and non traded) effect can be positive, if the positive effect in the traded goods sector outweighs the negative effect in the non traded goods sector (Ibid).

In general, the contractionary and expansionary effect of devaluation relies upon induced

or depressed demand and supply. Hanson (1983) quoted in Mulat (1992) stated that devaluation will have a contractionary effect on output if the depressing effects on aggregate domestic demand are not outweighed by the supply-stimulating aspects. And this will hold particularly if the elastic ties of import demand and export supply are small and the structure of production is weighted more towards tradable than towards non-tradable.

Krugman *et al.* (2003) quoted in El-Ramly (2008) contended that the devaluation of a country's currency theoretically triggers an "expenditure Switching" mechanism. Devaluation increases the prices of foreign goods relative to those of domestic goods. The rise in the price of foreign output directs domestic demand away from imports and towards domestic output thereby stimulating import substitution production. Also, the decline in the prices of the country's goods in terms of foreign currencies improves its international competitiveness, thus boosting exports. This results in an improvement in the country's trade balance and acts as a solution for shortages of international reserves. The expansionary effect of devaluation on aggregate demand is thus believed to increase output and reduce unemployment.

At the same time, the role of exchange rate policy in economic adjustment has become the subject of considerable debate. The "Orthodox" view [see eg. Guitian, 1976, and Dornbusch, 1988] has maintained that devaluation plays a positive and important role in balance -of-payments stabilization (through its expenditure-switching effects and increased production of tradable), while the New structuralist school has stressed the contractionary and otherwise perverse effects of exchange rate adjustment (Agenor, 1991).

It is argued that a devaluation or depreciation of currency raises the price of imports in comparison to that of its exports, and this causes the trade balance to improve. This leads to an

improvement in the foreign sector of economy. The improvement in the foreign sector raises output and employment in the overall economy. According to the traditional views such as the elasticities, absorption, and the Keynesian argue that devaluations have expansionary effect on output and aggregate demand (Kalyoncu *et al*., 2008).

Contrary to the traditional view, there are also other theoretical reasons why devaluation can have a contractionary impact on the economic activity. First, devaluation can redistribute income from groups with a lower to a higher marginal propensity to save. This may lead to a decline in aggregate demand and output (Krugman and Taylor, 1978). Secondly, a nominal devaluation can decrease the aggregate demand through the negative real balance effect due to a higher price level, which in turn may decrease the level of output. Thirdly, if the price elasticities of exports and imports are very low, then the trade balance expressed in terms of domestic currency may deteriorate causing a recessionary effect in the economy. In addition to these demand-side effects, there are also a number of supply-side channels through which devaluation can be contractionary. Exchange rate depreciation raises the cost of imported inputs, leading to a decrease in aggregate supply. Additionally, exchange rate depreciation may raise the domestic interest rate and wage level through an increase in the price level. This might also decrease the aggregate supply in the economy (Ibid).

On the other hand, the traditional view of exchange rate presumes that a nominal devaluation must lead to a real devaluation. For this to be pragmatic, Krugman *et al*. (2003) pinpointed that complete exchange rate pass-through and the assumption that aggregate demand increases caused by nominal devaluations do not fuel domestic inflation should be conceived. Edwards (1986) also argued that a nominal is translated into a real devaluation if it is

accompanied by the appropriate macroeconomic policies. Particularly, his publication in 1989b emphasized that fiscal and monetary policies must be consistent with the adopted exchange rate regime in order to maintain sustainable equilibrium (El-Ramly, 2008).

In line with the above, Golub *et al.* (2002) argued that the nominal exchange rate alone is clearly an unsatisfactory indicator of international price competitiveness, since movements in relative prices also matter. Instead, competitiveness is better measured by the real exchange rate q = ep/p*, which adjusts the nominal exchange rate e (foreign currency per unit of domestic currency) by domestic and foreign prices (p and p* respectively).They further defined that Price competitiveness as the relative price of foreign tradable goods in terms of domestic tradable goods. They also noted that a country's competitiveness "improves" if the relative price of its tradable goods declines.

The trade balance (current account) of a nation is improved or depressed so long as the Marshall-Lerner condition hold or not .The condition states that if the current account is initially zero, a real currency depreciation causes a current account surplus if the sum of the relative price elasticities of export and import demand exceeds unity, i.e. demand for imports and exports is sufficiently elastic with respect to the real exchange rate (Krugman *et al.,* 2009).

A country's current account worsens immediately after real currency depreciation and begins to improve only some months later and this is termed as J- curve effect (Ibid).Why this effect is occurring is reviewed by El-Ramly (2008) from different studies:

Krueger (1983) maintained that the trade balance deteriorates initially because in the short run it primarily includes transactions of goods in transit and under contract. However, as time passes, the relative price changes caused by devaluation start to improve the trade balance by

affecting export and import volumes. Magee (1973) introduced the "pass-through" analysis; the idea that, even in the absence of settled contracts, the degree of pass through is low in the period that immediately follows devaluation. Limited exchange rate pass-through reduces the effect of a nominal exchange rate on the real exchange rate which implies that the quantities of exports and imports remain unchanged for some time. Estimating the time path through which exports and imports respond to price changes, Junz and Rhomberg (1973) affirmed that 50 percent of the full effect of price changes is revealed during the first three years following devaluation, while it takes almost five years for 90 percent of the full effect to materialize.

2.2 Empirical Literature Review

There are four major empirical approaches in existing studies to examine the effects of devaluation on outputs. These are: *the before and after* ,which studies changes in country performance at the time of devaluation on output; *the control group approach,* which aims at separating the effect of devaluation from other factors on output; *the econometric approach*, that applies econometric methods to time series to investigate the effect of devaluations on output ; and *the macro-simulation approach* ,which employs simulation models to analyze the impact of exchange rate changes on output (Domac , 1997) quoted in (Kalyoncu *et al*., 2008).

This study reviews the empirical literatures by analogous fashion as indicated above.The empirical findings are in most cases inconsistent (i.e some have contractionary and some have expansionary results).

Under before-After approach, Diaz Alejandros [1965] quoted in Agenor (1991) showed that the 1959 devaluation of peso in Argentina was contractionary, because it induced a shift in

income distribution towards high-propensity savers, which in turn, depressed consumption and real absorption. By the same approach, cooper (1971) cited in Agenor (1991) surveyed twenty-four devaluation episodes involving nineteen different developing countries that took place between 1959 and 1966.His results showed that the trade balance (measured in foreign currency) and the balance of payments did improve in most cases, he also found evidence of contractionary tendencies following a devaluation. The study by Krugman-Taylor (1978) revised in the works of Lizondo *et al*.(1989) has attempted to assure that nominal devaluation could cause real output to contract. On the other hand, Khan et al. (1985) stated in Mulat (1992) explained that in the majority of the cases (i.e in different studies) output growth would be higher after devaluation rather than lower.

Agenor (1991) reviewed different studies: Kamin (1988), using *control group approach*, concluded that there is little evidence that devaluations are followed by significant contractions in output but recessions prior to devaluation appear to be more typical of the devaluation process. By employing the same approach, Edwards (1989a; 1989b) suggested that the observed decline in output growth in periods surrounding devaluations may not in fact be a consequence of exchange rate changes but may rather reflect the effects of a massive imposition of restrictions and other policies that have accompanied devaluations.

Under econometric approach, Edward (1986) revealed that real exchange-rate changes have a small contractionary effect in the short run. In the medium run, however, the perverse effect is completely reversed. In the long run, devaluations are neutral. . Kalyoncu *et al.* (2008), using unit root and co integration test approach, also studied the effect of currency devaluation on output level of 23 OECD countries. The empirical evidence suggests that, in the long run,

output growth is affected by currency devaluations in 9 out of 23 countries. In six out of nine countries, depreciation exerts a negative impact on output growth; however depreciation improves output in three countries. Solimano (1986), using a computable macro model for Chile, too showed a currency devaluation to be contractionary in the short run to medium run.

El-Ramly(2008) summarized that the contractionary effect of devaluation can be particularly evident in developing countries because of (i) their low import and export demand elasticities with respect to a change in the real exchange rate that result in a slow adjustment in their current accounts, (ii) their heavy dependence on imports of intermediate and capital goods which raises costs of production following devaluations, (iii) their large external debt denominated in foreign currencies that increases in terms of domestic currency as a result of devaluation causing bankruptcies, reducing the economy's net wealth and leading to a reduction in expenditure (Cooper (1971), Gylfason & Risager (1984), Van-Wijnbirgen (1986), Acar(2000)) ,(iv) the fact that their domestic price levels are more likely to rise after devaluation causing a wage-price spiral which negatively affects output and reduces competitiveness (Hanson (1983), Gylfason & Risager(1984),Solimano(1986),Van-Wijnbergen (1986) and Gylfason & Radetzki(1991)) and , (v) their high vulnerability to loss of capital caused by weakened confidence in the economy following a devaluation.

By employing Vector Auto regression Analysis (i.e. econometric approach) for Egyptian Economy, he further contended that the changes in the real exchange rate as a major determinant of the variations in the rate of growth of output in Egypt are essential. His results also support the presence of an initial contractionary effect of devaluation on output that lasts

for as long as four years before the expected positive effect starts to materialize. Besides, he inferred that consecutive short-run depreciations of the currency should be avoided because they result in a sustained negative impact on real output that delays the expected positive effect.

Even if there are debates as to whether devaluations have an expansionary or contractionary effect on output, most of the empirical studies done on developing countries have been focused on Latin American and South East Asian countries during the 1990s(Examples of such studies include Upadhyaya & Upadhayay (1999) that focused on Asian countries.; Bird and Rajan (2000) that paid attention to Thailand ;Rogers & Wang (1995) and Kamin & Rogers (1997) that concerned with Mexico; and Hoffmaister & Vegh (1996) that focused on Uruguay) (Ibid).

On the other hand, the empirical research on this topic that focused on Middle Eastern and African countries has been extremely limited .Some of them are : Risager and Tyler (1996), based on a simulation model applied on Jordan economy, concluded that devaluation has a negative impact on the current account while it is expansionary. Domaç (1997) employed an econometric approach in an application to the Turkish economy over the period 1960-1990. His empirical findings showed that an unanticipated increase in the exchange rate by 10% increased the real output growth by 1.5%. However, he found anticipated devaluations to be statistically insignificant. Kandil and Mirzaie (2003) used a sample of 11 Middle Eastern countries over the period 1971-2000. Their results showed that unanticipated devaluations have a significant influence on output and inflation that varies according to every country's specific circumstances. On the other hand, anticipated devaluations were found to have only a limited effect on output growth and inflation (Ibid).

Mulat (1992) studied the relationship between exchange rate policies and economic performance in Sub-Saharan Africa using the with-without method and econometric techniques. Actually, his results do not confirm that exchange rates positively affect agricultural or total output or export. He also revealed that on average, counties with significant currency depreciation were outperformed by countries with insignificant depreciation. And he further attempted to trace that the benefit of substantial initial devaluation (as recommended by the IMF and the World Bank) appeared doubtful.

A CGE analysis (i.e. the macro-simulation approach) for Zimbabwe by Mabugu (2001) pinpointed that Currency devaluation has an expansionary effect on GDP and export, and improves current account, Government revenue, but worsens income of wage earners (especially of unskilled workers) by redistributing in favour of profit earners. He also summarized different studies: Sahn *et al.* (1997) stated that country experiences are reported to have had a generally pro-rural-poor impact in Africa in the 1980s, because they raised the competitiveness of the tradable sector. Similarly, he noted that devaluations benefited food and agricultural producers in East Asia. The recent devaluations in East Asia had contractionary consequences – stronger than those generally experienced in parts of Africa, possibly because of their magnitude and of the different level and structure of banking and corporate foreign exchange liabilities. The devaluations contributed to the collapse of banks and companies that held imperfectly hedged foreign denominated debt, and thus to further declines in economic activity.

Buffie (1984) argued that devaluation is contractionary and demonstrated that with no tariffs on imported intermediates, devaluation raises their price thereby contracting the economy

through higher intermediate import costs. His result depends on two crucial assumptions: first, that there are no taxes on intermediate imports, and second that inflation translates into higher nominal wages (i.e. a higher indexation parameter). But Mabugu (2001) considered that the import tax on intermediates dampens the contractionary effect while nominal wage rigidity adds to the supply response. In another study, Pritchett (1990) found a weak relationship between the merchandise trade balance and the real exchange rate, after controlling for terms of trade improvements. Dixon et al (1984) also generated expansionary result by assuming real wage rigidity.

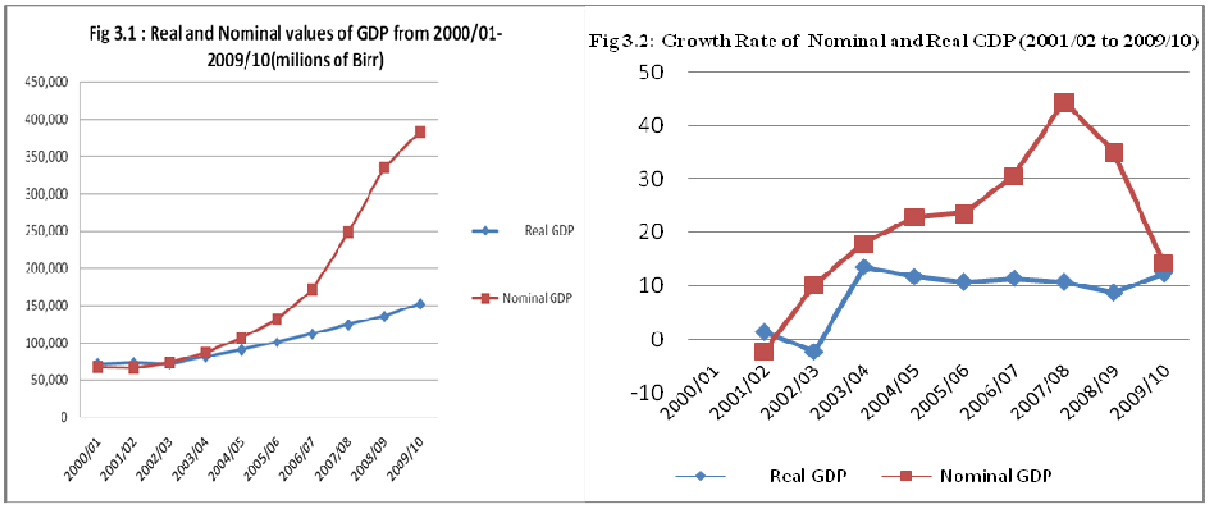
Taye (1999) cited in El-Ramly(2008) applied a macro-simulation approach to a macroeconomic model for Ethiopia. His results indicated that devaluation has a positive impact on the current account because of the reduction in imports, while it decreases output and employment.

Devaluation, in the case of Ethiopia, would help improve the current account balance but would be stagflationary. The improvement in the current account balance is, therefore, more likely due to a decrease in imports expenditure-reducing not expenditure switching and not due to an expansion in output and hence exports (Haile, 1999).

Chapter Three: A Brief Review of the Ethiopian Economy

3.1 Real and Nominal GDP

Ethiopian Economy has grown annually since 2003/04 by about 14%, 12%, 11%, 12%, 11%, 9% and 12%. Similarly, it has increased in nominal terms by about 18%, 23%, 24%, 31%, 44%, 35% and 14% over the same period. This is shown in Figure 3.2 and Appendix 8.



Source: NBE data , Appendix 8.

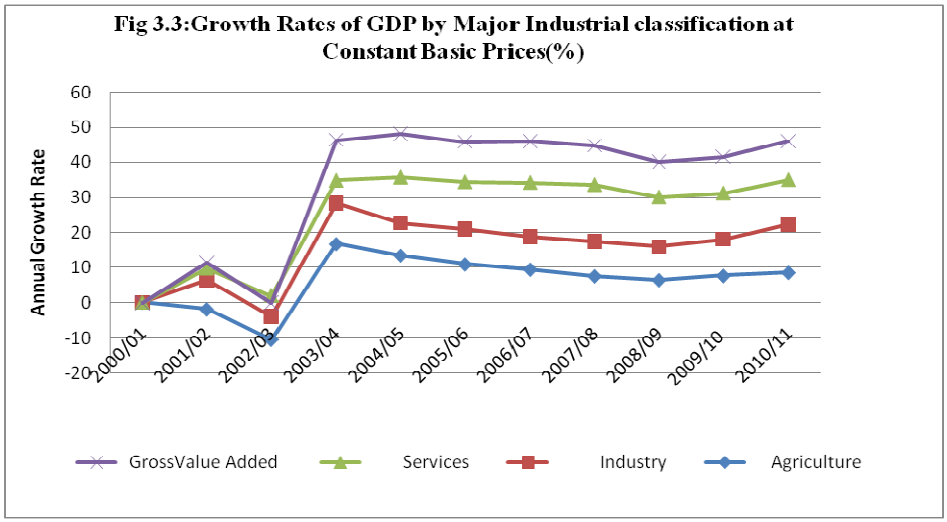
Both real and nominal GDP have boosted up in terms of values since 2003/04. They are augmented from Birr 81,421.07 millions and Birr 86,660.95 millions in 2003/04 to Birr 152,404.69 millions and Birr 383,364.28 million respectively.

According to National Bank of Ethiopia Report (2007/08), the continuous growth in real GDP over the mentioned period is broad based. These are differentiated based on sectors. In agricultural sector, there has been an increase in productivity, more land area brought under cultivation as well as favorable weather conditions. The noticeable growth of Industrial sector is mainly because of expanded investments in hydroelectric power generating stations and the

water sub-sectors. Among the service sector, the expansion in financial institution is remarkable.

3.2 Growth of Major Sectors of the Economy

As it can be observed from figure 3.3, the gross value added in the economy is represented by the highest trend. The figure reveals that the service sector is growing faster than the other two sectors since 2001/02. For Instance: It has annually augmented by 12.8%, 13.3%, 15.3%, 16%, 14%, 13%, and 12.5% since 2004/05 as it is indicated in Appendix 8. The trend is more or less stable. This is due to the fact that there have been continuous expansion of financial institutions (such as: Banks, Insurances and Micro finances), trades (including wholesales and retails), real estate, renting, transport and communication, educational sub sector, etc…..



Source: NBE data, Appendix 8.

Similarly, Industrial sector is rapidly expanding than agricultural sector, where its growth rate is increased from 9.4% in 2004/05 to 14% in 2010/11. Some of the factors which have

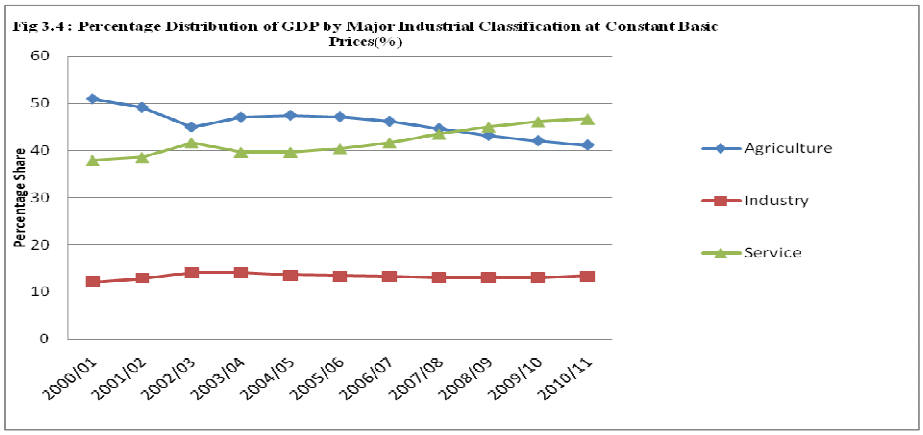
contributed to the growth are remarkable expansion in hydro electric power plantation, in the textile and leather manufacturing, Mining and quarrying, construction, etc…..

With respect to agricultural sector, its growth rate is remarkably increased from -10.5% in 2002/03 to 16.9% in 2003/04. But it has started to decline from 16.9% in 2003/04 to 6.4% in 2008/09.Again, it has started to revive and reached 8.5% in 2010/11.According to the National Bank of Ethiopia Annual Report 2007/08, the boost in agricultural output is attributed to improved productivity achieved through better use of modern agriculture inputs, favorable weather condition, expansion in cultivated land, etc….

The main driving force of agriculture is the crop sub sector. Among the crop, the increase in the production of cereals, pulses, and oilseeds is the most significant.

3.3 Share of GDP by major Industrial Classification

In terms of GDP, Agriculture has been the dominant sector of the economy until 2007/08. But latter, it has overtaken by service sector. As shown in figure 3.4 and Appendix 8, the share of agriculture has continuously been diminished from 50.9% in 2000/01 to 41.1% in 2010/11.



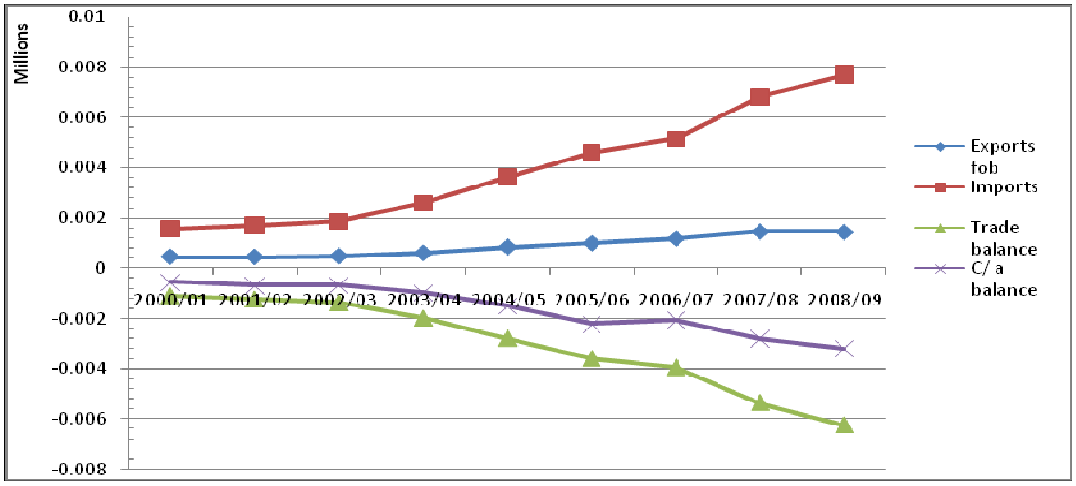
Source: NBE data, Appendix 8.

The share of service sector in GDP has boosted over time. It has increased from 38% in 2000/01 to 46.7% in 2010/11. Particularly, the share increases from 39.7% in 2004/05 to 46.7% in 2010/11.With respect to the industrial sector, its share in the GDP is almost stable for the last ten years between 12% and 14%.

3.4 Export, Import, Trade balance and Current Account

As it can be realized from figure 3.5 and Appendix 9, import increases largely higher than export. The values of import are US$ 1557 million in 2000/01 and US$7684 million 2008/09, whereas the values for export are US$ 463million and US$ 1448 million for the corresponding years.

Fig 3.5: Exports, Imports, Trade Balances and Current Accounts in Millions of US$ (2000/01-2008/09)



Source: NBE data, Appendix 9.

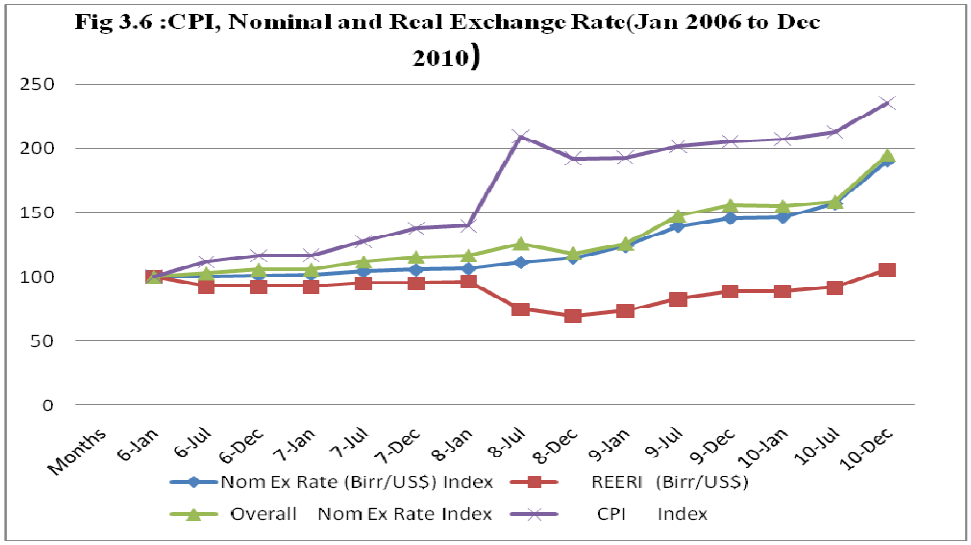
In line with this, trade balance (the difference between export and import of goods) has continuously deteriorated from -1094 to -6236. Similarly, the current account (i.e. the

summation of trade balance, net service and private transfers) is further worsened. It has moved negatively from US$ 542 million in 2000/01 to US$ 3202 million in 2008/09.

In short, both the trade balance and current account have negatively and significantly affected over time.

3.5 Consumer Price Index (CPI), Nominal and Real Exchange Rate

Figure 3.6 and Appendix 9 reveal that CPI has risen by 135.1% from January 2006 to December 2010.But the Real Effective Exchange Rate Index (REERI) is diminished only with 5.6% over the same period. This implies that the real exchange rate is highly deviated from its equilibrium position. And this calls for further depreciation so as to set it in equilibrium and curb the rise of price. In other words, the rise of general price level is an indication of real exchange rate appreciation from its equilibrium position.



Source: EDRI data ,Appendix 9.

Over the period 2006 to 2010, nominal exchange rate pegged to US dollar has partly depreciated and partly shocked all together by 90.1%. Similarly, the overall nominal exchange rate index has increased by 94.9%.This implies that the Birr has diminished in value against all foreign currencies by approximately equal level.

Chapter four: Methodology and Benchmark Data Statistics

4.1 Model Description

Exchange rate shock would have a significant impact on the domestic economic activity through external trade. It is through imported intermediate inputs such as fertilizers, pesticides, etc that it integrates to agricultural sector. The nexus is very strong and indispensable in the case of manufacturing where almost all capital goods and intermediate inputs are imported for the purpose of domestic production. As it can be grasped from the following sub section (Table 3.1), the service sector intensively employs capital which is signified by 77 percent of sector's value added paid to capital- land where the capital goods are imported.

So as to reveal the inter linkages which are induced by the exchange rate shocks, the standard computable general equilibrium model is employed. The model is based on the Social Accounting Matrix (SAM) with disaggregated factors, activities, commodities, and institutions. It is written as a set of simultaneous equations, many of which are nonlinear. There is no objective function (Lofgren *et.al*. 2002).

In other words, it is very decisive to model the economy wide impact of exchange rate shocks using a general equilibrium as there is a significant interaction between the foreign exchange market and the rest of the economy. In this analysis, alternative exchange rate shocks are simulated so as to observe the impacts under different scenarios.

4.2 The Static module

In this type of model, consumers and producers make "optimal" decisions within a single period, with no thought given to the future. That is, the model is a one-period static. It reveals the impacts of resources reallocation in the short run.

The basic characteristics of the model are summarized as follows:

The starting point of standard static CGE model is the neoclassical thought and the model is in line with the one used by International Food Policy Research Institute (IFPRI). Primarily, it is assumed that Product and factor markets clear as a result of market forces. All the following equations are taken from the standard CGE Model developed by Lofgren *et al*. (2002).

Activities: In standard neoclassical CGE model, each producer (represented by activities) is assumed to maximize profit, the difference between total revenue and factor costs plus intermediate input, subject to a production technology. Production technology has different forms but a popular choice is between the Leontief production function and the constant elasticity of substitution (CES) function.

Leontief Technology: Demand for aggregate value added:-

$$QVA_a = iva_a \cdot QA_a \qquad \text{…….(1)}$$

Leontief Technology: Demand for aggregate intermediate input:

$$QINTA_a = inta_a \cdot QA_a \quad \text{……..…….....…….…….....(2)}$$

CES Technology: Activity production function:-

$$QA_a = \alpha_a^a \cdot \left(\delta_a^a \cdot QVA_a^{-\rho_a^a} + (1-\delta_a^a) \cdot QINTA_a^{-\rho_a^a} \right)^{-\frac{1}{\rho_a^a}} \quad \text{…….……..….(3)}$$

CES Technology: Value-added intermediate-input ratio:-

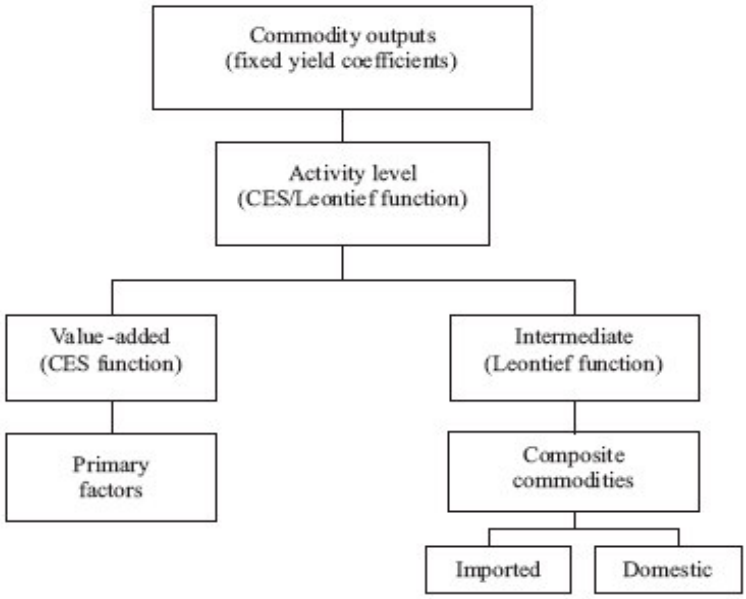
$$\frac{QVA_a}{QINTA_a} = \left(\frac{PINTA_a}{PVA_a} \cdot \frac{\delta_a^a}{1-\delta_a^a} \right)^{\frac{1}{1+\rho_a^a}} \quad \text{……....……..…..…(4)}$$

It is presumed that the production function is a constant return to scale type. It is also assumed that each activity uses a set of factors up to the point where the marginal revenue product of each factor is equal to its wage (also called factor price or rent). It is further presupposed that in each sector there is a representative firm that produces value added by combining primary factors (such as: labor and capital). A 'representative' firm assumption indicates that all producers within each sector are assumed to share the same behavior.

We adopt a nested structure for production. Activity output is a Leontief / a constant elasticity of substitution (CES) function of value added and total intermediate consumption. The Leontief alternative is the default. The CES alternative may be preferable for particular sectors if empirical evidence suggests that available techniques permit the aggregate mix between value-added and intermediate inputs to vary. Value added is itself a CES function of primary

factors whereas the aggregate intermediate input is a Leontief function of disaggregated intermediate inputs (Ibid).

Figure 4.1—Production Technology



Source: Lofgren *et.al.* (2002)

All the nexuses are summarizes in Figure 4.1.

Commodities: With the exception of home-consumed output, all commodities (domestic output and imports) enter markets. Domestic output may be sold in the market or consumed at home.

Commodity production and allocation:-

$$QXAC_{ac} + \sum_{h \in H} QHA_{ach} = \theta_{ac} \cdot QA_{a} \quad \text{……..……..……....(5)}$$

For marketed output, the first stage in the chain consists of generating aggregated domestic output from the output of different activities of a given commodity. These outputs are imperfectly substitutable as a result of, for example, differences in timing, quality, and distance between the locations of activities (Ibid).

Figure 4.2 reveals the flow of a single commodity from producers to final demand. First, there is the combination of goods from all producers in to an aggregate commodity output. This is achieved using a CES product demand system with the intention of leaving the option to the buyers as to how much to buy of each individual product (maximizing their consumption). The aggregate output is sold domestically or internationally. The producers' allocation between domestic sales and exports is specified via a Constant Elasticity of Transformation (CET) function, assuming imperfect transformability between export and domestic sales.

Output Transformation (CET) function:-

$$QX_c = \alpha_c^t \cdot \left(\delta_c^t \cdot QE_c^{\rho_c^t} + (1 - \delta_c^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}} \quad \text{……………………………………(6)}$$

Export price:-

$$PE_c = pwe_c \cdot (1 - te_c) \cdot EXR - \sum_{c' \in CT} PQ_{c'} \cdot ice_{c' c} \quad \text{…………………………………….…..(7)}$$

The producers will sell their products to the market with the highest profitability. The domestic good is combined with imports to produce the composite commodity.

Composite supply (Armington) function:-

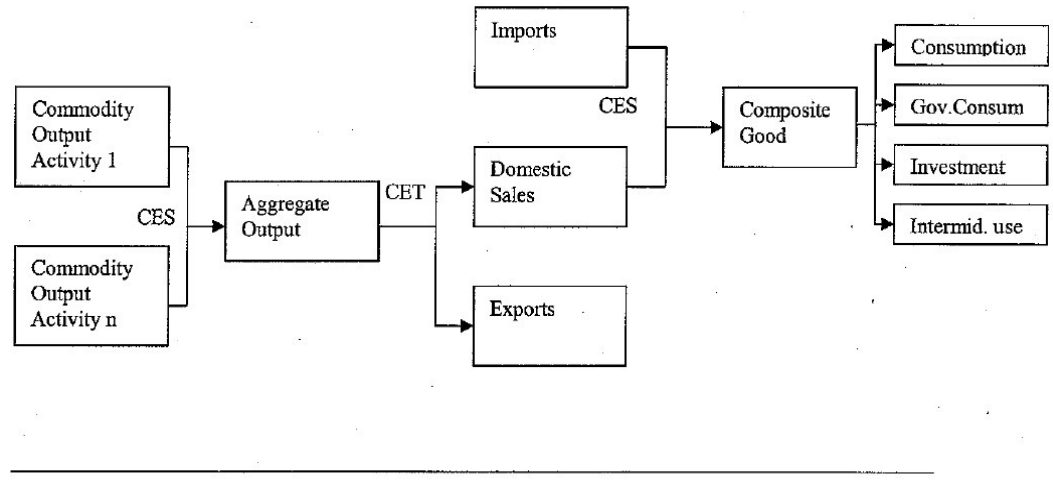
$$QQ_c = \alpha_c^q \cdot \left(\delta_c^q \cdot QM_c^{-\rho_c^q} + (1 - \delta_c^q) \cdot QD_c^{-\rho_c^q} \right)^{\frac{1}{\rho_c^q}} \quad \text{……………………………..........(8)}$$

Import price:-

$$PM_c = pwm_c \cdot (1 + tm_c) \cdot EXR + \sum_{c' \in CT} PQ_{c'} \cdot icm_{c',c} \quad \text{..... (9)}$$

For this the Armington specification is used, which mean that the domestically produced and imported goods are imperfect substitutes (Morley *et.al*, 2006).

Figure 4.2—Flow of goods from producers to the national composite commodity



Source: Morley *et.al*. (2006)

Domestic demand is made up of the sum of demands for household Consumption, government consumption, investment, intermediate inputs, and transactions (trade and transportation) inputs.

In the standard CGE model, institutions are represented by households, enterprises, the government, and the rest of the world.

Households: demand is represented by a linear expenditure system (LES) derived from the maximization of a Stone-Geary utility function (Annabi *et al*., 2004). They earn their income from production factors: labor, land and capital. They also receive dividends, intra-household transfers, government transfers and remittances. They pay direct income tax to the government. Household savings are a fixed proportion of total disposable income.

Household Consumption Spending on marketed commodities:-

$$PQ_c \cdot QH_{ch} = PQ_c \cdot \gamma^m_{ch} + \beta^m_{ch} \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^m_{c'h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'} \cdot \gamma^h_{ac'h} \right) \quad \text{……..……..(10)}$$

In figure 4.3 below, incomes and demands of institutions are clearly indicated.

Enterprises (Firms): Instead of being paid directly to the households, factor incomes may be paid to one or more enterprises. Enterprises may also receive transfers from other institutions. Enterprise incomes are allocated to direct taxes, savings, and transfers to other institutions. Enterprises do not consume. Apart from this, the payments to and from enterprises are modeled in the same way as the payments to and from households (Lofgren *et al*., 2002).

Investment Demand:

$$QINV_c = \overline{IADJ} \cdot \overline{qinv_c} \quad \text{…….……..……....…..(11)}$$

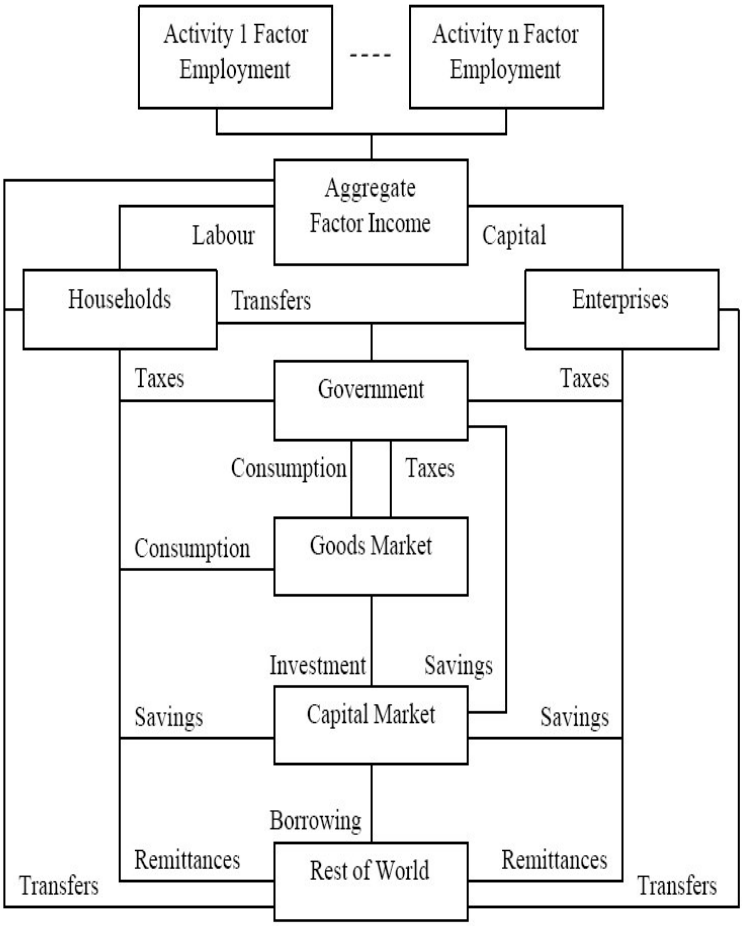
The Government: The government collects taxes and receives transfers from other institutions. In the basic model version, all taxes are at fixed ad valorem rates. The government uses this income to purchase commodities for its consumption and for transfers to other institutions. Government consumption is fixed in real (quantity) terms whereas government transfers to domestic institutions (households and enterprises) are CPI-indexed. Government savings (the difference between government income and spending) is a flexible residual (Ibid).

Government consumption demand:-

$$QG_c = \overline{GADJ} \cdot \overline{qg}_c \quad \text{……..(12)}$$

Rest of the world: transfer payments between the rest of the world and domestic institutions and factors are all fixed in foreign currency. Foreign savings (or the current account deficit) is the difference between foreign currency spending and receipts.

Figure 4.3—Institutional Incomes and Domestic Demand.



Source: James Thurlow (2004)

Equilibrium: General equilibrium is defined by the equality (in each period) between supply and demand of goods and factors, and the investment-saving identity (Annabi *et al.,* 2005).

Factor markets:-

$$\sum_{a \in A} QF_{f\,a} = \overline{QFS}_f \quad \text{…….. (13)}$$

Composite commodity markets:-

$$QQ_c = \sum_{a \in A} QINT_{c\,a} + \sum_{h \in H} QH_{c\,h} + QG_c + QINV_c + qdst_c + QT_c \quad \text{..... (14)}$$

Current –account balance for the rest of the world, in foreign currency:-

$$\sum_{c \in CM} pwm_c \cdot QM_c + \sum_{f \in F} trnsfr_{row\,f} = \sum_{c \in CE} pwe_c \cdot QE_c + \sum_{i \in INSD} trnsfr_{i\,row} + \overline{FSAV} \quad \text{……(15)}$$

Government Balance:

$$YG = EG + GSAV \quad \text{……. ….....……..……..…… (16)}$$

Savings-Investment Balance:-

$$\sum_{i \in INSDNG} MPS_i \cdot \left(1 - TINS_i\right) \cdot YI_i + GSAV + EXR \cdot \overline{FSAV} = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \quad \text{…….……..... (17)}$$

Closures: In CGE Model, there are two main balances, namely: macroeconomic and factors. The former includes: the (current) government balance, the external balance (the current account of the balance of payments, which includes the trade balance), and the Savings-Investment balance.

The latter comprises of factors which could be fully employed and mobile, or fully employed and activity specific, or unemployed and mobile. In Ethiopia, there are large numbers of unskilled labors (i.e daily labors) who are freely mobile among sectors and only seasonally employed. And, hence, the best closure for the factor is the third alternative.

Under Government balance, there are three options. Government saving is flexible in the first option and fixed in the second and third options. Whereas direct tax rates are fixed in the first option and, changed uniformly and scaled in second and third options respectively. In Ethiopia, tax rates are not frequently revised. Hence, it is more likely pragmatic to presume that direct tax rates are fixed and Government saving is flexible.

The external balance has two alternatives. These are: fixed foreign savings together with flexible real exchange rate , and flexible foreign savings accompany by fixed real exchange rate. As long as exchange rate is the policy instrument in this analysis, an appropriate alternative is the second one, though 'somewhat managed floating type' exchange rate regime exists in the country.

With respect to **saving-investment balance**, there are five choices. The first, the second, the fourth, and the fifth are investment-driven saving types where as the third one is saving-driven investment type. In Ethiopia, it is more realistic to presume the saving-driven investment closure since households and enterprises don't change their savings remarkably over series of time. The standard neoclassical CGE model presupposes neutrality of money which is induced by the use of a numéraire and the lack of an explicitly modeled monetary sector. In other words, only real flows of commodities and factors are considered. Nonetheless, Taylor (1983) cited in Thurlow (2004), in outlining the structuralist approach, disagreed that money-

neutrality is to hold and he argued that nominal changes can influence the real economy, particularly within the short-run and in respect to the demand for money balances. Dervis *et al*. (1982) quoted in Thurlow (2004) suggested however that, while separability is not always possible to preserve, the overall strength of the CGE approach lies in its ability to address questions of medium to long-term resource allocation .

Though neoclassical theory underscore that markets are assumed to clear through the interaction of relative prices, such that equilibrium is achieved in both goods and factor markets, some scholars, however, contend that that there are certain institutional and structural rigidities within the Less Developed country's (LDC's) economy, like Ethiopia, which result in cases of persistent disequilibrium or deviations from neoclassical theory.

To the best of my knowledge, there are no CGE Models designed to capture all institutional and structural rigidities prevailing in country like Ethiopia though some scholars constructively criticized the neoclassical theory underlying the models. But in this standard CGE model, neoclassical-structuralist modeling is followed as (Dervis *et al*., 1982) is cited in (Lofgren *et al.,* 2002).

Moreover, situations in developing countries are also addressed by outcomes of research projects conducted at IFPRI: household consumption of non marketed (or ˝home") commodities, explicit treatment of transaction costs for commodities that enter the market sphere and a separation between production activities and commodities that permit any activity to produce multiple commodities and any commodity to be produced by multiple activities (Ibid). Hence, it is reasonably fair to base the analysis on this neoclassical-structuralist CGE Model.

4.3 Benchmark Data Statistics

4.3.1 Benchmark Structure of Ethiopian Economy

The base run structure of the Ethiopian Economy is signified in the Social Accounting Matrix (SAM) for EFY[4] 1998 (2005/06). A social accounting matrix (SAM) is a comprehensive, economy wide data framework, typically representing the economy of a nation (Lofgren *et al.,* 2002). More technically, a SAM is a square matrix in which each account is represented by a row and a column. Each cell shows the payment from the account of its column to the account of its row. Thus, the incomes of an account appear along its row and its expenditures along its column. The underlying principle of double-entry accounting requires that, for each account in the SAM, total revenue (row total) equals total expenditure (column total) (Ibid).

SAM, which is a representation of an economy for a particular year, is the main database used to calibrate a CGE model. While the SAM provides insight into the sectoral and institutional structure of the economy, it does not contain information on the behaviour of the country's economic agents, or the process of dynamically updating the model across time. In such cases, information is taken from additional data sources and from the literature (Thurlow, 2004).

The 2005/06 Ethiopia SAM incorporates 256 separate accounts and is the first comprehensive SAM for Ethiopia (EDRI, 2009). Based on the aggregated macro SAM, the Economy is

[4] Ethiopian Fiscal year (EFY): runs from July through June.

represented by two major activities, i.e. agriculture and non agriculture. The latter includes manufacturing, other industries and services.

The total value-added (also called GDP at factor cost) is indicated in the following Table 4-1. Total value-added is the earnings received by factors of production, such as employee compensation and gross operating surplus etc … Ethiopia being an agricultural based economy, 48.1 percent of total GDP at factor cost is generated within this sector. It is followed by services which account for 40.4 percent. Other industries all together add 6.8 percent. The least is contributed by manufacturing which accounts for only 4.7 percent. Overall, the economy is suspended on two main pillars namely agriculture & related activities and service sectors which together account for 88.5 percent of total GDP at factor cost.

Observing across sectors, agriculture makes use of 73.5 percent of aggregate labor and 23.3 percent of aggregate capital-land of the economy. Whereas service sector employs 18.9 percent of aggregate labor and 61.4 percent of aggregate capital –land. Even if manufacturing is believed to have domination on capital-land resource of the country, unfortunately it makes use of the least and only 5.4 percent aggregate capital-land. In terms of labor, only 4 percent of the aggregate is employed in this specific sector. This reveals that manufacturing is creating less job opportunities, making use of small amount of capital-land factor and contributing very low to GDP.

Agriculture is the most labor intensive sector where 75.4 percent of the sector's value-added is paid to labor. The degree of intensity of labor in Manufacturing, other Industries and Services

sector is sequentially 41.4 percent, 26.7 percent and 23 percent of sector's value added. On the other hand, the large part of capital is concentrated (employed intensively) in service sector and indicated by 77 percent of Sector's value added paid to capita- land.

Table 4-1:share of GDP Generated by Sectors and in Relative Factor Shares in Production-Aggregated(2005/06)

Sectors	Factors		Share of GDP (Sector Value added)	Relative Factor Shares in Production		Sector Value Added
	Total Labor	Total Capital-Land		Labor	Capital-Land	
Agriculture & Related Activities	73.50%	23.30%	48.10%	75.40%	24.60%	100%
Manufacturing	4.00%	5.40%	4.70%	41.40%	58.60%	100%
Other Industries	3.70%	9.80%	6.80%	26.70%	73.30%	100%
Services	18.90%	61.40%	40.40%	23%	77%	100%
Total Value-added at Factor Cost	100%	100%	100%	49.30%	50.70%	100%

Source: EDRI, December 2009.

Among the service sector some of the sub sectors are the major one. These are: real estate, transport and communications and financial services. Other industries and manufacturing sectors are the next two sectors paying respectively 73.3 percent and 58.6 percent sect oral value added to capital - land .The major components of other industries are utilities such as electricity and water, and construction and mining.

Agriculture is the least capital intensive where only 24.6 percent of the sector's value-added is paid to capital-land. Overall, labor generates almost half of GDP (49.3 percent), while capital-land induces the other half (about 50.7 percent).

From Table 4-2, we realize that agriculture sector spends 90.5 percent of its outlay on total factor inputs and only 9.5 percent of its outlay on intermediate inputs. Among the factor inputs: agriculture labor and agricultural capital-land are the major one. On the other hand, outlays on intermediate inputs and factor inputs in the non agricultural sector are roughly equally distributed, where the former and the latter account for 48.1 percent and 51.9 percent respectively. This implies that for each Birr 100 worth of non agricultural output, about Birr 48.1 and Birr 51.9 are spent on intermediate inputs and facto inputs respectively. The two main components of factor inputs in the case of non agriculture sectors are non-Agriculture Labor and non-agriculture capital-land but the latter one is the major.

For the year 2005/06, the trade deficit of the country was Birr 30.24 billion, that accounted for 22.8 percent of GDP. On the other hand, the value of Ethiopia's total trade in EFY 1998 (2005/06) was almost half of its gross domestic product at market prices. This reveals that the country was a moderately open economy.

As it can be clearly understood from Table 4-3, the main exports of Ethiopia is primary agricultural products which account for 41 percent, and 12.8 percent in total exports and in its own sectoral production respectively and amounted to be Birr 6.88 billion in EFY 1998 (2005/06). On the other hand, transport services have the highest export intensity i.e., 53.1 percent of their production is employed by foreigners while their export share in total export is on the second rank with 27.5 percent. Metal and metal products are the second in export intensity and accounts for 28.7%.

The overall export intensity in the bench mark year is only 9 percent. This implies that only 9 percent of the aggregate GDP is exported to international market. On the other hand, Machinery, Transport, Electronic & Other Equipment are the first ranked in terms of shares in total import and account for 26.8%(i.e. Birr 12.62 billion) and ranked third in terms of import penetration ratio (i.e. ratio of import to total demand), next to fertilizers and Petroleum products. Fertilizer is the first in import penetration ratio (i.e. 72.2%).

Table 4-2:National Ratio of Spending on Factor and Non-factor Inputs of Production and Trade Related Indicators(2005/06)

National ratio of spending on factors and non-factor inputs			Trade related indicators (Values in billion of Birr)	
	Activities			
Inputs	Agriculture Sectors	Non-Agriculture Sectors	Trade Indicators	Ratio& Values
Goods & Services (Commodities)	9.50%	48.10%	Trade surplus (deficit)	30.24
Total Factor Inputs	90.50%	51.90%		
			Trade deficit as a share of GDP	22.80%
Agriculture Labor	68.10%			
			Openness of the Economy	
Agriculture Capital-Land	21.50%			
			Total trade	63.78%
Non-Agriculture Labor	0.10%	13.10%		
Capital-Land	0.80%	38.90%	Trade to GDP ratio	48.20%
Total Inputs=Gross output	100%	100%	GDP at market price	132.32

Source: EDRI, December 2009.

This implies that the country is importing so as to satisfy the demand as large as possible to the leading sector. But this calls for immediate domestic substitution for fertilizer production partly because it is an input to leading sector and partly because there is high domestic demand. The large part of international trade for the country is from imports which account for

17.6 percent of domestic demand (i.e. 17.6 percent of the total demand in the economy is supplied by foreigners.)

Table 4-3: Structure of Trade values in billion birr (2005/06)

Goods & Services	Exports of Goods &Services	Shares in Total Exports	Gross Domestic Output	Export Intensity (EI)	Imports of Goods &Services	Shares in Total Imports	Total Demand	Import Penetration Ratios (IPR)
Primary Agricultural Products	6.88	41%	53.79	12.80%	2.22	4.70%	63.33	3.50%
Processed Food Products	0.9	5.40%	15.53	5.80%	1.5	3.20%	19.62	7.70%
Tobacco & Beverage Products	0.19	1.10%	2.21	8.60%	0.23	0.50%	4.6	5.10%
Textile & Leather Products	0.68	4.10%	3.62	18.80%	2.21	4.70%	8.6	25.70%
Wood & Paper Products	0.08	0.50%	0.81	9.80%	1.02	2.20%	2.4	42.50%
Minerals & Mineral Products	0.01	0	1.9	0.30%	0.35	0.70%	3.81	9.20%
Petroleum Products					5.69	12.10%	8.24	69.10%
Fertilizers					1.3	2.80%	1.8	72.20%
Chemicals, Rubber & Plastic	0.32	1.90%	1.6	20%	4.46	9.50%	9.09	49.10%
Metals & Metal Products	0.57	3.40%	1.97	28.70%	4.01	8.50%	9.4	42.70%
Machinery, Transport, Electronic & Other Equipment	0.39	2.30%	2.31	16.70%	12.62	26.80%	20.47	61.70%
Electricity, Water & Communication Servic	0.56	3.30%	4.71	11.90%	0.31	0.70%	5.22	5.90%
Trade & Repair Servic	0.34	2.00%	25.75	1.30%	0.08	0.20%	26.22	0.30%
Hotel & Restaurant Services	0.4	2.40%	8.02	4.90%	0.48	1.00%	8.61	5.60%
Transport Services	4.61	27.50%	8.69	53.10%	8.04	17.10%	16.73	48.00%
Financial Services	0.24	1.40%	3.47	6.80%	0.57	1.20%	4.05	14.20%
Construction, Real Estate &Renal Services	0.1	0.60%	32.1	0.30%	0.03	0.10%	32.41	0.10%
Public, Social & Other Business Services	0.51	3.10%	20.69	2.50%	1.86	4.00%	22.78	8.20%
Total	16.77	100%	187.18	9.00%	47.01	#######	267.4	17.60%

Source: EDRI, December 2009.

From Table 4-4, we observe that 33.2 percent of total household income is earned from agricultural labour. This large share assures that agriculture is labour intensive as explained under Table 4-1.Of this share, almost two-third goes to rural non-poor and one-third to rural poor. In rural, non- poor earn 80.5 percent and poor earn 19.5 percent of agricultural capital –

land. This clearly indicates that rural non poor have more amount of capital that enhances the productivity of both labor and land. This in turn increases return to labour and capital-land.

Non agricultural capital land is the second largest share in the total house hold income which accounts for 31.2 percent (of which rural non poor earn 67.9 percent and urban non poor earn 22.1 percent). This indicates that rural non poor purchase and use large part of non agricultural capital- land. Most of the employees in non-agricultural sectors are urban non-poor and they receive 70.3 percent of non agricultural labour income. Overall, the largest share of factor income flows to rural non-poor.

Table 4-4 : Distribution of Households' Income Shares (2005/06)

	Factor Income					Government	Remittances	Total
	Agriculture	Agriculture	Non-Agriculture	Non-Agriculture	Total Factor	Transfers	from the rest	Household
Households	Labor	Capital-Land	Labor	Capital-Land	Income		of the world	Income
Rural Poor	36.70%	19.50%	1.70%	9.10%	19.80%	19.20%	10%	18.70%
Rural Non-Poor	63.30%	80.50%	8.50%	67.90%	59.40%	20.30%	25.50%	55%
Urban Poor			19.50%	1%	3.10%	12.50%	8%	3.80%
Urban Non-Poor			70.30%	22.10%	17.70%	48.10%	56.50%	22.60%
Total	100%	100%	100%	100%	100%	100%	100%	100%
Total Income by	33.20%	10.50%	12.10%	31.20%	87%	1.20%	11.90%	100%

Source: EDRI, December 2009.

Government transfers are in the form of food & related relief aid, pensions and other transfers. The largest part of them surges to urban non-poor. Furthermore, remittances from the rest of the world predominantly flow to the same household category.

4.3.2 15-Sectors Aggregation

Even though the 2005/06 Ethiopian SAM in billions of birr is the benchmark data for this analysis, it is easier to employ 15 sectors SAM which is aggregated by Ethiopian Development Research Institute from the same data.

The 15 sectors aggregation is organized as follows. Among the 99 production activities in the full SAM, 66 of them are agricultural activities, 24 of them are industrial activities and 9 of them are service activities. The first one is aggregated to 5 major agricultural sub sectors. These are: ateff, amzwh,antag,axcrp and alive. The second one is aggregated in to 7 major industrial subsectors. These are: afood, afuel, achem, amach, aoman, acons, and autil. The third one is aggregated in to 3 major service sub sectors. These are:-atrad, apsrv and agsrv.

ateff comprises of growing 5 varieties of teff whereas ***amzwh*** includes growing wheat and maize each with 5 types. ***antag*** consists of barely, sorghum , pulses, vegetable and fruits, oilseeds, and enset each with 5 varieties. ***axcrp*** encompasses 4 varieties of coffee, and 5 varieties of cash crops (such as Sugar cane and beet, tea, chat, plant-based fibers, cotton),and growing 5 types of cereal crops. ***alive*** involves 5 varieties of livestock farming, dairy farming and production of animal products.

Similarly, ***afood*** includes aofood (such as Production and preserving of meat and meat products, fish and fish products, fruit and vegetables, manufacture of vegetables and animal oils and fats, manufacture of prepared animal feeds, manufacture of bakery products, manufacture of macaroni, noodles, couscous and similar farinaceous products, manufacture of other food products), adairy (manufacture of dairy products), agmill(manufacture of grain mill

products), agmillserv (grain mill service),asug, abev, and amtob. ***afuel*** comprises manufacturing of fuel and other fuel products. But it is non existence in the case of Ethiopia. ***achem*** consists of manufacturing of chemicals, rubber and plastic products, etc...**amach** which includes manufacture of machinery for food, beverage and tobacco processing; manufacture of bodies (coachwork) for motor vehicles, trailers and semi-trailers 3420, parts and accessories for motor vehicles and their engines, accumulators, primary cells and primary batteries etc…**aoman** encompasses manufacturing of textiles, wearing apparel except fur apparel, tanning and dressing of leather, Wood and wood products, paper and paper products, etc… **acons** covers the construction activities. **autil:** comprises of aelect(such as: electricity, gas, steam and hot-water supply), afwater (incorporates: activity of collecting (fetching) free water(own consumption by households) and awater (activities such as :collection, purification and distribution of Water).

On the other hand, **atrad** consists of *atrad* (such as: wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods), *ahotel*(activities such as :hotels and restaurants) and , *atrncom* (includes activities such as :transport, storage and communications). **apsrv** encompasses *afserv* (comprises: financial intermediation), *arest* (covers activities such as: real estate, renting and business activities) and *aoserv* (business activities ,other community, social and personal service activities private households with employed persons). **agsrv** encompasses *apadmin* (includes activities such as public administration), *aeduc* (education), *aheal* (health and social work). Similarly, commodities are aggregated in to 15 sub sectors.

Factors of production are aggregated in to four major categories: such as labor, land, livestock and capital. Institutions are categorized in to: enterprise, households (comprising of: rural poor, rural non poor, urban poor, and urban non poor), Government and rest of the world. Furthermore, transaction costs are grouped in to 3, consisting of: domestic, export and import. Taxes are also categorized in to 3. These are: direct tax, import tax, and sales tax. The model further incorporates the stock change and saving-investment accounts.

The new SAM has both production and trade elasticities attached with. One of the shortcomings of 15 sectors might be lack of specific disaggregation.

Application of CGE model on 15-sectors aggregation using GAMS software provides the simulation results.

Chapter five: Simulation

5.1 Simulation Results

The results of the analysis are derived from the five levels of nominal exchange rate shocks (scenarios) imposed up on the 15 sectors which has been aggregated from 2005/06 Ethiopian SAM. Over the period of 2006 to 2010, Ethiopian Birr pegged to US dollar has been diminished in value by about 90% (Appendix 7). And the analysis captures the cited percentage as one scenario and put four alternatives (such as 60%, 75%, 105% and 120%). It should also be understood that this analysis presumes short run to medium term effects of the shocks. The results of the simulations are counterfactually compared with the benchmark (base) year case i.e 2005/06.

Thus, one can easily realize from the study what the Ethiopian economy would have been looked like (how endogenous variables change) had the exchange rate shocks been introduced to the benchmark year 2005/06 data.

5.1.1 Macroeconomic Variables

As shown in Table 5-1, some macroeconomic variables are positively and significantly affected when value of Birr further diminishes from 60% to 120%. Accordingly, real export increases from the bench mark year by 103.41% under 60% and by 179.39% under 120% simulations. These may emanate from the combined effects of two sources.

First, the prices of all exports grow but at decreasing rate (as cited in Table 5-8) as we move from the lowest shock to the highest and these become incentive to producers. Second, production of major export commodities(represented in Table 5-2 by axcrp) increases

relatively faster than other sub sectors. Similarly, real import increases by 26.54% and 78.92% from the benchmark year under corresponding simulations. But it should have been decreased as exchange rate diminishes since depreciation theoretically makes imports expensive. This is not happened due to the fact that price of imports grows only at decreasing rate rather than increasing so as to reduce the quantity and demand for intermediate inputs of manufacturing sector, where their large part is imported.

Table 5-1: Trends of Some macroeconomic variables (%ch)

		Nominal Exchange rate shocks				
	Base	60%	75%	90%	105%	120%
Welfare:Household Income(EV)	114.8	-3.5	-3	-2	-1.9	-1.2
Consumer Price Index(CPI)	100	12.7	9.4	6.5	6.5	5.2
Total Government Revenue	17.45	2.93	-0.72	-3.28	-7.5	-12.07
Real Exchange Rate	93.4	47	65.8	84.2	100.8	119.2
Nominal Exchange Rate	100	60	75	90	105	120
Private saving to GDP	11.7	0.6	1	1.7	1.9	2.4
Foreign saving to GDP	8.3	-12.3	-11.3	-8.1	-11.8	-12.8
Investment to GDP	21.3	-9.9	-8.9	-7	-10	-11.4
Gov saving to GDP	4.1	-0.7	-0.7	-0.6	-1.1	-1.6
Import Tax to GDP	5.3	1	2.2	3.7	4.1	5
Direct Tax to GDP	3.1	0.1	0.2	0.4	0.4	0.6
Real GDPMP	132.32	-9.21	-11.3	-14.49	-15.68	-17.89
Real Export	16.77	103.41	120.63	132.32	159.57	179.39
Real Import	-46.93	26.54	42.12	61.3	67.68	78.92

Besides, there is only limited capacity of import substitution and expenditure reducing effect on imported goods in the short run.

The results also reveal that Consumer Price Index (CPI) grows by 12.7% and 5.2% from bench mark under 60% and 120% simulations respectively. These adversely affect welfare of the households and where the lowest shock level largely downsizes it more than the other alternatives. It is about 3.5% loss from the benchmark year. There is about 1.2% for the largest

part of the shock. This is due to the fact that exchange rate shocks partly contribute to domestic inflation which in turn diminishes real income of the household. Hence, it calls for appropriate macroeconomic policies which accompany exchange rate realignment so that the adjustment does not fuel to domestic inflation. Besides, real exchange rate depreciation grows slowly at lowest and rapidly at the largest shock level. Total Government revenue declines highly as the value of Birr further diminishes. This is because of the negative and positive counteracting effects which are sequentially caused by curtailed quantity of imports as shown in Table 5-9 and the increased values of imports as cited in Table 5-1.So that import taxes (i.e. indirect taxes) increase only at margin. On the other hand, economic activity slows down as a result of severely declined investment and causes low employments and low consumption and hence induces direct taxes only to rise at margin (Table 5-1).

By and large, Welfare loses and CPI grows slowly where as real exchange rate move rapidly at the highest shock level.

On the other hand, real GDP at market price decreases by 9.12% and 17.89% under 60% and 120% simulations respectively. This is due to the fact that investment to GDP ratio downsizes by 9.9% (under 60% scenario) and 11.4% (under 120% scenario).

When we compare the outcomes of these simulations (specifically: one time 90% shock to the benchmark data) for real GDP with the actual data under sub sections 3.1(where the 90% exchange rate realignment has gradually introduced), there is a difference in the outcomes. That is, real GDP has actually increased over the period 2006 to 2010 with annual average growth rate of 11%.Whereas under the simulation: it downsizes and further diminishes as the level of shock increases. This disparity is due to the fact that simulation shows one time shock

of the bench mark data (i.e had exchange rate been shocked in line with the cited scenarios, what would have been happened to the economy in the short run to medium term) where as the actual data over the period 2006 to 2010 is the outcomes of gradual introduction of the shock and other policy packages. Hence, downsizing the value of Birr adversely affects Ethiopian economy in the short run.

Similarly, real export would have boosted up by 132.32% where as real import would have enhanced by 61.3% under 90% shock. But from the actual data under section 3.4, export increases largely less than imports where 90% shock is gradually induced from 2006 to 2010. This implies that export increases faster than import in the short run.

5.1.2 Sub-Sectoral Production

The percentage change of output in different sub-sectors is shown in Table 5-2. Majority of the sub sectors expand as a result of the shocks. All agricultural sub sectors, except activity ateff, gain from the shock. Overall, axcrp (which includes growing of Coffee, tea, chat, cotton, plant-based fibers, etc) is the one which gains the most from the shock. It increases by 9.11%, 6.71%, and 6.99% from the benchmark year under 60%, 90% and 120% simulations respectively. This is mainly because of the combined effect of relatively higher percentage increase in its activity prices (as shown in Appendix 10) in local currency and its competitiveness in the international market in foreign currency. Activity ateff, from agricultural sector, is the only one which is adversely affected. It declines by 1.07%, 0.68% and 1.31% from the benchmark year under similar simulations as of the above.

Industrial sub-sectors, which include achem, aoman, and amach, grow positively and more than the other remaining sector and subsectors. The activity achem increases by 6.46%, 5.79% and 5.77% under 60%, 90% and 120% scenarios respectively. Whereas, aoman changes positively by 5.3%, 4.22% and 2.83% from the benchmark year under respective simulations as in the above case. Similarly, amach expands from the benchmark year by 2.4%, 3.19% and 2.96% under respective simulations.

From the above analysis, we can realize that aoman and achem are light industry types and boost up than the other sub sectors of the industry. This is in line with the current capacity of the country in exporting outputs of light industry (such as: textile, leather, etc….).Whereas amach is the heavy industry type and grows slower than the light industry.

Based on the simulation results of Appendix 10, the increases in production of these industrial sub sectors are mainly due to an increase in activity prices of each of the sub sectors. This in turn enhances incentive of production of each sub sector. Accordingly, the activity prices of achem, aoman and amach augment by 22.5%,16.3% and 22.4% (under 60% scenario), 13.4%,9.1% and 13.4% (under 90% scenario) and 12.5%,6.9% and 11.6% (under 120% scenario) respectively.

It is further to be reminded theoretically that in this analysis the combined contractionary effects of demand side (expenditure reducing and expenditure shifting) on tradable goods are surpassed by the expansionary effect from supply so that output and employment increase. This phenomenon further leads to increase in exports.

Table 5-2: Percentage change in output						
			Nominal Exchange rate shocks			
	Base	60%	75%	90%	105%	120%
ateff	5.16	-1.07	-0.92	-0.68	-0.98	-1.31
amzwh	9.61	0.94	0.93	0.82	0.66	0.28
antag	21.23	1.22	1.1	1	0.86	0.79
axcrp	11	9.11	8.3	6.71	7.29	6.99
alive	17.99	1.38	1.27	1.22	1.19	1.31
afood	7.53	1.06	1.19	1.09	1.4	1.34
achem	1.6	6.46	7	5.79	6.9	5.77
amach	0.54	2.4	3.48	3.19	3.68	2.96
aoman	8.31	5.3	5.38	4.22	3.93	2.83
acons	21.98	-41.15	-37.75	-32.58	-42.95	-48.41
autil	3.26	-2.94	-2.65	-1.88	-2.41	-2.33
atrad	44.1	1.31	1.47	1.53	1.76	1.6
apsrv	17.92	-1.34	-0.95	-0.3	-0.3	0.13
agsrv	17.08	0	-0.01	0.03	0.02	0.07

On the other hand, construction (acons) and utility (autil) activities are industrial sub sectors which are adversely affected by the shocks. The former one significantly decreases by 41.15%, 32.58% and 48.41% from the benchmark under 60%, 90% and 120% respectively. This is due to the fact that its activity price goes down significantly as shown in Appendix 10. It downsizes by 14.7%, 14.4%, and 23.3% under 60%, 90% and 120% simulations respectively. Whereas the output of the latter one slightly declines by 2.94%, 1.88% and 2.33% under similar scenarios as of the above but its price goes up.

Due to the shock, the loss by the construction activity highly outweighs the gains by achem, amach and aoman. Except for apsrv, all of the service sub sectors are also augmented. To this end, price for activity fuel is not explicitly reported since the product is not currently extracted.

Production of all sub sectors in services either decline or insignificantly increase. This is because of the fact that most of them are non tradables and their prices are set in local currency domestically.

Furthermore, the non tradable outputs depress as a result of the shocks. This is due to the fact that expenditure switching effect of demand side is surpassed by the combined and adverse effects of expenditure reducing in the demand side (as confirmed by the decline of house hold consumption) and contractionary effect of supply side (because of the rise in price of composite goods specifically cost of imported raw material), as theoretically explained by Lizondo et al. (1989).

As shown in Appendix 2 and Table 5-5, real household consumption (specifically for rural non poor and rural poor) shrinks. This implies that a large part of the augmented production is allocated to export as it can be observed from Table 5-1 and Table 5-7.Whatsoever in the process of contractionary aggregate output, it is anticipated that there is less employment of factors. This in turn aggravates the chronic unemployment of the country.

In general, aggregate output diminishes even if both agricultural and service sectors expand. Industrial sector also shrinks. In industrial sector, the adverse effect on construction activity exceeds the positive impacts of all of its sub sectors. Besides, the significant part of the increased output is allocated to export rather than domestic consumption.

5.1.3 Real Factor Return and House Hold Income and Consumption

The results in Table 5-3 reveal that the growth in real returns to land, livestock and labour are positive and significant whereas, for capital it is small under the first two scenarios and even

diminishes from the base as the shock rises. Under the lowest and highest scenarios, the return to land enhances by 20.58% and 11.87%. To labor and capital, it grows by 10.38% and 2.67% (under the lowest), 4.75% and -2.93% (under the highest) respectively.

Table 5-3: Percentage change in real return to factors

		Nominal Exchange rate shocks				
	Base	60%	75%	90%	105%	120%
Labour	60.2936846	10.38	7.58	5.27	5.72	4.75
Land	8.464904	20.58	16.48	12.27	13.13	11.87
Livestocks	5.47380636	14	10.61	7.87	8.18	7.4
Capital	47.9906051	2.67	0.4	-0.35	-1.34	-2.93

Under 90% scenario, real returns to land, labor and capital are 12.27%, 5.27% and -0.35%. Under each simulation, even if the growth rate of the return is less than that of land and live stock, labor gains the most on aggregate and absolute terms. This assures that poor rural and urban households who own only their labors take better from the change and they are better compensated for the losses of their real income though fueled prices of the shock.

On the other hand, the return to capital declines as the level of the shock increases. This is because of the expansion of non-capital intensive agricultural sub sectors (Example: axcrp) and remarkable contractions of construction sub sector. This paves the way to the other factors to earn more than capital. In other words, capital is more intensively employed than labour in industrial sector. It find its earnings increased from expanded industrial sub-sectors and decreased from significant and contracted construction sub -sector given that their relative price increases in line with Stolper-Samuelson theorem (Appendix 10).

In Table 5-4, household is divided in to four categories. These are rural poor, rural non poor, urban poor and urban non poor.

Table 5-4: Income of (domestic non government) Institution (%ch)

		Nominal Exchange rate shocks				
	Base	60%	75%	90%	105%	120%
Enterprise	42.86	0.59	-1.38	-1.54	-2.63	-3.85
hhd-rurp	24.84	9.82	7.06	5.01	5.27	4.5
hhd-rurn	73.14	7.95	5.34	3.72	3.66	2.82
hhd-urbp	5	12.94	9.89	7.08	7.56	6.44
hhd-urbn	30.04	11.31	8.4	5.95	6.12	4.88

Except the enterprise, all the households are benefited from the exchange rate realignment. The incomes of urban poor and urban non poor scale up by 12.94% and 11.31% (under 60% scenario) and by 6.44% and 4.88% (under 120% scenario) from the benchmark year respectively. Under 90% scenario, their incomes sequentially augment by 7.08% and 5.95%.Similarily, the income of rural non poor increases successively by 7.95%, 3.72% and 2.82% under 60%, 90% and 120% simulations. Even if it seems that urban poor and rural poor households derive significant gain, actually their incomes increase in absolute term largely less than urban and rural non poor.

This certainly confirms what is proposed by Krugman and Taylor(1978) that exchange rate realignments redistribute income from the group with small marginal propensity to save (poor) to large marginal propensity to save (non poor),which in turn leads to contractionary aggregate demand and output.

In line with the decline of the return to capital, income to the enterprises is contracted. This is mainly because the income of enterprises is largely generated by supplying capital which has already derived less return.

Results in Table 5-5 demonstrate that real household consumption for urban poor increases marginally and for the rest of household types it decreases as the exchange rate realignment takes places. For urban poor, it grows at -0.1%, 0.4% and 1.4% under 60%, 90% and120% respectively. The adverse effect is high for rural non poor. And it decreases by 4.4%, 2.6% and 1.9% respectively in line with the above simulations. This is likely due to the fact that their income increases slower than the others as shown in Table 5-4. Urban non poor are the second group who are adversely affected. The real consumption of rural and urban non poor diminish larger than the others since they want to increase their saving level compared with before the shock as they are being pessimistic to the recession of the economy while their purchasing power is declining. This is resulted in an increase of private savings at margin as cited in Table 5-1. Besides, they own capital which drives less return relative to other factors.

Table 5-5: Real Household Consumption(%ch)

	Nominal Exchange rate shocks					
	Base	60%	75%	90%	105%	120%
hhd-rurp	21.1	-2.4	-2	-1.2	-1	-0.3
hhd-rurn	65.7	-4.4	-3.8	-2.6	-2.6	-1.9
hhd-urbp	4.3	-0.1	0.2	0.4	0.9	1.4
hhd-urbn	23.7	-2.6	-2.1	-1.2	-0.9	-0.4
total	114.8	-3.5	-3	-2	-1.8	-1.2

With respect to urban poor, they earn better income than the other groups as shown in Table 5.4. They also have higher marginal propensity to consume. The combined effects thus result in marginal increase of real consumption.

Overall, the real returns to factors except for capital and the incomes of all household except for enterprise grow positively where as the real consumption of all households except urban poor worsens off as the values of the Birr deteriorates.

The welfare of all households except urban poor diminishes as the shocks are introduced. As it can be observed from Table 5-6, the improvement for urban poor is also only at margin. It expands by -0.1%, 0.4% and 1.4% under 60%, 90% and 120% respectively. The welfare lose is the highest for rural non poor. That is, it increases negatively by 4.4%, 2.6% and 1.9% from the benchmark year under 60%, 90% and 120% respectively. The main reason for the deterioration of welfare is lower allocation of increased real income to real consumption compared with their saving behavior mentioned above for higher marginal propensity to save group.

Table 5-6: Equavalent variation(%ch)

		Nominal Exchange rate shocks				
	Base	60%	75%	90%	105%	120%
hhd-rurp	21.1	-2.4	-2	-1.2	-1	-0.3
hhd-rurn	65.7	-4.4	-3.9	-2.6	-2.6	-1.9
hhd-urbp	4.3	-0.1	0.2	0.4	0.9	1.4
hhd-urbn	23.7	-2.6	-2.1	-1.2	-0.9	-0.4
total	114.8	-3.5	-3	-2	-1.9	-1.2

Overall, all households all together lose or become worse off as a result of the shocks even if the loss declines as the Birr value further diminish.

The reason why real household consumption and welfare grow negatively while their incomes increase positively is that the growth of prices of composite goods (Appendix 3) outweighs the growth of incomes of the households indicated in Table 5-4. This is particularly true for commodities such as cxcrp, cfuel, cchem, cmach, and coman. This phenomenon enforces the real incomes of the households to decline and in turn adversely affect the purchasing power and real consumption of the households.

Besides, there may be differences with respect to weights of tradables in consumption and real income of households. This causes real income to deviate more from real consumption. Furthermore, the supply of composite goods (as indicated in Appendix 3) shrinks which in turn leads to further rise in the prices of composite goods on one side and more allocation of augmented output (Table 5-2) to exports.

On the other hand, the percentage change in the quantity of imports is negative as indicated in Table 5-9 even if its value grows positively as cited in Table 5-1.This implies that as the exchange rate policy shock is introduced to the economy, the supply of composite commodity shrinks partly because of negative growth of quantity of imports. The adverse effect is mainly because of faster growth rate of price of imports shown in Appendix 4.

Thus, the combined effect of the rise in the price of composite commodity, the decline in the quantity of imports and allocation of the large part of increased output to export altogether offset the growth of income, so that the growth in real consumption and welfare of the households adversely affected.

5.1.4 Exports, Imports and Trade Balances

Exports of agricultural and Industrial commodities remarkably rise where as in service sector the increment is relatively low except for trade (which includes wholesale and retail trade; repair of Motor vehicles, motorcycles and personal and household goods, hotels and restaurants transport, storage and communications).

Quantity of export commodities for coman, cntag, cxcrp, cchem, cfood, and clive extremely increases. Accordingly, coman (such as textiles, wearing apparel except fur apparel, wood and wood products, paper and paper products etc…) grows by 56.6%, 42.6% and 51.9% from the benchmark year under 60%, 90% and 120% simulations respectively.

This assures what the country is currently exporting in remarkable amount. The relatively small increases in the other two sub sectors of services sector are because most part of them is non tradable in nature.

cntag (which consists of commodities such as barely ,sorghum ,oilseeds, enset ,pulses ,fruit and vegetable, etc…) exported sequentially grows by 37.9%, 27.4% and 28.3% in line with the three simulations chosen above. Similarly, quantity of exportable cxcrp commodities (which include: coffee, chat, tea, cotton, plant base fiber, etc….) respectively augment by 33.9%, 25.1% and 26.2% from the bench mark year under the three scenarios selected above.

Furthermore, exportable quantities of commodities such as cchem (consisting of: chemicals, rubber and plastic products etc…), cfood (including of: grain mill products, dairy products,

processing and preserving meat products, etc….) and clive (comprising of: livestock farming, dairy farming, production of animal products, etc…) grow at 29.6%, 28.8% and 22.5% (under 60% scenario), at 26.8%, 21.8% and 16.8% (under 120% scenario) from the benchmark year respectively.

The remarkable rise in quantity of exports is due to the fact that the growth in the price of exports highly surpasses the rate of change of price of composite goods as indicated in Appendix 3.

It in turn implies that suppliers or producers derive more incentives as the value of Birr diminishes.

Table 5-7: Quantity of exports (%ch)

		Nominal Exchange rate shocks				
	Base	60%	75%	90%	105%	120%
cntag	2.2	37.9	34.5	27.4	30.3	28.3
cxcrp	2.9	33.9	31.3	25.1	27.6	26.2
clive	0.5	22.5	20.6	16.6	17.9	16.8
cfood	0.9	28.8	26.7	21.3	23.6	21.8
cchem	0.2	29.6	30.1	24.8	29.6	26.8
cmach	0.3	15.4	15.6	14.2	18.1	20.1
coman	1	56.6	52.7	42.6	51.7	51.9
cutil	0.1	14.8	19.3	20.6	34.4	37.9
ctrad	5.9	14.8	16.2	16.2	21.8	24
cpsrv	0.8	8.5	9.7	12.4	17.1	24.5
cgsrv	0.1	6.7	4.6	5.3	4.1	8.3

This may more be explained by the fact that Ethiopian real exchange rate has been appreciated over the period (July 2004 to June 2009) as shown in Table 1.1 under chapter 1 and the policy shocks of this analysis reverse the case.

Results in Table 5-8 reveal that prices of tradable agricultural commodities (such as: cntag, cxcrp, and clive) and industrial commodities (such cfood, cchem, cmach, coman) significantly rise as the policy of deteriorating Birr is introduced.

Table 5-8: Percentage change in Price of exports

		Nominal Exchange rate shocks				
	Base	60%	75%	90%	105%	120%
cntag	1	28.06	23.67	17.52	19.04	16.42
cxcrp	1	29.74	25.31	18.84	20.61	17.87
clive	1	26.41	22.07	16.23	17.5	14.98
cfood	1	28.4	24	17.78	19.35	16.7
cchem	1	30.9	26.39	19.71	21.65	18.84
cmach	1	28.25	23.85	17.67	19.21	16.57
coman	1	30.8	26.34	19.67	21.6	18.79
cutil	1	60	75	90	105	120
ctrad	1	60	75	90	105	120
cpsrv	1	60	75	90	105	120
cgsrv	1	60	75	90	105	120

Whereas prices of non tradable industrial commodities such as cutil and service sub-sectors (including: ctrad, cpsrv and cgsrv) increase by hundred percent of the shock. They have less relevance to international trade in general and exported commodities in particular.

As shown in Table 5-9, the percentage change in the quantity of imports is negative for all commodities. Quantity of imports for commodities such as **cmzwh** (including: wheat and maize), **cntag** (comprising: barely, sorghum, oilseeds, enset, pulses, fruit and vegetable, etc…), **cmach** (consisting of: machinery for food, beverage and tobacco processing; manufacture of bodies (coachwork) for motor vehicles, trailers and semi-trailers 3420, parts and accessories for motor vehicles and their engines, accumulators, primary cells and primary batteries etc…) decline significantly by 30.3%, 26.6%, and 27.1% (under 60% simulation) and by 20.09%,19.65% and 30.15% (under 120% simulation) respectively.

The restrain in the quantity of imports is partly because of high growth of price of imports introduced though exchange rate deterioration (Appendix 4). For non tradable commodities, their price increases by equal percentage as of the exchange rate shocks.

Table 5-9: Quantity of Imports(%ch)

		Nominal Exchange rate shocks				
	Base	60%	75%	90%	105%	120%
cmzwh	1.64	-30.28	-28.69	-22.38	-23.4	-20.09
cntag	0.3	-26.61	-24.97	-19.91	-21.07	-19.65
cxcrp	0.27	-33.55	-28.41	-19.97	-19.46	-14.29
cfood	1.9	-19.18	-17.7	-13.6	-14.16	-12.35
cfuel	8.25	-16.81	-15.26	-12.91	-16.91	-18.9
cchem	6.98	-6.25	-5.71	-4.32	-4.8	-4.28
cmach	15.17	-27.06	-24.83	-21.14	-27.29	-30.15
coman	10.88	-26.21	-24.28	-20.28	-24.78	-26.17
ctrad	8.96	-18.38	-15.15	-10.54	-11.13	-9.18
cpsrv	2.39	-19.3	-15.5	-10.47	-10.8	-8.77
cgsrv	0.08	-13.66	-10.01	-7.22	-6.68	-7.37

This decline in quantity of imports certainly confirms what the theory states. According to the theory, deterioration of exchange rate makes exportable commodity cheaper and imports expensive so that exports expand and imports shrink.

Table 5-10 shows that real values of imports and exports are increasing but the growth rate is higher for exports as explained in Table 5-1. Since imports outweigh exports in the case of Ethiopia, Trade balance is negative for all simulation. As the value of Birr further declines, trade balance first improves by 16.2% (under 60% scenario) and then deteriorates by 17.5% (under 75% scenario).

Table 5-10: Real Trade Balance and current Accounts Performance (mn. of Birr)

Nominal Exr. Shocks	Aggregate Import (mill. of Birr)	Aggregate Export (mill.of Birr)	Trade Balance (mill.of Birr)	Current Accounts (mill.of Birr
Base year	46932.24	16770.36	-30161.88	0
60%	59388.31	34112.14	-25276.17	4885.71
75%	66701.82	37000.66	-29701.16	-4424.99
90%	75702.27	38961.56	-36740.71	-7039.55
105%	78696.06	43531.65	-35164.41	1576.3
120%	83969.32	46853.96	-37115.36	-1950.95

Then it further worsens off by 23.7% (under 90% scenario).It starts to recover again by 4.3 % (under 105% simulation). Lastly, it adversely increases by 5.5% (under 120% simulations).

The current account of a nation improves or depresses so long as the Marshall-Lerner condition hold or not. As nominal exchange rate declines, so does the real exchange rate as indicated in Table 5-1. This implies that the latter one changes the relative prices of imports and exports after a certain period of time. What is expected, hence, is current account to improve according to the Marshall-Lerner condition given that the sum of the relative price elasticities of export and import demand exceeds unity. Further, it is theoretically expected that current account turns down immediately after the shocks and commences to recover (J-curve effect). Furthermore, Junz and Rhomberg (1973) affirmed that 50 percent of the full effect of price changes is revealed during the first three years following devaluation, while it takes almost five years for 90 percent of the full effect to materialize.

However, the current account improves for two of the scenarios and worsens for the three of the scenarios as indicated in Table 5-10. That is, it is got better for 60% and 105% simulations. As shown in Appendix 5, the positive effect is because of exports are increasing more than

imports. This is in turn because of the decline in absorption (comprising of: Private consumption, Fixed Investment, stock change and Government Consumption) that increases the outflow of goods and services. Absorption declines by Birr 17.08 billion and Birr 3.14 billion under 60% and 105 % scenarios respectively. The decrease in absorption is in turn due to the fact that growth rate of export price exceeds that of composite price.

Whereas the current account downsizes for the 75%, 90% and 120% simulations by Birr 4424.99 million, Birr 7039.55 million and 1950.95 million respectively. The justification for adverse effects is due to the fact that the increment in absolute terms for Imports exceeds that of export even though growth rate is higher for the latter (Appendix 5). This is in turn induced by the increase in absorption which enhances imports and downsizes exports. It is fixed investment part of absorption which increases more. This is because of an increase in investment demand. The negative effect is certainly not because of the J curve effects as long as the two scenarios with positive effects have completed the pass through on time.

By and large, positive exchange rate shocks are resulted in exports of agricultural and Industrial commodities to rise remarkably but relatively low increment in the service sector export except for trade. On the other hand, the percentage change in the quantity of imports is negative for all commodities. Moreover, the real values of the current accounts are partly positive and partly negative.

5.2 Sensitivity Analysis

All the simulation results analyzed in the previous chapter are based up on certain values for various elasticities. These values of elasticities are used in the model's equations to find market

clearing vector of prices and quantities. They are best estimates however they are still estimates. Under complex CGE model, it is necessary to check whether the results derived rely totally on selected values. By changing these elasticities (i.e. by varying the parameters), we realize and compare if the results change significantly from one set of parameters to another. Therefore, checking the robustness of the results to elasticities (i.e. parametric) changes is referred to as sensitivity test.

Elasticity of substitution (e) between labour, land, livestock and capital in the production of agricultural commodities is one of the important elasticities in this CGE analysis since agriculture is the dominant sector of the economy. This elasticity reveals the tradeoffs between inputs given a constant amount of output. For all the simulation results, it is estimated to be 0.75.

The second important elasticity is the elasticities of transformation (α) for agricultural commodities which are the major component of Ethiopian export. They are estimated to range from 1.3 up to 3.03 depending upon the type of commodities. Thirdly, Armington trade elasticities (γ) for Industrial commodities are essential one and are estimated to range from 1.9 up to 4.05 depending up on the types of the commodities. In this analysis, the robustness of the simulation results is checked by varying the values of elasticites and rerunning the simulation for each different set off parameters.

In the first sensitivity (S1), the elasticities of substitution and transformation for agriculture are reduced by half. In the second sensitivity (S2), these two elasticites are increased by 100

percent. In both S1 and S2, Armington trade elasticties are kept to their origin. In the third sensitivity (S3), the elasticities of substitution and transformation are kept at their original level and Armington trade elasticites are increased by 100 percent for Industrial commodities. The Tables listed below are based up on the 90% scenario. The percentage changes in the tables represent changes from benchmark values, provided that the exchange rate declines by 90%.

Table 5-11 Sensitivity results for outputs and imports under 90% Exchange rate shock Senario

	Level of Domestic Activity(output) (%Ch)					Quantity of Imports (%Ch)			
	Original	Sen 1	Sen 2	Sen 3		Original	Sen 1	Sen 2	Sen 3
ateff	-0.68	-0.55	-1.71	-0.91	cmzwh	-22.38	-28.33	-20.42	-22.35
amzwh	0.82	1.3	-0.7	0.53	cntag	-19.91	-25.98	-18.3	-19.99
antag	1	0.54	1.57	0.69	cxcrp	-19.97	-25.24	-16.07	-19.08
axcrp	6.71	4.24	12.05	6.57	cfood	-13.6	-16.98	-12.87	-23.1
alive	1.22	1.36	0.54	1.51	cfuel	-12.91	-15.58	-17.05	-13.52
afood	1.09	1.82	0.68	1.69	cchem	-4.32	-5.51	-4.53	-4.58
achem	5.79	7.33	5.94	6.81	cmach	-21.14	-25.93	-26.79	-22.53
amach	3.19	5.14	1.94	4.01	coman	-20.28	-24.95	-24.09	-24.2
aoman	4.22	6.25	1.92	8.1	ctrad	-10.54	-13.16	-10.76	-10.69
acons	-32.58	-39.86	-42.32	-34.7	cpsrv	-10.47	-13.08	-10.82	-10.55
autil	-1.88	-1.76	-2.96	-1.91	cgsrv	-7.22	-10.11	-6.01	-6.87
atrad	1.53	2.33	0.74	1.4					
apsrv	-0.3	0.08	-0.6	-0.26					
agsrv	0.03	0.09	-0.03	0.01					

In Table 5-11, simulations using original elasticities are presented in the columns 2 and 7.They are percentage changes from the benchmark under 90% scenario. For example: production of teff declines from the benchmark by 0.68%,0.55%,1.71% and 0.91% under original ,sensitivity 1,sensitivity 2,and sensitivity 3 respectively and all of them are manipulated under 90% scenario.

As we compare percentages change for the original from benchmark data with those under S1, S2, and S3, similar signs and insignificant differences are obtained in most cases.

Table 5-12: Sensitivity results for quantity and price of exports under 90% Senario

	Quantity of Export (%ch)				Price of Exports(%Ch)			
	Original	Sen 1	Sen 2	Sen 3	Original	Sen 1	Sen 2	Sen 3
cntag	27.4	17.7	50.8	26.9	17.52	20.98	16.88	17.24
cxcrp	25.1	17	43.8	24.8	18.84	22.65	18.21	18.58
clive	16.6	11.3	26.5	17.2	16.23	19.34	15.56	15.92
cfood	21.3	27.4	19.4	20.1	17.78	21.31	17.14	17.5
cchem	24.8	31.5	25.5	23.1	19.71	23.75	19.09	19.46
cmach	14.2	19.4	15.3	12.2	17.67	21.16	17.02	17.39
coman	42.6	56.6	43.3	40.2	19.67	23.69	19.05	19.42
cutil	20.6	48.9	22.7	22.7	90	90	90	90
ctrad	16.2	24.6	15.9	17.2	90	90	90	90
cpsrv	12.4	22.1	15.8	14.4	90	90	90	90
cgsrv	5.3	15.7	2	6.1	90	90	90	90

From both Tables given above, we can visualize that the percentages are highly stable specifically for quantity of imports and price of exports. Moreover, they are still relatively stable for level of domestic activity and quantity of exports. In Table 5-13, variations in incomes of domestic non government institution and real house hold consumptions are quite small and all signs remain unchanged.

Table 5-13 : Sensitivity results for income and household consumption under 90% Senario

	Income of (dom non-gov) institution (%)					Real Household Consumption(%ch)			
	Original	S1	S2	S3		Original	S1	S2	S3
Enterprise	-1.54	-2.76	-4.53	-2.72	hhd-rurp	-1.2	-1.5	-1.1	-1.3
hhd-rurp	5.01	4.55	5.22	4.75	hhd-rurn	-2.6	-2.9	-3.2	-2.9
hhd-rurn	3.72	3.28	2.96	3.17	hhd-urbp	0.4	0.5	0.9	0.4
hhd-urbp	7.08	7.08	7.41	6.83	hhd-urbn	-1.2	-1.4	-1.4	-1.5
hhd-urbn	5.95	6.06	5.28	5.45	total	-2	-2.2	-2.3	-2.2

Therefore, these findings support the initial results analyzed in this chapter under sub section 5.1 and reveal that the model's results are reasonably robust with respect to elasticities changes (parametric changes).

Chapter six: Conclusion and Policy Implications

6.1 Conclusion

This study has attempted to address the effects of exchange rate realignments using a static CGE model. The main results of the study include:

i. Real Gross Domestic Product (GDP) both at factor costs and market prices diminishes. The adverse effect is even more as the value of Birr further shrinks. Among the others, the large decline in real values and quantities of absorptions (particularly investments) contributes to the undesirable effect. This is, in turn, due to the rise in the cost of imported inputs, wage levels, rent of lands etc... induced by the increase of price levels. Moreover, the decline in investment causes unemployment to rise.

ii. Real GDP, investment, welfare, real household consumption and absorption are adversely affected as a result of lessened value of the Birr. This implies that the Ethiopian economy would have been worsened in the short run had the exchange rate been shocked in line with the scenarios.

iii. Total government revenue is also negatively affected. This is due to the fact that direct taxes only increase insignificantly as a result of decline in investments and employments. Besides, import taxes increase but quite small as a result of counteracting effects of the decline in quantities of imports and the rise in the price imports. And, the contracted revenue negatively affects government saving.

iv. Even if aggregate production (real GDP) is adversely affected, outputs of tradable sub-sectors boost up since contractionary effects of demand side (expenditure switching and reducing) are surpassed by expansionary effect of supply side. Whereas, outputs of non-tradables downsize since expenditure switching effect of demand side is surpassed by combined and adverse effects of expenditure reducing effects of demand and contractionary effects of supply.

v. At the sectoral level, the findings of the analysis reveal that while production in agriculture and service sectors increases, that of the industrial sector shrinks. In the industrial sector, particularly production of light industries grows faster than that of heavy industries. However, construction activity is remarkably contracted and offset the positive impacts in other sectors. The shrink in construction activity may emanate from the rise in the cost of production in construction activity as a result of the rise in the price of composite goods (including: imported cements, metals, machineries, etc….), wage, rent, interest rate, etc...

Overall, employment is likely to increase since job opportunities are created in the dominant sector (agriculture) and service sectors which outweigh the counteracting effects induced by the contraction of industrial sector. So long as agriculture and service have expanded and their composite prices largely increases, factors intensively involved in the sectors benefit more in line with Stolper-Samuelson theorem.

vi. Real returns to all factors grow positively except for the capital factor. In line with this, incomes of all households grow positively but that of enterprise is affected

adversely. Among the households, each unit of income increases the most for uban poor. Urban non-poor, rural poor and rural non-poor derive the gain in descending order. Though the growth rate of return on land and livestock is higher, labor gains the most in absolute terms as well as at aggregate level.

vii. Even if it seems that urban poor and rural poor households derive significant gains, actually their incomes increase in absolute term less than urban and rural non-poor. This confirms the arguments that exchange rate realignments redistribute income from the group with small marginal propensity to save (poor households)to large marginal propensity to save (non-poor households),which in turn leads to contractionary aggregate demand and output(Krugman and Taylor,1978).

viii. All households except for urban poor worsen off in terms of welfare as measured by real income. Besides, real household consumption diminishes for all households except urban poor. These adverse effects are mainly due to the decline in purchasing power of households. It is in turn induced by the cumulative results of the rise in the price of composite goods, the reduction in the quantity of imports and the allocation of large part of augmented output to export which all together out weight the growth of incomes of the households.

ix. Exports of agricultural and industrial outputs boost up whereas for service sector the increment is quite small. The remarkable rise in the first two sectors is because of the growth in the price of exports highly outweighs those of composite goods. Moreover, the percentage changes of quantity of imports for all commodities are negative mainly due to high growth in the price of imports.

x. The findings reveal that trade balance (i.e. the difference between export and import of merchandise) is negative under all scenarios whereas the current account (i.e. the summation of trade balance, net service and transfers) partly improves as a result of the contraction in absorption and partly deteriorates due to an increase in investment demand.

6.2 Policy Implications

The results of the study have the following policy implications:

i. Resources are more allocated to production of exportable agricultural and industrial commodities and relatively less to the production of exportable service. Following the reallocation, real household consumption and welfare for rural and urban non-poor are adversely affected. But appropriate shock level reverses the direction. Hence, setting optimum exchange rate and adopting certain reservation not to comply with international requirements benefits the society at large.

ii. Light industries are positively affected by the exchange rate realignments. This implies that production and employment boost up in this sub-sector where the country has relatively better comparative advantage. Thus, expansion of export-oriented light industry is vital in transforming the industrial sector, increasing production and export. Besides, top agricultural exports of Ethiopia are remarkably growing. This enforces the country to enhance the diversity and quantity of exports so that reasonable returns and improved trade balances and current accounts are derived as a result of the policy shock.

iii. Though it is not the primary focus of the paper, it is important to infer about income redistribution .Exchange rate shock entails redistribution of income from those with low propensity to save (poor households) to those with higher propensity to save (non-poor households). Hence, it calls for appropriate intervention for safeguarding the poor.

Besides, Incomes of urban households rise more than that of rural. This implies that there is a need to implement different programs (example: credit facility, safety net, etc…) in rural areas, especially to the rural poor so as to mitigate the adverse effect of the shock.

iv. The exchange rate shocks also induce investment to decline extremely. Thus, there is a need to mobilize domestic saving and channel to investment, and attract foreign direct investment (FDI) by designing different investment incentive schemes in order to restrain the adverse effect on absorption and real GDP .

v. Prices of composite and imported goods highly increase. This is an indication that the depreciation and the shock are likely fueling to domestic inflation. Moreover, there is a need to translate fully nominal currency realignment to real. Thus, appropriate fiscal and monetary policy packages should accompany the realignment so as to restrain the inflationary impacts.

References

Access capital investing in Ethiopia “Exchange Rate Review”- September 2010’

Agenor, P.R.,"Output, Devaluation and the Real Exchange Rate in Developing Countries." Weltwirtschaftliches Archis 1991, 127:18-41.

Alemu, Getnet , "Global Financial Crisis Discussion Series Paper 16; Ethiopia Phase 2." Overseas Development Institute, January 2010.

Annabi*,N., Cockburn*,J., and Decaluwe*,B.,” A Sequential Dynamic CGE Model For Poverty Analysis,” preliminary Draft1,may,2004.

Annabi1,N., Cissé2,F., Cockburn1,J. and Decaluwé1,B.,”Trade liberalisation, Growth and Poverty in Senegal: A Dynamic Micro simulation CGE Model Analysis,” January, 2005.

Degefa,Derrese, "The Parallel Foreign Exchange Market and Macroeconomic Performance in Ethiopia." African Economic Research Consortium, Nairobi. Research paper number 107, May 2001.

Demeke, Mulat, "Exchange Rate Policies and Economic Performance in Sub-Saharan Africa." Ethiopian Journal of Economics,Vol. I, No. 2, 1992, pp. 13-37.

Dorosh, P., Robinson , S. and Ahmed, Hashim“ Economic Implications of Foreign Exchange Rationing in Ethiopia”, ESSP-II Discussion Paper 9,Dec 2009,pp.4-6.

El-Ramly,H. “The Effect of Devaluation on Output in the Egyptian Economy: A Vector Auto regression Analysis.” International Research Journal of Finance and Economics, ISSN 1450-2887 Issue 14, 2008, pp.82-99.

Ethiopian Development Research Institute (EDRI), Ethiopia Input Output Table and Social Accounting Matrix, December 2009.

Golub, S.S.,and Ceglowski, J. " South African Real Exchange Rates And Manufacturing Competitiveness," the South African Journal of Economics, Vol. 70:6 ,September2002,PP. 1047-1075.

Kalyoncu, H., Artan S., and Tezekici,S. and Ozturk,I., "Currency Devaluation and Output Growth: An Empirical Evidence from Oecd Countries," International Research Journal of Finance and Economics, Issue 14, 2008, PP.233-238.

Kibret, Haile, "The Impact of Devaluation on Macroeconomic Performance: The case of Ethiopia," Journal of Policy Modeling, Vol. 21, Issue 4, 1999, pp. 481-496.

Krugman , P. and Obstfeld,M. "International Economics: Theory and Policy." 8th ed.Elm St. Publishing Services, 2009.

Lizondo,J.S. and Montile, P.J, "Contractionary Devaluation in Developing Countries." staff papers - IMF, Vol. 36, No. 1, 1989, pp. 182-227.

Lofgren, H., Lee Harris, R.., Robinson S.,"A Standard Computable General Equilibrium (CGE) Model in Gams," International Food Policy Research Institute,2002.

Mabugu , R "Macroeconomic Effects of a Devaluation in Zimbabwe A CGE Analysis", The South African Journal of Economics,Vol.69: 4 December-2001,PP.708-733.

Morley, S. and Pifieiro , V.," The Impact Of CAFTA in El Salvador : A Recursive Dynamic CGE Analysis," Draft, International Food Policy Research Institute, November,2006.

Thurlow, James, "A Dynamic Computable General Equilibrium (CGE) Model for South Africa: Extending the Static IFPRI Model," Trade and Industrial policy strategies, working paper 1-2004.

Appendices

Appendix 1: Mathematical Summary Statement for the Standard CGE Model

SETS

$\alpha \in A$	activities
$\alpha \in ACES (\subset A)$	activities with a CES function at the top of the technology nest
$\alpha \in ALEO (\subset A)$	activities with a Leontief function at the top of the technology nest
$c \in C$	commodities
$c \in CD (\subset C)$	commodities with domestic sales of domestic output
$c \in CDN (\subset C)$	commodities not in CD
$c \in CE (\subset C)$	exported commodities
$c \in CEN (\subset C)$	commodities not in CE
$c \in CM (\subset C)$	imported commodities
$c \in CMN (\subset C)$	commodities not in CM
$c \in CT (\subset C)$	transactions service commodities
$c \in CX (\subset C)$	commodities with domestic production
$f \in F$	factors
$i \in INS$	institutions (domestic and rest of the world)
$i \in INSD (\subset INS)$	domestic institutions
$i \in INSDNG$ $(\subset INSD)$	domestic nongovernment institutions
$h \in H (\subset INSDNG)$	households

PARAMETERS

Latin Letters

$cwts_c$	weight of commodity c in the CPI
$dwts_c$	weight of commodity c in the producer price index
$ica_{c\,a}$	quantity of c as intermediate input per unit of activity a
$icd_{c\,c'}$	quantity of commodity c as trade input per unit of c' produced and sold domestically
$ice_{c\,c'}$	quantity of commodity c as trade input per exported unit of c'
$icm_{c\,c'}$	quantity of commodity c as trade input per imported unit of c'
$inta_a$	quantity of aggregate intermediate input per activity unit

	iva_a	quantity of value-added per activity unit
	$\overline{mps_i}$	base savings rate for domestic institution i
	$mps01_c$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
	pwe_c	export price (foreign currency)
	pwm_c	import price (foreign currency)
	$qdst_c$	quantity of stock change
	$\overline{qg_c}$	base-year quantity of government demand
	$\overline{qinv_c}$	base-year quantity of private investment demand
	$shif_{if}$	share for domestic institution i in income of factor f
	$shii_{ii'}$	share of net income of i' to i ($i' \in INSDNG'$; $i \in INSDNG$)
	$t\alpha_\alpha$	tax rate for activity a
	te_c	export tax rate
	tf_f	direct tax rate for factor f
	$\overline{tins_i}$	exogenous direct tax rate for domestic institution i
	$tins01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
	tm_c	import tariff rate
	tq_c	rate of sales tax
	$trnsfr_{if}$	transfer from factor f to institution i
	tva_a	rate of value-added tax for activity a
Greek Letters	α_a^a	efficiency parameter in the CES activity function
	α_a^{va}	efficiency parameter in the CES value-added function
	α_a^{ac}	shift parameter for domestic commodity aggregation function
	α_c^q	Armington function shift parameter
	α_c^t	CET function shift parameter
	β_{ach}^h	marginal share of consumption spending on home commodity c from activity a for household h
	β_{ch}^m	marginal share of consumption spending on marketed commodity c for household h
	δ_a^a	CES activity function share parameter
	δ_{ac}^{ac}	share parameter for domestic commodity aggregation function
	δ_c^q	Armington function share parameter
	δ_c^t	CET function share parameter
	δ_{fa}^{va}	CES value-added function share parameter for factor f in activity a
	γ_{ch}^m	subsistence consumption of marketed commodity c for household h
	γ_{ach}^h	subsistence consumption of home commodity c from activity a for household h

	θ_{ac}	yield of output c per unit of activity a
	ρ_a^a	CES production function exponent
	ρ_a^{va}	CES value-added function exponent
	ρ_c^{ac}	domestic commodity aggregation function exponent
	ρ_c^q	Armington function exponent
	ρ_c^t	CET function exponent
EXOGENOUS VARIABLES	$\overline{CPI}$	consumer price index
	$\overline{DTINS}$	change in domestic institution tax share (= 0 for base; exogenous variable)
	$\overline{FSAV}$	foreign savings (FCU)
	$\overline{GADJ}$	government consumption adjustment factor
	$\overline{IADJ}$	investment adjustment factor
	$\overline{MPSADJ}$	savings rate scaling factor (= 0 for base)
	$\overline{QFS}_f$	quantity supplied of factor
	$\overline{TINSADJ}$	direct tax scaling factor (= 0 for base; exogenous variable)
	$\overline{WFDIST}_{fa}$	wage distortion factor for factor f in activity a
ENDOGENOUS VARIABLES	$DMPS$	change in domestic institution savings rates (= 0 for base; exogenous variable)
	DPI	producer price index for domestically marketed output
	EG	government expenditures
	EH_h	consumption spending for household
	EXR	exchange rate (*LCU* per unit of *FCU*)
	$GOVSHR$	government consumption share in nominal absorption
	$GSAV$	government savings
	$INVSHR$	investment share in nominal absorption
	MPS_i	marginal propensity to save for domestic non-government institution (exogenous variable)
	PA_a	activity price (unit gross revenue)
	PDD_c	demand price for commodity produced and sold domestically
	PDS_c	supply price for commodity produced and sold domestically
	PE_c	export price (domestic currency)
	$PINTA_a$	aggregate intermediate input price for activity a
	PM_c	import price (domestic currency)
	PQ_c	composite commodity price
	PVA_a	value-added price (factor income per unit of activity)
	PX_c	aggregate producer price for commodity
	$PXAC_{ac}$	producer price of commodity c for activity a
	QA_a	quantity (level) of activity
	QD_c	quantity sold domestically of domestic output

QE_c	quantity of exports
QF_{fa}	quantity demanded of factor f from activity a
QG_c	government consumption demand for commodity
QH_{ch}	quantity consumed of commodity c by household h
QHA_{ach}	quantity of household home consumption of commodity c from activity a for household h
$QINTA_a$	quantity of aggregate intermediate input
$QINT_{ca}$	quantity of commodity c as intermediate input to activity a
$QINV_c$	quantity of investment demand for commodity
QM_c	quantity of imports of commodity
QQ_c	quantity of goods supplied to domestic market (composite supply)
QT_c	quantity of commodity demanded as trade input
QVA_a	quantity of (aggregate) value-added
QX_c	aggregated marketed quantity of domestic output of commodity
$QXAC_{ac}$	quantity of marketed output of commodity c from activity a
$TABS$	total nominal absorption
$TINS_i$	direct tax rate for institution i ($i \in INSDNG$)
$TRII_{ii'}$	transfers from institution i' to i (both in the set INSDNG)
WF_f	average price of factor f
YF_f	income of factor f
YG	government revenue
YI_i	income of domestic nongovernment institution
YIF_{if}	income to domestic institution i from factor f

$$PM_c = pwm_c \cdot (1+tm_c) \cdot EXR + \sum_{c' \in CT} PQ_{c'} \cdot icm_{c'c} \quad \text{.... (1)}$$

$$PE_c = pwe_c \cdot (1-te_c) \cdot EXR - \sum_{c' \in CT} PQ_{c'} \cdot ice_{c'c} \quad \text{.... (2)}$$

$$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'} \cdot icd_{c'c} \quad \text{..... (3)}$$

$$PQ_c \cdot (1-tq_c) \cdot QQ_c = PDD_c \cdot QD_c + PM_c \cdot QM_c \quad \text{..... .(4)}$$

$$PX_c \cdot QX_c = PDS_c \cdot QD_c + PE_c \cdot QE_c \quad \text{..... (5)}$$

$$PA_a = \sum_{c \in C} PXAC_{ac} \cdot \theta_{ac} \quad \text{..... (6)}$$

$$PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{ca} \quad \text{..... (7)}$$

$$PA_a \cdot (1-ta_a) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a \quad \text{..... (8)}$$

$$\overline{CPI} = \sum_{c \in C} PQ_c \cdot cwts_c \quad \text{..... (9)}$$

$$DPI = \sum_{c \in C} PDS_c \cdot dwts_c \quad \text{..... (10)}$$

$$QA_a = \alpha_a^a \cdot \left(\delta_a^a \cdot QVA_a^{-\rho_a^a} + (1-\delta_a^a) \cdot QINTA_a^{-\rho_a^a} \right)^{\frac{1}{\rho_a^a}} \quad \text{..... (11)}$$

$$\frac{QVA_a}{QINTA_a} = \left(\frac{PINTA_a}{PVA_a} \cdot \frac{\delta_a^a}{1-\delta_a^a} \right)^{\frac{1}{1+\rho_a^a}} \quad \text{..... (12)}$$

$$QVA_a = iva_a \cdot QA_a \quad \text{..... .... (13)}$$

$$QINTA_a = inta_a \cdot QA_a \quad \text{..... (14)}$$

$$QVA_a = \alpha_a^{va} \cdot \left(\sum_{f \in F} \delta_{fa}^{va} \cdot QF_{fa}^{-\rho_a^{va}} \right)^{\frac{1}{\rho_a^{va}}} \quad \text{..... .....(15)}$$

$$WF_f \cdot \overline{WFDIST}_{fa} = PVA_a (1-tva_a) \cdot QVA_a \cdot \left(\sum_{f \in F'} \delta_{fa}^{va} \cdot QF_{fa}^{-\rho_a^{va}} \right)^{-1} \cdot \delta_{fa}^{va} \cdot QF_{fa}^{-\rho_a^{va}-1} \quad \text{.....(16)}$$

$$QINT_{ca} = ica_{ca} \cdot QINTA_a \quad \text{..... (17)}$$

$$QXAC_{ac} + \sum_{h \in H} QHA_{ach} = \theta_{ac} \cdot QA_a \quad \text{..... .....(18)}$$

$$QX_c = \alpha_c^{ac} \cdot \left(\sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{\frac{1}{-\rho_c^{ac}-1}} \quad \text{.....(19)}$$

$$PXAC_{ac} = PX_c \cdot QX_c \left(\sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{-1} \cdot \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}-1} \quad \text{..... (20)}$$

$$QX_c = \alpha_c^t \cdot \left(\delta_c^t \cdot QE_c^{\rho_c^t} + (1-\delta_c^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}} \quad \text{..... (21)}$$

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c} \cdot \frac{1-\delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}} \quad \text{..... (22)}$$

$$QX_c = QD_c + QE_c \quad \text{..... (23)}$$

$$QQ_c = \alpha_c^q \cdot \left(\delta_c^q \cdot QM_c^{-\rho_c^q} + (1-\delta_c^q) \cdot QD_c^{-\rho_c^q} \right)^{\frac{1}{\rho_c^q}} \quad \text{..... (24)}$$

$$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1-\delta_c^q} \right)^{\frac{1}{1+\rho_c^q}} \quad \text{..... (25)}$$

$$QQ_c = QD_c + QM_c \quad \text{..... .(26)}$$

$$QT_c = \sum_{c' \in C'} \left(icm_{c\,c'} \cdot QM_{c'} + ice_{c\,c'} \cdot QE_{c'} + icd_{c\,c'} \cdot QD_{c'} \right) \quad \text{..... (27)}$$

$$YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{f\,a} \cdot QF_{f\,a} \quad \text{.....(28)}$$

$$YIF_{i\,f} = shif_{i\,f} \cdot \left[\left(1-tf_f\right) \cdot YF_f - trnsfr_{row\,f} \cdot EXR \right] \quad \text{.....(29)}$$

$$YI_i = \sum_{f \in F} YIF_{i\,f} + \sum_{i' \in INSDNG'} TRII_{i\,i'} + trnsfr_{i\,gov} \cdot \overline{CPI} + trnsfr_{i\,row} \cdot EXR \quad \text{(30)}$$

$$TRII_{i\,i'} = shii_{i\,i'} \cdot \left(1-MPS_{i'}\right) \cdot \left(1-TINS_{i'}\right) \cdot YI_{i'} \quad \text{.... (31)}$$

$$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{i\,h} \right) \cdot \left(1-MPS_h\right) \cdot \left(1-TINS_h\right) \cdot YI_h \quad \text{. (32)}$$

$$PQ_c \cdot QH_{c\,h} = PQ_c \cdot \gamma_{c\,h}^m + \beta_{c\,h}^m \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma_{c'\,h}^m - \sum_{a \in A} \sum_{c' \in C} PXAC_{a\,c'} \cdot \gamma_{a\,c'\,h}^h \right) \quad \text{..(33)}$$

$$PXAC_{a\,c} \cdot QHA_{a\,c\,h} = PXAC_{a\,c} \cdot \gamma_{a\,c\,h}^h + \beta_{a\,c\,h}^h \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma_{c'\,h}^m - \sum_{a \in A} \sum_{c \in C} PXAC_{a\,c'} \cdot \gamma_{a\,c'\,h}^h \right) \quad \text{.....(34)}$$

$$QINV_c = \overline{IADJ} \cdot \overline{qinv}_c \quad \text{.....(35)}$$

$$QG_c = \overline{GADJ} \cdot \overline{qg}_c \quad \text{.....(36)}$$

$$YG = \sum_{i \in INSDNG} TINS_i \cdot YI_i + \sum_{f \in F} tf_f \cdot YF_f + \sum_{a \in A} tva_a \cdot PVA_a \cdot QVA_a + \sum_{a \in A} ta_a \cdot PA_a \cdot QA_a + \sum_{c \in CM} tm_c \cdot pwm_c \cdot QM_c \cdot EXR + \sum_{c \in CE} te_c \cdot pwe_c \cdot QE_c \cdot EXR + \sum_{c \in C} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YIF_{gov\,f} + trnsfr_{gov\,row} \cdot EXR \quad \text{..(37)}$$

$$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNG} trnsfr_{i\,gov} \cdot \overline{CPI} \quad \text{.....(38)}$$

$$\sum_{a \in A} QF_{f\,a} = \overline{QFS}_f \quad \text{.....(39)}$$

$$QQ_c = \sum_{a \in A} QINT_{c\,a} + \sum_{h \in H} QH_{c\,h} + QG_c + QINV_c + qdst_c + QT_c \quad \text{.....(40)}$$

$$\sum_{c \in CM} pwm_c \cdot QM_c + \sum_{f \in F} trnsfr_{row\,f} = \sum_{c \in CE} pwe_c \cdot QE_c + \sum_{i \in INSD} trnsfr_{i\,row} + \overline{FSAV} \quad \text{.....(41)}$$

$$YG = EG + GSAV \quad \text{..... (42)}$$

$$TINS_i = \overline{tins_i} \cdot \left(1 + \overline{TINSADJ} \cdot tins01_i\right) + \overline{DTINS} \cdot t_i \quad \text{..... (43)}$$

$$MPS_i = \overline{mps_i} \cdot \left(1 + \overline{MPSADJ} \cdot mps01_i\right) + DMPS \cdot mps01_i \quad \text{..... (44)}$$

$$\sum_{i \in INSDNG} MPS_i \cdot \left(1 - TINS_i\right) \cdot YI_i + GSAV + EXR \cdot \overline{FSAV} = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \quad \text{.....(45)}$$

$$TABS = \sum_{h \in H} \sum_{c \in C} PQ_c \cdot QH_{c\,h} + \sum_{a \in A} \sum_{c \in C} \sum_{h \in H} PXAC_{a\,c} \cdot QHA_{a\,c\,h} + \sum_{c \in C} PQ_c \cdot QG_c + \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \quad \text{.....(46)}$$

$$INVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \quad \text{.....(47)}$$

$$GOVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QG_c \quad \text{.....(48)}$$

Appendix 2:Quantity consumed of marketed commodity by house hold(%ch)

		cteff	cmzwh	cntag	cxcrp	clive	cfood	cfuel	cchem	cmach	coman	ccons	cutil	ctrad	cpsrv	cgsrv
Base	hhd-rurp	0.98	2.711	4.064	1.264	1.378	2.378	0.116	0.599	0.22	1.054	0.002	0.1781	1.461	2.231	0.14
	hhd-rurn	2.315	6.508	12.37	3.079	3.527	7.505	0.512	2.167	1.33	4.821	0.08	0.4281	6.801	6.516	0.4
	hhd-urbp	0.368	0.247	0.463	0.233	0.188	0.788	0.069	0.166	0.07	0.244	0.006	0.1079	0.348	0.467	0.07
	hhd-urbn	1.006	0.431	1.264	0.585	0.705	3.412	0.409	0.89	2.605	2.066	0.17	0.6828	2.935	3.63	0.37
60%	hhd-rurp	-0.67	-3.16	-0.15	-4.84	0.23	-2.98	-9.4	-9.82	-10.9	-7.51	6.76	2.24	-1.31	-0.75	-1.6
	hhd-rurn	-1.82	-5.19	-1.83	-6.45	-1.42	-4.6	-10.97	-11.38	-12.5	-9.09	5.08	0.57	-2.95	-2.38	-3.3
	hhd-urbp	1.28	0.23	2.75	-2.27	3.09	-0.29	-7.08	-7.52	-8.7	-5.08	10.04	5.22	1.48	2.06	1.11
	hhd-urbn	0.25	-1.58	1.24	-3.68	1.61	-1.73	-8.43	-8.87	-10	-6.46	8.51	3.7	0.01	0.59	-0.3
75%	hhd-rurp	-0.52	-2.94	-0.01	-4.42	0.25	-2.64	-8.52	-8.97	-10.1	-6.87	10.5	2.68	-0.2	0.04	-1.2
	hhd-rurn	-1.61	-4.87	-1.6	-5.95	-1.31	-4.18	-10.03	-10.47	-11.6	-8.38	8.9	1.1	-1.77	-1.51	-2.8
	hhd-urbp	1.29	0.19	2.66	-2.03	2.88	-0.15	-6.33	-6.8	-8.01	-4.59	13.68	5.44	2.43	2.67	1.34
	hhd-urbn	0.31	-1.52	1.24	-3.37	1.49	-1.52	-7.62	-8.09	-9.28	-5.9	12.19	4.01	1.03	1.28	-0
90%	hhd-rurp	-0.22	-2.22	0.36	-3.25	0.45	-1.85	-6.38	-6.78	-7.73	-5.03	13.65	2.09	0.76	0.76	-0.5
	hhd-rurn	-1.06	-3.72	-0.87	-4.44	-0.76	-3.05	-7.56	-7.96	-8.91	-6.21	12.42	0.88	-0.45	-0.45	-1.7
	hhd-urbp	1.16	0.15	2.39	-1.42	2.44	0.04	-4.69	-5.11	-6.12	-3.28	16.22	4.17	2.78	2.77	1.42
	hhd-urbn	0.39	-1.2	1.27	-2.49	1.34	-1.04	-5.73	-6.15	-7.14	-4.33	15.03	3.05	1.67	1.66	0.33
105%	hhd-rurp	-0.25	-2.34	0.6	-3.43	0.5	-1.86	-6.48	-6.96	-8.04	-4.81	23.42	3.4	2.05	1.78	-0.3
	hhd-rurn	-1.31	-4.22	-0.95	-4.92	-1.02	-3.35	-7.94	-8.42	-9.49	-6.28	21.71	1.86	0.51	0.25	-1.8
	hhd-urbp	1.26	0.25	2.85	-1.44	2.69	0.22	-4.63	-5.14	-6.28	-2.88	26.81	5.75	4.33	4.04	1.91
	hhd-urbn	0.28	-1.46	1.41	-2.79	1.29	-1.15	-5.94	-6.45	-7.56	-4.21	25.09	4.3	2.9	2.62	0.52
120%	hhd-rurp	-0.14	-2.03	1.27	-2.6	0.9	-1.25	-5.32	-5.81	-6.77	-3.46	33.47	3.23	3.04	2.75	0.47
	hhd-rurn	-1.26	-4	-0.36	-4.17	-0.7	-2.83	-6.87	-7.35	-8	-5.02	31.55	1.6	1.42	1.13	-1.1
	hhd-urbp	1.16	0.21	3.24	-0.86	2.82	0.57	-3.71	-4.23	-5.23	-1.76	37	5.26	5.06	4.75	2.36
	hhd-urbn	0.09	-1.67	1.66	-2.35	1.27	-0.95	-5.16	-5.67	-6.66	-3.24	34.95	3.68	3.49	3.18	0.82

Appendix 3: Price of composit goods(%ch)

	Nominal Exchange rate shocks					
	Base	60%	75%	90%	105%	120%
cteff	1.04	10.55	7.61	5.21	5.53	4.76
cmzwh	1.06	12.44	9.46	6.81	7.21	6.29
cntag	1.15	9.52	6.69	4.46	4.48	3.23
cxcrp	1.2	15.18	11.85	8.46	8.97	7.37
clive	1.07	9.1	6.41	4.37	4.59	3.59
cfood	1.23	12.92	9.77	6.9	7.18	5.88
cfuel	1	21.09	16.89	12.07	12.55	10.45
cchem	1.27	21.64	17.45	12.55	13.14	11.03
cmach	1.15	23.15	18.91	13.69	14.46	12.16
coman	1.28	18.57	14.81	10.5	10.56	8.32
ccons	1.01	-5.47	-9.92	-10.76	-18.05	-22.98
cutil	1.02	6.91	3.78	2.62	1.52	1.2
ctrad	1.01	11.05	7.08	4.06	2.99	1.39
cpsrv	1.02	10.14	6.62	4.03	3.23	1.69
cgsrv	1.01	11.2	8.03	5.42	5.38	4.04

Quantity of Composite Good supply(%ch)

	Nominal Exchange Rate Shock					
	Base	60%	75%	90%	105%	120%
cteff	5.15568541	-1.44	-1.24	-0.87	-1.17	-1.31
cmzwh	11.2482937	-3.86	-3.59	-2.69	-3.01	-2.77
cntag	21.3044335	-2.79	-2.46	-1.72	-2.18	-1.93
cxcrp	6.41280053	-4.44	-4.03	-2.98	-3.35	-2.87
clive	7.25585005	-0.1	-0.04	0.19	0.07	0.26
cfood	18.7816844	-2.32	-2.03	-1.37	-1.45	-1.12
cfuel	8.24810696	-16.78	-15.23	-12.89	-16.88	-18.9
cchem	8.35237394	-4.85	-4.32	-3.22	-3.55	-3.25
cmach	15.575348	-26.68	-24.46	-20.82	-26.89	-29.72
coman	18.2152593	-16.59	-15.11	-12.62	-16.06	-17.42
ccons	21.9764428	-41.6	-38.07	-32.75	-43.09	-48.41
cutil	3.01824148	-2.89	-2.27	-1.94	-2.44	-3.07
ctrad	47.1776025	-4.01	-3.33	-2.49	-3.13	-3.41
cpsrv	19.5127177	-3.76	-2.9	-1.95	-2.15	-2.03
cgsrv	17.1067265	-0.12	-0.09	-0.04	-0.03	0.01

Appendix 4: Income of Institution from factor f(%ch)

			Nominal Exchange rate shocks				
		Base	60%	75%	90%	105%	120%
Enterprise	capital	48.22890509	2.33	0.14	-0.47	-1.45	-2.84
hhd-rurp	labor	16.4834892	10	7.26	5.09	5.54	4.75
	land	0.896223782	20.22	16.15	12.08	12.93	11.87
	livestock	1.816222019	13.64	10.3	7.69	8	7.4
hhd-rurn	labor	29.39666468	10	7.26	5.09	5.54	4.75
	land	7.568680215	20.22	16.15	12.08	12.93	11.87
	livestock	3.657584338	13.64	10.3	7.69	8	7.4
hhd-urbp	labor	3.137894356	10	7.26	5.09	5.54	4.75
hhd-urbn	labor	11.27563632	10	7.26	5.09	5.55	4.75

Price of Imports(%ch)

	Nominal Exchange rate shocks					
	Base	60%	75%	90%	105%	120%
cmzwh	1.1	24.6	20.3	14.8	15.8	13.4
cntag	1.2	23.4	19.2	13.9	14.7	12.4
cxcrp	1.2	22.7	18.4	13.3	14	11.7
cfood	1.2	23.3	19	13.7	14.5	12.2
cfuel	1	21.2	17	12.1	12.6	10.5
cchem	1.3	22.3	18	13	13.6	11.4
cmach	1.1	23.3	19.1	13.8	14.6	12.3
coman	1.3	22.3	18	13	13.6	11.4
ctrad	1	60	75	90	105	120
cpsrv	1	60	75	90	105	120
cgsrv	1	60	75	90	105	120

Appendix 5: Change in real values in some macrovariables (Billions of Birr)

			Nominal Exchange Rate shocks				
		Base	60%	75%	90%	105%	120%
REAL	Absorption	162.48487	145.40602	147.06882	149.88668	146.74193	145.76344
	Change		-17.07885	1.6628	2.81786	-3.14475	-0.97849
	Priv. consumption	114.75464	110.75605	111.33535	112.50748	112.6475	113.39124
	Change		-3.99859	0.5793	1.17213	0.14002	0.74374
	Fixed Investment	28.17781	15.09756	16.18106	17.82678	14.54201	12.81979
	Change		-13.08025	1.0835	1.64572	-3.28477	-1.72222
	Stock change	3.64266	3.64266	3.64266	3.64266	3.64266	3.64266
	Change		0	0	0	0	0
	Gov Consumption	15.90976	15.90976	15.90976	15.90976	15.90976	15.90976
	Change		0	0	0	0	0
	Exports	16.77036	34.11214	37.00066	38.96156	43.53165	46.85396
	Change		17.34178	2.88852	1.9609	4.57009	3.32231
	Imports	-46.93224	-59.38831	-66.70182	-75.70227	-78.69606	-83.96932
	Change		-12.45607	-7.31351	-9.00045	-2.99379	-5.27326
	GDP at Market Pri	132.323	120.12986	117.36766	113.14597	111.57753	108.64808
	Change		-12.19314	-2.7622	-4.22169	-1.56844	-2.92945
	Net Indirect Tax	10.1	11.54218	12.59176	13.90962	14.12373	14.69967
	Change		1.44218	1.04958	1.31786	0.21411	0.57594
	GDP at Factor Cost	122.223	121.30169	121.51634	121.77066	121.19898	120.85114
	Change		-0.92131	0.21465	0.25432	-0.57168	-0.34784

Appendix 6 :Quantity and Values of some Macrovariables(%ch)

		Nominal Exchange rate shocks				
	Base	60%	75%	90%	105%	120%
QABSTOT	158.8	-10.8	-9.7	-7.9	-9.9	-10.5
QHTOT	114.8	-3.5	-3	-2	-1.8	-1.2
QINVTOT	28.2	-46.4	-42.6	-36.7	-48.4	-54.5
QETOT	16.8	27.1	26.1	22.3	26.6	27
QMTOT	46.9	-20.9	-18.8	-15.1	-18.2	-18.7
REXR	93.4	47	65.8	84.2	100.8	119.2
NEXR	100	60	75	90	105	120
PDIND	107	8.8	5.5	3.2	2.1	0.4
CPI	100	12.7	9.4	6.5	6.5	5.2
INVGDP	21.3	-9.9	-8.9	-7	-10	-11.4
PRVSAVGDP	11.7	0.6	1	1.7	1.9	2.4
FORSAVGDP	8.3	-12.3	-11.3	-8.1	-11.8	-12.8
TRDDEFGDP	37.2	-8.8	-6.5	-2.4	-4.4	-3.7
GOVSAVGDP	4.1	-0.7	-0.7	-0.6	-1.1	-1.6
IMPTAXGDP	5.3	1	2.2	3.7	4.1	5
DIRTAXGDP	3.1	0.1	0.2	0.4	0.4	0.6

Real GDP at Factor costs by activity(%ch)

		Nominal Exchange rate shocks				
	Base	60%	75%	90%	105%	120%
ateff	4.446343	-1.14	-0.98	-0.72	-1.01	-1.31
amzwh	8.086306	0.89	0.89	0.79	0.63	0.28
antag	18.35651	1.2	1.08	0.99	0.84	0.79
axcrp	10.2877	9.1	8.29	6.71	7.29	6.99
alive	17.60189	1.37	1.26	1.21	1.17	1.31
afood	2.921176	1.09	1.17	1.08	1.36	1.34
achem	0.370995	6.810001	6.67	5.49	6.24	5.77
amach	0.110382	6.07	5.99	4.46	4.66	2.96
aoman	2.368373	5.3	5.37	4.21	3.91	2.83
acons	5.986673	-41.14	-37.75	-32.58	-42.96	-48.41
autil	2.293226	-2.92	-2.64	-1.87	-2.41	-2.33
atrad	22.70957	1.3	1.46	1.52	1.74	1.6
apsrv	15.37207	-1.92	-1.39	-0.53	-0.49	0.13
agsrv	11.31179	0.01	0	0.03	0.04	0.07
total	122.223	-0.75	-0.58	-0.37	-0.84	-1.12

Appendix 7 :Nominal and Real Exchange Rates, and CPI for Ethiopia(2006-2010)

		REERI			
Months	Nom Ex Rate (Birr/US$)	Exported Weighted	Total Trade Weighted	Overall NEER Index	Consumer Price Index
Jan-06	8.68	91.54	91.20	74.74	86.1
Feb-06	8.69	93.38	93.09	75.21	87.1
Mar-06	8.69	94.03	93.77	75.04	88.0
Apr-06	8.69	93.10	92.79	74.32	88.1
May-06	8.69	94.84	94.46	72.67	91.6
Jun-06	8.69	97.48	97.03	73.04	93.3
Jul-06	8.70	99.06	98.67	72.94	95.9
Aug-06	8.70	98.90	98.65	72.40	97.2
Sep-06	8.70	100.19	100.01	72.60	98.0
Oct-06	8.70	100.51	100.39	72.88	98.7
Nov-06	8.71	99.96	99.77	72.11	99.2
Dec-06	8.75	98.97	98.73	70.81	100.0
Jan-07	8.81	98.88	98.69	70.80	100.4
Feb-07	8.84	98.01	97.85	70.12	102.3
Mar-07	8.84	99.38	99.28	69.80	104.3
Apr-07	8.85	98.60	98.45	69.00	105.8
May-07	8.92	96.66	96.67	68.48	106.3
Jun-07	9.01	96.09	96.28	67.95	107.4
Jul-07	9.03	95.87	95.80	67.02	109.6
Aug-07	9.03	99.49	99.11	67.29	112.7
Sep-07	9.04	99.92	99.57	66.72	115.3
Oct-07	9.04	98.35	98.21	65.96	117.1
Nov-07	9.04	95.96	95.84	65.02	117.2
Dec-07	9.13	95.92	95.82	64.79	118.4
Jan-08	9.21	94.83	94.72	64.16	120.2
Feb-08	9.29	97.86	98.18	63.42	125.7
Mar-08	9.45	99.84	100.32	60.91	135.2
Apr-08	9.51	98.71	99.19	60.25	137.1
May-08	9.55	104.53	105.55	60.37	147.8
Jun-08	9.59	115.08	116.42	60.14	166.7
Jul-08	9.63	121.04	122.32	59.45	179.9
Aug-08	9.66	126.12	127.16	60.90	182.3
Sep-08	9.68	132.71	133.58	62.17	184.1
Oct-08	9.75	140.51	140.85	64.20	182.0
Nov-08	9.91	139.56	139.75	65.00	175.1
Dec-08	9.94	131.74	131.49	63.31	165.0

Months	Nom Ex Rate (Birr/US$)	REERI Exported Weighted	Total Trade Weighted	Overall NEER Index	Consumer Price Index
Jan-09	10.74	123.73	123.59	59.51	165.6
Feb-09	11.04	124.53	124.96	58.75	167.1
Mar-09	11.08	124.95	125.54	58.12	167.2
Apr-09	11.14	123.38	123.93	57.31	169.2
May-09	11.20	118.89	119.42	55.94	168.8
Jun-09	11.65	112.83	113.73	52.80	171.2
Jul-09	12.11	109.58	110.28	50.68	173.3
Aug-09	12.49	105.44	106.30	48.82	175.1
Sep-09	12.50	105.17	106.26	48.44	176.6
Oct-09	12.55	103.71	104.95	47.97	178.4
Nov-09	12.58	101.41	102.44	47.59	176.1
Dec-09	12.62	102.36	103.22	47.97	176.7
Jan-10	12.69	102.49	103.10	48.17	178.2
Feb-10	13.33	99.54	100.06	46.85	178.9
Mar-10	13.38	97.54	98.22	47.04	179.6
Apr-10	13.43	96.82	97.27	46.74	180.7
May-10	13.47	100.36	100.74	48.48	181.2
Jun-10	13.51	101.11	101.79	47.98	183.7
Jul-10	13.62	98.93	99.53	47.17	183.1
Aug-10	13.77	97.53	98.09	46.46	184.3
Sep-10	16.37	83.49	84.06	38.89	189.9
Oct-10	16.41	82.53	82.93	37.74	193.9
Nov-10	16.5	82.25	82.67	37.79	194.1
Dec-10	16.5	85.80	86.40	38.34	202.4

Source:Ethiopian Development Research Institute(EDRI)

Appendix 8: Values (in millions of Birr) and Growth Rate for Nominal and Real GDP

	Real GDP	Nominal GDP	Real GDP (%ch)	Nominal GDP(%ch)
2000/01	72181.097	68026.808		
2001/02	73274.436	66556.647	2	-2
2002/03	71690.915	73432.22	-2	10
2003/04	81421.066	86660.951	14	18
2004/05	91044.094	106472.755	12	23
2005/06	100,908.38	131641.453	11	24
2006/07	112468.464	171989.141	12	31
2007/08	124602.185	248302.677	11	44
2008/09	135557.204	335379.89	9	35
2009/10	152404.692	383364.277	12	14

Growth Rates of GDP by Major Industrial classification at Constant Basic Prices(%)

	Sectors			
	Agriculture	Industry	Services	GrossValue Added
2000/01				
2001/02	-1.9	8.3	3.3	1.6
2002/03	-10.5	6.5	6	-2.1
2003/04	16.9	11.6	6.3	11.7
2004/05	13.5	9.4	12.8	12.6
2005/06	10.9	10.2	13.3	11.5
2006/07	9.4	9.5	15.3	11.8
2007/08	7.5	10.1	16	11.2
2008/09	6.4	9.7	14	10
2009/10	7.6	10.6	13	10.4
2010/11	8.5	14	12.5	11.1

Percentage Distribution of GDP by Major Industrial classification at Constant Basic Prices(%)

	Agriculture	Industry	Service
2000/01	50.9	12.1	38
2001/02	49.1	12.9	38.6
2002/03	44.9	14	41.7
2003/04	47	14	39.7
2004/05	47.4	13.6	39.7
2005/06	47.1	13.4	40.4
2006/07	46.1	13.2	41.7
2007/08	44.6	13	43.5
2008/09	43.1	13	45
2009/10	42	13	46.1
2010/11	41.1	13.4	46.7

Source: NBE data

Appendix 9 : Consumer Price Index,Nominal and Real Exchange Rate

Months	Nom Ex Rate (Birr/US$)	Nom Ex Rate (Birr/US$) Index	Total Trade Weighted (US$/Birr)	REERI Total Trade Weighted (Birr/US$)	Overall Nom Ex Rate	Overall Nom Ex Rate Index	CPI	CPI base=100
6-Jan	8.68	100	91.2	100	74.74	100	86.1	100
6-Jul	8.7	100.2304147	98.67	92.43	72.94	102.47	95.9	111.3821
6-Dec	8.75	100.8064516	98.73	92.37	70.81	105.55	100	116.144
7-Jan	8.81	101.4976959	98.69	92.41	70.8	105.57	100.4	116.6086
7-Jul	9.03	104.0322581	95.8	95.2	67.02	111.52	109.6	127.2938
7-Dec	9.13	105.1843318	95.82	95.18	64.79	115.36	118.4	137.5145
8-Jan	9.21	106.1059908	94.72	96.28	64.16	116.49	120.2	139.6051
8-Jul	9.63	110.9447005	122.32	74.56	59.45	125.72	179.9	208.9431
8-Dec	9.94	114.516129	131.49	69.36	63.31	118.05	165	191.6376
9-Jan	10.74	123.7327189	123.59	73.79	59.51	125.59	165.6	192.3345
9-Jul	12.11	139.516129	110.28	82.7	50.68	147.47	173.3	201.2776
9-Dec	12.62	145.3917051	103.22	88.35	47.97	155.81	176.7	205.2265
10-Jan	12.69	146.1981567	103.1	88.46	48.17	155.16	178.2	206.9686
10-Jul	13.62	156.9124424	99.53	91.63	47.17	158.45	183.1	212.6597
10-Dec	16.5	190.0921659	86.4	105.56	38.34	194.94	202.4	235.0755

Source:Calculated from Appendix 7

Exports,Imports,Trade Balances and Current Accounts of Ethiopia (US$ millions)

	Exports fob	Imports	Trade balance	C/A balance
2000/01	463	1557	-1094	-542
2001/02	452	1696	-1243	-686
2002/03	483	1856	-1374	-667
2003/04	600	2587	-1986	-969
2004/05	847	3633	-2786	-1495
2005/06	1000	4593	-3592	-2218
2006/07	1185	5127	-3942	-2055
2007/08	1466	6811	-5345	-2793
2008/09	1448	7684	-6236	-3202

Source:NBE data

Appendix 10: Disaggregated Activity prices(%ch)

	Nominal Exchange rate shocks					
	Base	60%	75%	90%	105%	120%
ateff	100	10.2	7.3	5.1	5.4	4.9
amzwh	100	10.4	7.6	5.5	5.8	5.4
antag	100	11.1	8.2	5.7	6	4.8
axcrp	100	18.6	14.9	10.9	11.8	10.2
alive	100	11.9	9	6.4	6.8	5.6
afood	100	13	9.9	7.2	7.6	6.4
afuel	100					
achem	100	22.5	18.3	13.4	14.2	12.5
amach	100	22.4	18.4	13.4	13.9	11.6
aoman	100	16.3	12.9	9.1	8.9	6.9
acons	100	-14.7	-16.6	-14.4	-21.1	-23.3
autil	100	8.8	6.1	4.2	3.9	2.8
atrad	100	13.7	10.7	7.7	8	6.3
apsrv	100	11.4	8.2	5.4	5.1	3.2
agsrv	100	11.3	8.1	5.5	5.5	4.1

Declaration

I, the undersigned, declare that this project is my original work and has not been presented for a degree in any other university, and that all sources of materials used for the study have been duly acknowledged.

Declared by:

Name: _____

Signature: _____

Date: _____

Confirmed by advisor:

Name: _____

Signature: _____

Date: _____

Place of submission: Addis Ababa University

School of Economics

Date of submission: 6th June 2011.