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The Impact of Aid for Trade in Ethiopia

(Dynamic General Equilibrium Model)

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This is to certify that the project prepared by Feben Abebe, entitled: *The impact of aid for trade in Ethiopia (Dynamic General Equilibrium Model)* and submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Economics (Applied Trade Policy Analysis) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Approved By: Signature

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Abstract

The impact of aid for trade in Ethiopia

(A Dynamic Computable General Equilibrium Model)

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This study analyses the impact of aid for trade using Dynamic Computable General Equilibrium (DCGE) model. It utilized the updated 2005/06 Ethiopian SAM. In order to investigate the effects of foreign aid having aid for trade benefits, seven simulations were made with percentages employed based on empirical evidence. First, an increase in foreign aid is introduced to show the impacts of foreign aid only. Consecutively, aid for trade benefits are included with an increase in aid. The model shows an appreciation of exchange rate and decline in exports due to an increase in aid inflows. However, when aid for trade is included, export increases by far compared with the aid only result. Among the aid for trade interventions, aid for building productive capacity more than offsets the appreciation of exchange rate and decline in export that follow the inflows of foreign aid. Furthermore, the other aid for trade benefits also at least partially offset the decline in export and appreciation of exchange rate. The results are not sensitive to the change in the simulated percentages. The study in general implies foreign aid that has trade benefit component improves export in Ethiopia.

Key word: Dynamic CGE, SAM and Aid for Trade

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Acronyms

CES – Constant Elasticity of Substitution

CET – Constant Elasticity of Transformation

CGE-Computable General Equilibrium

CRS-Creditors Reporting System

DCGE-Dynamic Computable General Equilibrium

EDRI- Ethiopian Developmental Research Institute

EXR- Exchange Rate

FCU-Foreign Currency Unit

GAMS – General Algebraic Modelling System

GDP – Gross Domestic Product

GTPL-Growth and Transformation Plan at Lower case

IFPRI- International Food Policy Research Institute

ILEAP-International Lowers and Economists Against Poverty

IMF-International Monetary Fund

LCU – Local Currency Unit

MA-TTRI- Market Access Tariff Trade Restrictiveness index

MFN- Most Favored Nation

MPS- Marginal Propensity to Save

ODA- Official Developmental Assistance

OECD- Organization for Economic Cooperation and Development

PASDEP- Plan for Accelerated and Sustained Development to End Poverty

ROW – Rest of the World

SAM- Social Accounting Matrix

S-I – Saving – Investment

SPS/TBT- Related Intellectuals Property Right (TRIPS)/ Sanitary and Phytosanitary Measures

TRIPS- Trade Related Intellectuals Property Right

TRTA/CB- Trade Related Technical Assistance and Capacity Building

TTRI- Tariff Trade Restrictiveness index

WTO- World Trade Organization

1. Introduction

Aid for trade is becoming a prominent concept among donors and aid recipients. It includes any form of assistance directed towards helping poor countries in promoting international trade. It is a flow of resources to developing countries to build infrastructure, trade capacity and achieve institutional reforms which improves the trade performance of the recipient countries and enable them to be competitive in the international market. Because of the binding constraints which tackle developing countries, their true potential in trade may not be known. The constraints prevent those countries to utilize market opportunities, promote trade and accelerate economic growth. In order to reduce the constraints and increase the trade performance of those countries, external assistance is essential.

Even though the focus of aid for trade is on trade and related support, it is a part of overall development assistance. According to Organization for Economic Cooperation and Development OECD (2011), the four most common objectives of Aid for trade have the potential to enhance growth and reduce poverty in developing countries- these are: - increasing trade, diversifying export, maximizing linkages with the domestic economy and increasing adjustment capacity.

Nowadays, international institutions and donors are giving much attention for aid for trade. This is mainly due to the potential of trade in inducing economic growth and reducing poverty for low income countries. Therefore, assisting those countries in reducing the constraints to trade is expected to foster development. On the other hand

countries are not equally benefited from trade liberalization and globalization: particularly developing countries are lagging behind to the advanced nation. To take part in international trade and benefit accordingly from trade liberalizations, low income countries should be supported through external assistance. (Beáta Udvari, 2010)

As part of addressing developmental challenges of developing countries, the Doha World Trade Organization (WTO) ministerial declaration launched in 2001 raises the agenda to help developing countries overcome their trade-related institutional, human resource and supply-side capacity problems. The 2005 Hong Kong WTO Ministerial Declaration also established a task force to provide specific recommendations on how to operationalise aid-for-trade (OECD, 2006). The taskforce concluded that additional and effective financing is fundamental for fulfilling the aid for trade mandate and it also distinguished five different categories of Aid for Trade, these are- trade policy regulation, trade development, building productive capacity; trade-related infrastructure; and trade-related adjustment.

Like the Official Developmental Assistance (ODA), aid for trade is provided by both bilateral and multilateral donors. Although bilateral donors provide the majority of aid for trade which close to 57% of the total in 2009, the total commitments from bilateral donors declined by 20% from 2008. On the other hand, there is an increase in multilateral flows- from 28% in 2008 to 42% in 2009. The majority of aid for trade recipients are least developing countries. From the list of top 20 recipients which receive half of total aid for trade ten are African countries and aid for trade to the continent has increased

every year by 20% on average from 2002 to 2005 and now stands at over USD 16 billion (OECD, 2011).

Africa in general and Ethiopia in particular has experienced low export performance and as Yishak (2009) referred from (IMF and World Bank, 2001) deep rooted structural problems, weak policy frameworks and institutions are the major reason for Africa's poor export performance. Like other African countries Ethiopia has also faced such problem for a long period. Supply side conditions such as institutional quality and infrastructure appear to be the major determinants of Ethiopia's export (Yishak, 2009). This implies the need for assistance which can effectively eliminate or reduce such problem and improve the county's export performance.

External assistance for Ethiopia is recognized to be an important factor for economic growth and development as well as for the improvement of different sectors (Assefa, 2005). Like others least developed countries, Ethiopia has been receiving huge amount of foreign aid and other assistance. For instance, the country is found in the top 20 recipients of aid for trade in 2009 and the total disbursements of aid for trade for the year 2009 was 5406; 95 for trade policy and regulation, 373 for economic infrastructure and 4939 for building productive capacities, disbursement is in USD' 000. (OECD, 2011)

Despite the amount of disbursement the country has received, little is known about aid for trade and its impact on the trade performance of the country. Essentially the inflow of foreign currency causes appreciation of exchange rate which makes the export of a country less competitive abroad which is termed as the Dutch disease effects of aid.

However, aid could also encourage export through tackling supply side constraints of the sector.

Empirical studies have used cross-country, time series or general equilibrium approaches to examine the impact of aid for trade. The studies show that through improving the supply side condition of an economy aid for trade could increase export.

According to Cali *et al* (2009) aid for economic infrastructure and productive capacity increases export. Using cross section data the study analyzed the effect of aid for trade on trade cost and export. The study done by Jon Pycroft (2008) employed static general equilibrium model to analyze the impact of aid for trade in Ethiopia. It shows that whenever aid is combined with trade benefit support, it promotes export. However, in this study we examined not only the direct and static effect of aid for trade. We tried to capture the overall impact as well as the dynamic effects of aid for trade. In light of this, the study addressed the following research question:-

- What is the overall effect of foreign aid in Ethiopia?
- How trade benefits aid affect the performance of Ethiopian export?
- What is the impact of improving supply side constraints of the country on export?
- Which aid for trade intervention is relatively important in promoting export in Ethiopia?

Partial equilibrium analysis is not comprehensive enough to capture the overall impact of aid for trade and account for all the complex interrelationships between aid and trade. Thus computable General Equilibrium model is employed to analyze the impact of aid

for trade in Ethiopia. Furthermore, to see the long run impact of aid for trade dynamic CGE model is used. The study utilized Ethiopian Social Accounting Matrix (SAM) 2005/06 updated in 2009 completed by Ethiopian development research institute (EDRI) in collaboration with the institute of development studies at the university of Sussex and used the IFPRI recursive dynamic model for Ethiopia. The CGE model is solved using General Algebraic Modeling Systems (GAMS 23.7).

2. Literature review

2.1 Definition and conceptual framework of aid for trade

Aid for trade is a program initiated by the world rich countries and international institution in order to help developing countries in promoting trade through overcoming different constraints to trade and enable them to be competitive in the international market. As the level of development which comprise different facilities and performance of the economy goes with income, developing countries has low level of facilities and poor economic performance. They are facing different substantial constraints to trade and not capable enough to compete with other developed countries exporters in the international market. (Page, 2007)

Moreover, despite the gross welfare gains from trade liberalization and integration into the world trading system, countries need to incur associated costs in the process of reforms and integration. The processes of reform are expected to bear adjustment costs as there would be transfer of resources among sectors in the economy. When it comes to developing countries the costs are very large; they need to incur additional costs as they lack the necessary infrastructure such as efficient ports, adequate roads, reliable electricity and communications. In order to meet product standards for the international market, they also lack technology and knowledge such as sanitary measures, technical barriers, certification and the like. To realize the full benefit of new market opportunity, developing countries are expected to make both public investment in infrastructure and institution as well as private investment in productive capacity. (Stiglitz *et al.*, 2006)

According to Busse *et al.* (2010) aid for trade is a developmental assistance intended to improve the structure of trade related aid activities. By considering policy as well as supply side constraints to trade in developing countries, it helps the countries to overcome challenges and benefit from integration into the international trading system.

Generally, two facts brought the idea of aid for trade. First, the level of export could not be increased because of the elimination of tariff and non tariff barrier only. This can be proved by the fact that developing countries has been receiving preferential treatment through decreasing their barriers to trade, however, their share of world export is declining from time to time. Second, there is a considerable pressure of integration into multilateral trade liberalization from World Trade Organization (WTO) Doha round: developing countries are facing additional costs in the process of the trade integration. (Cali *et al.,* 2009)

Developing countries are expected to make huge amount of investment which can improve supply side condition and enable them to be beneficial from international trade flows and multilateral trade integration. In order to meet all the necessary investment and overcome the constraints to trade, developing countries are highly dependent on external support. Therefore aid for trade consider the incapability of developing countries in achieving different infrastructural and institutional investment and through overcoming their constraint to trade, aid for trade has an objective of promoting trade and increase their benefit from multilateral and bilateral trade integrations.

The aid for trade agenda has three different categories; these are trade-related technical assistance & capacity building, supply-side constraints and adjustment. Trade policy & regulations and trade development are categorized under the first category; trade-related infrastructure and building productive capacity are grouped in the second category; the last one refers to macro and micro economic supports. Trade related infrastructure includes transport & Storage, communication and energy. Building productive capacity comprise banking & financial services, business & other services, agriculture, forestry & fishing, industry & mining and tourism. (OECD, 2006)

Trade Related Technical Assistance and Capacity Building (TRTA/CB) and infrastructure are being considered as the minimum requirement for aid for trade agenda. However, there is less agreement on the components of supply side constraint and the inclusion of adjustments in the aid for trade agenda. Ibid

According to International Lowers and Economists against Poverty ILEAP (2006), aid for trade can be defined by different extent. One can define narrowly by the WTO need and other may define it with the broader need of building the trade capacity of a country and other interest. The WTO needs include:

- The realization of existing commitments and obligations of the Doha round. In order to implement the agreements in the Doha round developing countries has to be supported by the developed ones.
- Support for the implementation of the clear commitments in the Uruguay round to the net food importing developing countries.

- Costs of other WTO reforms to the developing countries which are aimed at benefiting others should be considered. For instance costs of preference erosion.

- Other implementation costs that are required to execute several agreements in Doha rounds should also be considered. For example those required to implement the Trade Related Intellectuals Property Right (TRIPS) and Sanitary and Phytosanitary Measures SPS/TBT agreements.

- The costs of liberalizing a country's own imports. Even though there is fiscal cost: loss of government revenue, it is a transfer from government to those who buy the imports.

Definition of aid for trade with the broader need includes:-

- Assistance for conventionally accepted trade capacity building activities.

- Aid to support for infrastructure, investment, and other measures to improve supply side conditions.

- Aid to support for the improvement of supply capacity.

- Support for institutional development which improve trade capacity.

- Aid for building up private sector enterprise in new export or import replacing areas. This is support for supply side constraints which move up with infrastructure.

2.2 The overall impact of Foreign aid

Foreign aid is the most important element of external forces that influence an economy. The impact of it depends on the way it is provided, the motives behind it, the amount and various condition in the recipient countries. Some of the impacts of foreign aid are discussed below.

Foreign aid could stimulate economic growth through increasing domestic saving. Conventional macroeconomic theories of aid conceive that aid increase domestic saving which increase investment and capital stocks and lead to a higher rate of economic growth. The aid induced growth in turn increase income hence, the capacity of the recipient countries to import foreign goods and services will rise. (Ekanayake *et al*, 2010, Morrissey, 2001)

Aid increases imports of the recipients from the rest of the world and from their respective donors. Foreign exchange obtained from aid increase country's capacity to import and on the other hand according to McGillivray and Morrissey (1998) aid may create trade dependency as recipients import from their donors granting them large amount of aid and the aid is considered as conditional on the imports. The economic growth in the recipient countries obtained from aid increases donor's export to their respective recipients. Since it benefits donors by increasing their export, they would like to maintain or increase the aid flow.

On the other hand aid has a positive impact on the export capacity of aid recipients through improving their supply side problems. When aid is given to build different infrastructure, institution, increase productivity, generally to overcome supply side problems, it will improve export performance and build trade capacity.

Aid could also affect the socio-political relationship of the donors and the recipients (McGillivray, 1998). Donors are willing to provide assistance as long as the recipients could accept their ideologies and the recipients also try to compromise their ideas with

that of the donors. Therefore, aid has a smoothing effect on the socio-political relations of donors and recipients.

McGillivray *et al.* (2006) suggests four main alternative views on the effectiveness of aid first, aid have decreasing returns. Second, external and climatic condition determines the effectiveness of aid. Third, aid effectiveness is influenced by political conditions, and lastly institutional quality determines the effectiveness of aid.

Dutch disease is the most commonly mentioned effect of foreign aid. The inflow of foreign currency in the form of aid appreciates the exchange rate locally making export expensive and less competitive abroad.

2.3 Aid and trade

Openness to trade is an important determinant of economic growth and components of successful development (Higgins and Prowse, 2010). However, there may be costs arises due to trade for some group particularly, developing countries faces different costs along with trade. Aid enables those countries to benefit from trade and improve their capacity to produce and supply goods and services for the available market (Page, 2007). It also promotes trade by overcoming different constraints.

The literature on the causality between these two elements is vast. In the argument that aid causes trade there is tied aid where aid is directly tied to exports by a formal agreement. Whenever a country receives aid, formal agreement will be made to import

from the donor. Such type of aid were discouraged by different international organization, and, at the end of 1990s, it had been declined to 17.7%. (Wagner, 2003)

In the absence of tied aid there are also possibilities where aid cause trade, aid increases income of the recipients resulting in an increase in import. The recipients may consider the import from the donors as an obligation in order to maintain the aid flow (McGillivray and Morrissey, 1998). On the other hand, the donors may prefer to finance developmental project which require imports of goods in which the donors has comparative advantage (Wagner, 2003). This leads to an increase in trade between the donors and the recipients

Donors may also prefer to provide aid for those who have a strong commercial link, when trade between countries becomes intense the richer country will prefer to give aid for the trade partner. This support the argument that trade causes aid. (Nelson *et al.*, 2008) Wagner, 2003 noted that both aid and trade levels can be determined by different factors reflecting the existence of no relation or contemporaneous relation between the two variables.

The negative relationship between aid and trade could possibly exists when the donors use aid as a strategy to promote trade in countries where they have low market share, as their share increase the amount of aid given will be reduced (Lloyd et al, 2000). Donors may consider trade as an indicator of recipient's prosperity, therefore when trade increase in the recipient country, aid will decline. (Osei et al, 2004)

2.4 Constraints to trade

Trade can be constrained by internal and external factors which determine the trading capacity of an economy. These constraints are also referred to as determinants of export performance. Market access conditions and other factors affecting import demand are included in external factors and internal factors are related to supply side conditions (Fugazz, 2004). Infrastructure, institutional development and skilled labor are mentioned as supply side determinants and these are very essential in determining the export potential of an economy. (Fugazz, 2004;Yishak, 2009).

Internal transport infrastructure is an important supply side element which determines the trade performance of a country. Developing countries are likely to suffer from multi-faceted supply side constraints such as policy barriers, poor infrastructure and trade logistics, limited access to finance and technology, etc. These internal constraints to trade also limit the ability of those countries in responding to available market opportunities. (Martina, 2008)

2.5 Empirical literatures review

Limited numbers of studies are found on the impact of aid for trade and trade facilitation. Most of the studies available on aid for trade agenda were conducted on the effects of improving supply side of an economy on cost of trading and export performance. Using various empirical techniques, such as cross-country econometric analysis, computable general equilibrium (CGE) models, and descriptive country case study analysis, the studies found that aid spends on improving supply side constraints promotes trade.

Busse *et.al*, (2010) analyzed the impact of foreign aid spent on aid for trade and trade facilitation on the costs of trading. Using panel data estimation for a sample of 99 developing countries for the period 2004-2009, the authors investigated the impacts of aid for trade, trade facilitation and trade policy and regulations on trade costs and the time of trading. To control other non-observed country-specific effect they estimated using fixed-effect model. They pointed out that aid for trade and aid for trade facilitation may lower trade costs and play an important role in helping developing countries to benefit from trade. Even though the evidence on time of trading is less robust, they found that due to aid used to improve trade policies; time of trading will be lower.

Other studies also support that through improving supply side condition hence reducing the cost of trading, aid for trade increases trade. For instance Vijil and Wagner (2010) found that infrastructure is a potential channel of transmission by which aid for trade might affect export performance. Focusing on the determinants of trade, the paper adopts two step estimations. First, in order to test whether institutions and infrastructure determine trade flows, they investigated the determinants of trade flows between considered countries. They found that, infrastructure is highly significant in determining export performance whereas the institutional one turns out to have limited impact on developing countries' exports. In the second stage, the authors tested the impact of sectoral flow of aid for trade on the determinants of the level of infrastructure and found that aid for infrastructure has a strong and positive impact on the level of infrastructure. This paper also supported that aid for trade is a powerful instrument to assist developing

countries in their attempt to enhance export performance and integration into the global economy.

Trade facilitation which comprises aid for trade benefit also encourages trade. Wilson *et al*, (2005) investigated the benefit of trade facilitation in global perspectives. They considered four categories of trade facilitation; port infrastructure, customs environment, regulatory environment and e-business infrastructures. These trade facilitation measures for countries as importers and exporters are included in a gravity model. By using data on manufactures trade among 75 countries from 2000 to 2001, they found that, the increased trade in manufacturing goods from trade facilitation improvements in all four areas yields increases in both exports and imports. The most important ingredient in achieving these gains is a country's own trade facilitation reform efforts. They used the estimated model to simulate the effect of country-specific improvements in each trade facilitation measure. The Simulations are designed to take account of the differential character of trade facilitation in each country as measured by each of the four categories. Their simulation result indicates that improvement in all four forms of trade facilitation increase global trade.

Helble *et al.* (2009) also found that assistance directed towards trade facilitation enhance the trade performance of recipient countries. The authors used a disaggregated data on aid flows from the OECD Creditor Reporting System (OECD CRS) database for the years from 1990 to 2005. They estimate, with a gravity model, that a one percent increase in assistance to trade facilitation could generate an increase in global trade of about USD 415 million. Their result suggests that aid given for trade facilitation has a small, but

significant relationship to greater trade flows. The relationship appears to be stronger for imports overall; although when aid is provided for trade policy and regulations, the effects seems stronger both in robustness and magnitude with a particularly high impact on aid recipient's exports.

Cali and te Velde (2009) found that aid for trade facilitation reduces the export time and the cost to export. Using data on a large subset of developing countries over time, they also assess the impact of different types of aid for trade flows on the economic environment of recipient countries. They tested if aid related to infrastructure and capacity building has an impact on sectoral and total exports and their result shows that aid for infrastructure has a positive and significant impact on both sectoral and total exports. Nevertheless, the effect of aid to capacity building is only revealed using sectoral exports. The sectoral analysis reveals that aid to infrastructure is particularly beneficial for mining and manufacturing exports, while it has no effect for tourism and a marginally positive impact in food export. Indeed, this paper investigates on the various channels – namely trade and production cost- through which aid for trade enhances export performance.

Adam and Bevan (2005) used a recursively dynamic real computable general equilibrium model of a small open economy calibrated to reflect the principal features of a representative low- income aid-dependent economy. The authors analyzed the effects of aid flows by running five simulations. The simulations are made to analyze the impact of an increase in public infrastructure investment financed by an increase in aid inflow to the economy. They included the productivity effect of investment on private sectors on

different simulations. They also simulate with productivity effect bias to export and domestic goods. Their findings shows that, despite the short run Dutch disease effects of aid, when infrastructure enhance the productivity of private factors, there are potentially large medium-term welfare gains from aid-funded increases in public investment. Public infrastructure investment that generates a productivity bias in favor of non tradable production delivers the largest aggregate return to aid, but at the cost of deterioration in the income distribution.

Nelson and Silva (2008) assessed the impacts of foreign aid on trade using Gravity equation. They proposed a more appropriate empirical model which takes into account the fact that there is different pattern of trade between developed and less developed countries and aid is donated by developed countries to less developed ones. In addition, the writers used a very convenient empirical tool which allows computing general equilibrium comparative statics that multilateral effects are properly tacked. They used the "bilateral economical and political link" channel as a way that aid affects trade and included it in the trade resistance barriers concept. The finding of the paper shows that Foreign aid has a positive significant impact on exports from the donor to the recipient.

Jon Pycroft (2008) also showed that if aid is appropriately designed or supported by supply side benefit, it need not be in conflict with trade policy. Using a static computable general equilibrium (CGE) model, he analyzed the impact of aid for trade in Ethiopia. The author has used a social accounting matrix (SAM) for Ethiopia completed in a collaborative project between the Ethiopian Development Research Institute, the Institute of Development Studies, and the Universities of Sussex and Sheffield. He employed a

standard IFPRI model. To show the impact of foreign aid having aid for trade benefit, first the author made an in increase in foreign aid only then he includes aid for trade benefit with the increase in aid. The aid only simulation showed that even though the extra aid delivers some welfare benefit to the economy, if it has no benefit to the exporters, it appears to be structurally damaging to the economy in that there is a shift away from exports, however when he includes aid for trade benefits export improved compared to the aid only simulation.

3. Overview on constraints to trade and external assistance in Ethiopia

3.1 Constraints to trade in Ethiopia

Economic development in Ethiopia has been hampered by different factors. In addition to the country's own problem of underdevelopment, political conflict within the country and war with neighboring countries affect the development processes. Focusing on trade development, the country faces many constraints to trade such as poor infrastructural and institutional development, restricted trade policy, difficulties in accessing markets and running businesses. These factors can also be considered as a reason for the country's poor trade performance (see Yishak, 2009 and Alero et al., 2010).

According to world trade indicator 2009/10 the country ranked at 109th out of 125 countries in trade policy; the rank is based on Tariff Trade Restrictiveness index Most Favored Nation TTRI[1] (MFN-applied tariff) for all goods. Hence, the country's trade policy is more restricted.

The other indicator is trade facilitation[2] based on logistic performance index in which Ethiopia is found at 123th out of 155 countries. This indicates the presence of poor trade facilities in the country in relation to other countries with similar economic environment.

The country ranked at 107th out of 183 countries in institutional environment which is based on ease of doing business. This also indicates that it is difficult to run business in

[1] the index shows how much a country restrict its trade 1st is least restrictive

[2] Trade facilitation includes efficiency of customs and other border procedures, quality of transport and infrastructure, costs of importing and exporting and other element.

the country due to poor institutions. In external environment based on Market Access (MA-TTRI including preferences) referring country's trade relation with the rest of the world the county stood at 46th out of 125. This shows that relatively the country has good market access and preference. In trade outcome based on real growth in trade of goods and services, Ethiopia positioned at 76th out of 157 countries[3] which can be considered as a moderate level relative to the other countries.

Ethiopia's low performance of infrastructure and trade facilities is indicated by low logistic performance index[4]. As World Bank reported in 2010 it is amounted to 2.41 in 2009 and the logistics performance index for quality of trade and transport-related infrastructure was 1.77 in 2009. Both indices show the presence of moderate or low infrastructural and trade facilities.

Therefore, it can be realized that the country under the study is facing many difficulties to trade. High cost of trading, restricted trade policies which hinder the flow of goods and services, poor institutional development and difficulties in running businesses, are included in the major constraints. These could be improved by external assistance targeting the trade performance of the country; in which aid for trade could play significant role.

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[3] Trade outcome measure includes real growth rate and shares of trade variables in different market, FDI and remittance inflows.

[4] The overall logistics performance and trade and transportation index ranges from 1 to 5 1=low to 5=high

3.2 Foreign aid, Official development assistance (ODA), aid for trade in Ethiopia

Ethiopia as one of the poorest nation in the world has a long history of aid receipt from both bilateral and multilateral donors. With a great ambition to reduce poverty and achieve economic growth as well as social and political development, external assistance for the country is considered as a major source of finance.

Table 1: Growth of foreign aid in Ethiopia from 2004 to 2009

Years	2004	2005	2006	2007	2008	2009
Aid*	211705.44	222406.16	227674.15	287508.85	346649.95	324341.98
%change		5.1	2.4	26.3	20.6	-6.4

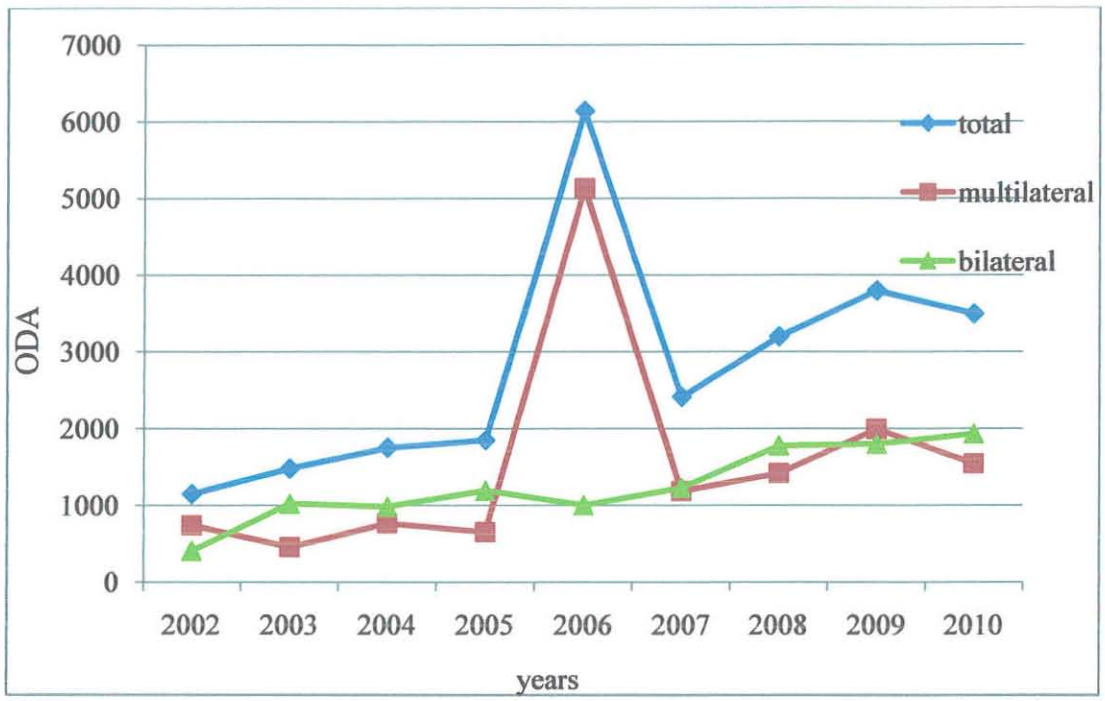
Source: World Bank database

*(In '000's of Birr)

The above table shows that foreign aid had been increasing from 2004 to 2008. In 2009 it declined by 6.4% which may be due to the fact that donors were caught by their internal economic problem. However, the average growth rate of foreign aid from 2005 to 2009 is 9.6%, which shows that foreign aid is increasing as the country is one of the least developing countries in the world and running different developmental projects which could attract donors to keep up their provision of aid.

The inflow of Official Development Assistance (ODA) in the country is also considerable financing a large portion of the country's projects. Both bilateral and multilateral donors provide this developmental assistance.

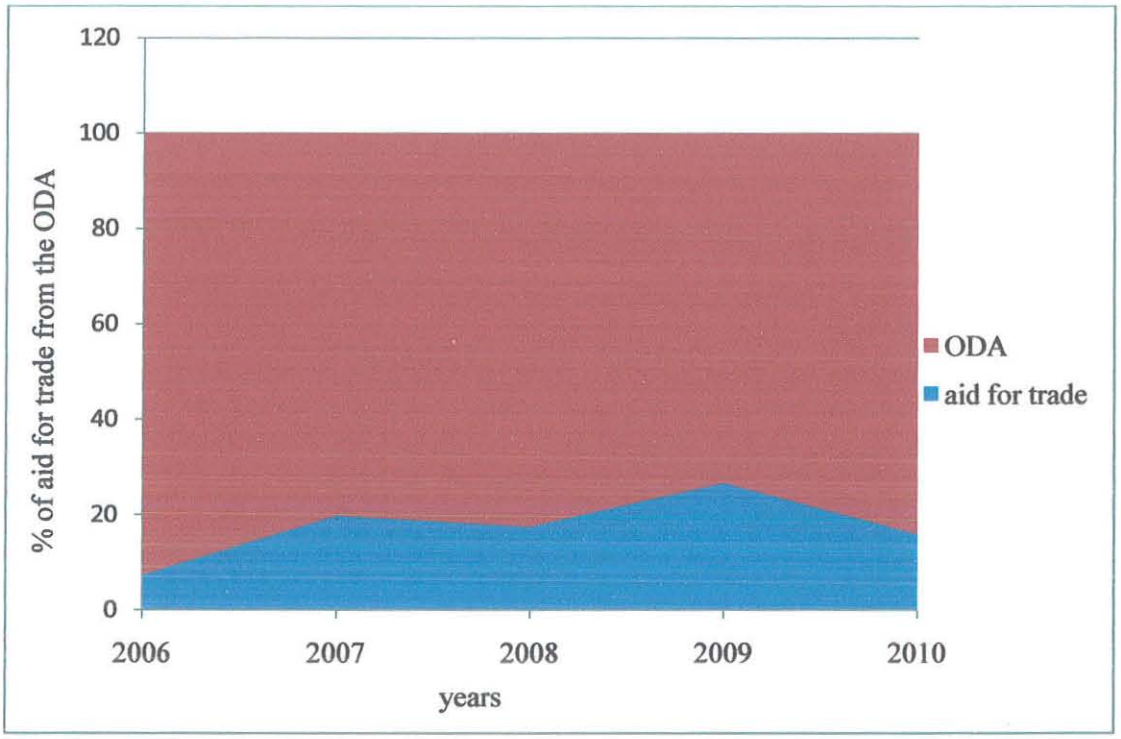
Chart 1: Trends in ODA in Ethiopia from 2002 to 2010



Source: OECD database

As shown, the inflow of ODA steadily increased from 2002 to 2005 due to sustainable developmental poverty reduction program in 2001/02. A sharp increase in 2006 is observed mainly because the new "Plan for Accelerated and Sustained Development to End Poverty" (PASDEP) is adapted in Ethiopia in 2006. In 2007 it declined sharply, and slightly increased up to 2009 then the total and multilateral assistance declines slightly up to 2010 while the bilateral has an increasing trend. The reason for the donors to reduce their development assistance for the country in 2007 might be due to the global financial crises which highly disturbed the internal economy of donors.

Chart 2: portion of aid for trade in ODA from 2006 to 2010



Source: OECD database

It is difficult to identify aid for trade elements from non aid for trade flows of donor's assistance. However, using a broad definition of aid for trade a share of aid for trade from the total ODA is calculated. It is apparent that considerable portion of ODA in Ethiopia is aid for trade flows. In 2009 around one fourth of ODA is classified as aid for trade.

Table 2: Growth rate of aid for trade categories from 2007 to 2010

	2007	2008	2009	2010	AVR GR
economic infrastructure	57.59	-39.62	0.18	118.99	34.29
trade policy and regulation	-38.87	154.35	347.01	-31.36	107.78
Building productive capacity	31.30	-14.68	331.14	-64.34	70.86

Source: OECD database

The above table shows that provision of aid for trade on average is increasing in the country. The average growth rate for the three categories of aid for trade is shown to be positive and large. From 2007 to 2010 aid for trade policy and regulation grows at 107.7% which is the largest of other categories. Aid for building productive capacity and economic infrastructure grows at 70.8% and 34.2% respectively. These imply that provision of aid for trade in Ethiopia is increasing through time.

4. Data and methodology

A Dynamic CGE model will be used to investigate the impacts of different types of aid for trade intervention on Ethiopian economy. As the effect of interventions may not be immediate, in order to study the full magnitude of its impact by including time factor and analyze the long run impact of different aid for trade interventions on the economy, it is appropriate to employ the dynamic CGE model.

4.1 Social accounting matrix (SAM)

A social accounting matrix (SAM) is a comprehensive, economy wide data framework, which represents the structure of an economy, usually a nation for a given period of time. Accounts in the SAM are represented by a row and a column in a square matrix. The row and column indicate income and expenditure of an account respectively. For each account in the SAM total revenue (row total) and total expenditure (column total) is equal. (Lofgren *et. al.*, 2002)

The standard SAM basically has four major accounts. These are activities (production sector), commodities, factors of production, and institutions which include households, enterprises, government and the rest of the world (ROW) account. (EDRI, 2009)

Activities account summarizes the production in the domestic economy; the row in the activities account shows the value of commodities supplied by producers' activities and the column shows expenditures of factors of production. Activities accounts are distinguished from commodities; receipts are measured at producer prices in the activity

account and at market prices in the commodities account. Activities and commodities are separated in order to allow the activities to produce a multiple of commodities. The commodities are activity's outputs, either exported or sold domestically, and imports. Demand for commodities appear on the row side whereas supply expenditures appear on the column side of the commodity account. (Lofgren *et. al.*2002)

Payments to factors from activities in the domestic economy and the rest of the world; and the distribution of income of factors to various institutions are displayed in row and column of factor account respectively. The row and column of institutions account define the income and expenditures of each institution respectively, including the transfer between institutions. Government receives income from direct and indirect taxes and transfer from household and ROW fixed in foreign currency. Household's income is generated from factors and transfers from other household, government and ROW. For ROW account sale of imports and factors are the source of income. The column for all institutions represents expenditure of each institution; household and government expend for consumption, transfer to household (households also transfer to the other household) and savings with additional spending of households on direct tax. The income of the enterprises account comes from factor income (profits) and transfer from another enterprises, government and ROW. The expenditure of ROW includes payments for exports, factors, transfer to households and the government which constitute foreign savings representing the inflows of foreign exchange. Enterprises do not consume thus there expenditure is confined to indirect taxes, saving and transfer to households, ROW and other enterprises. (Ibid)

The remaining account in the SAM includes the saving-investment (S-I), direct and indirect taxes and marketing margins referring trade and transportation costs. The S-I account shows the savings of different institutions in the row and investment expenditures in the column. The direct and indirect taxes are collected from households and commodities respectively in the row section to be paid to the government in the column section. The marketing margins account records the transaction costs because of trade flows and transportation in relation to domestic, import and export marketing. (Ibid)

The benchmark data for this study is the 2005/2006 Ethiopian SAM updated in 2009/10. The 2005/06 SAM is the first comprehensive SAM for the country, completed by Ethiopian Development Research Institute (EDRI) in collaboration with the Institute of Development Studies at the University of Sussex. The SAM is produced at different level of aggregations. The regionalized referred as the micro SAM is a fully disaggregated SAM with 255 rows and columns. It has disaggregated agricultural production and income generation regionally for the five main agro-ecological zones of Ethiopia.[5]

The 2009/10 updated SAM is disaggregated into 113 activities, 77 agricultural activities by agro-ecological zones, 64 commodities, 16 factors and 13 institutions including 12

[5] The agro-ecological zones are subdivided in to five zones: Zone 1 – Humid Lowlands Moisture Reliable, Zone 2–Moisture Sufficient Highlands (Cereal Based), Zone 3 – Moisture Sufficient Highlands (Enset Based), Zone 4 – Drought Prone (Highlands), Zone 5 – Drought Prone (Lowlands).)

households. The SAM also has different taxes, saving-investment, inventory, and rest of the world accounts to show the interaction of different economic agents.

4.2 Model specification

Computable General Equilibrium (CGE)

A CGE model is generally appropriate in the study where an economy wide impact of a given policy is analyzed. In order to study the economy wide impacts of aid for trade, a general equilibrium approach is suitable as the approach enable us to assess both the direct and indirect effects of the intervention in the economy. Moreover, to see the impacts of aid for trade through time it is proper to use dynamic CGE model.

Mostly dynamic CGE models are categorized in to two: intertemporal and sequential (recursive). Intertemporal dynamic model is based on optimal growth theory where the behavior of economic agents is characterized by perfect foresight. On the other hand, in the recursive model agents make their decisions on the basis of past and current information. (Lofgren and Robinson, 2004)

A recursive dynamic model combines a within period module and a between-period module. The within-period model is essentially the static model while the between-period model links the within periods modules by updating selected parameters (population) on the basis of exogenous trends and past endogenous variables (investment) (Lofgren and

Robinson, 2004).[6]In this study a recursive dynamic CGE model for Ethiopia is used for analysis purpose.[7]

The ''Within Model''

This model integrates the static part of the recursive dynamic CGE model. A standard CGE model is written as a set of simultaneous linear and non linear equations defining the behaviors of different actors in the economy. The model explains the flows of payment recorded in the SAM. There is no single objective function in the model. Production and consumption behaviors are captured by first order optimality condition; the system includes producers' profit and consumers' utility maximization subject to technology and income constraints respectively. A different market and macro aggregates constraints, which has to be satisfied by the system, are also included in the equations. A technology is specified in the model by a constant elasticity of substitution (CES) or a Leontief function of the quantities of value-added and intermediate input. (Lofgren *et. al.*2002)[8]

The model also includes equations for closures that adjust the economy to ensure equilibrium. The model follows the SAM disaggregation of factors, activities,

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[6]The recursive CGE models are solved sequentially for each period. (Hedi et. al, 2002).

[7]Cockburn and Decluwé (2006) showed that it is generally impractical to assume perfect foresight, particularly for developing countries. Consequently, in most of empirical studies myopic sequential dynamic model is adopted. Thus, for Ethiopia it is appropriate to adopt a recursive dynamic model rather than an intertemporal dynamic model.

[8] This section is mainly depends on Lofgren *et al.* 2002

commodities, and institutions. The equations in the model are divided in to four blocks; these are prices, production and trade, institutions, and system constraints block.

Price Block

The price block specifies equations for the endogenous model prices that are linked to other endogenous or exogenous prices and to non price model variables. Some of the model prices are discussed below.

The domestic import price of a commodity is the tariff and exchange rate adjusted world price of that commodity plus transaction costs to move the commodity from the border to the demander. Mathematically the import price is expressed as follows:-

$$PM_c = pwm_c.(1+tm_c).EXR + \sum_{c' \in CT} PQ_{c'}.icm_{c'c} \qquad c \square CM \quad (4.1)$$

Where, C is a set of commodities, CM is a set of imported commodities, CT is a set of domestic trade inputs that are distribution commodities, PM_c is import price in local currency unit (LCU) including transaction costs, pwm_c is cost, insurance and freight (c.i.f) import price in foreign-currency units (FCU), tm_c is import tariff rate, EXR is exchange rate LCU per FCU, PQ_c is composite commodity price inclusive of sales tax and transaction costs, and $icm_{c'c}$ is quantity of commodity c' as trade input per imported unit of c. This model takes the exchange rate and the domestic import price as flexible, while the tariff rate and the world price are kept fixed.[9]

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[9] Based on the assumption of small country, the modeled country faces an infinitely elastic supply curve at the prevailing world price (Lofgren et al., 2002)

The export price of a commodity received by domestic producers in the export market is similar to that of import price with difference in tax and cost of trading; unlike the import price, tax [10] and cost of trading reduces the price paid to the domestic exports.

$$PE_c = pwe_c.EXR - \sum_{c' \in CT} PQ_{c'}.ice_{c'c} \qquad c \in CE \qquad (4.2)$$

Where, CE a set of exported commodities, PE_c is export price in LCU, Pwe_c is free on board (f.o.b) export price in FCU, and $ice_{c'c}$ is quantity of commodity c' as trade input per exported unit of c.

The model distinguishes the price paid by domestic demanders and received by suppliers due to the presence of transaction costs. The demand prices of a commodity that are neither imported nor exported are defined as the supply price plus cost of transaction to move the product to the domestic demander.

$$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'}.icd_{c'c} \qquad c \in CD \qquad (4.3)$$

Where, CD is a set of commodities with domestic sales of domestic output, PDD_c is demand price for commodity produced and sold domestically, PDS_c is supply price for commodity c and $icd_{c'c}$ is quantity of commodity c' as trade input per unit of c.

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[10] Ethiopia does not have export tax thus, te_c turn out to be zero

The model also define consumer and producer price for domestically marketed output.

$$\overline{CPI} = \sum_{c \in C} PQ_c.cwts_c \qquad (4.4)$$

Where, $cwts_c$ is weight of commodity c in consumer price index and $\overline{CPI}$ is consumer price index (it is exogenous variable)

$$DPI = \sum_{c \in C} PDS_c.dwts_c \qquad (4.5)$$

Where, $dwts_c$ represent the weight of commodity c in the producer price index and is producer price index for domestically marketed output (non tradable commodities).

The total domestic spending on a commodity at domestic demander prices are defined as absorption; it is the sum of spending on the domestic output and imports at the demand price without the commodity sales tax but includes the cost of trade inputs.

$$PQ_c.(1-tq_c).QQ_c = PDD_c.QD_c + PM_c.QM_c \qquad c \in (CD \cup CM) \qquad (4.6)$$

Where, QQ_c is quantity of goods supplied to domestic market (i.e., composite supply), QD_c is quantity sold domestically of domestic output, QM_c is quantity of imports of commodity, and tq_c rate of sales tax.

Production and trade block

Production in the economy is carried out by activities which are assumed to maximize profits subject to their technology taking prices as given and acts in a perfectly competitive setting. The production technology is chosen from the two specification permitted in the model, these are the constant elasticity of substitution (CES) and

Leontief function at the top level of the technology nest. The activity level is either a CES or a Leontief function of the quantities of value-added and aggregate intermediate input use.

In this study, the Leontief technology is at the top level of the technology nest. The production function for activity is a function of the quantities of aggregate value added and intermediate inputs that yield commodity outputs in the production process. The quantity of value-added is a CES function of disaggregated primary factors. The demand for aggregate value added and intermediate inputs are formulated as fixed share of activity level.

$$QVA_a = iva_a.QA_a \qquad a \in ALEO \qquad (4.7)$$

$$QINTA_a = \text{int}\, a_a.QA_a \qquad a \in ALEO \qquad (4.8)$$

Where, a represent a set of activities in the Leontief activity function, iva_a represents quantity of value-added per activity unit, and $\text{int}\, a_a$ represents quantity of aggregate intermediate input per activity unit and QAa is the quantity or level of activity.

After all commodities enter in to the market with the exception of home consumed output a CES function aggregate domestic output from the output of different activities of a given commodity. These outputs are imperfect substitutes.[11] The aggregated marketed domestic outputs are allocated for domestic sales and export, expressed by a constant

[11] due to differences in timing, quality, and distance between the locations of activities

elasticity of substitution.[12] The composite commodity supplied domestically is produced by domestic and imported commodities. The Armington function aggregates the composite commodities supplied domestically which are produced by domestic and imported commodities; and both imported and produced domestically.

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

Institutional block

Institutional block contains the income and expenditure of the four major institutions (households, government, enterprises and ROW). Household and enterprises obtain their income from payment of factors made by each activity and transfers from other institutions. Households expend their income for consumption, saving, directs tax and transfer to other household and institution. With the exception of consumption and tax (enterprises do not consume[13] and pay indirect tax), the expenditure pattern of the enterprises is similar to that of the households. Government revenue is collected from taxes, factors payment and transfer from the ROW. Its expenditure is confined to consumption, saving and transfers to domestic institution.

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[12] It is assumed that suppliers maximize sales revenue for any given aggregate output level, subject to imperfect transformability between exports and domestic sales, expressed by a constant elasticity of transformation (CET)

[13] Households only demand commodity among domestic non government institution

The total income of each factor is defined as the sum of activity payments. Mathematically, factor income is given as:-

$$YF_f = \sum_{a \in A} WF_f . \overline{WFDIST}_{fa} . QF_{fa} \qquad f \in F \qquad (4.9)$$

Where, YF_f denotes factor incomes, WF_f denotes the average factor price, $\overline{WFDIST}_{fa}$ denotes the wage distortion factor, and QF_{fa} denotes the quantity demanded of factor f from activity a.

The wage distortion factor measures the deviation from the average wage. It is fixed because for each factor in the model, the deviation is the same.

Institutional factor income is distributed among domestic institution in fixed shares after payment of direct factor taxes and transfer to the rest of the world.

$$YIF_{if} = shif_{if} . \left[YF_f - trnsfr_{rowf} . EXR \right] \qquad i \in INSD \qquad (4.10)$$

Where, i stands for institutions which is an element of INDS representing a set of domestic institutions, YIF_{if} represents institutional factor income, $shif_{if}$ represents the share of domestic institution i in income of factor f, and $trnsfr_{rowf}$ represents transfer from factor f to institution i [14].

[14] The direct tax rate for factor f in the above equation is taken as zero as Ethiopia does not impose direct tax for factor (tf_f)

The government revenue is the sum of different types of taxes, factor payment and transfer from the ROW. It uses the income to purchase commodities for its own consumption (fixed in real term) and to make transfer to other institutions. Mathematically, it is described as follows:-

$$YG = \sum_{i \in INSDNG} TINS_i.YI_i + \sum_{c \in CM} tm_c.pwm_c.QM_c.EXR + \sum_{c \in C} tq_c.PQ_c.QQ_c + \sum_{f \in F} YIF_{govf} + trnsfr_{govrow}.EXR \quad (4.11)$$

Where, YG is government revenue, $TINS_i$ is direct tax rate for institution i, YI_i is income of institution i, tm_c is import tariffs, pwm_c is world price of import, QM_c is quantity of import, tq_c is indirect sales tax, PQ_c is composite commodity price, QQ_c is composite supply, YIF_{govf} is transfer from institution to the government, $trnsfr_{govrow}$ is transfer from the ROW to the government, and EXR is exchange rate[15].

The mathematical definition for government expenditure:-

$$EG = \sum_{c \in C} PQ_c.QG_c + \sum_{i \in INSDNG} trnsfr_{i\ gov}.\overline{CPI} \quad (4.12)$$

Where, EG stands for government expenditure, PQ_c stands for composite price, QG_c stands for government consumption demand for commodity, $trnsfr_{igov}$ stands for transfers from government to institution i, and CPI stands for consumer price index.

[15] Shown in the work of Dorosh *et al.*, (2009) in Ethiopia direct tax from factors, ''value-added taxes'' on activities, activity taxes and export taxes are excluded from the equation specifying the government revenue sources. This is because those taxes are fictional in Ethiopia

System constraints block

This block constitutes formulation of the system closures which equilibrate the model (keeping the equality of equations and endogenous variables) by fixing some variable for the model to have a solution. These are factor market and macroeconomic closure (commodity market, current account balance and government balance). The choice of closure affects all simulations other than the base simulation. The selected closures in this study are those applicable for the country under the study.

The first closure in the standard CGE model is for factor markets. It equalizes the total quantity demanded and supplied for each factor in the factor market.

Mathematically this can be shown as follows:

$$\sum_{a \in A} QF_{fa} = \overline{QFS_f} \quad f \in F \qquad (4.13)$$

Where, $\overline{QFS_f}$ denotes quantity supply of factor f. An economy wide wage variable is free to vary to assure that the sum of demands of factors from all activities equals the quantity supplied. Each activity pays an activity-specific wage that is the product of the economy wide wage and an activity-specific wage distortion term which is fixed for this closure.

Labor in the model is disaggregated in to skilled, semi-skilled and non skilled. Factor market closure where skilled and semiskilled labor is fully employed and non skilled labor is unemployed and mobile across sectors; land is fully employed and mobile across sectors and capital is fully employed and activity specific is used in this study. The

implication of full employment of skilled, semiskilled labor, land and capital is the fixation of their quantity. But for the case of unskilled labor since there is a room for unemployment, its employment is flexible and wages are fixed in real terms hence, supply adjusts itself to match demand. The mobility of labor and land across sectors implies that they can be employed in different activities, whereas capital is activity specific as it is immobile across sectors in Ethiopia.

Current government balance imposes equality between current government revenue and the sum of current government expenditures and savings. For the government balance, flexible government saving ($GSAV$) which balance the government account and fixed direct tax rates closure is used. Other two alternative closures for government balance are when the direct tax rates of domestic institutions are adjusted endogenously to generate a fixed level of government savings and fixed government savings and scaled direct tax rates for selected institutions. Mathematically the government balance is expressed as follow:-

$$YG = EG + GSAV \tag{4.14}$$

Where, YG is government revenue, EG government expenditure and GSAV is government saving.

The external balance requires the equality between the country's earning and spending of foreign exchange. The fixed foreign savings (trade balance) and flexible exchange rate which plays the role of equilibrating variables to the current account balance closure will be used in this specific study. There is also an alternative closure for external balance; exchange rate may be fixed and foreign savings unfixed. Mathematically it is given as:-

$$\sum_{c \in CM} pwm_c.QM_c + \sum_{f \in F} trnsfr_{rowf} = \sum_{c \in CE} pwe_c.QE_c + \sum_{i \in INSD} trnsfr_{irow} + \overline{FSAV} \tag{4.15}$$

Where, $\overline{FSAV}$ denotes foreign saving (in FCU). The above equation defines the external balance; import spending plus factor transfers to the ROW must equal the sum of export earning, institutional transfers from the rest of the ROW and foreign savings.

The last closure in the model is the saving-investment balance (S-I), enforcing the equality of total savings and total investment. There are five alternative closures in the S-I balance. The default closure for this balance is, fixed propensities to save for all non-government domestic institutions and flexible capital formation (saving-driven closure). Among the remaining four closures the first alternative is investment- driven closure, where saving adjust to maintain the equality; uniform saving rates (MPS) adjust for selected institutions to finance the cost of investment. The other alternative is similar with the above closure (investment-driven) but the saving rates are not uniform rather are scaled. The remaining two closures are also the variants of investment-driven closure, but they impose an adjustment rule for government consumption. Therefore, in the last two alternative closures, both investment and government consumption absorption shares are fixed while MPS is uniform for the former and scaled for the later (Lofgren et al., 2002). Mathematically S-I balance are described as follows:-

$$\sum_{i \in INSDNG} MPS_i.(1-TINS_i).YI_i + GSAV + EXR.\overline{FSAV} = \sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c \tag{4.16}$$

Where, $qdst_c$ represent the quantity of stock changes. Accordingly, the sum of savings from the government, domestic non-government institutions and the ROW are equated

with the sum of fixed investment and stock change. To cater for imbalance, the S-I balance also has an optional addendum in 'WALRAS' which is valued at zero if the model is in equilibrium (balanced).

The ''between model''

The "between model" is an engine of the dynamic process that links the within periods modules. In the model, labor supply will be determined exogenously (updated by the population growth rate) while capital accumulation is determined endogenously. In a given time period the total available capital is determined by the previous period's capital stock and investment spending then new capital will be distributed among sectors based on each sector's initial share of aggregate capital income.

5. Simulations and result

5.1 Description of simulations

The depictions of each scenario used to show the impact of aid for trade interventions are discussed in this section. We have a base line scenario and seven other simulations; all of which include an increase in government transfer from the ROW. First, in order to analyze the overall impacts of foreign aid without trade benefit an increase in government transfer from the ROW is introduced subsequently based on the effects of aid for trade categories, six simulations are included. All percentage change is made for five years from 2012 to 2016[16] which enable us to consider the future changes in aid for trade benefits and to show their impact on the economy assuming that the proposed changes can be achieved throughout this period of time.

The base line scenario is made to evaluate the economy without any change in the study variables. It serves as a reference point for the other simulations. In this particular study the country's five years growth and transformation plan at lower case (GTPL) is used as base case which is intended to analyze the impact of aid for trade given the economy is growing at GTPL rate.

First, government transfer from the ROW (TRSGRW) is increased by 9.6%. This simulation is made to see the overall impacts of foreign aid without trade benefits. The

[16] The percentage change for the aid for trade simulations is derived from Jon Pycroft (2008), his percentage change is equally disseminated for five years, and percentage changes of aid for trade interventions is also considered.

percentage change is taken from empirical data; foreign aid increased on average by 9.6% from 2005 to 2009.[17]

The next simulation is based on the first category of aid for trade, technical assistance and capacity building which includes trade policy and regulation, and trade development. The first one focuses on enabling the country to implement suitable trade policy which promotes and facilitates trade through provisions of training for government officials, experts and advise. This in turn increases productivity of skilled labor in the country. While the later is about developing the country's trade performance through institutional reforms and streamlining bureaucracy faced by exporters and importers. Based on the effects of aid for trade policy and regulation, a 2% increase in skilled labor productivity is made with the aid only simulation[18] (TRSSKTFP).

The second aid for trade category is for improving supply side constraints; economic infrastructure and building productive capacity. It is unambiguous that constructions and improvements of economic infrastructures reduce trade and transportation costs. Aid for economic infrastructure increased on average by 34.29% from 2007 to 2010. This increment is assumed to bring a 6% reduction in trade margins.[19] Hence 6% cut in trade

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[17] It is assumed that 9.6% is a yearly growth rate

[18] Trends show that on average aid for trade policy and regulation increased by 107.8% from 2007 to 2010 and it is assumed that a 2% increase in skilled labor productivity could be achieved by the provision of training, expertise and advises in the form of this category of aid for trade.

[19] Given the poor performance of infrastructure and high trade and transportation cost in the country, reduction of 6% of trade margin seems plausible and the effect of trade development in reducing trade cost is also considered.

and transportation margins for all commodities is introduced with an increase in aid simulations (TRSTRM). A separate scenario for cut in margin for exporters only is also made (TRSETRM), with similar percentage change, to assess the effects of improving institutions and infrastructural facilities for exporters only.

Building productive capacity of major sectors in the economy involves in raising factors productivity. On average aid for building productive capacity has increased by 70.8% from 2007 to 2010. Therefore, a 2% increase in total factor productivity is made[20] with an increase in aid (TRSATFP). Major sectors of the economy addressed by this category have the largest share of the country's export. An increase in total factor productivity for exportable only (TRSETFP), with the same percentage change, is made to analyze the effect of building productive capacity aid on raising total factor productivity of exportable.

The last category of aid for trade is for assisting government in covering adjustment costs of implementing new policies stream out from multilateral and international trade agreements. Since this has the effect of raising the government transfer from the ROW which we already included in all simulation, a separate simulation is not introduced for this category.

In order to analyze the possible effects of aid for trade benefits in the economy, a combination of the above simulations is run with the aid only simulation (TRSALL).

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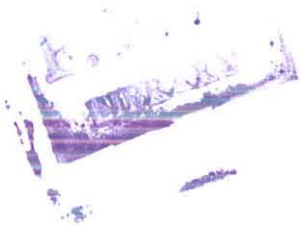
[20] It is assumed that 70% increase in building productive capacity for major sectors in the economy could increase total factor productivity by 2%.



These include an increase in TFP, an increase in skilled labor productivity and a cut in margins for all commodities

5.2 Results of simulations

The results of each simulation are presented in this section. Comparison is made between the base simulation (GTPL) and other simulations. As the focus of this study is on the impact of trade benefit aid, special emphasis is given to compare the TRSGRW simulation (an increase in government transfer from ROW) with others aid for trade benefits simulations which also incorporate an increase in foreign aid.

Table 3: % changes of macro variables from the base (GTPL)

	GTPL	TRSGRW	TRSSKTFP	TRSETFP	TRSATFP	TRSETRM	TRSTRM	TRSALL
Real Export	114.3	-9.4	-7.3	4.1	9.0	-1.5	15.1	38.9
REXR	1.0	-3.1	-2.6	-1.8	0.4	-10.6	-6.5	-2.5
Absorption	671.4	3.7	4.5	10.2	14.8	4.7	14.4	28.2
Investment	147.0	13.1	16.5	17.7	27.6	10.0	28.1	49.4
Private consumption	464.3	1.2	1.2	9.2	12.6	3.6	12.0	25.2
Real import	-299.7	4.4	5.7	12.1	14.9	9.0	18.4	31.9
GDP at MP	585.0	0.8	1.8	8.4	13.6	2.0	13.2	29.1
GDP at FC	543.5	0.5	1.4	8.0	13.5	0.4	4.3	19.0

Source: Simulation results from the CGE model

*negative change in real exchange rate shows appreciation

Comparing with the base run, TRSGRW shows the expected appreciation of exchange rate; real exchange rate appreciates by 3.1%. Export fell by 9.4% because of the appreciation. Absorption has increases by 3.6%, GDP at market price (MP) by 0.8%. This suggests that despite its effect on absorption and GDP, foreign aid could affect exports negatively.

Unlike the other aid for trade simulation the increase in total factor productivity for all activities (TRSATFP) result in both depreciation of exchange rate and rise in export. It increase exports by 8.9%, depreciate the real exchange rate by 0.4%, increases absorption and GDP (at MP) by 14.7% and 13.4% respectively comparing to the base run. This indicates that if 2% increase in total factor productivity realized through aid for trade for the coming five years, exchange rate will depreciate and export will rise.

The increase in skilled labor productivity (TRSSKTFP) simulation results in appreciation of exchange rate and reduction of exports comparing to the GTPL simulation. The appreciation is due to the inflow of foreign aid which reduces export. In this scenario the effects of an increase in aid outweigh the effect of an increase in skilled labor productivity. However both the appreciation and the decline in export is less than the aid only simulation. In addition, positive change in absorption and other macro variable from the base run is observed. All the other simulation also results in a less appreciation of exchange rate and rise in exports. The appreciation in reduction of trade and transportation margin for export only (TRSETRM) is the highest of other simulations. The reduction in trade and transport margin increases productivity of

tradable which could further appreciates the exchange rate and through this reduces exports by 1.4% from the base run.

However, when we reduce trade and transportation margins for all commodities the appreciation is lower than the TRSETRM simulation and export increases. The possible aid for trade benefit simulation (TRSALL) results in huge increments in export and appreciation of exchange rate by only 2.4% from the GTPL simulation. Here the effect of possible aid for trade benefits on export is larger than the appreciation effect which results in higher export. Absorption and GDP at market price increase in this simulation by 28.2% and 29% respectively. Here we can see that the other proposed aid for trade intervention could also increase the value of macro variables and offset the negative impact of foreign aid on export and exchange rate.

Table 4: % change of macro variables from the aid only simulation

	TRSGRW	TRSSKTFP	TRSETFP	TRSATFP	TRSETRM	TRSTRM	TRSALL
Real Export	103.50	2.38	14.89	20.29	8.78	27.05	53.35
REXR	0.94	0.53	1.38	3.61	-7.76	-3.51	0.64
Absorption	695.92	0.7	6.34	10.71	1.01	10.41	23.71
Investment	166.17	3.02	4.12	12.90	-2.66	13.33	32.13
Private Consumption	469.64	0.07	7.93	11.30	2.44	10.71	23.77
Real import	-209.57	1.17	7.35	10.02	4.34	13.36	26.35
GDP at MP	589.86	0.90	7.48	12.63	1.19	12.28	27.98
GDP at FC	550.93	0.90	7.52	12.93	-0.07	3.80	18.48

Source: Simulation results from the CGE model

*Negative changes in exchange rate is appreciation

In order to examine the difference between the impacts of introducing aid for trade benefits and foreign aid only, the changes of major macro variables from the aid only simulation is computed. Aid for trade benefits simulation except the two trade margin simulations, which show appreciation of exchange rate, results in large positive change in export and depreciation of real exchange rate comparing to the aid only value.

The increase in skilled labor productivity simulation depreciate the real exchange rate by 0.5% from the aid only simulation, increase the real export by 2.3%, absorption and GDP at MP has also further increases by 0.7% and 0.9% respectively. This suggests that if aid for trade raises skilled labor productivity in the country, the appreciation of real exchange rate and the decline in export that comes from the inflow of foreign aid will reduces and further increment in absorption, GDP and other macro variables will be obtained.

For increasing total factor productivity for exportable only (TRSETFP), real exchange rate depreciates by 1.38% comparing to the aid only simulation. Export increases by 14.89%, absorption increases by 6.33%, GDP at MP increases by 7.4%. When aid for trade focused on increasing total factor productivity of exportable only, it could improve export and exchange rate in addition to its positive impact on macro variables.

Due to the increase in total factor productivity for all activities, export and exchange rate shows huge improvement from the aid only simulation. Real exchange rate depreciates by 3.6% (the largest of all simulation); showing that the total factor productivity effects of aid for trade could more than offset the appreciation of exchange rate caused by the

inflow of foreign aid. Export increases by 20.3%, absorption increases by 10.7% (the largest of all simulation next to TRSALL) and GDP at MP increases by 12.6%. If the proposed increase in total factor productivity achieved through Aid for trade, the aid only exchange rate will depreciate and the further increase in export and other macro variables will be achieved.

When trade and transportation margins reduced for exportable sector only, real exchange rate further appreciates by 7.75% from the aid only simulation and export increase by 8.7%. The reduction in trade and transportation margin for exportable only increases the productivity of tradable which could further appreciate the exchange rate. Absorption increases by only 1%, export boost by 8.7%, and GDP at MP increases by 1.1%. However, in TRSTRM simulation large increase in export is shown and the appreciation is also smaller than TRSETRM simulation. Export, absorption and GDP at market price increase by 27.05%, 10.4% and 12.2% respectively. The increase in export is higher next to the TRSALL simulation. This suggests that when aid for trade improves infrastructures and trade facilities in the country which can reduce trade and transportation cost for all commodities, enhanced effect on export and absorption will be realized.

The last simulation which comprises the rise in foreign aid, an increase in skilled labor productivity, an increase in total factor productivity for all sectors, and a cut in margins for all commodities resulted in huge changes in export from the aid only simulation. It increases export by 53.3% (the largest of all simulations), depreciate the exchange rate by 0.63%, absorption has also increases by 23.7%, and GDP at market price increases by 27.9% comparing to the aid only simulation. Therefore, if the proposed changes in the

above aid for trade benefits achieved with in the five years, the reduction in export and the appreciation of real exchange because of the inflow of foreign aid will improved.

Table 5: %change in sector's output from the base (GTPL)

	GTPL	TRSGRW	TRSSKTFP	TRSETFP	TRSATFP	TRSETRM	TRSTRM	TRSALL
Agriculture	3014.15	-0.02	0.16	7.04	15.54	0.02	7.18	24.76
Industry	240.96	4.62	6.93	11.31	18.51	3.61	22.79	42.81
Service	410.60	0.37	1.59	7.43	11.64	0.39	-0.62	11.73

Source: Simulation results from the CGE model

Concerning to the effects of simulations on different activities, we categorized activities in the economy in to three sectors. These are agriculture, industry and service sector. The output of agricultural sector declines slightly by 0.02% from the base following the increase in aid, while industry and service sector's production rise by 4.6% and 0.37% respectively. As the lion share of the country's export is from agricultural sector, appreciation of exchange rate, because of the inflow of foreign aid, which affects export negatively, might be the reason for the decline in agricultural production. However, in all the other simulations the production of agricultural sector increases due to the introduction of aid for trade benefits.

Except the trade margin simulation, all the other aid for trade benefits simulations changes the output of the three sectors positively. The reduction in trade and transportation margins for all commodities obviously reduces the output in the service

sector[21]. The highest percentage change from the base in sector's output is observed in TRSALL simulation. This suggests that if the proposed changes in aid for trade benefits are attained, output of the three sectors will increase more than the GTPL case,

Table 6: % change in sector's output from the aid only simulation

	TRSGRW	TRSSKTFP	TRSETFP	TRSATFP	TRSETRM	TRSTRM	TRSALL
Agriculture	3013.41	0.18	7.07	15.57	0.04	7.20	24.80
Industry	252.08	2.21	6.40	13.28	-0.96	17.37	36.51
Service	412.13	1.22	7.03	11.23	0.02	-0.99	11.32

Source: Simulation results from the CGE model

A positive change in the output of the three sectors from the aid only simulation is observed in all aid for trade benefit simulations except for the reduction in trade margin. The TRSETRM and TRSTRM reduce the output of industry sector by 0.96% and service sector by 1% respectively from the aid only simulation. The decline in the production of service sector in TRSTRM simulation from TRSGRW may be due to similar reason given for the reduction of output of service sector from the base run. Production in the industry sector declines as a result of appreciation of exchange rate that comes from an increase in productivity of tradable. It is obvious that appreciation encourages import that can reduce the local production of importable in which much of it in the country is produced by the industry sector.

[21] Trade and transportation margins of commodities are components of the service sector in the SAM.

Nevertheless, in TRSALL simulation output in agriculture sector increases more by 24.7%, industry and service sector increases by 36.5% and 11.3% respectively from the aid only simulation. This suggests that aid for trade benefits can increase the output that could be obtained by the increase in foreign aid.

Table 7: % change in output of exportable and non exportable from the base (GTPL)

	GTPL	TRSGRW	TRSSKTFP	TRSETFP	TRSATFP	TRSETRM	TRSTRM	TRSALL
EXPRTBL	1209.21	-0.39	0.19	8.51	13.60	-0.08	5.20	21.08
NEXPRTBL	2234.61	0.81	1.20	6.31	16.24	0.66	8.65	26.47

Source: Simulation results from the CGE model

In relation to exportable and non exportable activities the expected effect of foreign aid on exportable are observed. Exportable output declines by 0.4% in TRSGRW simulation. This is due to the appreciation of exchange rate following the inflow of aid. Production of exportable also declines only by 0.08% in TRSETRM simulation because of appreciation but the appreciation here is due to an increase in productivity of tradable. Next to the TRSALL simulation the increase in total factor productivity results in higher percentage change in both exportable and non exportable from the GTPL run. The other aid for trade benefit simulation also results in positive effect on both sectors.

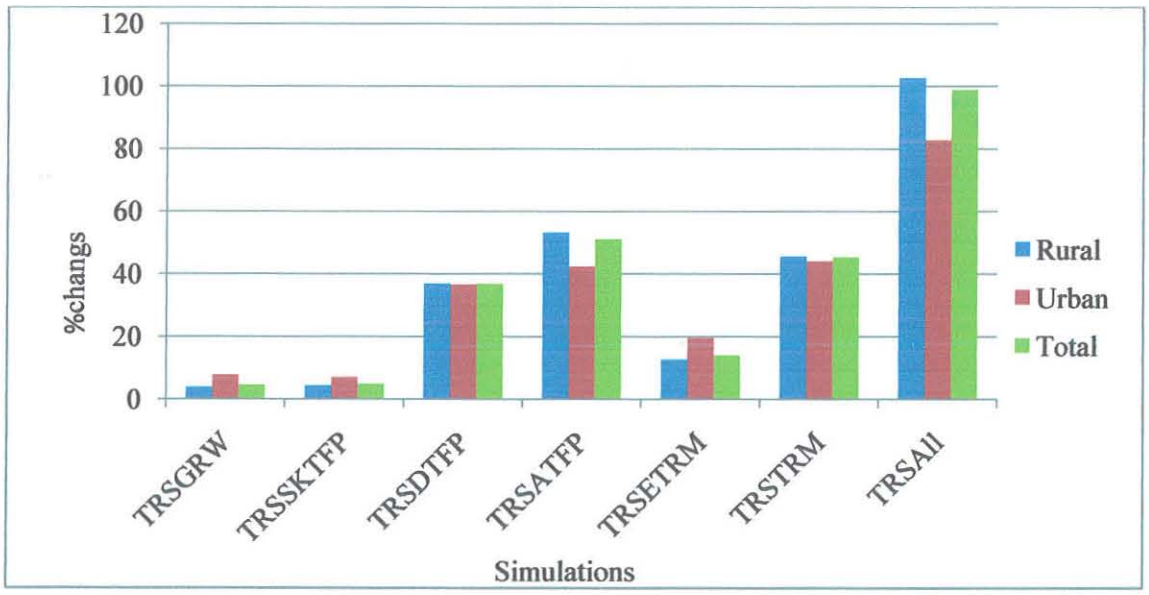
Table8: % change in output of exportable and non exportable from the aid only

	TRSGRW	TRSSKTFP	TRSETFP	TRSATFP	TRSETRM	TRSTRM	TRSALL
EXPRTBL	1204.49	0.58	8.93	14.04	0.31	5.61	21.56
NEXPRTBL	2252.64	0.39	5.46	15.31	-0.15	7.78	25.46

Source: Simulation results from the CGE model

From the aid only value of exportable and non exportable sector, large positive change in both sectors is observed in all simulation except in reduction of trade and transportation margin for exportable only. The increase in productivity of exportable due to the reduction in trade and transportation margin attracts factors in the economy. This will reduces the available factors of production for the non exportable sectors which can reduces the sector's output.

Chart 3: changes in household welfare from the base



Source: Simulation results from the CGE model

Welfare impact in the CGE model is usually computed by equivalent variation (EV). The change in household's welfare from the base simulation is presented in charter 3. All simulations show positive changes in household's welfare. The TRSALL simulation results in highest welfare improvement for rural and urban households while the lowest welfare change for the urban and rural households is recorded in TRSSKTFP and TRSGRW simulation respectively. The reduction of margins for all commodities brings the next higher welfare improvements of urban household due to the enhancement of different infrastructures and facilities while for the rural households the total factor productivity effect of aid for trade benefit results the next higher welfare changes for the rural households from the aid only simulation. We can see that aid for trade benefits enhance welfare of households in the country.

Table 9: Factors income % change from the base run

	GTPL	TRSGRW	TRSSKTFP	TRSETFP	TRSATFP	TRSETRM	TRSTRM	TRSALL
flab-sk	38.02	0.74	-1.13	10.97	1.49	2.85	10.12	9.68
flab-ss	84.20	1.71	2.10	10.11	13.84	5.14	11.33	25.49
flab-un	56.24	1.18	1.53	12.00	11.90	2.43	18.28	31.43
flab-agri	77.38	-0.27	0.06	9.00	9.07	0.97	14.91	26.87
Fcap	173.87	2.23	2.06	10.97	12.54	5.11	14.90	27.14
Flnd	56.17	-0.82	-0.34	12.11	11.33	1.76	19.88	36.10
Fliv	46.69	0.48	0.72	5.13	8.97	2.11	19.09	29.82

Source: Simulation results from the CGE model

The Income of skilled labor increases by only 0.74% from the base due to the increase in foreign aid. TRSSKTFP simulation reduces their income by 1.13%. We assumed that skilled labor is fully employed in the economy so that when their productivity increase, the full employment level of output can be attained by less skilled labor; hence their employment may be reduced which might be the reason for the decline in the total skilled labor income.

All aid for trade simulations results in positive change in income of skilled labor. The TRSETFP simulation which increases total factor productivity for export sector only results in higher percentage change in skilled labor income. Much of exportable activities are from agricultural sector which uses less of skilled labor. When those activities become more productive, their demand for skilled labor may increase which intern increase the income of the total skilled labor.

For all other factors the TRSALL simulation records the highest increase in income. Which shows that if the desired aid for trade benefits are achieved for the given period, income of those factors will increase more than the GTPL growth.

6. Conclusion and Recommendation

The impact of provision of foreign aid having aid for trade benefit in the economy of recipient's countries is analyzed in this study. The study used the updated 2005/06 Ethiopian SAM and employed a dynamic CGE model. It finds that when provision of foreign aid has some components of aid for trade benefit it will not affect the trade performance of the economy negatively.

The possible aid for trade benefit is addressed in the study. These are an increase in total factor productivity for all commodities, for exportable only, an increase in skilled labor productivity, reduction in trade and transportation margin for all commodities and export commodities only.

The model shows appreciation of exchange rate and reduction of exports for the inflow of foreign aid without aid for trade benefit. However the inclusion of the aid for trade benefits, in addition to further increment in absorption and GDP, depreciate the real exchange rate and has positive impact on the export of a country or at least they offset the appreciation of exchange rate and the decline in export caused by the inflow of foreign aid partially.

Improvements of economic infrastructure which can reduce trade and transportation margin for all commodities increase export more in relation to the other aid for trade benefit and in aspect of the total output of export sector, building productive capacity which increase total factor productivity in the economy leads to higher output of the sector.

When aid for trade intervention is introduced welfare of the rural, urban and total households' increases and the total factor productivity effect of aid for trade increase the household's welfare more relative to the others benefits. The income of different factor in the economy also increases due to the aid for trade benefits.

Since better improvement on export and depreciation of the exchange is achieved through reduction of trade and transportation margin for all commodities rather than for exportable only, aid for economic infrastructure should focus on reducing trade margin for all commodities rather than for exportable only.

Building productive capacity through increasing total factor productivity in the economy increases the export and depreciates the exchange rate more than the other aid for trade benefits. Therefore, for the country to be more beneficiaries from aid for trade program donors should give more attention for aid for building productive capacity.

All the above possible benefits of aid for trade can be realized through proper management and allocation of the inflow of aid for trade. Hence, the government of Ethiopia should establish a separate entity for administrating, monitoring, and evaluating the inflow of aid for trade program so that the possible benefits can be obtained.

For further research, it is better to include the other possible benefits and costs (if any) of aid for trade and estimate the elasticities of aid for trade interventions which enable to run simulations based on the actual changes rather than proposed changes.

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APPENDICES

Appendix A: Sensitivity analysis

Since the percentage used in simulations is not based on elasticities estimate rather taken by assumption, sensitivity analysis is made. Changes in the assumed percentages of aid for trade benefit simulations are carried out to see if there is any difference on the results of the study. The percentage values are increased and decreased by fifty percent.

Taking the impacts on export and absorption under higher, actual and lower percentage value, it is shown that the direction of the impacts remains unchanged. The magnitude changes with the percentage value; both absorption and export are higher when we increased the percentage. However, still aid for trade benefits improves export showing that the overall message of the study is remain the same.

Table A1: sensitivity analysis

	TRSGRW	TRSSKTFP	TRSDTFP	TRSATFP	TRSETRM	TRSTRM	TRSALL
Absorption							
1.5(Actual)	695.92	1.15	9.62	16.49	1.67	15.86	37.69
actual	695.92	0.77	6.34	10.71	1.01	10.41	23.71
0.5(Actual)	695.92	0.38	3.13	5.22	0.44	5.10	11.14
Export							
1.5(Actual)	103.50	3.54	22.82	31.10	13.36	42.56	86.61
actual	103.50	2.38	14.89	20.29	8.78	27.05	53.35
0.5(Actual)	103.50	1.20	9.93	7.29	4.20	12.84	24.78

Appendix B: The 'Within' Model

Formation of the static CGE model that has been used in our study is presented in this appendix. The sets, parameters and variables are stated in appendix B1whereas the model equation is given in appendix B2.

Appendix B1: Sets, Parameters and Variables in the model

Sets

$\alpha \in A$ -activities

$\alpha \in ALEO(\subset A)$ - 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_{ca} - quantity of c as intermediate input per unit of activity a

$icd_{cc'}$ - quantity of commodity c as trade input per unit c' produced and sold domestically

$ice_{cc'}$ - quantity of commodity c as trade input per exported unit of c'

$icm_{cc'}$ - quantity of commodity c as trade input per imported unit of c'

$\text{int}\,a_a$ - quantity of aggregate intermediate input per activity unit

iva_a - quantity of value-added per activity unit

$\overline{mps_i}$ - base saving 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 price)

$qdst_c$ - 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 ($i' \in INSDNG'; i \in INSDNG$)

$\overline{tins_i}$ - exogenous direct tax rate for domestic institution i

$tins01_i$ - 0 - 1parameter 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

Parameters (Greek Letters)

α^{va}_{a} - efficiency parameter in the CES value – added function

α^{ac}_{a} - shift parameter for domestic commodity aggregation function

α^{q}_{c} - Armington function shift parameter

α^{t}_{c} - CET function shift parameter

β^{h}_{ach} - marginal share of consumption spending on home commodity c from activity a for household h

β^{m}_{ch} - marginal share of consumption spending on marketed commodity c for household h

δ^{ac}_{ac} - share parameter for domestic commodity aggregation function

δ^{q}_{c} - Armington function share parameter

δ'_c - CET function share parameter

δ^{va}_{fa} - CES value –added function share parameter for factor f in activity a

γ^{m}_{ch} - subsistence consumption of marketed commodity c for household h

γ^{h}_{ach} - subsistence consumption of home commodity c from activity a for household h

θ_{ac} - yield of output c per unit of activity a

ρ^{va}_{a} - CES value – added function exponent

ρ^{ac}_{a} - domestic commodity aggregation function exponent

ρ^{q}_{c} - Armington function exponent

ρ^{t}_{c} - 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 saving rates (= 0 for base; exogenous variable)

DPI - producer price index for domestically marketed output

EG - government expenditure

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 price)

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 import 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 ($i \in INSDNG$)

$TRII_{ii'}$ - transfer from institution i' to i (both in the rest $INSDNG$)

WF_f - average price of factor f

YF_f - income of factor f

YG - government revenue

YI_i - income of domestic non-government institution

YIF_{if} - income to domestic institution i from factor f

Appendix B2: Model Equation

Price Block

[1]Import price

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

[2] Export price

$$PE_c = pwe_c.EXR - \sum_{c' \in CT} PQ_{c'}.ice_{c'c} \qquad c \in CE$$

[3] Demand price of domestic non-traded goods

$$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'}.icd_{c'c} \qquad c \in CD$$

[4] Absorption

$$PQ_c.(1-tq_c).QQ_c = PDD_c.QD_c + PM_c.QM_c \qquad c \in (CD \cup CM)$$

[5] Marketed output value

$$PX_c.QX_c = PDS_c.QD_c + PE_c.QE_c \qquad c \in CX$$

[6] Activity price

$$PA_a = \sum_{c \in C} PXAC_{ac}.\theta_{ac} \qquad a \in A$$

[7] Aggregate intermediate input price

$$PINTA_a = \sum_{c \in C} PQ_c.ica_{ca} \qquad a \in A$$

[8] Activity revenue and costs

$$PA_a.QA_a = PVA_a.QVA_a + PINTA_a.QINTA_a \qquad a \in A$$

[9] Consumer price index

$$\overline{CPI} = \sum_{c \in C} PQ_c.cwts_c$$

[10] Producer price index for non-traded market output

$$DPI = \sum_{c \in C} PDS_c.dwts_c$$

Production and Trade Block

[11] Leontief technology: Demand for aggregate value-added

$$QVA_a = iva_a.QA_a \qquad a \in ALEO$$

[12] Leontief technology: Demand for aggregate intermediate input

$$QINTA_a = \text{int}\, a_a.QA_a \qquad a \in ALEO$$

[13] Value-added and factor demands

$$QVA_a = \alpha^{va}{}_a \left(\sum_{f \in F} \delta^{va}{}_{fa}.QF_{fa}{}^{-\rho^{va}{}_a} \right)^{-\frac{1}{\rho^{va}{}_a}} \qquad a \in A$$

[14] Factor Demand

$$WF_f.\overline{WFDIST}_{fa} = PVA_a.QVA_a \left(\sum_{f \in F'} \delta^{va}{}_{fa}.QF_{fa}{}^{-\rho^{va}{}_a} \right)^{-1} .\delta^{va}{}_{fa}.QF_{fa}{}^{-\rho^{va}{}_a - 1} \quad a \in A; f \in F$$

[15] Disaggregated intermediate input demand

$$QINT_{ca} = ica_{ca}.QINTA_a \qquad a \in A; c \in C$$

[16] Commodity production and allocation

$$QXAC_{ac} + \sum_{h \in H} QHA_{ach} = \theta_{ac}.QA_a \qquad a \in A;\ a \in CX$$

[17] Output aggregation function

$$QX_c = \alpha^{ac}{}_c \cdot \left(\sum_{a \in A} \delta^{ac}{}_{ac}.QXAC_{ac}{}^{-\rho^{ac}{}_c} \right)^{-\frac{1}{\rho^{ac}{}_c - 1}} \qquad c \in CX$$

[18] First-order condition for output aggregation function

$$PXAC_{ac} = PX_c.QX_c\left(\sum_{a\in A'}\delta^{ac}{}_{ac}.QXAC_{ac}{}^{-\rho^{ac}{}_c}\right)^{-1}.\delta^{ac}{}_{ac}.QXAC_{ac}{}^{-\rho^{ac}{}_c-1} \quad a\in A\ ;\ c\in CX$$

[19] Output transformation (CET) function

$$QX_c = \alpha^t{}_c.(\delta^t{}_c.QE_c^{\rho^t{}_c} + (1-\delta^t{}_c).QD_c^{\rho^t{}_c})^{\frac{1}{\rho^t{}_c}} \qquad c\in(CE\cap CD)$$

[20] Export-domestic supply ratio

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c}.\frac{1-\delta^t{}_c}{\delta^t{}_c}\right)^{\frac{1}{\rho^t{}_c-1}} \qquad c\in(CE\cap CD)$$

[21] Output transformation for non-exported commodities

$$QX_c = QD_c + QE_c \qquad c\in(CD\cap CEN)\cup(CE\cup CDN)$$

[22] Composite supply (Armington) function

$$QQ_c = \alpha^{\square}{}_c.(\delta^{\square}{}_c.QM_c^{-\rho\square} + (1-\delta^{\square}{}_c).QD_c^{-\rho\square})^{-\frac{1}{\rho\square}} \qquad c\in(CM\cap CD)$$

[23] Import-domestic demand ratio

$$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c}.\frac{\delta^{\square}{}_c}{1-\delta^{\square}{}_c}\right)^{\frac{1}{1+\rho\square}} \qquad c\in(CM\cap CD)$$

[24] Composite supply for non-imported outputs and non-produced imports

$$QQ_c = QD_c + QM_c \qquad c \in (CD \cap CMN) \cup (CM \cup CDN)$$

[25] Demand for transaction services

$$QT_c = \sum_{c' \in C'} (icm_{cc'}.QM_{c'} + ice_{cc'}.QE_{c'} + icd_{cc'}.QD_{c'}) \qquad c \in CT$$

Institutional Block

[26] Factor income

$$YF_f = \sum_{a \in A} WF_f.\overline{WFDIST}_{fa}.QF_{fa} \qquad f \in F$$

[27] Institutional factor incomes

$$YIF_{if} = shif_{if}.\left[YF_f - trnsfr_{rowf}.EXR\right] \qquad i \in INSD;\ f \in F$$

[28] Income of domestic, non-government institutions

$$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{gov}.\overline{CPI} + trnsfr_{irow}.EXR \qquad i \in INSDNG$$

[29] Intra-institutional transfers

$$TRII_{ii'} = shii_{ii'}.(1 - MPS_{i'}).(1 - TINS_{i'}).YI_{i'} \qquad i \in INSDNG;\ i' \in INSDNG'$$

[30] Household consumption expenditure

$$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{ih}\right).(1 - MPS_h).(1 - TINS_h).YI_h \qquad h \in H$$

[31] Household consumption demand for marketed commodities

$$PQ_c.QH_{ch} = PQ_c.\gamma^m{}_{ch} + \beta^m{}_{ch}.\left(EH_h - \sum_{c' \in C} PQ_{c'}.\gamma^m{}_{c'h} - \sum_{a \in A}\sum_{c' \in C} PXAC_{ac'}.\gamma^h{}_{ac'h}\right) \quad c \in C \ ;$$

$h \in H$

[32] Household consumption demand for home commodities

$$PXAC_{ac}.QHA_{ach} = PXAC_{ac}.\gamma^h{}_{ach} + \beta^h{}_{ach}.\left(EH_h - \sum_{c' \in C} PQ_{c'}.\gamma^m{}_{c'h} - \sum_{a \in A}\sum_{c' \in C} PXAC_{ac'}.\gamma^h{}_{ac'h}\right)$$

$a \in A \ ; c \in C \ ; \ h \in H$

[33] Investment demand

$$QINV_c = \overline{IADJ}.\overline{qinv_c} \qquad c \in CINV$$

[34] Government consumption demand

$$QG_c = \overline{GADJ}.\overline{qg_c} \qquad c \in C$$

[35] Government revenue

$$YG = \sum_{i \in INSDNG} TINS_i.YI_i + \sum_{c \in CM} tm_c.pwm_c.QM_c.EXR + \sum_{c \in C} tq_c.PQ_c.QQ_c$$

$$+\sum_{f \in F} YIF_{govf} + trnsfr_{govrow}.EXR$$

[36] Government expenditure

$$EG = \sum_{c \in C} PQ_c.QG_c + \sum_{i \in INSDNG} trnsfr_{i\ gov}.\overline{CPI}$$

System Constraint Block

[37] Factor market

$$\sum_{a \in A} QF_{fa} = \overline{QFS_f} \qquad f \in F$$

[38] Composite commodity markets

$$QQ_c = \sum_{a \in A} QINT_{ca} + \sum_{h \in H} QH_{ch} + QG_c + QINV_c + qdst_c + QT_c \qquad c \in C$$

[39] Current account balance for the rest of the world (in foreign currency)

$$\sum_{c \in CM} pwm_c.QM_c + \sum_{f \in F} trnsfr_{rowf} = \sum_{c \in CE} pwe_c.QE_c + \sum_{i \in INSD} trnsfr_{irow} + \overline{FSAV}$$

[40] Government balance

$$YG = EG + GSAV$$

[41] Direct institutional tax rates

$$TINS_i = \overline{tins_i}.(1+\overline{TINSADJ}.tins01_i) + \overline{DTINS}.tins01_i \qquad i \in INSDNG$$

[42] Institutional savings rates

$$MPS_i = \overline{mps_i}.(1+\overline{MPSADJ}.mps01_i) + DMPS.mps01_i \qquad i \in INSDNG$$

[43] Saving-investment balance

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

[44] Total absorption

$$TABS = \sum_{h \in H}\sum_{c \in C} PQ_c.QH_{ch} + \sum_{a \in A}\sum_{c \in C}\sum_{h \in H} PXAC_{ac}.QHA_{ach} + \sum_{c \in C} PQ_c.QG_c$$

$$+\sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c$$

[45] Ratio of investment to absorption

$$INVSHR.TABS = \sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c$$

[46] Ratio of government consumption to absorption

$$GOVSHR.TABS = \sum_{c \in C} PQ_c.QG_c$$

Appendix C: The ''Between '' Model

[1] Average capital rental rate

$$AWF_{ft}^{\ a} = \sum_{a}\left[\left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}}\right).WF_{ft}.WFDIST_{fat}\right]$$

[2] Share of New Capital

$$\eta^{a}{}_{fat} = \left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}}\right).\left(\beta^{a}.\left(\frac{WF_{ft}.WFDIST_{fat}}{AWF_{ft}^{\ a}} - 1\right) + 1\right)$$

[3] Quantity of new capital by sector

$$\Delta K^{a}{}_{fat} = \eta^{a}{}_{fat}.\left(\frac{\sum_{a} PQ_{ct}.QINV_{ct}}{PK_{ft}}\right)$$

[4] Unit price of capital

$$PK_{ft} = \sum_{c} PQ_{ct}\frac{QINV_{ct}}{\sum_{c'} QINV_{c't}}$$

[5] Average capital rental rate

$$QF_{fat+1} = QF_{fat}.\left(1 + \frac{\Delta K^{a}{}_{fat}}{QF_{fat}} - v_{f}\right)$$

[6] Average capital rental rate

$$QFS_{ft+1} = QFS_{ft} \cdot \left(1 + \frac{\sum_{a} \Delta K_{fat}}{QFS_{ft}} - v_f \right)$$