

MACROECONOMIC EFFECTS OF FOREIGN AID IN ETHIOPIA
USING DYNAMIC COMPUTABLE GENERAL EQUILIBRIUM MODEL

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ABSTRACT

Macroeconomic Effects of Foreign Aid in Ethiopia using Dynamic Computable General Equilibrium Model

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Macroeconomic effects of foreign aid depend on how it affects savings, investment and government behaviour. The study used recursive dynamic general equilibrium (DCGE), autoregressive distributed lag model approach to cointegration (ARDL) and vivid three gap based descriptive reports aiming to find out the preponderant effect. The data used in descriptive analysis and ARDL were collected from World Bank, Organization for Economic Cooperation and Development, and International Monetary Fund data bases. DCGE requires social accounting matrix (SAM) and that was obtained from Ethiopian Development Research Institute (EDRI). The SAM was built in 2005 and updated its key accounts in 2009¹. Using recursive DCGE, the study shows that aid inflow can result in export reduction and exchange rate appreciation. But, it leads to higher government revenue, expenditure and savings. Aid's effect in total absorption and gross domestic product is not discernible. Thus, the study's results are ambiguous to generalize. The long run results of the ARDL model also show significant positive relationship between national income and domestic savings. However, the relationship between Development Assistance Committee (DAC)-aid inflow and domestic savings is significantly inverse².

¹ The recursive feature of the model ensures generation of SAM in years when SAM was not actually collected.

² A 1 unit increment in DAC-aid inflow results in 0.5 unit reduction in domestic savings.

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ACRONYMS AND ABBREVIATIONS

ARDL	Autoregressive Distributed Lag Model
BoP	Balance of Payments
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE	Computable General Equilibrium
CIF	Cost Insurance Freight
CPIA	Country Policy and Institutional Assessment
DAC	Development Assistance Committee
DCGE	Dynamic Computable General Equilibrium
EDA	Effective Development Assistance
EDRI	Ethiopian Development Research Institute
ERP	European Recovery Program
FCU	Foreign Currency Units
FDI	Foreign Direct Investment
FOB	Free on Board
GDP	Gross Domestic Product
IMF	International Monetary Fund
IS-LM	Investment Saving-Liquidity preference Money supply
IFPRI	International Food Policy Research Institute
LCU	Local Currency Units
LDCs	Less Developed Countries
MDGs	Millienium Development Goals
MOFED	Ministry of Finance and Economic Development

NAT	Net Aid Transfers
NGOs	Non-governmental Organizations
ODA	Official Development Assistance / Overseas Development Assistance/
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Square
OOF	Other Official Flows
PPP	Purchasing Power Parity
ROW	Rest of the World
SAM	Social Accounting Matrix
S-I	Saving-Investment

CHAPTER ONE

INTRODUCTION

1.1. BACKGROUND OF THE STUDY

Official development Assistance³ dependency (herein after called foreign aid or ODA dependency interchangeably) is a reality in developing countries in general and in Ethiopia in particular. Due to past structural and institutional backwardness of the country, growth financing schemes of Ethiopia economy were and are found to be aid dependent. Why and how that happened has been a public agenda for years. The widely mentioned reason for aid dependency of Ethiopia economy is that the domestic economy is still not capable of financing strategies designed to tackle the multifaceted and deep rooted poverty of the country. Besides, history revealed that not only for growth financing, but also to fight famine and drought the country has been wandering in the doors of donors. The story quite works for other aid dependent developing countries as well (Mercieca, 2010),(Geda, 2010), (Enos and Griffin, 1971).

Despite the fact that Ethiopia's recent economic growth was reported to be in excess of the population growth rate and the rate required for achieving the MDG goals, the country is still in

³ Foreign aid, Official development assistance, External aid, Overseas aid, Overseas assistance, External assistance are used interchangeably.

the inner parts of the vicious cycles of aid dependency. However, behind the foreign aid inflow there are implicit assumptions or benign intentions of its role. One of these intentions is if aid can fill the saving, fiscal and foreign exchange constraint gaps that limit the growth potential of an economy; it will have a positive relationship with investment and thence growth. Thus, claims of aid importance are not accepted unanimously rather followed by severe criticisms of their stands. Especially, aid's implicit considerations, in which the bedrocks of aid programs have been conceived, get criticisms from different realms (Carl-Johan Dalgaard et al., 2004), (Griffin and Enos, 1970), (Griffin, 1970), (Hancock, 1989).

As it is hardly possible to simultaneously observe the same country 'with aid' and 'without aid', there is no way of addressing the 'true' measure of aid impact without making assumptions that are bound to be debatable, both in theory and in practice. For this – and ideological – reasons, the impact of aid remains highly contentious as well as subject to polarized views (Easterly, 2003), (Mark MacGillivray and Oliver Morrissey, 2001), (Alberto Alesina and David Dollar, 2000), (Vos, 1994).

To come up with the exact impacts of aid donors do analysis. Such work is supposed to yield important policy conclusions about where, when, and especially, how aid is given. Most of the time donors' analysis is guided by principal agent theory. Principal agent theory emphasizes that the benefactors of foreign aid have no incentive to inform the donor agencies of concerns with the aid. However, in practice the contrary happens. Because, aid is a flow of economic resources, those who receive aid also do analysis regarding its economic impact on their economy. For instance, in Ethiopia case the past two decades have witnessed a massive outpouring of studies on the effectiveness of foreign aid. Among others, in their writings pertaining role of aid in

Ethiopian economy, Geda and Degfe (1998) as cited in (Geda, 2010) found out the long run impact of aid but no short run effects of it. On the other hand, well known skeptics of aid effectiveness (Easterly, 2003) (pp. 40-41) witnessed the positive impact of aid on growth and the presence of appropriate channels of transmitting aid to their proper goals in Ethiopia. Water aid project in Ethiopia has been mentioned in his work. And, quoting what he has written:

“With the new water pipe, life was better. I don't know if this experience is replicable on a broader scale or even if this anecdote of Water Aid offers any insight into how to make aid more effective. But I am glad that some aid dollars can reach some very needy people some of the time.”

Thus, judgments based on experiences create a new path of thinking as skeptic that aid can be made better and is still good with its caveats. Moreover, (Tadesse, 2011) found the relevance of (Craig Burnside and David Dollar, 2004) argument of aid effectiveness that asserts foreign aid is effective in enhancing growth, though bad policies can constrain aid effectiveness. Furthermore, for Tadesse the importance of aid as a source of financing development and growth is unquestionable.

Generally speaking, there is a considerable literature to show that assistance could cover the investment, fiscal and trade gaps of the developing countries and lead to economic growth and eradication of poverty. But, after years of aid propagations connotations like poverty shows relatively few signs of disappearing are also not hard to swallow. Thus, leads to the opposite arguments that hold development assistance is either harmful or ineffective. Nevertheless, in the

aid literature not only new data bring new results, but also new answers raise new questions. Such controversial scenarios hold for most of the developing countries (Finn Tarp et al., 2009), (Hristos Doucouliagos and Martin Paldam, 2009), (William Easterly et al., 2003), (Chenery and Carter, 1973).

As explained above, it is evident that the empirically tested role of foreign aid in economic development of developing countries is, like its theoretical foundations, a hackneyed question and a moot debate. The plethora of evidences provides neither a theoretical nor an empirical knock out. The role of aid is still swinging from it works to it depends and it does not (Mark McGillivray et al., 2006), (Roodman, 2007),(Hudson, 2004), (Chenery and Strout, 1966).

1.2. PROBLEM OF THE STUDY

Nowadays, Attention getting slogans of aid effectiveness are here and there. Their specter is spreading stingingly. These slogans range from optimistic views of Jeffery Sachs to pessimistic insights of Dambisa Moyo. There are also who put their thought in the skeptic corner like that of William Easterly. Those who favor aid call for a doubling of aid to end poverty and hunger. In contrast, those who are against aid urge a complete and immediate cessation of aid flow. Aid is back on the international agenda (Finn Tarp et al., 2009).

In addition to that, understanding the status quo of Ethiopia economy and the period in which the study was conducted can give a glimpse of ideas to realize why it is important to raise questions of aid effectiveness nowadays. Ethiopia has been on the track of growth for the last decade and grown by a considerable rate. So as to make the growth sustainable, achieve the millennium development goals and join the middle income category by 2025 the country has officially

launched all rounded growth and transformation plan. The country's saving as well as investment potential are reported to be far less from the needed amounts to accelerate and attain the intended goals (Tadesse, 2011). Thus, aid is expected to play its own partial role in filling the gaps. And, this alarms call for doubling aid to aid-darlings and aid-orphans to be considered as plausible. On the other hand, Moyo, one of the proponents of ceasing aid, as cited in (Finn Tarp et al., 2009) suggested that aid donors should commit themselves to cut off aid not later than this year, that is 2014, to encourage greater use of other instruments of accelerating development⁴. Common sense dictates that the criticisms of aid inflow are worthy to be considered. Because, as per the opponents of aid it is reported as failed history and judged as harm of the economy and cause of poverty.

Thus, if arguments forwarded by those who claim aid as harm or less good are right, but ignored, then growth will be deterred, opportunity cost will be unbearable burden and poverty will be exacerbated. But if their stands are found to be groundless, but persuade policy makers and subsequently aid reduced, and then growth will be low and poverty will be worse. After all, foreign aid is believed to be impermanent. So, making efforts to assess whether the evidence supports those optimistic or pessimistic arguments is second to none.

Besides, literatures so far undertaken are liable to the weakness of partial statistical analysis. For this reason a general equilibrium framework seems required to analyze the different mechanisms and interactions underlying the link between aid, growth and macroeconomic adjustment. In line

⁴ Doctor Moyo recently stated that she was misquoted by those who thought her book entitled dead aid as call for immediate cessation of aid by 2009, a year in which her book was published.

with all these sorts of intentions the study addresses the following research questions using a CGE approach:

- ✚ Is aid substantiating growth?
- ✚ Does aid change the behavior of government fiscal policy?
- ✚ Will aid result in a savings increment?
- ✚ What are the implications of aid for “Dutch-Diseases”?
- ✚ What happens to investment when aid flows changes?

1.3. OBJECTIVES OF THE STUDY

General objectives

The objective of the study is to model the macroeconomic effects of net development official assistance in Ethiopia economy context.

Specific objectives

The study was intended to go beyond the tautological thoughts of aid. It aimed to address objectives which are many folds, videlicet:

- ✚ To identify the role of foreign aid in growth
- ✚ To analyze the fiscal response of foreign aid
- ✚ To assess the foreign aid-saving relationship
- ✚ To investigate “Dutch-Diseases” implications of foreign aid
- ✚ To draw possible policy recommendations

1.4. SIGNIFICANCE OF THE STUDY

The study can play a multifaceted significance. Students and researchers willing to engage in the study area and field of study, inter alia, can use it as an additional road map. Besides, the work can be an extra speck in the realms of literatures concerning the study matter. Moreover, concerned bodies can use the results and ways of analysis to make further evaluations or policy actions.

1.5. SCOPE AND LIMITATIONS OF THE STUDY

The study was intended to scrutinize the validity and relevance of aid effectiveness in the Ethiopian economy. To deal with this, it encompasses the dynamic CGE model that has been devised by IFPRI. The model is built around the SAM for the year 2005/2006 and its adjusted values in 2009.

Reasons like time, cost and others constrain the study from being all inclusive. Besides, the model used in the study contains considerable limitations; thus a caution seems appropriate. Specially, in understanding its inherent assumptions, care is necessary. However, it should be understood that it comprehends inklings as much as possible to represent the generalities.

1.6. ORGANIZATION OF THE STUDY

The remainder of the study is organised as follows. In the literature review, well thought out isms of the theoretical framework of the study are compiled by giving a comparative reference. And, empirical evidences break down into essential scrutinized constituents. From there, in the third chapter, methodology procedures are elucidated adequately and handily. In the fourth chapter, analysis and discussion of the results are presented. Lastly, the conclusion is summed up and recommendation is put forward followed by a comprehensive list of extra useful information in the annex.

CHAPTER TWO

LITERATURE REVIEW

2.1. DEFINITION OF BASIC TERMS

Stock: a stock is measured at a point in time.

Flow: a flow is measured over a period.

Disbursements – money that has left the donor.

Commitments – a firm written obligation, backed by an appropriation.

Project aid: aid given for a specific purpose..

Programme aid: aid given for a specific sector.

Tied aid: foreign aid given on condition that the recipient purchases the exports of the donor country.

Third World: Developing economies apart from oil producers, with low per capita incomes, large agricultural sectors and a shortage of most kinds of capital. Some have defined the “Third World” as those countries in receipt of foreign aid.

Samaritan’s dilemma: The vulnerability of the compassionate person who suffers predatory attacks from those helped.

2.2. DEFINITION OF FOREIGN AID

There is no clear cut answer to the question of what is foreign aid. It is because of the fact that foreign aid takes many forms. However, the most notable measurements of foreign aid are:

1. ODA-official development assistance

ODA, the most important component of foreign aid in terms of its size and influence, is defined by the DAC of OECD as grants or loans to developing countries which:

- a. Are undertaken by the official sector of the donor country;
- b. Have the promotion of economic development and welfare in recipient countries as the main objective; and
- c. Are on concessional financial terms (that is, with a grant element equal to at least 25 per cent of the total) ⁵.

In the Ethiopian economy context the meaning of aid is subtle different. The reason is that the definition assumes at least 35% of gift element out of the total (MOFED, 2013).

It is worth to notice the following aspects of ODA:

- While it is common to treat ODA and foreign aid as the same thing, this is misleading.
- ODA of aid is that part of official transfers that normally includes an element of concession. Thus, not all types of ODA take the form of ‘give away’ grants or charitable donations.

⁵ The grant can be in the form of grace period, interest rate or repayment schedule.

- Net ODA is a capital flow concept. That is, Net ODA counts net only of disbursements of concessional (low-interest) loans, but at full face value. As a capital flow concept, it doesn't net out interest payments on old loans.
- ODA consists of grants (including technical assistance), concessionary loans, and contributions in kind, suppliers' credit, and reparations payments.
- Other flows or Transfer payments to private individuals, donations from the public, non-concessional official flows (OOF), commercial loans and FDI are not counted under ODA.
- Grants, loans and credits for military purposes are excluded from ODA. Not explicit military aid but aid in implicit pursuit of military objective can be recorded as ODA.
- Assistance funded by NGOs is foreign aid but not ODA.

2. EDA-effective development assistance

EDA is the grant component of the aid. EDA alters two aspects of net official development assistance measure. First, EDA excludes technical assistance. Second, it differs in its treatment of loans. That is, EDA comprises loans regardless of how concessional, but counts only their gift element-that is, their net present value (Craig Burnside and David Dollar, 2000).

3. NAT-net aid transfer

NAT is another measure of aid which has been computed by Roodman. The NAT variable differs in two major respects from Net ODA measure. First, NAT is a net transfer concept. That is NAT is net of principle payments received on ODA loans plus interest received on them. Second, NAT excludes cancellation of old non-ODA loans.

4. Current balance

Lots of aid effectiveness literatures used the current account balance of the recipient countries as a proxy variable for foreign aid.

5. Balance of payments

Alemayehu Geda and Befekadu Degfe (1998) used an ingenious formula which is explained below to measure external assistance for Ethiopia. They derived it from the balance of payment tables. According to Alemayehu and Befekadu, external assistance is explained as the following:

$$A=(T_p-T_{pp})+T_0+B_n$$

Where A, T_p , T_{pp} , T_0 and B_n stands for external assistance, private transfer, private transfer to the private sector, including wage remittances and family support, official transfer and net borrowing from official sources and under conditions that satisfies the DAC definition respectively (Geda, 2010).

6. Genuine aid (Real Economic assistance)

Aid is the real cost or sacrifice to the countries providing the nominal flows of resources.

2.3. FORMS OF AID

Foreign aid takes many forms. As a result, there is no agreement on the definition of aid and hence its measurement. But, a given definition of aid can be classified in various categories basis on different criteria. For instance, aid is for humanitarian or for growth and development based on the aim of its allocation. More specifically, basis on to what purpose they are allotted to, aid can be classified as food aid, commodity aid, project aid, program aid, technical help, humanitarian assistance, and so on. Besides, some aid financed activities are productive and others not. The result of those which are productive may be directly discernible or occur with lags. Founded in gestation period of such aid financed projects it might also be grouped as a contemporaneous versus lagged aid. This sort of distinction takes into account the short run and long run returns of aid. In case of lagged aid it continues for a long period of time before its effect is noticed. For instance, if foreign aid has been used to build the basic infrastructure or income had not increased sufficiently its result in savings increment and thence growth will not be evident in a short period of time. The other widely used categorization is commonly known as bilateral versus multilateral aid, according to the donor type. Generally speaking, official sources include bilateral transfers that came from other governments, and multilateral transfers that are from international organizations or agencies for say. Other possible sources are individuals or public donors. Furthermore, considering for how long aid flow lasted may lead one to sort it as temporary or permanent. Lastly, Volatile or non-volatile, predictable or non-predictable,

stabilizing or destabilizing and optimal or non-optimal types of aid are some among the remaining many aid classifications (Lisa Chauvet and Patrick Guillaumont, 2009), (Henrik Hansen and Finn Tarp, 2000). Aid can also be regarded as an input or as an incentive.

In other instances, aid may be tied or untied at all. Aid may be tied to purchases in the donor country as a form of subsidy for their exporters or to quid pro qua that require the recipient to export to the donor country. Basis on whether aid is provided on conditional terms or not aid can be regarded as conditional or non-conditional. It is also common to classify aid basis on the allocation rule of the donor countries, the definition of its components and so on (Craig Burnside and David Dollar, 2000), (Alberto Alesina and David Dollar, 2000).

2.4. FOREIGN AID IN HISTORICAL PERSPECTIVE

The political economy of development assistance starts from questioning who aids whom and why⁶. In principle the developed or rich countries are said to be the donors where as the developing⁷ receivers of aid. However, this issue has raised controversies over the years. On one hand, in practice, it is common to observe the rich receives and poor aids which is, irrespective of the definition of rich and poor, contrary to the very basic nature of aid ideology. Besides, for myriad reasons years have elapsed since the world community cast a doubt in believing nations aid just for the sake of philanthropy. On such basis aid is regarded as a foreign policy instrument.

⁶ Motives to give aid extends from the gift economy of Shakespeare's Portia to conspiracy theories of the new world order. Charity in sense of pure altruism (price of humanitarian reasons) to rational selfishness are all embraced with in it.

⁷ aka less developed, under developed, mismanaged countries, least developed, poor countries or weak countries

Therefore, as long as aid is a foreign policy instrument its main intent is to create a political and economic means in the world in which the developed countries can best follow their own ends (Alberto Alesina and David Dollar, 2000), (Griffin and Enos, 1970).

On the other hand, since the early age of classical economists capital was considered as the most crucial ingredient in creating and accelerating growth. Hence, aid plays a major role in building capital was there from the very old days of economics. However, following the teachings of Keynes and success stories of his ideas in the 1930's contemporary development economists stressed importance of stimulating an economy through government financing development investments and injection of aid from other development partners⁸. The most widely cited Harrod-Domar model of aid came thereafter. The possible positive impacts of aid inflow were, later on, demonstrated using IS-LM framework. Moreover, economists like Rosenstein-Rodan and Rostow continued to claim the usefulness of foreign aid in promoting growth in developing countries. And, eventually the US funded Marshall Plan⁹ was announced officially in 1947 so as to re-habilitate and re-construct the war stricken Europe. The logic behind the call for aid flood was technically straightforward in the sense that growth comes from accumulated capital and investment and to foster capital and accelerate investment savings is needed. In order to save per capita income and growth must outweigh the dollar needed to cover at least the absolute level of poverty equivalent needs. This indicates the developing economies are caught by vicious cycles of low saving-low growth. Therefore, aid can play a part in letting the developing economies

⁸ For some critics these success stories are overstated.

⁹ Aka European Recovery Program

transit and transform their economy to the virtuous circles of development or at least break the vicious cycles of backwardness (Mercieca, 2010), (Taylor, 1994).

To sum, in line with the early economics views, the aid flow in Europe was accompanied by triumph and great achievements. Circa 1949 optimistic views that emanate from the success stories of Marshall Plan lead US to publicize a program of increased foreign assistance to the developing world. But in next to no time bizarre comments about aid effectiveness start to emerge, and doubts in the theoretical literatures begin to appear. Because, as clearly witnessed from the experience of some countries, aid inflow program fails to ingeminate the performance of the early years of its provision. Prominent scholars of the then time like Joseph Schumpeter start to go further and argue that foreign aid only leads to growth when combined with the transfer of entrepreneurship and new skills thereby enhancing the absorptive capacity of the recipient economy. The debate continues afterwards, though changing its forms. However, the sad part of the story is consensus seems far fetched (Hristos Doucouliagos and Martin Paldam, 2009).

2.5. FREQUENTLY ASKED QUESTIONS IN AID LITERATURE

The following are only some of the myriad questions and criticisms that flooded the aid effectiveness literature:

- Is developing countries reliance on assistance emanates from the hard fact that their economy is constrained by the availability of capital?
- What would have happened to the recipients' economy without the aid they received?
Would their economy have been more or less developed?

- What are the guarantees so as to believe that the objective of aid is to bridge the saving , foreign exchange and fiscal gaps?
- Is importance of foreign aid indisputable and compulsory to the well being of the developing countries economy?
- What makes the performance of developing countries economy in improving the level of the resource gaps through domestic sources far from adequate?
- Is aid an alternative or the only option to fill the resource gaps?
- Does the extent of aid have something to do with the magnitude of the resource gaps and activities related to them?
- Should donors stop giving aid to poor performing countries?
- How much do higher aid contribute to raising growth?
- What policy measures are the most effective in allotting aid?
- Why do aid's return differ so much across countries and time periods?
- Why have aid and growth collapsed in some countries?
- How effective is aid in raising savings?
- Who does the aid? Does it matter who aids?
- How does foreign saving affect growth?
- Why is foreign aid far from equally effective everywhere?
- What would the aid effectiveness results have been if scholars had used other estimation mechanisms or sample years?
- How countries can escape aid's curse ?
- What really constitutes aid ?

- What would be an adequate index of aid?
- Who is to blame for aid ineffectiveness? recipient or donor?
- Should aid donations be proportional to current good policy (however defined) or the extent of poverty?
- What will happen if aid donors base their allocations upon current realities rather than future promises?
- Is aid an inferior good?
- Foreign aid: good intention with unintended consequences? or Foreign invasion?
- Dumping the surplus or foreign aid?
- Will it make a difference if aid is channeled to individuals rather than governments?
- Is foreign aid efficacious? /When is foreign aid effective?/
- What factors influence the overall economic efficiency of foreign aid?
- Can aid's impact be measured empirically?
- Can technology save foreign aid?
- What works? What could work? What is scalable? what is transferable?

2.6. THEORETICAL LITERATURE

Many studies have tried to assess the effectiveness of aid, theoretically. Some of them argued that aid 'works', others regard it as counter productive. A thematic classification of these theoretical literatures is made in the following section.

2.6.1. AID WORKS

In the 'big push' thesis context, foreign aid is believed to encourage economic development of the recipient country. It is assumed to foster economic development by filling resource gaps of an economy. The possible resource gaps and other channels through which foreign aid supposed to work in producing development are elucidated below.

1. Savings Gap /Investment Gap/¹⁰

The Harrod-Domar model presupposes that growth is constrained only by availability and productivity of capital. The availability of capital in turn is determined by the level of savings. However, savings in developing economies are too low to achieve the target level of investment and therefore growth. Following this, it was assumed that the difference between domestic saving and the level of required investment can be filled with inflows of foreign aid (Nushiwat, 2007),(Shields, 2007).

2. Foreign Exchange Gap /Trade Gap/¹¹

The theory behind foreign exchange gap is that aid inflow will be required not only to make an investment rate of a given economy in excess of its saving capacity, but also to finance imports of capital goods which are not produced domestically and hence the name two-gap model. The gap was developed and demonstrated by Chenery and Strout (Mercieca, 2010), (Mark McGillivray et al., 2006).

¹⁰ SAVINGS + AID=INVESTMENT

¹¹ EXPORT + AID= IMPORT

3. Fiscal Gap /Revenue Gap/¹²

According to three gap model, the investment and imports gaps may disappear, but aid will still be needed to close a revenue gap. Bacha and Taylor play a major role in extending the two-gap model into three gap model of ‘capital bottleneck theories’ (Mark MacGillivray and Oliver Morrissey, 2001), (White, 1992).

4. Growth

Generally speaking, theoretically, savings, fiscal and foreign exchange constraints limit the growth potential of developing economies. The perception that followed is that if foreign aid can close the gap caused by these constraints, it must have a positive correlation with capital output ratio, investment and growth. Likewise, Provision of foreign is based on low interest rates, reasonable grace periods, flexible repayment schedules and seldom loan cancellations. These features make aid preferable to other official inflows. Human capital assistance and technical help components of foreign aid flows, through skill and technology transfer, can also augment institutional and structural environment that the developing economies lack. And, by doing so the country can attain its self-sustaining goal and the foreign aid may not be needed any more (Carl-Johan Dalgaard et al., 2004), (Taylor, 1994).

5. Other Benefits of Aid /Aid’s Non-Growth Outcomes/

According to proscriptive ‘Ladder Approach’ (‘planned’ approach) proponents, aid can of course contribute to poverty reduction or more generally well being enhancement via channels

¹² REVENUE + AID= EXPENDITURE

other than growth. So, claims about the effectiveness of aid based on what happens to only economic growth in recipient countries are not sound. That is why some scholars opt to use aid's impact on human development indexes to assess its effectiveness instead of looking at mere growth figures. Besides, foreign aid can be used to address basic needs of those who are in need of it. Such humanitarian works lead one to imagine beyond growth impacts of foreign aid. To put the matter precisely, As cited in (Hassoun, 2010), since the publication of Peter Singer's revolutionary article entitled "Famine, Affluence, and Morality" the following arguments have been forwarded, at least in theory, as a motivation to give aid¹³:

Premises 1: Suffering and death from lack of food and shelter and medicine are bad.

¹³ Records regarding aiding, helping and begging in their spiritual dimensions are found in scriptures centuries before Singer's publication. The following verses are from Christians' Bible and Muslims' Qur'an.

"Sell all that thou hast, and distribute unto the poor." Luke 18;22, Matthew 19;21

"For the poor shall never cease out of the land: therefore I command thee, saying, Thou shalt open thine hand wide unto thy brother, to thy poor, and to thy needy, in thy land." Deut 15;11

Qur'an 2:273-277 "(Alms are) for the poor who are confined in the way of Allah -- they cannot go about in the land; the ignorant man thinks them to be rich on account of (their) abstaining (from begging); you can recognise them by their mark; they do not beg from men importunately; and whatever good thing you spend, surely Allah knows it. (As for) those who spend their property by night and by day, secretly and openly, they shall have their reward from their Lord and they shall have no fear, nor shall they grieve."

Premises 2: If something can be done to help prevent suffering and death from lack of food and shelter and medicine without sacrificing anything morally significant (or of morally comparable worth) then that should be done.

Conclusion: So suffering and death should be prevented by giving aid.

So, the possibility of a world without poverty verged on unimaginable. However, a world without widespread poverty is possible through aid. Moreover, foreign aid as a foreign policy tool can also create vivid pictures of its non-economic benefits.

2.6.2. AID FAILS

Those who put aid in the basket of bad goods claim some extreme points. One of these points is aid hinders economic growth. Their claim stands even to the extent that in its absence growth would be higher. According to these scholars, foreign aid deters growth of an economy by a variety of transmission mechanisms. Some of these mechanisms are listed below.

1. Aid substitutes savings

According to the mainstream economics theories foreign aid is considered as complementary to domestic savings. This complementary view was challenged on two grounds. Firstly, foreign aid may finance consumption and this would reduce the average savings rate. Secondly, foreign aid inflow may cause a reduction of the government savings endeavor. As a result of these two arguments, it was concluded that savings without aid would have been better. (Nushiwat, 2007) (Griffin, 1970). Aid can also be used to finance government consumption because some of the consumption is in fact costs related to the sustainability of the projects financed by aid.

2. Aid crowds out private investment

Foreign aid is usually channeled through the public sector. Because, the public sector gets the aid finance, relatively, in low interest rate, enough grace period and long repayment periods it actually crowds out private investment.

3. Aid results in ‘Dutch Diseases’¹⁴

Aid can involve inflows of money to poor countries that have some similarities to inflows of money from natural resources that provoke the resource curse. Thus, foreign aid may have undesirable effect which can lead to an appreciated exchange rate and reduction of export. This happens when the recipient economy uses the aid flow to finance consumption rather than investment. For aid is additional income to the recipient, it can trigger demand of products. Guided by the local demand, exporters can alter their production. Consequently, loss of markets, appreciation of the exchange rate, wage inflation and unemployment in export and import competing sectors follow (Hristos Doucouliagos and Martin Paldam, 2009), (Vos, 1994).

4. Aid affects government expenditure negatively

This sort of argument (fiscal response literature argument) makes fungibility central to its analysis. Fungibility is the notion used to express when aid is allotted to finance the activity to which it is not originally intended or it does not reach those who are intended to receive it. That

¹⁴ Dutch disease aka resource curse or transfer problem appeared in the Dutch economy when sea gas revenues upset the macroeconomic balance. There by, the name ‘Dutch diseases’.

is, fungibility of foreign aid increases government non-developmental expenditure so leads to a less than one-for-one increase in government developmental expenditure. Thus, it is said to weaken governance by increasing the returns to corruption and/or increasing rent seeking activities (Anthony Birchwood and Rudolph Matthias, 2002), (Heller, 1975).

5. Aid reduces government revenue

Foreign aid may be used to offset either taxes or borrowing. Thus, aid decreases government revenue in the sense that aid makes government revenue lower than what the revenue might have been in its absence (Mark MacGillivray and Oliver Morrissey, 2001).

The link between citizens and their governments resides in taxation with representation to provide the society with necessary public goods. However, foreign aid breaks this link by diverting the effort of government officials to court the donor agencies. Thus, the economy becomes a battle field of receiving and donating foreign aid. Once citizen-government link broke corruption follows. National purse becomes the pocket of government individuals. And, the battle becomes war and it will never cease. Then, to help the poor aid will become imperative. But, that will be pouring water into a sieve. Even citizens can be killed for receiving aid. This is the way how rampant poverty is invented.

6. Aid results in dependency culture and ‘Samaritan's dilemma’

Foreign aid is blamed for invoking the spectre and cycles of dependency. If aid is provided to those who are considered poor, it creates dependency. That is, it let them live in poverty because

they think that future poverty will call forth future aid. In this fashion aid becomes wasteful (Easterly, 2003). And, it is known that, sometimes, the road to hell is paved with good intentions.

Expectation of aid lead governments to emphasis in cure than preventing poverty. Even in some instances, this makes individuals evil doers. To get aid based wealth they tend to fabricate riots. Rather than solving social problems it motivates them to create destructive agendas. Foreign aid is a means of preaching poverty offers endless problems and everlasting opportunity. Because, as it is said, wheresoever the body is, thither will the eagles be gathered together.

7. Aid aggravates poverty

Different growth paths affect a poor differently. Thus, even if aid brings growth there is no guarantee that it will be pro-poor. So, Taking aid-growth positive association in its face value is misleading. And, Aid effectiveness conclusions made without incorporating its distributional ramifications are not sound. If distributional effects of aid are accounted, aid flow actually worsens inequality and aggravates poverty. Because, it distorts equitable distribution of domestic wealth, and promotes corruption and inefficiency in governments. Thus, aid does not increase growth nor benefit the poor. However, this sort of conclusion highly relies on the view that the foreign aid's major portion is its concessional loan component.

8. Aid discourages other sources of finance

Foreign aid is a veil that blindfolds the recipients not to perceive other sources of financing development works. It also interferes with the market and disturbs allocation of productive

resources. That is, aid should not be encouraged because it brings growth, rather it should be prioritized only if it is more effective than alternative instruments of fostering development.

9. Aid causes moral hazard and adverse selection

According to agency theory, foreign aid induces incentive problems like moral hazard and adverse selection and hence inefficient aid expenditure. For aid is not grant at all it has to be repaid. And, if only some portion of it has been used efficiently the ability to repay will be low. And, it puts the recipient in debt trap and endless debt servicing. This makes the cost greater than the benefit.

10. Aid reduces efforts

An argument called 'psychological hypothesis' asserts that an increase in foreign aid would cause a relaxation of efforts. So, indicators of development would be higher in the absence of aid. Most of the aforementioned arguments take the 'psychological hypothesis' assumption as their cornerstone.

11. Aid creates social as well as economic duality

Because, aid by its very nature is excludable, social, economical, and technological dualities are indispensable. Aid is channeled through government. Nonetheless, NGOs are viable alternatives in instances. The payment system and work environment of NGOs are quite different from the local institutions thereby duality rear.

12. Aid discourages indigenous development

Aid is often given based on the questionable interest and motives of donors. Donors also make some conditionality, tied policies, or allocation guidelines to achieve their goals. These requirements are biased towards 'the modern sector' that the developing economies lack. Besides, they cause government officials to succumb to "pleasing donors" rather than pursuing the development goals of their countries. Therefore, benefit the economy of donor countries at the expense of the recipient countries. Moreover, assistance from altruism is a good thing. But it is good only when it is done well. In a nutshell, assistance can hurt through externality. For instance, certain kind of aid undercut local producers. In such fashion aid can create monopolization and trigger inflation in the long run. Therefore, the "White Man's Burden" notion discourages indigenous development pathways. This is analogous to infant industry abolishing argument in international trade literature. They killed two birds with one stone and subsidize their producers while creating diplomacy by giving foreign aid.

Dignity is a very important parcel of wealth. After all, what people want is freedom, choice and opportunity. Because, that is where dignity starts. However, the so-called donor– recipient ideology erodes the dignity and self-reliance psychology of the so-called recipient, especially when they grown up receiving alms as if they were incapable to stand and mature by themselves.

13. Link problems

The recommendations of the gap models go against the endowment of the developing countries. Savings–investment-growth, import-capital-growth, import-export-growth, export-import-growth, and expenditure-capital-growth links are also dubitable. So, pursuing capital intensive

than labor intensive technologies and exporting to import can't be remedies to the multifaceted problems that exist in developing countries. And, aid is not a panacea either. The solutions to the problems dwell instead in institutional and structural adjustments required by the developing economies.

14. Other negative impacts of aid

Aid is not a gift at all. So, it must be repaid. Because, aid is counterproductive recipient fail to service their payments. Therefore, it leads to enmity that spring up from the partnership. Some people also regard foreign aid as the very avatar of colonialism. Moreover, something is misused sometimes does not mean again ever be used correctly. Furthermore, aid financed projects are making peaceful revolution (good governance and free and fair elections) impossible and violent revolution inevitable. Finally, the genuineness of food and medicine supplies in the form of aid is susceptible.

In this imperfect environment it is too hard to believe in eradication of poverty. What could be done is to alleviate it up to a certain degree. According some thinkers, the problem with foreign aid is that it aggravates relative poverty. It is designed to make the rich richer and the poor poorer. Aid is not a re-distribution of wealth. Thus, they beseech that trying to tackle poverty through foreign aid would just be throwing good money after bad. They added, aid being as gateway to resources, as cover of geo-political agendas, as condition to pursuit irrelevant policy adjustments and cultural changes causes unprecedented landscape of poverty. A poverty that takes away the liberity and security of human beings. And, they warn the recipient countries saying sword is the last resort to conqueror. There is a cost-efficient innovation called debt in the field of invasion.

According to other analysts, to divert their internal tensions, powerful countries declare war against human beings' common enemy, that is, poverty. At the same time, they donot want to create a new super power by any means, let alone by giving for say their tax payers money. For this reason, they set condition on how to import and export. They dictate the recipients how to make structural adjustments. Through such mechanisms they let the recipient economy open to their giant companies and markets, imposed a debt burden, take the life and possessions of the leaders away in the name of corruption and eventually milk the fruits of the recipient resources. Those analyst put the future as darkness saying if they nurture for slavery, if they help for their own end, if they save to oppress eventually they will not hire immigrants even if they agree to sacrifice their liberity and security. And, they cocluded pointing powerful countries are building roads in developing countries, deducting otherwise how they are going to take the resources and arguing colonizers have done the same¹⁵.

Some skeptics also concern that even if aid saves lives premises is taken for granted, it in turn increases the population of the recipient countries. Added with poor productivity, it results in deteriorated per capita goods or services¹⁶. Then, cements foreign aid dependency culture. Thus, it is better to leave the poverty agenda for natural adjustment which is survival of the fittest. And, they insist on self-reliance paradigm and end of concidering developing countries as guinea-pig

¹⁵ scholars often compare this with the rotten kid theorem version of national security and world peace.

¹⁶ This sort of conotation assumes the Malthusian multiplication (reproduction) view. Besides, it neglects the fact that children are normal goods and people tend to have few children when they have access to contraception methods. Moreover, it denies the fact that people tendency to opt immortality than reproduction when they feel safety and certainty.

of development theories and aid experiments. Let's not kick away the ladder! Let's throw them back on their own resources! are their time invariant slogans.

To sum up, opponents of aid have made the following arguments to reach at a conclusion that aid is counterproductive and recommend it should be stopped altogether.

- Foreign aid is inefficient and counterproductive.
- The harm exceeds the good. It causes more problems than it solves. And, this can't be ameliorated by any means.
- Other sources of development can be better pursued in the absence of aid than with it.

However, failing to confirm the above arguments would not necessarily imply foreign aid is good and effective.

2.6.3. AID WORKS BUT IT DEPENDS

According to other proponents of aid, it is true that aid has not worked well in some instances, but it is not the whole story. They mention numerable successful accounts of aid effectiveness. Their arguments are as follows:

1. Arguments against aid are not plausible

Over the years innumerable arguments have been forwarded against aid. But, in their proper context those arguments do not provide a sufficient case for arguing that aid has failed. For instance, fungibility and excludability behaviors of aid are some among other many valid grounds for criticism. However, they set forth an example for why aid has not worked better than aid's counter productivity.

Similarly, a lot of aid goes to countries with weak institutions, poor governance and so on. But, these neither proves that aid itself is used improperly nor that aid encourages improper usage of resources elsewhere in the economy, instead they point areas in which improvements need to be made.

In like manner, the recommendations made by the gap models will hold true only if incentives to invest are conducive. For example, if the cause of low investment is that the incentives to invest are poor, then aid will not increase investment. But, it is worth noting that the problem resides in incentives to invest rather than inflows of foreign aid. In addition to that, aid can be used to offset taxes. Thence, reduce government tax revenue. However, additional aid income still makes better tax revenue compared to its absence. Moreover, Aid can be used to finance consumption, hence lessens domestic savings. Nonetheless, increases consumption induces investment.

Even if foreign aid displaces domestic savings it makes total savings increase by increasing the foreign saving. Actually, aid increases total saving means aid makes total savings better than what the total savings might have been in its absence.

2. Aid effectiveness is conditional

Due to Institutions¹⁷, initial conditions, aid management schemes, macroeconomic policies, political situations and exogenous shocks differences in the recipients foreign aid is far from equally effective everywhere. Thus, the differences in the recipient countries require some conditionality to achieve and replicate results. In line with this, “New Conditionality” claims that

¹⁷ Institutions are expected to provide frameworks for organizing factors in a manner that is productive.

the most important factors in efficiency of aid are income distributions in the recipient country and corruption. The ‘absorptive capacity’¹⁸ concern argue that determining appropriate amount of the flow is crucial. “Searchers Approach” assert people know what is best for themselves and the planned approach is obsolete. Besides, policies like migration of professionals and tariffs and subsidies in the international markets can undermine aid’s impact. Moreover, mitigating the knowledge, incentive and feedback problems of gift economy is expected to ameliorate the results of foreign aid.

The existence of diverse definitions of aid likely makes the aid effectiveness results different. Various forms and different compositions of aid are also expected to show different aid effectiveness outcomes. Besides, a given definition of aid comprises different components. Thus, aid effectiveness results vary accordingly. Furthermore, the existence of different donors of aid likely makes the aid effectiveness results different. Moreover, aid is supposed to be subject to diminishing returns. That is, while aid is positively associated growth, there can be too much of good thing, with aid being to be subject to ‘aid-Laffer curve’ or ‘aid-kuznet curve’.

According to the proponents of patient capital, foreign aid is considered as an offsetting mechanism to the deeds of an economic man in capitalist society. For reasons like imperfection capitalism is not an absolute fair play. Thus, it is said through schemes like foreign aid supported capitalism human beings can strive for common good.

¹⁸ too much of a good thing

In conclusion, these sort of arguments do not amount to a refusal of the aid ineffectiveness hypothesis; rather they do suggest that the doubt is overstated. And, they contend that this hurdle should not disqualify aid effectiveness. It is like a case of not throwing the baby out with the bath water. New innovations in delivery of foreign aid like shift from traditional and autocratic donors to public-private partnership in aid, change from poverty reduction agenda to wealth creation order, shipping costs reduction in commodity aid because of advancement in technology, introducing competition in aid providing agencies added with the impatience of the donors citizens are expected to determine the future of aid effectiveness debate. Buying food aid from local producers, voucher method in medical assistance, doing the intended projects with close supervision of the donors accompanied by financing entrepreneurs in developing countries and reducing tariffs in the world market are also promising other hope for aid's efficacy.

Following the above line of reasonings proponents of aid assert:

- Even if only a small portion of the foreign aid is effective, it is better than none for two reasons. Firstly, the harm is less than the good. Secondly, the harm can be minimized using correcting mechanisms.
- Aid works but it depends does not mean in the absence of the conditions aid is ineffective rather the existence of the conditions increases the probability of its effectiveness. So, donors should not stop giving aid even to poor performing countries.
- Recipients may not be endowed with the favorable conditions, however, the good news is the conditions can be created.

2.6.4. ECONOMETRIC ISSUES

The econometric aid-growth literature has been criticised on several grounds: sample size and composition, data quality, econometric technique and specification. Many scholars, subscribing to different paradigms of development thinking, have grappled with topic revolved around the association of foreign aid and economic growth. And, they found the topic too easy to pose difficult to answer. This stems, partly, from methodological challenges. By methodological challenge refers to econometric problems like endogeneity, omitted variable bias, Parameter instability and so on (Moreira, 2003).

In the realms of aid effectiveness literature to puzzle out methodological challenges, methodologies have varied, different sample size has been employed , different definitions of the variables have been used, various methods of estimation have been pursued. As a result, outcomes vary greatly. These variations added with problems of both the quality and amount of data, and difficulty of finding suitable proxies for institutional variables lead the aid effectiveness literature to be caught by the vicious circle of new data-new result-new doubt (William Easterly et al., 2003).

2.7. EMPIRICAL LITERATURE REVIEW

The question of foreign aid's impact needs not only theoretical responses but also empirical justifications. So, a brief survey of the main findings of the existing large empirical literatures is attempted in the following sub-sections.

2.7.1. AID WORKS

(Shields, 2007) examines the relationship between foreign aid and savings using annual data for 119 countries. And, few countries show evidence of substantial crowding out. However, for the preponderance of these countries aid was found as supplement to saving and, hence, investment.

(Karuna Gomanee et al., 2002) also studied a sample of sub Saharan African countries over the period 1970 to 1997 and point a highly significant positive effect of foreign aid on growth. Moreover, (Jones, 2013) argues that aid can increase growth based on results that indicate a long run relationship between aid and growth.

2.7.2. AID FAILS

There are plenty of studies that demonstrate aid's failure to raise savings and promote economic growth. In a cross-country study conducted by (Griffin, 1970) the positive association between foreign capital flows and domestic savings predicted by the gap models was ruled out based on argument that asserts unless an aid recipients' marginal propensity to save is equal to 1, a part of foreign aid will always be allocated to consumption rather than savings.

(Chung-Yee Liew et al., 2012) conducted a study to analyze the relationship between economic growth and foreign aid flows in five East African Community member countries for the period of 1985 to 2010. The results suggest that for the countries under study, foreign aid was found to have significant negative influence on economic growth. And, concluded that aid-led growth is unrealizable hope. Besides, (Mallik, 2008) examines the effectiveness of foreign aid for economic growth in the six poorest and highly aid dependent African countries of the study period. The empirical result shows that in the short run aid growth has no significant effect on

economic growth per capita for most of the countries. Besides, the long run effect of aid on growth was found to be negative for five out of the six countries included in the study. Above all, a study by (Hristos Doucouliagos and Martin Paldam, 2009), using meta-analysis covering 68 papers containing a total of 543 direct estimates, it is found that the effect of aid on growth estimates scatter considerably and add up to a small positive, but insignificant, effect on growth.

2.7.3. AID WORKS BUT IT DEPENDS

(Ramesh Durbarry et al., 1998) assesses the impact of foreign aid on growth for a large sample of developing countries. Their results strongly support the view that foreign aid does have some positive impact on LDC growth, conditional on a stable macroeconomic policy environment. They also find that these results vary according to income level, levels of aid allocation and geographical location.

(Craig Burnside and David Dollar, 2000) find that aid has a positive impact on growth in developing countries with the same policies that affect growth but has little effect in the presence of poor policies. Their results suggest that aid would be more effective if it were more systematically conditioned on good policy.

There are decreasing returns to aid, and the estimated effectiveness of aid is highly sensitive to the choice of estimator and the set of control variables (Henrik Hansen and Finn Tarp, 2000). Multiple objectives often work against each other and weaken each other, so that aid may end up serving none of its multiple goals especially well (Easterly, 2003).

Claims made on the importance of the policy environment for the effectiveness of aid are rather fragile. In a study conducted by (Henrik Hansen and Finn Tarp, 2000) It is shown that aid in all

likelihood increases the growth rate, and this result is not conditional on ‘good’ policy. The fragile results on aid effectiveness remain evident when varying the sample (William Easterly et al., 2003).

(Finn Tarp et al., 2009) report the revival micro-macro paradox. And, their findings show that aid has a positive and statistically significant causal effect on growth over the long run. In the shorter term, however, the analysis indicates that the impact of aid is difficult to discern. But, (Henrik Hansen and Finn Tarp, 2000) beg to differ. They note that the positive aid-aggregate saving-investment-growth link is a robust result from a survey of empirical analysis from 30 years of work in assessing the effectiveness of foreign aid. And, argue that using perceived ineffectiveness of aid as an argument against crosscountry regressions is not substantiated.

(Geda, 2010) estimated aid-investment, aid-saving, aid-revenue, aid-expenditure, aid-dutch diseases equation separately. Two single equation models were used. One with the differenced values of the variables and the other is an ECM. Aid-saving results indicate aid inflows do not have statistically significant impact on the level of saving both in the short and long run. However, it has a positive sign in the short run but a negative sign in the long run. The aid-investment results also show that aid doesn’t have statistically significant impact on the investment ratio (and hence growth) in the short run of both models, even if it has statistically significant positive impact in the long run of the ECM. Besides, both the short and long run coefficients of aid effect on tax revenue show a negative coefficient. But, both are found to be statistically insignificant. On the contrary, the short and long run coefficients of aid effect on government current expenditure exhibit positive and statistically significant values. The “Dutch

disease” effect coefficient also has a statistically significant positive impact in the long run and short run. (Tadesse, 2011) also argued the overall effect of aid on economic growth to be negative due to lack of good policies.

The study seeks to overcome some of the criticisms of previous econometric aid growth studies by using recursive DCGE. The merits of the model are explicated in the following section of the study.

CHAPTER 3

METHODOLOGY OF THE STUDY¹⁹

3.1. METHODOLOGY

A recursive dynamic computable general equilibrium model (DCGE) was used to analyze the macroeconomic effects of foreign aid on Ethiopia economy. Employing DCGE was appropriate. Because, aid affects the economy through interwoven transmission mechanisms that determine how the dynamic of its effect evolves with time. Thus, so as to capture the economy wide effects of aid inclusion of interlinked simultaneous equations and time factor were crucial to the study. Interesting part of the recursive DCGE model is its inherent feature of computing the model sequentially. It was this feature of the recursive DCGE that created SAM for the base period upon which simulations were conducted. Without this feature it was hardly possible to apply CGE model to Ethiopia economy context. Because, the then existing SAM was recorded in 2005 and updated, in sense of few changes, in 2009.

3.2. DATA AND DATA SOURCES

For the descriptive part, it was not possible to obtain relevant aid data from government sources. so the study relied on the OECD-DAC, World Bank development indicators, IMF statistics and David Roodman's NAT measure datasets, which are donor's measure of aid²⁰.

¹⁹ The econometric packages used in the study are: (1) STATA 12, (2) STATA 10, (3) Microfit 4.1 and (4) GAMS 23.7.

For the inferential part, the study used social accounting matrix. The benchmark (initial) data for this study was the 2005/06 SAM for Ethiopia which was updated in 2009/10. The 2005/06 SAM is the first comprehensive SAM for the country, formed by EDRI in collaboration with other partners. The 2009/10 updated SAM is disaggregated into 118 activities and 65 commodities. The SAM also has different taxes, saving-investment, inventory, and rest of the world accounts that show the interaction of different economic agents.

3.3. MODEL SPECIFICATION

3.3.1. COMPUTABLE GENERAL EQUILIBRIUM (CGE)

CGE model is written as a set of simultaneous linear and non-linear equations which define the behaviors of different actors in the economy. There is no single objective function in CGE model. In the recursive (sequential) computable general equilibrium model agents make their decisions on the basis of past and current information. Besides, a recursive dynamic model

²⁰ Copies of the data used can be obtained from “(booknote76@gmail.com)” upon request or can be downloaded from : World Bank’s ‘African and World Development Indicators’ data sheet ((<http://data.worldbank.org/country/ethiopia>)) or ((<http://api.worldbank.org/v2/en/country/eth?downloadformat=excel>)),

OECD datasets www.oecd.org/dac/stats/idsonline or <http://stats.oecd.org/qwids>,

IMF statistics <http://www.imf.org/external/pubs/ft/weo/2014/02/weodata/index.aspx> ,

David Roodman’s measures of aid <http://www.cgdev.org/publication/net-aid-transfers-data-set-1960%E2%80%932012> .

combines a within period module and a between period module. The within period is essentially the static model while the between period model links the within periods modules by updating selected parameters, population and investment. The equations in the static model are divided into four blocks; these are prices, production and trade, institutions, and system constraints block. Production and consumption behaviors are captured by first order optimality condition; the system includes producers' profit and consumers' utility maximization subject 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. The model also includes equations for closures that adjust the economy to ensure equilibrium. The model is too bulky. So, it was preferred to present it in the appendix to putting it in the main body.

A single equation Keynes-Griffin type model of saving is also used to check the robustness of the DCGE model results. And, autoregressive distributed lag model approach to cointegration is applied to solve the equation. Autoregressive distributed lag model approach to cointegration is useful in case of having small sample size and variables integrated of different order²¹.

In Ethiopia, saving is computed by residual method, that is, $S = Y - C$ or $S + C = Y$. In the Keynesian consumption theory consumption is a function of income. Hence, $C = a + bY$. And, according to Griffin aid inflow is addition to the national income. Thus, consumption and saving functions become as follows:

$$C = a + b(Y + A)$$

$$S = Y - (a + bY + bA)$$

²¹ The variables are assumed to be integrated of order 0 or 1.

$$S = -a + (1-b)Y - bA$$

$$S = \beta_0 + \beta_1 Y + \beta_2 A$$

Where $\beta_0 = -a$, $\beta_1 = 1-b$, and $\beta_2 = -b$ ²²

3.3.2. MIXED COMPLEMENTARY PROGRAMMING /MIXED COMPLEMENTARY PROBLEM/ (MCP)

MCP was used to come up with the equilibrium solutions of the recursive DCGE model. MCP is used to solve mixed complementary problems (MCP) where the model statement identifies the equations present in the model and their complementary relationships with the problem variables²³

²² S= domestic savings Y=national income C=total consumption A=aid a=autonomous consumption and b= marginal propensity to consume.

²³ Fundamental to all complementarity problems are the complementarity conditions, each of which requires the product of two (or more) non-negative quantities to be zero. Mathematically, x is complementary to y if

$$x \geq 0, y \geq 0, \text{ and } x^T y = 0,$$

which is typically written as $0 \leq x \perp y \geq 0$.

CHAPTER 4

DISCUSSION OF RESULTS

4.1. DESCRIPTION OF KEY VARIABLES

By all accounts, conclusions, summary and recommendations emanate from inferences. However, for all intents and purposes simple and detail descriptions forerun probability of illations. In spirit of this fact, the following section provides details of descriptive statistics for relevant economic variables. The descriptive statistics is thematically sorted out into four parts: descriptive statistics of key macroeconomic variables, three gaps of economic growth, justifying and measuring ODA and evaluating ODA.

4.1.1. DESCRIPTIVE STATISTICS OF KEY MACROECONOMIC VARIABLES

Table 1 below contains details of some macro economic variables of Ethiopia economy for the period that ranges from 1980 to 2013. These macro economic variables are pertinent to the study. As it can be seen from the table, on average, gross domestic product for the last 34 years was 14.344 Billion (US \$) with 10.322 Billion (US \$) annual deviation. General government total expenditure and general government revenue for the same period amounted 25.806 and 22.045 Billion (Birr), respectively. Besides, total investment and gross national savings as a percent of GDP averaged out 19.044 and 13.412. Moreover, the percentage change of volume of imports and exports of goods and services accounted 6.691 and 5.826. Furthermore, the deviation of skewness from zero, the departure of kurtosis from three and the variation between median and mean of all variables are vivid indicators of uneven distributional flow across time. It is also worth noting that the more they deviated, the lesser they even.

Therefore, the bottom line is that these figures in table 1 signal only a glimpse of the status quo and are also mere a vague indication. However, they imply that all macro variables might be important and not equally decisive.

Table 1: Table of descriptive Stats

variable	mean	median	variance	s.d.	skewness	kurtosis	N
gdp	14.344	9.793	106.540	10.322	1.835	5.285	34
expen	25.806	10.105	1551.527	39.389	2.508	8.915	34
revn	22.045	8.547	1218.132	34.902	2.475	8.737	34
ishare	19.044	17.852	30.057	5.482	0.800	3.427	34
sshare	13.412	11.424	52.757	7.263	0.513	1.935	34
mg	6.691	7.928	179.448	13.396	-0.059	2.624	34
xg	5.826	5.287	457.704	21.394	0.485	4.754	34
✓ gdp= Gross Domestic Product (in Billion US \$)							
✓ expen= General Government Total Expenditure (in Billion Birr)							
✓ revn= General Government Revenue (in Billion Birr)							
✓ ishare= Total Investment (Percent of GDP)							
✓ sshare= Gross National Savings (Percent of GDP)							
✓ mg=Volume of Imports of Goods and Services (Percent Change)							
✓ xg= Volume of Exports of Goods and Services (Percent Change)							

Source: author's own computation

4.1.2. THREE GAPS OF ECONOMIC GROWTH

To explain the objective of the study in a nutshell, narrowing down the circle of discussion to be-all and end-all of the study is necessary. In foreign aid literature, economic growth of a country is said to be constrained by resource gaps. The dominant three resource gaps are saving gap (investment-saving difference), trade gap (import-export deviation) and fiscal gap (expenditure-

revenue variation). Out of the macroeconomic variables listed in table 1 all but GDP are reviewed using figure 1 to depict the three gaps of economic growth.

From figure 1, it is clearly evident that the value of both investment and savings of the country rose significantly. And, as time elapsed the gap widened. An acute reason for this occurrence is the rising in saving fails to cope up with the growing investment. The same story happens to import-export gap. Both variables grew with widening incremental rate. Specifically, in recent years the gaps worsened. The fiscal gap turned out jagged curves. Though there was a gap between expenditure and revenue, it was just unsystematic. Nevertheless, actual expenditure-revenue gap is broader than what is depicted in the graph. This is because the variables are in percent of GDP.

From the aforementioned context, we can reason out that growth of the country has been hindered by resource gaps. Unless this condition is abridged the gaps will bottleneck endeavors to be made to ameliorate the economy. The gaps can also be used to measure the recipient country's dependence on aid.

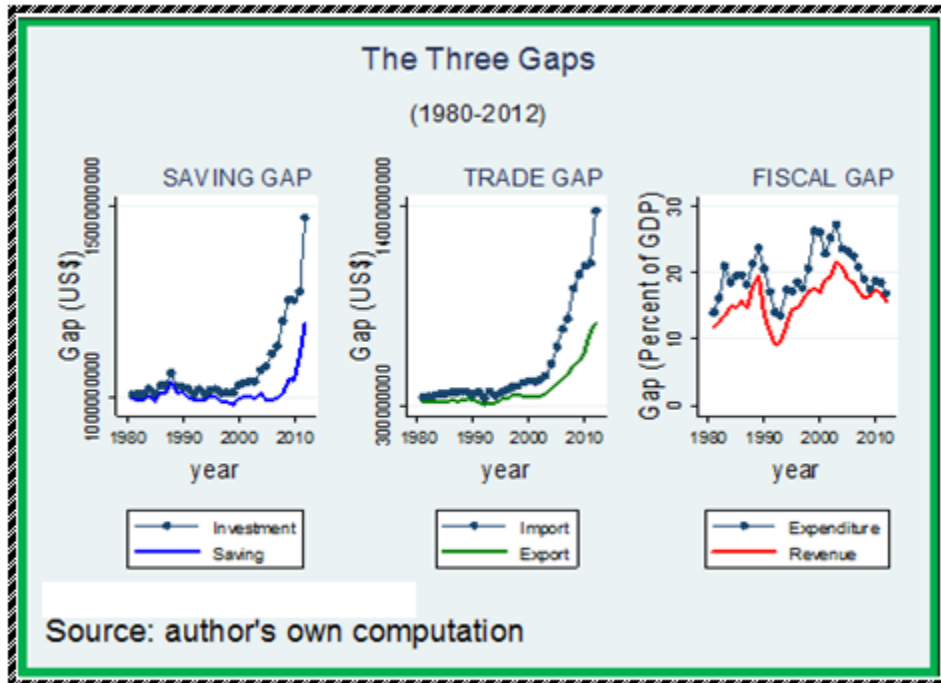


Figure 1: Three gaps of economic growth

4.1.3. JUSTIFYING AND MEASURING ODA

There are many possible ways used to fill resource gaps. ODA is one and central theme of the study. It is said that developing countries opt for ODA to reap its concessional nature. And, the benign intention behind ODA is that if ODA fill the gap it will have a positive impact on investment and growth in turn. Surprisingly, there is no a consentaneous definition of ODA. Different scholars suggest various measures, however, only gross ODA, net ODA and NAT are notable in recent aid researchs.

Gross ODA is the amount that a donor spends in a given year. The net variable alters two aspects of gross ODA measure. First, Net ODA is net only of principle payments received on ODA loans made in prior years, not of interest received on such loans, while NAT is net of both. Second,

NAT excludes offsetting entries for forgiven debt (cancellation of old non-ODA loans) and any recoveries made on grants. However, that cancellation is ODA.

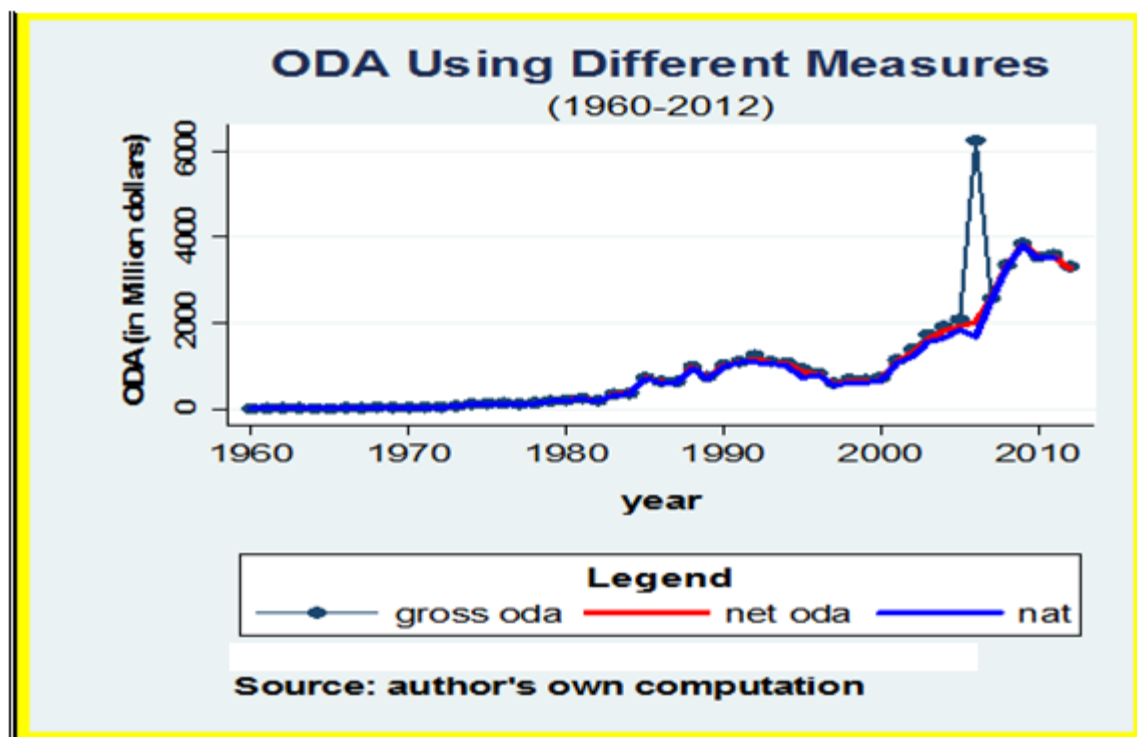


Figure 2: Flow of Net ODA using different measures

Figure 2 above illustrates the trend of three ODA measures, namely gross ODA, net ODA and NAT for the period that ranges from 1960-2012. Despite their definition differences, the values of the three measures are more or less equal throughout the study time period. Using one of the three measures doesn't bring substantial divergent results. But, for the sake of comparison with existing literature net ODA is used, purposefully, in subsequent analysis.

Figure 3 below clearly puts the value of net ODA in million Dollars for the years that range from 2000 to 2012. Mean and Standard deviation (SD), drew as green solid lines, are for the period between 1960 and 2012. Statistically speaking, net ODA rises considerably. There was a reduction in it that lasts but relatively a short span of time.

Figure 4A and Figure 4B present the trend of net ODA at current and constant price, respectively. The years covered in the figure range from 1961 to 2012. The inflation adjusted (real) flow reveals the recent rising, accompanied by a reduction in the immediate past in ODA which is similar to that of nominal net ODA or net ODA flow in current prices.

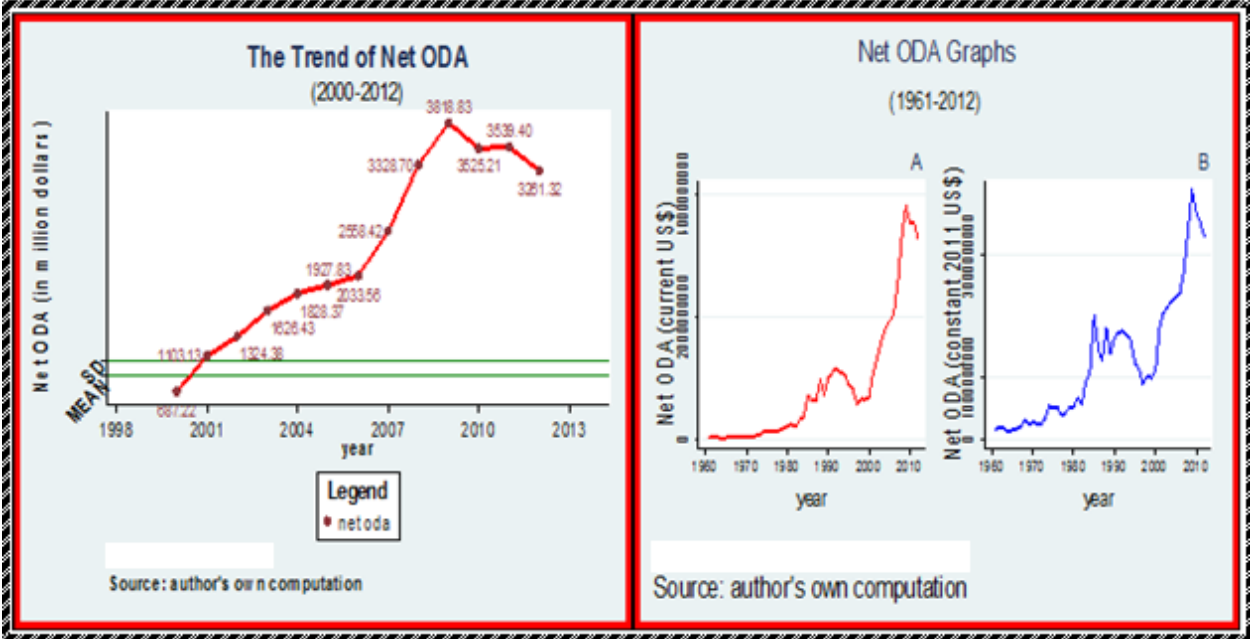


Figure 3: Flow of net ODA

Figure 4:Flow of Net ODA at current and constant prices

A critical look at figure 1 and figure 4 enables one to understand that in the last 4 years resources gaps widened. Then, commonsensically, net ODA is expected to augment so as to satiate the demanding gap. Actually, the contrary happened. In these years net ODA reduced meaningfully. For the figures are mere descriptions it is hardly possible to know why and how this encounter. However, an elaborated rationale and explanation will be given in due course.

4.1.4. EVALUATING NET ODA

For net ODA flow is the hub of the study, describing it from different dimensions is helpful. Tuned by this intent table 2 , presented below, describes net ODA and NAT flows in different decades.

Table 2: ODA measures by decade category (1960-2011)

category	stats	netoda	nat
1960-1969	mean	25.92	25.81
1960-1969	sd	8.82	8.71
1960-1969	count	10	10
1970-1979	mean	103.38	100.37
1970-1979	sd	50.68	49.16
1970-1979	count	10	10
1980-1989	mean	501.89	491.74
1980-1989	sd	265.31	261.57
1980-1989	count	10	10
1990-1999	mean	898.16	853.81
1990-1999	sd	213.82	215.26
1990-1999	count	10	10
2000-2009	mean	2023.69	1934.81
2000-2009	sd	974.07	993.47
2000-2009	count	10	10
2010-2015	mean	3532.3	3508.88
2010-2015	sd	10.03	0.22
2010-2015	count	2	2
Total	mean	819.13	790.06
Total	sd	1003.17	983.74
Total	count	52	52

Note: figures of mean and standard deviation are in millions (US \$). Figures of count are in units.

Source: author's own computation

Apparently, not only average net ODA increases, but also its fluctuation in a given decade vary enormously over time. Even, more than half of the total net ODA was received in the last two

decades. The increments in average net ODA were possibly on account of two factors: change in nominal values and real terms. Nevertheless, evidences from figure 4 claimed changes in real terms outnumber nominal variations. The increments and fluctuation in net ODA of table 2 perse are not harmful. Their accurate effect is dependent on whether these things were stabilizing or not. In this case there is no way of knowing that without collecting additional data and is left to be disclosed by the analysis section.

Another helpful way to look at net ODA is identifying who donates it. Net ODA is provided by different development partners. The common mode of classifying donors is basis on channels through which foreign aid is transferred. Thus, donors are either bilateral or multilateral. Bilateral transfers come from official sources of other governments, whereas multilateral transfers are from international agencies. The former type of donors is usually further grouped as DAC²⁴ and non-DAC countries²⁵.

According to table 3 below, the country received, on average, 453.3, 401.3 and 11 million (US \$) each year from DAC countries, Multilateral agencies and non-DAC countries, respectively. The flow from DAC countries is liable to high average volatility compared to the remaining two. Net ODA from DAC countries and multilateral organizations rose sharply with the passage of time.

²⁴ DAC Countries Grouping: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom and United States.

²⁵ Non-DAC Countries Grouping: Hungary, Israel, Turkey, Bulgaria, Chinese Taipei, Cyprus, Estonia, Kuwait (KFAED), Latvia, Liechtenstein, Lithuania, Malta, Romania, Russia, Saudi Arabia, Thailand, United Arab Emirates and other donor countries.

But, the country didn't receive non-DAC net ODA in the 1960s. However, thenceforth it became a viable source of external finance with irregular flows. As it is indicated by a standard deviation of 527.8 and 493.3 million (US \$) the 2000s was characterized by relatively high volatility of net ODA from all donors. The difference between DAC and multilateral net ODA over the study period was purely episodic. All the time majority of net ODA flow was obtained from DAC countries followed by multilateral agencies²⁶ and non-DAC countries.

Table 3: Net ODA by donors (1960-2012)

decade category	relative freq.	DAC ODA			NON-DAC ODA			MULTI ODA		
		mean	sd	count	mean	sd	count	mean	sd	count
1960-1969	19%	22.2	6.6	10	0	0	10	3.8	3.1	10
1970-1979	19%	56.9	17	10	2	5	10	44.4	34.1	10
1980-1989	19%	260.2	177.2	10	11	22	10	231.1	99.4	10
1990-1999	19%	445.7	76.4	10	10	21	10	442.1	174.3	10
2000-2009	19%	1,043.20	527.8	10	27	6.3	10	953.7	493.3	10
2010-2015	5%	1,914.90	69.6	3	22	10	3	1,505.20	86.5	3
Total	100%	453.3	564.1	53	11	16	53	401.3	489.2	53

Note: figures of mean and standard deviation are in millions (US \$). Figures of count are in units.

Source: author's own computation

²⁶ Multilateral Agencies Grouping: AfDB (African Dev. Bank), AfDF (African Dev. Fund), Arab Fund (AFESD), AsDB (Asian Dev. Bank), AsDB Special Funds, BADEA, CarDB (Caribbean Dev. Bank), EBRD, EU Institutions, GAVI, GEF, Global Fund, IAEA, IBRD, IDA, IDB, IDB Spec. Fund, IFAD, IFC, IMF Trust Fund, IMF (Concessional Trust Funds), MONTREAL PROTOCOL, Nordic Dev. Fund, OFID, OSCE, UNAIDS, UNDP, UNECE, UNEP, UNFPA, UNHCR, UNICEF, UNPBF, UNRWA, UNTA, WFP, WHO and other Multilateral Agencies.

Generally speaking, the table demonstrates the differences of flow and change in net ODA of diverse donors. Hence, the whole evidences and explanations put forward above assert that disaggregating net ODA by donor types likely boost possibility of getting precise results.

Ratio of the grant element in net ODA is also used in several instances to attest efficacy of foreign aid. Normally, grants are defined as disbursements for which there is no repayment obligation. Nevertheless, the grant element in the ODA definition is computed as the difference between the face value of a loan and the present value²⁷ of the service payments, expressed as a percentage of the face value. Customarily, the grant element is offered in the form of interest rate reduction, grace period elongation, or maturity extension.

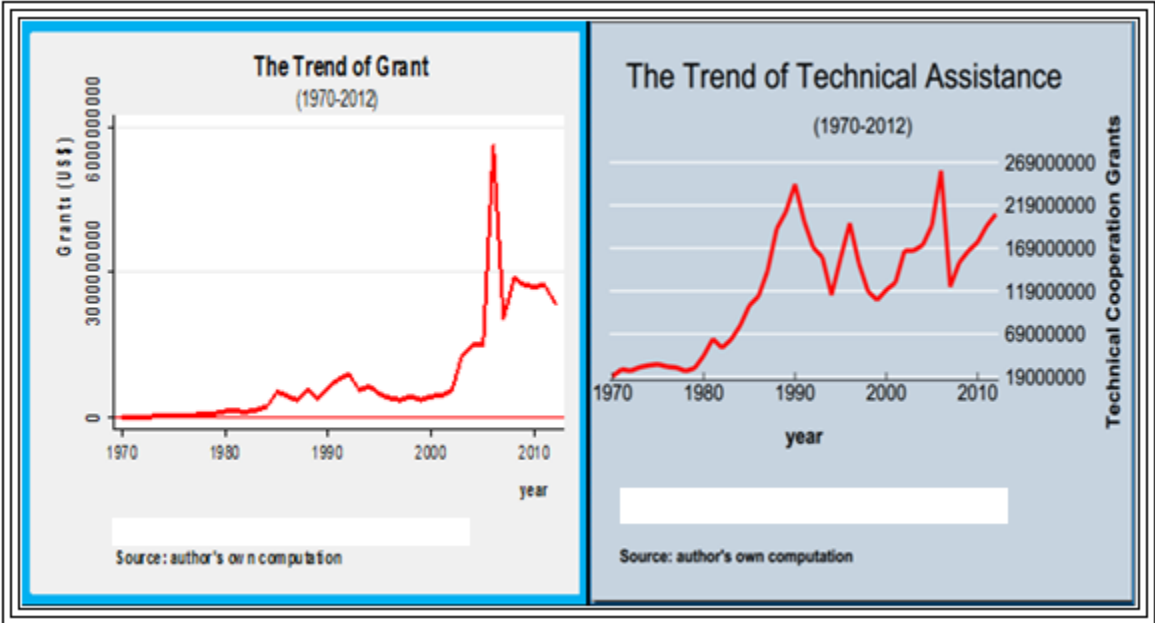


Figure 5: Grants, excluding technical cooperation (Bop, current US \$)

Figure 6: Technical grants (Bop, current US \$)

²⁷ As a rule, the present value is calculated at a discount rate of 10 per cent.

Figure 5 displays the trend of grant element in net ODA flow. The figure of grant for the most part drifted from the average course. And, lately there has been an immense reduction in its values. Tout ensemble, recently the importance of the grant element palled on time. This is not harmful as such. But, ceteris paribus, the diminution in the grant, in all likelihood, would limit and minify prospects of aid effects.

Examining the purpose and type of aid can reasonably facilitate grasping the essence of aid transfer, as well. Guided by this proposition, indicants that suggest for what purpose aid was transferred are presented in figure 6 and table 4. More specifically, figure 6 shows technical cooperation record track. And, table 4 puts down the flow of humanitarian and development food aid.

Technical cooperation grants are grants which are aimed at financing the transfer of technical and managerial skills or of technology without reference to any specific investment projects. So, the sole purpose of such grants is to build up national capacity. However, humanitarian aid, in technical terms, is assistance provided for humanitarian purposes like saving lives, alleviating suffering and suchlike emergency. Resultantly, the aim of development aid is to address the underlying socioeconomic factors which may have led to a crisis that brought forth need for humanitarian aid.

Technical cooperation grants follow uneven pattern. It rose unprecedentedly in 1980s and then fall sharply till mid 1990s. There was also a resurgence of technical cooperation grant as of late. Therefore, in generalities, concomitant effects are anticipated to produce mixed results even if further analysis is needed to distinguish the preponderant outcome.

Due to data unavailability numbers of observations included in the first and last categories of table 4 are a range of 5 and 3 years. As tabularized below humanitarian aid flow change upwardly with the highest disparity recorded in 2000s. Development food aid flow features a mixed pattern with high flow latterly.

Disparity and inconsistency in humanitarian aid flow results from sporadic crisis in the country and so can be utterly justified. In contrast inequality and inconsistency in development food aid and the effects thereof are partially unjustifiable. Above all, development food aid didn't absolutely address the inherent factors which evoke danger to human welfare yet. That is why cessation of humanitarian aid is still imaginative. However, development food aid can contribute to growth, if rather unsuccessful to address the humanitarian crisis significantly.

Table 4: Types of aid (1975-2012)

category	Humanitarian Aid Current Prices (USD millions)	Developmental Food Aid Current Prices (USD millions)
1970-1979	0.35	14.11
	(0.29)	(6.07)
1980-1989	27.13	94
	(29.66)	(55.40)
1990-1999	50.12	129.98
	(19.35)	(72.50)
2000-2009	403.98	122.46
	(251.29)	(88.17)
2010-2015	550.83	290.61
	(101.26)	(23.59)
Total	170.17	115.97
	(236.78)	(89.56)
Standard deviations in parentheses		

Source: author's own computation

In addition net ODA per capita comparison can serve as cogent evidence of aid effectiveness. As it is shown in table 5, lowest average net ODA per capita added up with the relatively modest standard deviation signal that the country has lowest net ODA per capita compared to other African countries included in the study. The other African countries included in the study are Tanzania (tza), Uganda (uga), Zambia (zmb), Sudan (sdn), Rwanda (rwa), Niger (ner), Mauritania (mrt), Ghana (gha), Cameroon (cmr), Burkina-Faso (bfa) and Burundi (bdi). Besides, figure 7 reassures that net ODA of Ethiopia is below that of the other countries for the specified time horizon. From the lowest is the best paradigm perspective the relatively lowest figure signifies the country's success in handling amount of net ODA received. Otherwise, it is known that the lowest value by itself cannot be taken for granted as a good indicator.

Net ODA per capita, of figure 7, is computed as net ODA received divided by midyear population estimate. Thus, the rising net ODA per capita, from 1997 to 2009, notwithstanding the population growth of the country indicates that the increment in net ODA was higher than the population growth. In the last three years the net ODA exhibit slight reduction. The reason was a decline in net ODA in these years. Altogether, the figure informs indeterminable association between net ODA flow and population growth. But, this can't be used to generalize the issue unless it is confirmed by appropriate statistical tests.

Table 5: Net ODA per capita (1960-2012)

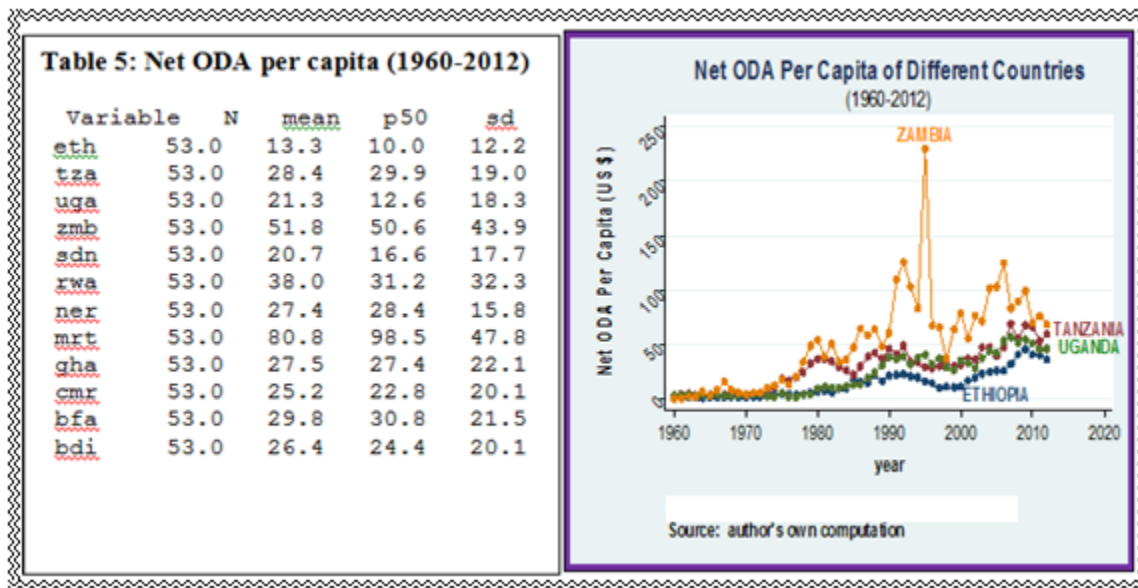


Figure 7: Net ODA received divided by mid year population estimate

In this day and age, CPIA, which is developed and reported by the World Bank is also another diagnostic tool used as a benchmark to evaluate effective use of ODA. The CPIA is intended to measure the extent to which a country's policy and institutional arrangement supports socioeconomic goals. It rates countries on a scale of 1 (low) to 6 (high).

Figure 8 and figure 9 illustrate CPIA based ratings of revenue mobilization efficiency and fiscal policy performance, respectively. Both measures denote the country's ability to utilize net ODA without offsetting tax revenue or aggravating fungibility. By referring to these figures both ratings were above the par so affects tax collection and expense scheme accordingly. However, extrapolation requires further verification of appropriate statistical tests.

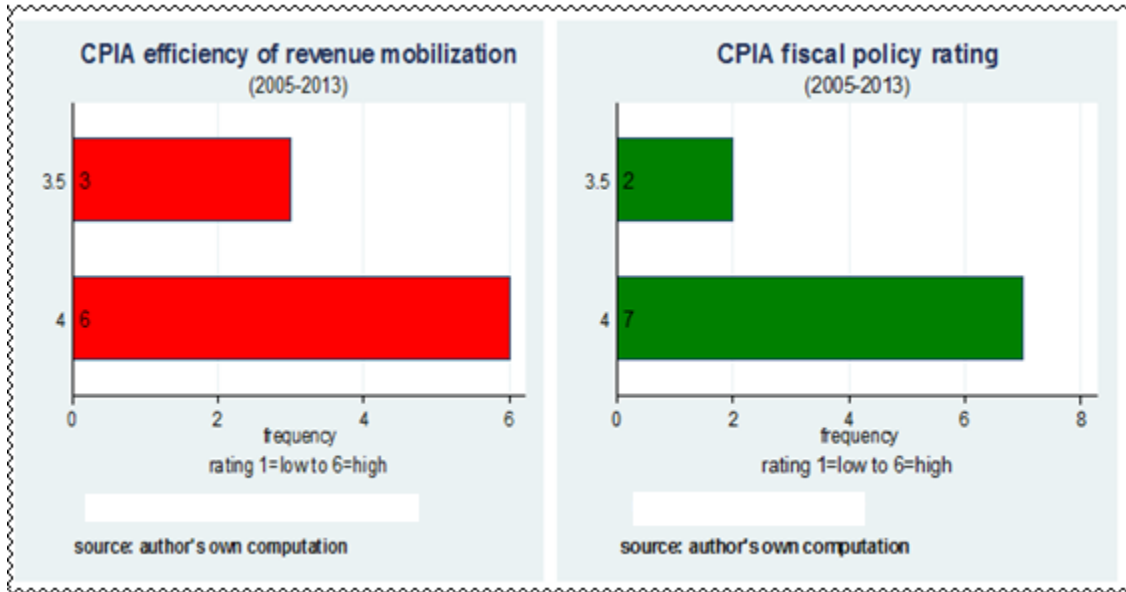


Figure 8: CPIA efficiency of revenue mobilization

Figure 9: CPIA fiscal policy rating

Net ODA as share of some key macroeconomic variables is presented below in table 6. The values are ratios of net ODA and their respective macroeconomic variables. The small ratio indicates higher denominator and vice versa.

On the one hand, strict decrement in net ODA as share of gross national income and decline in net ODA as a share of gross capital formation are indicated. On the other hand, net ODA as a share of import of goods, services and primary income and net ODA as a share of central government expense evidenced assorted pattern.

A reduction in the ratio is asserted as promising. The assertion rested on an implicit premise that exhorts “the lower the better”. Because, had the net ODA been allotted to finance one gap a time it would have covered much as the ratios explained in the table. Nodaofgcf, nodaofimp,

nodaofexpe indicate ratios that would have been covered if net ODA had been used to finance investment, import and government expenditure, respectively.

Table 6: Net ODA as share of macroeconomic variables (2005-2011)

	nodaofgni	nodaofgcf	nodaofimp	nodaofexpe
	15.88	59.68	39.00	104.67
	13.59	48.52	38.27	139.85
	13.21	54.06	36.86	168.75
	12.52	50.72	34.55	95.50
	12.01	46.87	42.03	96.87
	12.04	43.74	35.31	94.19
	11.31	40.49	30.16	104.66
Mean	12.94	49.16	36.60	114.93
N	7	7	7	7

✓	nodaofexpe = Net ODA received (% of central government expense)
✓	nodaofimp = Net ODA received (% of imports of goods, services and primary income)
✓	nodaofgcf = Net ODA received (% of gross capital formation)
✓	nodaofgni = Net ODA received (% of GNI)

Source: author's own computation

Table 7 shows correlation of net ODA with other variables. The correlation matrix which is the gist of the aid effectiveness descriptive results is attached to simple inferential test. A cell contains a correlation value, Bonferroni-adjusted significance levels, and number of observations successively. Those marked with an asterisk are significant at 5 percent level of significance. Besides, the non-symmetrical missing values imply that they are not correlated even at 10 percent level of significance.

Table 7: Correlation of net ODA with other macroeconomic variables (2005-2012)

	noda	cdebt	m	x	sdom	gcf	gdp
noda	1.0000						
cdebt	8	1.0000					
m		8	1.0000				
x			8	1.0000			
sdom			0.9474 ⁺ 0.0074	0.9522 ⁺ 0.0055	1.0000		
gcf			8	8	8	1.0000	
gdp			0.9848 ⁺ 0.0002	0.9365 ⁺ 0.0128	0.9585 ⁺ 0.0036	8	1.0000
			8	8	8	8	8

✓	noda= Net official development assistance (current US\$)
✓	cdebt= Concessional debt (% of total external debt)
✓	m= Imports of goods and services (current US\$)
✓	x= Exports of goods and services (current US\$)
✓	sdom= Gross domestic savings (current US\$)
✓	gcf= Gross capital formation (current US\$)
✓	gdp= GDP (current US\$)

Source: author's own computation

The correlations simply replicate the main findings of figure 1 and figure 4. Net ODA was not correlated with import and export of goods and services. Thus, the transfer flow was not guided by the trade gap in that economy. Because, had it been guided by the gap it would have followed the same pattern and consequently correlated. But, this doesn't necessarily imply net ODA was incapable of filling the gap.

Besides, neither gross capital formation nor gross domestic savings were systematically associated with net ODA. So, the flow was not determined by the saving gap either. Most especially, the relationship between net ODA and gross domestic product was statistically insignificant. A detailed and elaborated explanation of the relation and causation between the two will be provided in the next part.

4.2. SIMULATION RESULTS

Scenarios assumed to simulate the macro economic effects of foreign aid are the themes of this section. The study has three scenarios. The first scenario (SIMS_AID1) presupposes constant rise in official development assistance up to some period. The second scenario (SIMS_AID2) is depicted as a gradual decline in foreign aid. The third scenario (SIMS_AID3) requires a big bush initially followed by reduction in aid flows. All percentage changes of the three scenarios are made for five years; from 2014 to 2018. Hence, the base line scenario of the study is the economy set up in the year 2013. The base line scenario in turn serves as a reference for other simulations. Due to lack of actual SAM for 2013, growth and transformation plan at lower case (GTPL) is used as an economic context to recursively compute SAM for 2013 from SAM of 2009. The study believes in the validity of the compelling reasons putforwarded to choose 2014-2018 as the five years of simulation periods. In the international agenda, some are urging doubling of aid before the year setted to achieve millennium development goals, 2015. Development economists from the emerging countries are also stating a need to abolish historically failed foreign aid and then to find new innovative path ways to development. Specifically, they demand the millienium development goals agenda through foreign aid to come to an irretrievable end. In Ethiopia economy context, the year 2014 is marked by evaluating the

first growth and transformation plan and preparing to launch its subsequent program. There is also another event in the year followed expected to be the center of attention, that is national election. Thus, foreign aid would be a good bet. Legally election is held every five years. Customarily, programs are planned for five years. Following these guidelines the study extends the simulation period from 2014 to 2018. Fortunately, the study is also conducted in 2014.

The assumed future changes of ODA in all scenarios are adapted from average view of foreign aid's recent past trends and contributions. In spirit of this law, in the first scenario foreign aid is assumed to boost the foreign saving account by 13.5% annually. In the second scenario foreign aid contribution to foreign saving is supposed to gradually decline with passage of time, 1%, 3.375%, 6.75%, 10.125% and 13.5%, respectively. In the third and last scenario foreign aid's contribution to foreign saving will get higher initially and declined eventually. Based on aid calls and aid curses the study presupposes 27%, 20.25%, 13.5%, -6.75% and -13.5% changes in foreign aid's contribution for the five simulation periods, respectively.

Figure 10 depicts resultant changes in total government expenditure. All simulations result in increasing government expenditure. But, it is only SIMS_AID2 (gradual reduction in foreign aid) that leads to higher government expenditure relative to what the baseline scenario creates. The possible source of the expenditure is the income generated by the government in that situation and time period. Figure 11 holds significant clue regarding this case. SIMS_AID2 is characterized by increasing total government income. The government income is not only increasing but also amounts above what the baseline scenario assures. Exploring the recursive DCGE model linkage is enough to comprehend the effect and its possible outcomes. Households income and consumption affect the government income. The households income and

consumption are also affected by factors income. Thus, factors income through households income and consumption is one source of the deviation accounted in the different scenario results. Another source of the deviation stems from export and import performances expected to prevail in the assumed environments. Specially import through taxes can create a difference in government income. The import and export performance and household consumption values in all simulation scenarios , including the baseline, can be found in table 9. The actual values of EGX, YGX and GSAVX are also presented in the annex as table 11.

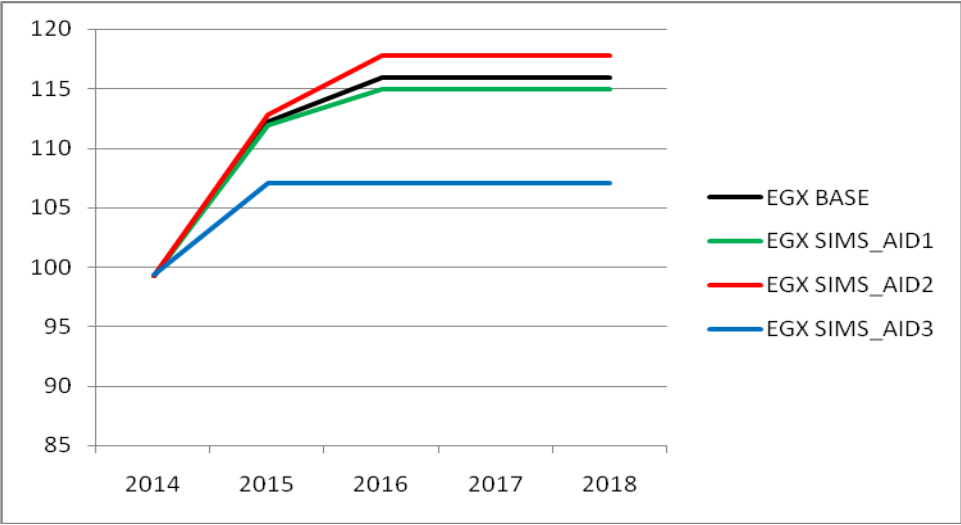


Figure 10: Total current government expenditure²⁸

Source: author’s own computation

²⁸ EGX= Total current government expenditure

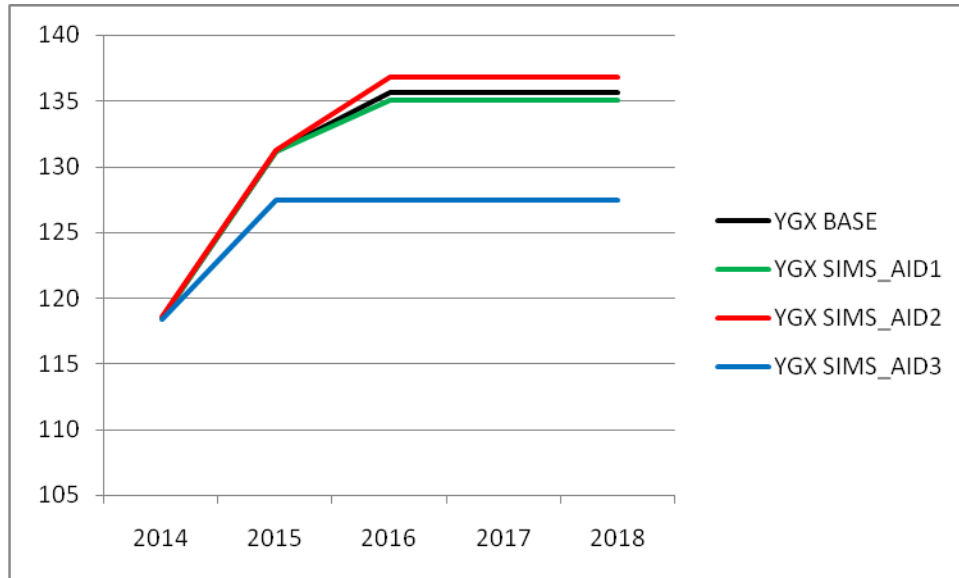


Figure 11: Total current government income²⁹

Source: author's own computation

Another interesting result worthy of explanation is government savings. In the recursive DCGE model government savings is assumed as flexible factor that determine the equilibrium of government expenditure and government revenue. According to government income performance, figure 11 evidenced SIM_AID2 is better. But, if government savings performance is incorporated in to account the study reveals mixed suggestions. Because, it is SIM_AID3 (big bush initially followed by a reduction in foreign aid) that can create (assure) increasing government savings. A close look at figure 12 enable one to recognize the reduction in government savings in the remaining simulation scenarios. Thus, SIM_AID3 is preferable for two good reasons. Firstly, it results in increasing government savings. Secondly, it doesn't result in negative government savings.

²⁹ YGX= Total current government income

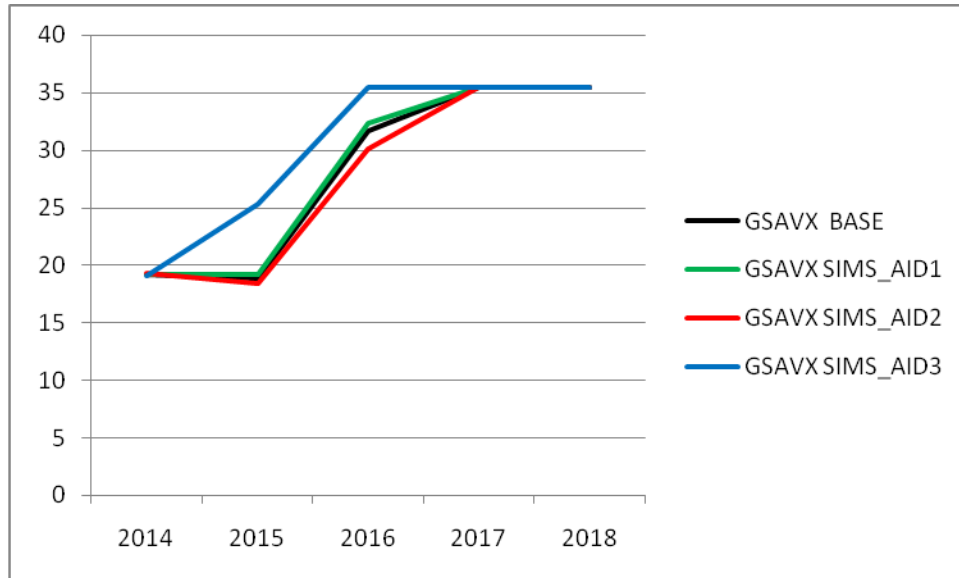


Figure 12: Government savings³⁰

Source: author's own computation

In general, the following table elucidates percentage changes of some macroeconomic variables in the simulation period horizon. However, the values under the 'initial' column are actual figures in billions of LCU. The percentage changes were computed by taking 2018 (the final year of simulation periods) and 2014 (the starting year of simulation periods) as last and initial values of the variable under consideration, respectively. as it is shown in the table, total absorption, total hoshold consumption, total investment, government consumption, export and import in all scenarios increase in real terms. The increment in these macroeconomic variables is accompanied by appreciation of exchange rate in two of the three simulation scenarios.

Two things are worthy of attention. The relative increment of these variables and their co-existence with appreciating exchange rate. Intems of absorption and investment SIMS_AID1 outweighs others. Intems of household consumption SIMS_AID2 seems plausible. Intems of

³⁰ GSAVX= Government savings

net export balance all simulations fail to come up with better result than what the baseline status will generate. Export performance of the economy in SIMS-AID1 and SIMS-AID3 is below the value expected to be attained following the baseline scenario underpinning. The obvious cause is the appreciation in exchange rate in these environments. The results present mixed information in the sense that it is not simple to generalize it.

	INITIAL	BASE	SIMS_AID1	SIMS_AID2	SIMS_AID3
QABSTOT	455.92	99.36	100.03	98.41	91.47
QHTOT	338.61	76.25	75.97	76.94	68.26
QINVTOT	85.49	138.9	143.62	131.09	128.45
QGTOT	31.82	239.04	239.04	239.04	239.04
QETOT	45.8	249.42	241.57	264.27	189.69
QMTOT	172.94	140.89	141.11	141.07	120.87
REXR	90.85	4.12	4.08	4.19	3.98

Table 8: Macroeconomic variables (LCU at base prices)³¹

Source: author's own computation

Table 9, presented below, shows values of some macroeconomic variables for all scenarios and their respective simulation periods. There is nothing new and significant variation compared to the aforementioned results. The table is presented here for the sake of having disaggregated values.

³¹ QABSTOT=real absorption(LCU at base prices), QHTOT = real household consumption (LCU at base prices), QINVTOT= real investment (LCU at base prices), QGTOT= real government consumption (LCU at base prices), QETOT= total real exports (LCU at base prices), QMTOT= total real imports (LCU at base prices), and REXR= PPP real exchange rate (LCU per FCU).

		2014	2015	2016	2017	2018
ABSORP	BASE	744.8445	837.78	877.4213	887.1897	898.2378
ABSORP	SIMS_AID1	747.6715	843.8235	880.4999	890.2683	901.3164
ABSORP	SIMS_AID2	740.7554	828.1662	873.0755	882.8443	893.9012
ABSORP	SIMS_AID3	757.0491	832.8064	841.4434	851.2118	862.2599
PRVCON	BASE	530.2494	580.382	596.7994	596.7994	596.7994
PRVCON	SIMS_AID1	530.9318	581.4325	595.8477	595.8477	595.8477
PRVCON	SIMS_AID2	529.2812	578.743	599.1394	599.1395	599.1425
PRVCON	SIMS_AID3	533.275	569.7591	569.7591	569.7591	569.7591
GOVCON	BASE	58.29444	65.93101	74.56797	84.33637	95.38444
GOVCON	SIMS_AID1	58.29444	65.93101	74.56797	84.33637	95.38444
GOVCON	SIMS_AID2	58.29444	65.93101	74.56797	84.33637	95.38444
GOVCON	SIMS_AID3	58.29444	65.93101	74.56797	84.33637	95.38444
EXPORTS	BASE	143.999	187.5162	205.3992	205.3992	205.3992
EXPORTS	SIMS_AID1	142.9126	185.0308	200.2161	200.2161	200.2161
EXPORTS	SIMS_AID2	145.5725	191.471	215.1828	215.1833	215.1916
EXPORTS	SIMS_AID3	139.3193	166.8993	166.8993	166.8993	166.8993
IMPORTS	BASE	-239.762	-288.297	-307.668	-307.668	-307.668
IMPORTS	SIMS_AID1	-240.859	-290.547	-307.766	-307.766	-307.766
IMPORTS	SIMS_AID2	-238.184	-284.733	-308.218	-308.218	-308.226
IMPORTS	SIMS_AID3	-244.537	-281.661	-281.661	-281.661	-281.661
GDPMP	BASE	649.0815	736.9988	775.1522	784.9206	795.9687
GDPMP	SIMS_AID1	649.7248	738.3072	772.9501	782.7185	793.7666
GDPMP	SIMS_AID2	648.1439	734.9044	780.0406	789.8095	800.8665
GDPMP	SIMS_AID3	651.8312	718.0448	726.6818	736.4502	747.4982
GDPFC2	BASE	603.7577	686.2617	717.5069	719.4105	721.3964
GDPFC2	SIMS_AID1	604.1237	686.9909	714.6655	716.5694	718.5557
GDPFC2	SIMS_AID2	603.2267	685.1077	723.5372	725.4408	727.4378
GDPFC2	SIMS_AID3	605.3319	665.1779	667.003	668.9069	670.8933

Table 9: National accounts (in real term values)³²

Source: author's own computation

The Keynes-Griffin type equation of saving is solved using autoregressive distributed lag model approach to cointegration. The results are described below. If F-statistics from OLS regression of the unrestricted error correction model out numbers the upper bound of critical values for the bound test, it signifies the existence of long run relationship in the model. The F-statistic (**F**

³² ABSORP= Total absorption, PRVCON= Private consumption, GOVCON=Government consumption, GDPMP= Gross domestic product at market price, and GDPFC2=Gross domestic product at factor cost.

Statistic: $F(3, 23) = 4.7556$ [.010] is higher than the bound test critical values ($K=3$, $I(0)=3.272$ and $I(1)=4.306$) at 5 percent level of significance. Thus, long run relationship exists.

The variables used are domestic savings (S), national income (Y) and aid from DAC countries (DAC). The reason DAC-aid is preferred to total foreign aid emanates from the fact that DAC-aid is aimed at development and growth concerns. The long run results presented below show significant positive relationship between national income and savings. However, the relationship between DAC-aid inflow and savings is significantly inverse. A 1 unit increment in DAC-aid inflow results in 0.5 unit reduction in domestic savings. The short run results are a bit different. DAC-aid inflow's effect on domestic savings is significantly positive. National income's effect is also positive but not significant. The error correction parameter is negative and significant. The short run results, Diagnostic Tests and stability (structural break tests) are presented in the appendix.

Estimated Long Run Coefficients using the ARDL Approach			
ARDL(1,0,1) selected based on Akaike Information Criterion			
Dependent variable is S			
31 observations used for estimation from 1982 to 2012			
Regressor	Coefficient	Standard Error	T-Ratio[Prob]
Y	.25046	.13532	1.8509[.076]
DAC	-.55355	.15466	-3.5792[.001]
INPT	1.09E+09	1.42E+08	7.6920[.000]

Table 10: Long run results using ARDL
Source: author's own computation

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1. SUMMARY OF FINDINGS

It is clear from the implications of growth theory that the macroeconomic effects of aid depend on how it affects savings, investment and government behaviour. Using recursive DCGE, the study shows that aid inflow can result in export reduction and exchange rate appreciation. But, it leads to higher government revenue, expenditure and savings. Aid's effect in total absorption and GDP is also not discernible. Thus, the study's results are ambiguous to generalize.

The objective of the study was to find out the reality of aid led growth paradigm in Ethiopia economy context. The aid led growth transmission mechanisms are savings, investment and government behavior. Thus, to come up with how the aid-led growth works or fails the study also aimed to test aid-fiscal response relationship, aid curse paradox (aid-dutch disease) and aid-saving dilemmas. As clearly explained in the previous paragraph, based on baseline scenario and rational if-scenarios the aid-led growth evidences are fragile. The aid curse problem is apparent. Aid-fiscal response and aid-savings dilemmas are , atleast, not problematic.

5.2. CONCLUSIONS

Based on the summary of findings, as it always was foreign aid is a mixed blessing. Not all help is helpful. Not all aid assists. Theoretically, aid has not been as effective as had been hoped or its proponents claimed for it. Existing practical stories also do not deny that aid can be inefficient or that negative side-effects may arise. It is also neither analytically defensible nor empirically

credible to argue from the outset that aid never works. So, logically speaking, if the growth which a nation achieves or fails to achieve is related to the assistance it receives one finds that there is no support for the view that aid encourages growth and development. History has also shown that aid is neither necessary nor sufficient for growth and development. What is assumed is that aid can serve as an amplifier in the sense that it can play a crucial role in enhancing the probability of achieving growth and development. Aid is an ill wind that blows no body any good.

5.3. RECOMMENDATIONS

The above conclusion is drawn from objectives and findings of the study. Based on that conclusion, the study recommends the following points:

- Foreign aid is not only an economic question. It is a part of development, and development is a very important political question. Thus, a political thought, perspective and ideology and the entire political process is related to it. Thus, accountability, transparency and aid management platforms are operative concepts.
- In social studies there are no hard and fast rules of separating wheat from chaff. Works are done and people are guided by tendencies. These tendencies are forms not formulas. Because, variables of interest are multiple and their measurement is complicated. Therefore, the study stress the need for more theoretical frame work than empirical analysis for policy purposes regarding foreign aid. A better theoretical understanding of the difficulties involved in the subject matter is second to none to validate what the data warrants.

- All ways hastened to the obvious recommendation, that is, to understand price of foreign aid and make decisions systematically keeping aid's track record is not-optional. Making the record up to date is also an imperative. Because, in this turbulent time and dynamic world methodologies to be applied, data quality and data quantity to be employed, definition of terms to be used and so on are in everlasting change. That is why this study is claimed as not an attempt to resolve the disputes in the aid literature. The study further signifies much work remains to be done. It also recites not to stop learning about how aid works or how to do aid better. Ultimately, aid inflows have to be repaid. Thus, the challenges is to improve foreign assistance effectiveness by having clear measurements of economic, cultural and geopolitical advantages and disadvantages of aid.
- Local development associations which are engaged in tackling poverty reduction and wealth creation can take springboard lessons from accumulation of evidences in the foreign aid literature.

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APPENDIX

		2014	2015	2016	2017	2018
GSAVX	BASE	19.23438	18.90427	31.65848	35.48685	35.48685
GSAVX	SIMS_AID1	19.20299	19.2496	32.39644	35.48685	35.48685
GSAVX	SIMS_AID2	19.27433	18.39273	30.06967	35.48682	35.48676
GSAVX	SIMS_AID3	19.07604	25.37187	35.48685	35.48685	35.48685
EGX	BASE	99.27369	112.2412	115.897	115.897	115.897
EGX	SIMS_AID1	99.28571	111.8605	114.9005	114.9005	114.9005
EGX	SIMS_AID2	99.25602	112.7988	117.7815	117.7816	117.7829
EGX	SIMS_AID3	99.32456	107.0462	107.0462	107.0462	107.0462
YGX	BASE	118.5081	131.1455	135.6304	135.6304	135.6304
YGX	SIMS_AID1	118.4887	131.1101	135.0547	135.0547	135.0547
YGX	SIMS_AID2	118.5304	131.1915	136.7731	136.7732	136.7748
YGX	SIMS_AID3	118.4006	127.4116	127.4116	127.4116	127.4116

Table 11: Government savings, expenditure and income

Source: author's own computation

Diagnostic Tests			

* Test Statistics *	LM Version	* F Version	*

* A:Serial Correlation*	*CHSQ(1)= 3.0121[.083]*	*F(1, 25)= 2.6906[.113]*	*
* B:Functional Form	*CHSQ(1)= .013980[.906]*	*F(1, 25)= .011279[.916]*	*
* C:Normality	*CHSQ(2)= 2.7300[.255]*	Not applicable	*
* D:Heteroscedasticity*	*CHSQ(1)= 1.0816[.298]*	*F(1, 29)= 1.0484[.314]*	*

A:Lagrange multiplier test of residual serial correlation			
B:Ramsey's RESET test using the square of the fitted values			
C:Based on a test of skewness and kurtosis of residuals			
D:Based on the regression of squared residuals on squared fitted values			

Table 12: Diagnostic tests using ARDL

Source: author's own computation

Error Correction Representation for the Selected ARDL Model

ARDL(1,0,1) selected based on Akaike Information Criterion

Dependent variable is dS

31 observations used for estimation from 1982 to 2012

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
dY	.18185	.11183	1.6262[.116]
dDAC	.60792	.33573	1.8107[.081]
dINPT	7.92E+08	2.00E+08	3.9567[.000]
ecm(-1)	-.72606	.17336	-4.1881[.000]

List of additional temporary variables created:

dS = S-S(-1)

dY = Y-Y(-1)

dDAC = DAC-DAC(-1)

dINPT = INPT-INPT(-1)

ecm = S -.25046*Y + .55355*DAC -1.09E+09*INPT

R-Squared	.46914	R-Bar-Squared	.38747
S.E. of Regression	3.23E+08	F-stat. F(3, 27)	7.6589[.001]
Mean of Dependent Variable	-2.75E+07	S.D. of Dependent Variable	4.12E+08
Residual Sum of Squares	2.71E+18	Equation Log-likelihood	-648.6160
Akaike Info. Criterion	-653.6160	Schwarz Bayesian Criterion	-657.2010
DW-statistic	2.3681		

Table 13: Short run results using ARDL

Source: author's own computation

Plot of Cumulative Sum of Recursive Residuals

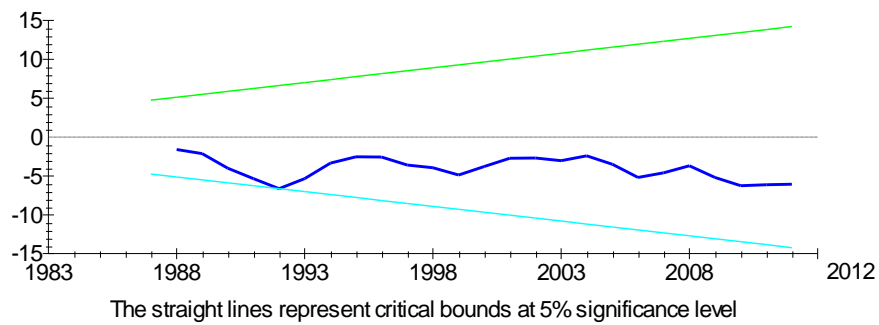


Figure 13: Stability test (CUSUM)

Source: author's own computation

Plot of Cumulative Sum of Squares of Recursive Residuals

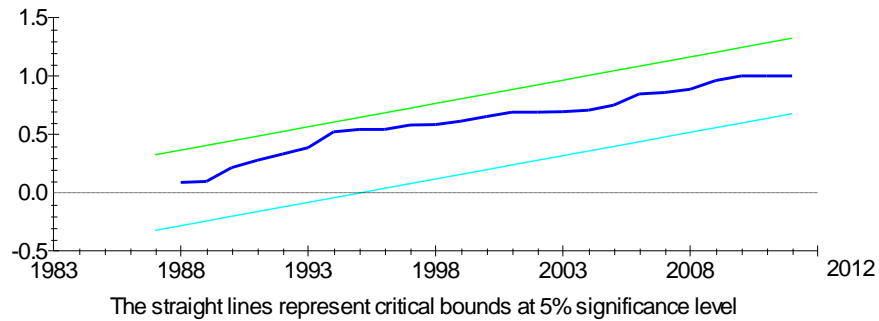


Figure 14: Stability test (CUSUMSQ)

Source: author's own computation

Formulation of the CGE model that has been used in the study is presented in this appendix³³.

THE WITHIN MODEL

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.

1. Import price³⁴

³³ The model is commonly known as IFPRI standard basic model. The notational principles make it possible to distinguish endogenous variables (Upper-case Latin letters without a bar), exogenous variables (Upper-case Latin letters with a bar), parameters (Lower-case Latin letters (with or without a bar) or lower-case Greek letters (with or without superscripts)), and set indices (Lower-case Latin letters as subscripts to variables and parameters).

³⁴ The import price in LCU (local-currency units) is the price paid by domestic users for imported commodities (exclusive of the sales tax). The above equation states that it is a transformation of the world price of these imports, considering the exchange rate and import tariffs plus transaction costs (the cost of trade inputs needed to move the commodity from the border to the demander) per unit of the import. For all commodities, the market price paid by domestic commodity demanders is the composite price, PQ; in the above equation, PQ applies only to payments for trade inputs. The exchange rate and the domestic import price variables (upper-case Latin letters) are flexible, while the tariff rate and the world import price parameters (lower-case Latin letters) are fixed. The fixedness of the world import price stems from the “small-country” assumption. That is, for all its imports, the assumed share of world trade for the modeled country is so small that it faces an infinitely elastic supply curve at the prevailing world price.

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

$$\left[\begin{array}{c} \text{import} \\ \text{price} \\ \text{(LCU)} \end{array} \right] = \left[\begin{array}{c} \text{import} \\ \text{price} \\ \text{(FCU)} \end{array} \right] \cdot \left[\begin{array}{c} \text{tariff} \\ \text{adjust-} \\ \text{ment} \end{array} \right] \cdot \left[\begin{array}{c} \text{exchange rate} \\ \text{(LCU per} \\ \text{FCU)} \end{array} \right] + \left[\begin{array}{c} \text{cost of trade} \\ \text{inputs per} \\ \text{import unit} \end{array} \right]$$

where

$$\left[\begin{array}{l} c \in C = \text{a set of commodities (also referred to as } c' \text{ and } C'), \\ c \in CM (\subset C) = \text{a set of imported commodities (a subset of the commodity set),} \\ c \in CT (\subset C) = \text{a set of domestic trade inputs (distribution commodities) or (transactions service commodities),} \\ PM_c = \text{import price in LCU (local-currency units) including transaction costs,} \\ pwm_c = \text{c.i.f. import price in FCU (foreign-currency units),} \\ tm_c = \text{import tariff frate,} \\ EXR = \text{exchange rate (LCU per FCU),} \\ PQ_c = \text{composite commodity price (including sales tax and transaction costs), and} \\ icm_{c'c} = \text{quantity of commodity } c' \text{ as trade input per imported unit of } c. \end{array} \right]$$

2. Export price³⁵

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

$$\left[\begin{array}{c} \text{export} \\ \text{price} \\ \text{(LCU)} \end{array} \right] = \left[\begin{array}{c} \text{export} \\ \text{price} \\ \text{(FCU)} \end{array} \right] \cdot \left[\begin{array}{c} \text{tariff} \\ \text{adjust-} \\ \text{ment} \end{array} \right] \cdot \left[\begin{array}{c} \text{exchange rate} \\ \text{(LCU per} \\ \text{FCU)} \end{array} \right] - \left[\begin{array}{c} \text{cost of trade} \\ \text{inputs per} \\ \text{export unit} \end{array} \right]$$

where

$$\left[\begin{array}{l} c \in C = \text{a set of commodities (also referred to as } c' \text{ and } C'), \\ c \in CT (\subset C) = \text{a set of domestic trade inputs (distribution commodities),} \\ c \in CE (\subset C) = \text{a set of exported commodities (with domestic production),} \\ PE_c = \text{export price (LCU),} \\ pwe_c = \text{f.o.b. export price (FCU),} \\ te_c = \text{export tax rate,} \\ EXR = \text{exchange rate (LCU per FCU),} \\ PQ_c = \text{composite commodity price (including sales tax and transaction costs), and} \\ ice_{c'c} = \text{quantity of commodity } c' \text{ as trade input per exported unit of } c. \end{array} \right]$$

³⁵ The export price in LCU is the price received by domestic producers when they sell their output in export markets. Unlike the import price, the tax and the cost of trade inputs reduce the price received by the domestic producers of exports. Besides, Ethiopia doesn't have export tax. Thus, te_c turn out to be zero. The model does not include any commodities that are imported for immediate re-export. As long as such traded uses domestic factors (and, possibly, intermediate inputs), it can be handled without any changes in model structure by including an activity in the SAM that imports a non-produced commodity and exports all of its output.

3. Demand price of domestic non-traded goods³⁶

$$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'} \cdot icd_{c',c} \quad c \in CD$$

$$\begin{bmatrix} \text{domestic} \\ \text{demand} \\ \text{price} \end{bmatrix} = \begin{bmatrix} \text{domestic} \\ \text{supply} \\ \text{price} \end{bmatrix} + \begin{bmatrix} \text{cost of trade} \\ \text{inputs per} \\ \text{unit of} \\ \text{domestic sales} \end{bmatrix}$$

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $c \in CD (\subset C)$ = a set of commodities with domestic sales of domestic output,
 $c \in CT (\subset C)$ = a set of domestic trade inputs (distribution commodities),

PDD_c = demand price for commodity produced and sold domestically,
 PDS_c = supply price for commodity produced and sold domestically,
 PQ_c = composite commodity price (including sales tax and transaction costs), and
 $icd_{c',c}$ = quantity of commodity c' as trade input per unit of c produced and sold domestically.

4. Absorption³⁷

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

$$\begin{bmatrix} \text{absorption} \\ \text{(at demand} \\ \text{prices net of} \\ \text{sales tax)} \end{bmatrix} = \begin{bmatrix} \text{domestic demand price} \\ \text{times} \\ \text{domestic sales quantity} \end{bmatrix} + \begin{bmatrix} \text{import price} \\ \text{times} \\ \text{import quantity} \end{bmatrix}$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $c \in CM (\subset C)$ = a set of imported commodities,
 $c \in CD (\subset C)$ = a set of commodities with domestic sales of domestic output,

PQ_c = composite commodity price (including sales tax and transaction costs),
 tq_c = rate of sales tax (as share of composite price inclusive of sales tax),
 QQ_c = quantity of goods supplied to domestic market (composite supply),
 PDD_c = demand price for commodity produced and sold domestically,
 QD_c = quantity sold domestically of domestic output,
 PM_c = import price in LCU (local-currency units) including transaction costs, and
 QM_c = quantity of imports of commodity.

³⁶ 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.

³⁷ Absorption is expressed as the sum of spending on domestic output and imports at the demand prices, PDD and PM. The prices PDD and PM include the cost of trade inputs but exclude the commodity sales tax.

5. Marketed output value³⁸

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

$$\begin{bmatrix} \text{producer price} \\ \text{times marketed} \\ \text{output quantity} \end{bmatrix} = \begin{bmatrix} \text{domestic supply price} \\ \text{times} \\ \text{domestic sales quantity} \end{bmatrix} + \begin{bmatrix} \text{export price} \\ \text{times} \\ \text{export quantity} \end{bmatrix}$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $c \in CX$ ($\subset C$) = a set of commodities with domestic output,

PX_c = aggregate producer price for commodity,
 QX_c = aggregate marketed quantity of domestic output of commodity,
 PDS_c = supply price for commodity produced and sold domestically,
 QD_c = quantity sold domestically of domestic output,
 PE_c = export price (LCU), and
 QE_c = quantity of exports.

6. Activity price³⁹

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

$$\begin{bmatrix} \text{activity} \\ \text{price} \end{bmatrix} = \begin{bmatrix} \text{producer prices} \\ \text{times yields} \end{bmatrix}$$

where

$a \in A$ = a set of activities,
 $c \in C$ = a set of commodities (also referred to as c' and C'),

PA_a = activity price (gross revenue per activity unit),
 $PXAC_{ac}$ = producer price of commodity c for activity a , and
 θ_{ac} = yield of output c per unit of activity a .

³⁸ For each domestically produced commodity, the marketed output value at producer prices is stated as the sum of the values of domestic sales and exports. This value excludes the value of home-consumed output. Domestic sales and exports are valued at the prices received by the suppliers, PDS and PE, both of which have been adjusted downwards to account for the cost of trade inputs.

³⁹ The gross revenue per activity unit, the activity price, is the return from selling the output or outputs of the activity, defined as yields per activity unit multiplied by activity-specific commodity prices, summed over all commodities. This allows for the fact that activities may produce multiple commodities.

7. Aggregate intermediate input price⁴⁰

$$PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{ca} \quad a \in A$$

$$\begin{bmatrix} \text{aggregate} \\ \text{intermediate} \\ \text{input price} \end{bmatrix} = \begin{bmatrix} \text{intermediate input cost} \\ \text{per unit of aggregate} \\ \text{intermediate input} \end{bmatrix}$$

where

$a \in A$ = a set of activities,
 $c \in C$ = a set of commodities (also referred to as c' and C'),

$PINTA_a$ = aggregate intermediate input price for activity a ,
 PQ_c = composite commodity price (including sales tax and transaction costs), and
 ica_{ca} = quantity of c per unit of aggregate intermediate input a .

8. Activity revenue and costs⁴¹

$$PA_a \cdot (1 - ta_a) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a \quad a \in A$$

$$\begin{bmatrix} \text{activity price} \\ \text{(net of taxes)} \\ \text{times activity level} \end{bmatrix} = \begin{bmatrix} \text{value-added} \\ \text{price times} \\ \text{quantity} \end{bmatrix} + \begin{bmatrix} \text{aggregate} \\ \text{intermediate} \\ \text{input price times} \\ \text{quantity} \end{bmatrix}$$

where
 $a \in A$ = a set of activities,

PA_a = activity price (gross revenue per activity unit),
 ta_a = tax rate for activity,
 QA_a = quantity (level) of activity,
 PVA_a = price of (aggregate) value added,
 QVA_a = quantity of (aggregate) value-added,
 $PINTA_a$ = aggregate intermediate input price for activity a , and
 $QINTA_a$ = quantity of aggregate intermediate input.

⁴⁰ The activity-specific aggregate intermediate input price shows the cost of disaggregated intermediate inputs per unit of aggregate intermediate input. It depends on composite commodity prices and intermediate input coefficients, which show the quantity of input commodity c per unit of aggregate intermediate input (not per unit of output).

⁴¹ For each activity, total revenue net of taxes is fully exhausted by payments for value-added and intermediate inputs. Implicitly defines the value-added price, PVA.

9. Consumer price index⁴²

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

$$\left[\begin{array}{l} \text{consumer} \\ \text{price index} \end{array} \right] = \left[\begin{array}{l} \text{prices times} \\ \text{weights} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),

\overline{CPI} = consumer price index,

PQ_c = composite commodity price (including sales tax and transaction costs), and

$cwts_c$ = weight of commodity c in the consumer price index.

10. Producer price index for non-traded market output

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

$$\left[\begin{array}{l} \text{producer price index} \\ \text{for non-traded output} \end{array} \right] = \left[\begin{array}{l} \text{prices times} \\ \text{weights} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),

DPI = producer price index for domestically marketed output,

PDS_c = supply price for commodity produced and sold domestically, and

$dwts_c$ = weight of commodity c in the producer price index.

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.

⁴² The CPI is fixed and functions as the numeraire in the basic model version. A numeraire is required since the model is homogenous of degree zero in prices—a doubling of the value of the numeraire would double all prices but leave all real quantities unchanged. All simulated price and income changes should be interpreted as changes vis-à-vis the numeraire price index.

11. CES technology: Activity production function⁴³

$$QA_a = \alpha_a^a \cdot (\delta_a^a \cdot QVA_a^{-\rho_a^a} + (1 - \delta_a^a) \cdot QINTA_a^{-\rho_a^a})^{-\frac{1}{\rho_a^a}} \quad a \in ACES$$

$$\left[\begin{array}{c} \text{activity} \\ \text{level} \end{array} \right] = \text{CES} \left[\begin{array}{c} \text{quantity of aggregate value added,} \\ \text{quantity of aggregate intermediate input} \end{array} \right]$$

where

$a \in ACES (\subset A) = a$ set of activities with a CES function at the top of the technology nest,
 $a \in A = a$ set of activities,

$QA_a =$ quantity (level) of activity,
 $\alpha_a^a =$ efficiency parameter in the CES activity function,
 $\delta_a^a =$ CES activity function share parameter,
 $QVA_a =$ quantity of (aggregate) value-added,
 $\rho_a^a =$ CES production (activity) function exponent, and
 $QINTA_a =$ quantity of aggregate intermediate input.

12. CES technology: value-added intermediate-input quantity ratio⁴⁴

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

$$\left[\begin{array}{c} \text{value-added-} \\ \text{intermediate-} \\ \text{input quantity} \\ \text{ratio} \end{array} \right] = f \left[\begin{array}{c} \text{intermediate-} \\ \text{value-added} \\ \text{price ratio} \end{array} \right]$$

where

$a \in ACES (\subset A) = a$ set of activities with a CES function at the top of the technology nest,
 $a \in A = a$ set of activities,
 $QVA_a =$ quantity of (aggregate) value-added,
 $QINTA_a =$ quantity of aggregate intermediate input,
 $PINTA_a =$ aggregate intermediate input price for activity a ,
 $PVA_a =$ price of (aggregate) value added,
 $\delta_a^a =$ CES activity function share parameter, and
 $\rho_a^a =$ CES production (activity) function exponent.

⁴³ The production function for activity is a CES function of the quantities of aggregate value added and intermediate inputs that yield commodity outputs in the production process.

⁴⁴ The optimal mix of intermediate inputs and value-added is a CES function of the relative prices of value-added and the aggregate intermediate input. ρ_a^a , is a transformation of the elasticity of substitution between value-added and the aggregate intermediate input: the higher this elasticity, the smaller the value of ρ_a^a and the larger the optimal change in the ratios between the quantities of value-added and the intermediate input aggregate in response to changes in their relative prices.

13. Leontief technology: Demand for aggregate value-added⁴⁵

$$QVA_a = iva_a \cdot QA_a \quad a \in ALEO$$

$$\left[\begin{array}{c} \text{demand for} \\ \text{value added} \end{array} \right] = f \left[\begin{array}{c} \text{activity} \\ \text{level} \end{array} \right]$$

where

$a \in A$ = a set of activities,
 $a \in ALEO(\subset A)$ = a set of activities with a Leontief function at the top of the technology nest,

QVA_a = quantity of (aggregate) value-added,
 iva_a = quantity of value-added per activity unit, and
 QA_a = quantity (level) of activity.

14. Leontief technology: Demand for aggregate intermediate input⁴⁶

$$QINTA_a = int a_a \cdot QA_a \quad a \in ALEO$$

$$\left[\begin{array}{c} \text{demand for aggregate} \\ \text{intermediate input} \end{array} \right] = f \left[\begin{array}{c} \text{activity} \\ \text{level} \end{array} \right]$$

where

$a \in A$ = a set of activities,
 $a \in ALEO(\subset A)$ = a set of activities with a Leontief function at the top of the technology nest,

$QINTA_a$ = quantity of aggregate intermediate input,
 $int a_a$ = quantity of aggregate intermediate input per activity unit, and
 QA_a = quantity (level) of activity.

⁴⁵ The demand for aggregate value added is a fixed share of activity level.

⁴⁶ The demand for aggregate intermediate inputs is a fixed share of activity level. The demands for value-added and the aggregate intermediate inputs are defined as Leontief functions of the activity level. Each element is an element in either ACES or ALEO, but not both.

15. Value-added and factor demands⁴⁷

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

$$\left[\begin{array}{l} \text{quantity of aggregate} \\ \text{value added} \end{array} \right] = \text{CES} \left[\begin{array}{l} \text{factor} \\ \text{inputs} \end{array} \right]$$

where

$a \in A = a$ set of activities,
 $f \in F (=F')$ = a set of factors,

QVA_a = quantity of (aggregate) value-added,
 α_a^{va} = efficiency parameter in the CES value-added function,
 δ_{fa}^{va} = CES value-added function share parameter for factor f in activity a ,
 QF_{fa} = quantity demanded of factor f from activity a , and
 ρ_a^{va} = CES value-added function exponent.

16. Factor demand⁴⁸

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

$$\left[\begin{array}{l} \text{marginal cost of} \\ \text{factor } f \text{ in activity } a \end{array} \right] = \left[\begin{array}{l} \text{marginal revenue product} \\ \text{of factor } f \text{ in activity } a \end{array} \right]$$

where

$a \in A = a$ set of commodities (also referred to as c' and C'),
 $f \in F (=F')$ = a set of factors,

WF_f = average price of factor,
 \overline{WFDIST}_{fa} = wage distortion factor for factor f in activity a ,
 PVA_a = price of (aggregate) value-added,
 tva_a = rate of value-added tax for activity a ,
 QVA_a = quantity of (aggregate) value-added,
 δ_{fa}^{va} = CES value-added function share parameter for factor f in activity a ,
 QF_{fa} = quantity demanded of factor f from activity a , and
 ρ_a^{va} = CES value-added function exponent.

⁴⁷ The quantity of value-added is a CES function of disaggregated primary factors.

⁴⁸ Activities demand factors at the point where the marginal cost of each factor (define on the left-hand side as the activity-specific factor price) is equal to the marginal revenue product (net of intermediate input costs) of the factor.

ρ_a^{va} , is a transformation of the elasticity of factor substitution: the higher the elasticity, the smaller the value of

ρ_a^{va} and the larger the optimal change in the ratios between different factor quantities in response to changes in

17. Disaggregated intermediate input demand

$$QINT_{ca} = ica_{ca} \cdot QINTA_a \quad a \in A, c \in C$$

$$\begin{bmatrix} \text{int ermediate demand} \\ \text{for commodity } c \\ \text{from activity } a \end{bmatrix} = f \begin{bmatrix} \text{aggregate int ermediate} \\ \text{input quantity} \\ \text{for activity } a \end{bmatrix}$$

where

$a \in A$ = a set of activities,
 $c \in C$ = a set of commodities (also referred to as c' and C'),
 $QINT_{ca}$ = quantity of commodity c as an int ermediate input to activity a ,
 ica_{ca} = quantity of c per unit of aggregate int ermediate input a , and
 $QINTA_a$ = quantity of aggregate int ermediate input.

18. Commodity production and allocation

$$QXAC_{ac} + \sum_{h \in H} QHA_{ach} = \theta_{ac} \cdot QA_a \quad a \in A, c \in CX$$

$$\begin{bmatrix} \text{marketed quantity} \\ \text{of commodity } c \\ \text{from activity } a \end{bmatrix} + \begin{bmatrix} \text{household home} \\ \text{consumption} \\ \text{of commodity } c \\ \text{from activity } a \end{bmatrix} = \begin{bmatrix} \text{production} \\ \text{of commodity } c \\ \text{from activity } a \end{bmatrix}$$

where

$a \in A$ = a set of activities,
 $c \in CX$ ($\subset C$) = a set of commodities with domestic output,
 $h \in H$ ($\subset INSDNG$) = a set of households,

$QXAC_{ac}$ = marketed output quantity of commodity c from activity a ,
 QHA_{ach} = quantity of household home consumption of commodity c from activity a for household h ,
 θ_{ac} = yield of output c per unit of activity a , and
 QA_a = quantity (level) of activity.

relative factor prices. The fact that the average factor price is an endogenous variable while the activity-specific “wage-distortion” factor is exogenous reflects the treatment of factor markets in the basic model version.

19. Output aggregation function

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

$$\left[\begin{array}{l} \text{aggregate} \\ \text{marketed} \\ \text{production of} \\ \text{commodity } c \end{array} \right] = \text{CES} \left[\begin{array}{l} \text{activity-specific} \\ \text{marketed} \\ \text{production of} \\ \text{commodity } c \end{array} \right]$$

where

$c \in C$ = a set commodities (also referred to as c' and C'),
 $c \in CX (\subseteq C)$ = a set of commodities with domestic output,
 $a \in A$ = a set of activities,

QX_c = aggregate marketed quantity of domestic output of commodity,
 α_c^{ac} = shift parameter for domestic commodity aggregation function,
 δ_{ac}^{ac} = share parameter for domestic commodity aggregation function,
 $QXAC_{ac}$ = marketed output quantity of commodity c from activity a , and
 ρ_c^{ac} = domestic commodity aggregation function exponent.

20. First-order condition for output aggregation function

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

$$\left[\begin{array}{l} \text{marginal cost of com-} \\ \text{modity } c \text{ from activity } a \end{array} \right] = \left[\begin{array}{l} \text{marginal revenue product of} \\ \text{commodity } c \text{ from activity } a \end{array} \right]$$

where

$a \in A$ = a set of activities,
 $c \in CX$ = a set of commodities (also referred to as c' and C'),

$PXAC_{ac}$ = producer price of commodity c for activity a ,
 PX_c = aggregate producer price for commodity,
 QX_c = aggregate marketed quantity of domestic output of commodity,
 δ_{ac}^{ac} = share parameter for domestic commodity aggregation function,
 $QXAC_{ac}$ = marketed output quantity of commodity c from activity a , and
 ρ_c^{ac} = domestic commodity aggregation function exponent.

21. Output transformation (CET) function⁴⁹

$$QX_c = \alpha_c^t \cdot (\delta_c^t \cdot QE_c^{\rho_c^t} + (1 - \delta_c^t) \cdot QD_c^{\rho_c^t})^{\frac{1}{\rho_c^t}} \quad c \in (CE \cap CD)$$

$$\left[\begin{array}{l} \text{aggregate marketed} \\ \text{domestic output} \end{array} \right] = \text{CET} \left[\begin{array}{l} \text{export quantity, domestic} \\ \text{sales of domestic output} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $c \in CE (\subset C)$ = a set of exported commodities (with domestic production),
 $c \in CD (\subset C)$ = a set of commodities with domestic sales of domestic output,

QX_c = aggregate marketed quantity of domestic output of commodity,

α_c^t = a CET function shift parameter,

δ_c^t = a CET function share parameter,

QE_c = quantity of exports,

ρ_c^t = a CET function exponent, and

QD_c = quantity sold domestically of domestic output.

22. Export-domestic supply ratio

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c} \cdot \frac{1 - \delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}} \quad c \in (CE \cap CD)$$

$$\left[\begin{array}{l} \text{export-domestic} \\ \text{supply ratio} \end{array} \right] = f \left[\begin{array}{l} \text{export-domestic} \\ \text{price ratio} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $c \in CE (\subset C)$ = a set of exported commodities (with domestic production),
 $c \in CD (\subset C)$ = a set of commodities with domestic sales of domestic output,

QE_c = quantity of exports,

QD_c = quantity sold domestically of domestic output,

PE_c = export price (LCU),

PDS_c = supply price for commodity produced and sold domestically,

δ_c^t = a CET function share parameter, and

ρ_c^t = a CET function exponent.

⁴⁹ The aggregated marketed domestic outputs are allocated for domestic sales and export, expressed by a constant elasticity of substitution. 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).

23. Output transformation for non-exported commodities

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

$$\begin{bmatrix} \text{aggregate} \\ \text{marketed} \\ \text{domestic output} \end{bmatrix} = \begin{bmatrix} \text{domestic market} \\ \text{sales of domestic} \\ \text{output [for } c \in (CD \cap CDN)] \end{bmatrix} + \begin{bmatrix} \text{exports [for} \\ c \in (CE \cap CDN)] \end{bmatrix}$$

where

$c \in C$ = a set of commodities (also referred to as c and C),
 $c \in CD (\subset C)$ = a set of commodities with domestic sales of domestic output,
 $c \in CEN (\subset C)$ = non-exported commodities (complement of CE),
 $c \in CE (\subset C)$ = a set of exported commodities (with domestic production),
 $c \in CDN (\subset C)$ = commodities without domestic market sales of domestic output (complement of CD),

QX_c = aggregate marketed quantity of domestic output of commodity,
 QD_c = quantity sold domestically of domestic output, and
 QE_c = quantity of exports.

24. Composite supply (Armington) function⁵⁰

$$QQ_c = \alpha_c^q \cdot (\delta_c^q \cdot QM_c^{-\rho_c^q} + (1 - \delta_c^q) \cdot QD_c^{-\rho_c^q})^{-\frac{1}{\rho_c^q}} \quad c \in (CM \cap CD)$$

$$\begin{bmatrix} \text{composite} \\ \text{supply} \end{bmatrix} = f \begin{bmatrix} \text{import quantity, domestic} \\ \text{use of domestic output} \end{bmatrix}$$

where

$c \in C$ = a set of commodities (also referred to as c and C),
 $c \in CM (\subset C)$ = a set of imported commodities,
 $c \in CD (\subset C)$ = a set of commodities with domestic sales of domestic output,

QQ_c = quantity of goods supplied to domestic market (composite supply),
 α_c^q = an Armington function shift parameter,
 δ_c^q = an Armington function share parameter,
 QM_c = quantity of imports of commodity, and
 ρ_c^q = an Armington function exponent.

⁵⁰ 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.

25. Import-domestic demand ratio

$$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1 - \delta_c^q} \right)^{\frac{1}{1 + \rho_c^q}} \quad c \in (CM \cap CD)$$

$$\left[\begin{array}{l} \text{import-domestic} \\ \text{demand ratio} \end{array} \right] = f \left[\begin{array}{l} \text{domestic-import} \\ \text{price ratio} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as \bar{c} and \mathcal{C}),
 $c \in CM (\subset C)$ = a set of imported commodities
 $c \in CD (\subset C)$ = a set of commodities with domestic sales of domestic output,

QM_c = quantity of imports of commodity,
 QD_c = quantity sold domestically of domestic output,
 PM_c = import price in LCU (local-currency units) including transaction costs,
 PDD_c = demand price for commodity produced and sold domestically,
 δ_c^q = an Armin gton function share parameter, and
 ρ_c^q = an Armin gton function exponent.

26. Composite supply for non-imported outputs and non-produced imports

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

$$\left[\begin{array}{l} \text{composite} \\ \text{supply} \end{array} \right] = \left[\begin{array}{l} \text{domestic use of} \\ \text{marketed domestic} \\ \text{output [for} \\ \text{c} \in (CD \cap CMN)] \end{array} \right] + \left[\begin{array}{l} \text{imports [for} \\ \text{c} \in (CM \cap CDN)] \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $c \in CD (\subset C)$ = a set of commodities with domestic sales of domestic output,
 $c \in CDN (\subset C)$ = commodities without domestic market sales of domestic output (complement of CD),
 $c \in CM (\subset C)$ = a set of imported commodities,
 $c \in CMN (\subset C)$ = a set of non-imported commodities,

QQ_c = quantity of goods supplied to domestic market (composite supply),
 QD_c = quantity sold domestically of domestic output, and
 QM_c = quantity of imports of commodity.

27. Demand for transactions services

$$QT_c = \sum_{c' \in C'} (icm_{c,c'} \cdot QM_{c'} + ice_{c,c'} \cdot QE_{c'} + icd_{c,c'} \cdot QD_{c'}) \quad c \in CT$$

$$\left[\begin{array}{l} \text{demand for} \\ \text{transactions} \\ \text{services} \end{array} \right] = \left[\begin{array}{l} \text{sum of demands} \\ \text{for imports, exports,} \\ \text{and domestic sales} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $c \in CT (\subset C)$ = a set of domestic trade inputs (distribution commodities),

QT_c = quantity of commodity demanded as transactions service input,
 $icm_{c,c'} = icm_{c',c}$ = quantity of commodity c' as trade input per imported unit of c ,
 $QM_{c'} = QM_c$ = quantity of imports of commodity,
 $ice_{c,c'} = ice_{c',c}$ = quantity of commodity c' as trade input per exported unit of c ,
 $QE_{c'} = QE_c$ = quantity of exports,
 $icd_{c,c'} = icd_{c',c}$ = quantity of commodity c' as trade input per unit of c produced and sold domestically, and
 $QD_{c'} = QD_c$ = quantity sold domestically of domestic output.

INSTITUTION BLOCK

Institutional block contains the income and expenditure of the four major institutions (households, government, enterprises and ROW).

28. Factor income⁵¹

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

$$\left[\begin{array}{l} \text{income of} \\ \text{factor } f \end{array} \right] = \left[\begin{array}{l} \text{sum of activity payments} \\ \text{(activity-specific wages} \\ \text{times employment levels)} \end{array} \right]$$

where

$a \in A$ = a set of activities,
 $f \in F (=F')$ = a set of factors,

YF_f = income of factor f ,
 WF_f = average price of factor,

\overline{WFDIST}_{fa} = wage distortion factor for factor f in activity a , and
 QF_{fa} = quantity demanded of factor f from activity a .

29. Institutional factor incomes⁵²

$$YIF_{if} = shif_{if} \cdot \left[(1 - tf_f) \cdot YF_f - trnsfr_{rowf} \cdot EXR \right] \quad i \in INSD, f \in F$$

$$\left[\begin{array}{l} \text{income of} \\ \text{institution } i \\ \text{from factor } f \end{array} \right] = \left[\begin{array}{l} \text{share of income} \\ \text{of factor } f \text{ to} \\ \text{institution } i \end{array} \right] \cdot \left[\begin{array}{l} \text{income of factor } f \\ \text{(net of tax and} \\ \text{transfer to RoW)} \end{array} \right]$$

where

$i \in INS$ = a set of institutions (domestic and rest of the world),
 $i \in INSD (\subset INS)$ = a set of domestic institutions,
 $i \in INSDNG (= INSDNG' \subset INSD)$ = a set of domestic non-government institutions,
 $f \in F (=F')$ = a set of factors,

YIF_{if} = income to domestic institution i from factor f ,
 $shif_{if}$ = share of domestic institution i in income of factor f ,
 tf_f = direct tax rate for factor f ,
 YF_f = income of factor f ,
 $trnsfr_{rowf}$ = transfer from factor f to institution i (RoW), and
 EXR = exchange rate (LCU per FCU).

⁵¹ The total income of each factor is defined as the sum of activity payments. 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.

30. Income of domestic, non-government institutions

$$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{i\ gov} \cdot \overline{CPI} + trnsfr_{i\ row} \cdot EXR \quad i \in INSDNG$$

$$\left[\begin{array}{c} \text{income of} \\ \text{institution } i \end{array} \right] = \left[\begin{array}{c} \text{factor} \\ \text{income} \end{array} \right] + \left[\begin{array}{c} \text{transfers} \\ \text{from other domestic} \\ \text{non-government} \\ \text{institutions} \end{array} \right] + \left[\begin{array}{c} \text{transfers} \\ \text{from} \\ \text{government} \end{array} \right] + \left[\begin{array}{c} \text{transfers} \\ \text{from} \\ \text{RoW} \end{array} \right]$$

where

$i \in INS$ = a set of institutions (domestic and rest of the world),
 $i \in INSD (\subset INS)$ = a set of domestic institutions,
 $i \in INSDNG (= INSDNG' \subset INSD)$ = a set of domestic non-government institutions,
 $f \in F (= F')$ = a set of factors,

YI_i = income of institution i (in the set $INSDNG$),
 YIF_{if} = income to domestic institution i from factor f ,
 $TRII_{ii'}$ = transfers from institution i' to i (both in the set $INSDNG$),
 $trnsfr_{i\ gov}$ = transfers from government,
 \overline{CPI} = consumer price index,
 $trnsfr_{i\ row}$ = transfers from RoW, and
 EXR = exchange rate (LCU per FCU).

31. Intra-institutional transfers

$$TRII_{ii'} = shii_{i'} \cdot (1 - MPS_{i'}) \cdot (1 - TINS_{i'}) \cdot YI_{i'} \quad i \in INSDNG, i' \in INSDNG'$$

$$\left[\begin{array}{c} \text{transfer from} \\ \text{institution } i' \text{ to } i \end{array} \right] = \left[\begin{array}{c} \text{share of net income} \\ \text{of institution } i' \\ \text{transferred to } i \end{array} \right] \left[\begin{array}{c} \text{income of institution} \\ i', \text{ net of savings and} \\ \text{direct taxes} \end{array} \right]$$

where

$i (= i') \in INS$ = a set of institutions (domestic and rest of the world),
 $i (= i') \in INSD (\subset INS)$ = a set of domestic institutions,
 $i (= i') \in INSDNG (= INSDNG' \subset INSD)$ = a set of domestic non-government institutions,

$TRII_{ii'}$ = transfers from institution i' to i (both in the set $INSDNG$),
 $shii_{i'}$ = share of net income of i' to i ($i' \in INSDNG'$; $i \in INSDNG$),
 $MPS_{i'}$ = marginal propensity to save for domestic non-government institution,
 $TINS_{i'}$ = direct tax rate for institution i ($i \in INSDNG$), and
 $YI_{i'}$ = a set of domestic non-government institutions.

⁵² 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. The direct tax rate factor f in the above equation is taken as zero as Ethiopia does not impose direct tax for factor, that is tf_f is zero.

32. Household consumption expenditure

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

$$\left[\begin{array}{l} \text{household income} \\ \text{disposable for} \\ \text{consumption} \end{array} \right] = \left[\begin{array}{l} \text{household income, net of direct} \\ \text{taxes, savings, and transfers to} \\ \text{other non-government institutions} \end{array} \right]$$

where

$i \in INS$ = a set of institutions (domestic and rest of the world),
 $i \in INSD (\subset INS)$ = a set of domestic institutions,
 $i \in INSDNG (= INSDNG' \subset INSD)$ = a set of domestic non-government institutions,
 $h \in H (\subset INSDNG)$ = a set of households,

EH_h = household consumption expenditures,
 $shii_{i,h}$ = household income (share of net income of h to i)
 MPS_h = savings (marginal propensity to save for h)
 $TINS_h$ = direct tax rate for h (net of direct taxes), and
 YI_h = income of h .

33. Household consumption demand for marketed commodities

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

$$\left[\begin{array}{l} \text{household consumption} \\ \text{spending on market} \\ \text{commodity } c \end{array} \right] = f \left[\begin{array}{l} \text{total household consumption} \\ \text{spending, market price of } c, \text{ and other} \\ \text{commodity prices (market and home)} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $h \in H (\subset INSDNG)$ = a set of households,

$PQ_c = PQ_{c'}$ = composite commodity price (including sales tax and transaction costs),
 $QH_{c,h}$ = quantity of consumption of marketed commodity c for household h ,
 $\gamma_{c,h}^m = \gamma_{c',h}^m$ = subsistence consumption of marketed commodity c for household h ,
 $\beta_{c,h}^m$ = marginal share of consumption spending on marketed commodity c for household h ,
 EH_h = household consumption expenditures,
 $PXAC_{ac} = PXAC_{ac}$ = producer price of commodity c for activity a , and
 $\gamma_{ac,h}^h = \gamma_{ach}^h$ = subsistence consumption of home commodity c from activity a for household h .

34. Household consumption demand for home commodities

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

$$c \in C, h \in H$$

$$\left[\begin{array}{l} \text{household consumption} \\ \text{spending on home commodity} \\ \text{c from activity a} \end{array} \right] = f \left[\begin{array}{l} \text{total household consumption spending,} \\ \text{producer price, and other} \\ \text{commodity prices } \in (\text{market and home}) \end{array} \right]$$

where

$a \in A$ = a set of activities,
 $c \in C$ = a set of commodities (also referred to as c' and C'),
 $h \in H (\subset \text{INSDNG})$ = a set of households,

$PXAC_{ac} = PXAC_{ac}$ = producer price of commodity c for activity a ,
 QHA_{ach} = quantity of household consumption of commodity c from activity a for household h ,
 $\gamma_{ach}^h = \gamma_{ac'h}^h$ = subsistence consumption of home commodity c from activity a for household h ,
 β_{ach}^h = marginal share of consumption spending on home commodity c from activity for household h ,
 EH_h = household consumption expenditures,
 $PQ_{c'} = PQ_{c'}$ = composite commodity price (including sales tax and transaction costs), and
 $\gamma_{c'h}^m = \gamma_{c'h}^m$ = subsistence consumption of marketed commodity c for household h .

35. Investment demand

$$QINV_c = \overline{IADJ} \cdot \overline{qinv}_c \quad c \in CINV$$

$$\left[\begin{array}{l} \text{fixed investment} \\ \text{demand for} \\ \text{commodity c} \end{array} \right] = \left[\begin{array}{l} \text{adjustment factor} \\ \text{times} \\ \text{base-year fixed} \\ \text{investment} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $QINV_c$ = quantity of fixed investment demand for commodity,
 \overline{IADJ} = investment adjustment factor, and
 \overline{qinv}_c = base-year quantity of fixed investment demand.

36. Government consumption demand

$$QG_c = \overline{GADJ} \cdot \overline{qg}_c \quad c \in C$$

$$\left[\begin{array}{l} \text{government} \\ \text{consumption} \\ \text{demand for} \\ \text{commodity c} \end{array} \right] = \left[\begin{array}{l} \text{adjustment factor} \\ \text{times} \\ \text{base-year government} \\ \text{consumption} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 QG_c = government consumption demand for commodity,
 \overline{GADJ} = government consumption adjustment factor, and
 \overline{qg}_c = base-year quantity of government demand.

37. Government revenue⁵³

$$\begin{aligned}
 YG = & \sum_{i \in \text{INSDNG}} TINS_i \cdot YI_i + \sum_{f \in F} tf_f \cdot YF_f + \sum_{a \in A} tva_a \cdot PVA_a \cdot QVA_a + \sum_{a \in A} ta_a \cdot PA_a \cdot QA_a + \\
 & \sum_{c \in \text{CM}} tm_c \cdot pwm_c \cdot QM_c \cdot EXR + \sum_{c \in \text{CE}} te_c \cdot pwe_c \cdot QE_c \cdot EXR + \sum_{c \in \text{EC}} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YIF_{\text{gov } f} + \text{trnsfr}_{\text{gov row}} \cdot EXR \\
 \left[\begin{array}{c} \text{government} \\ \text{revenue} \end{array} \right] = & \left[\begin{array}{c} \text{direct taxes} \\ \text{from} \\ \text{institutions} \end{array} \right] + \left[\begin{array}{c} \text{direct taxes} \\ \text{from} \\ \text{factors} \end{array} \right] + \left[\begin{array}{c} \text{value-} \\ \text{added} \\ \text{tax} \end{array} \right] + \left[\begin{array}{c} \text{activity} \\ \text{tax} \end{array} \right] + \left[\begin{array}{c} \text{import} \\ \text{tariffs} \end{array} \right] + \left[\begin{array}{c} \text{export} \\ \text{taxes} \end{array} \right] + \left[\begin{array}{c} \text{sales} \\ \text{tax} \end{array} \right] + \left[\begin{array}{c} \text{factor} \\ \text{income} \end{array} \right] + \left[\begin{array}{c} \text{transfers} \\ \text{from} \\ \text{RoW} \end{array} \right]
 \end{aligned}$$

where

$i \in \text{INS}$ = a set of institutions (domestic and rest of the world),
 $i \in \text{INSD} (\subset \text{INS})$ = a set of domestic institutions,
 $i \in \text{INSDNG} (= \text{INSDNG}' \subset \text{INSD})$ = a set of domestic non-government institutions,
 $f \in F (= F')$ = a set of factors,
 $c \in C$ = a set of commodities (also referred to as c' and C'),
 $a \in A$ = a set of activities,
 $c \in \text{CM} (\subset C)$ = a set of imported commodities,
 $c \in \text{CE} (\subset C)$ = a set of exported commodities (with domestic production),

YG = government revenue,
 $TINS_i$ = direct tax rate for institution i ($i \in \text{INSDNG}$),
 YI_i = income of institution i (in the set INSDNG),
 tf_f = direct tax rate for factor f ,
 YF_f = income of factor f ,
 tva_a = rate of value-added tax for activity a ,
 PVA_a = price of (aggregate) value-added,
 QVA_a = quantity of (aggregate) value-added,
 ta_a = tax rate for activity,
 PA_a = activity price (gross revenue per activity unit),
 QA_a = quantity (level) of activity,
 tm_c = import tariff rate,
 pwm_c = c.i.f. import price in FCU (foreign-currency units),
 QM_c = quantity of imports of commodity,
 EXR = exchange rate (LCU per FCU),
 te_c = export tax rate,
 pwe_c = f.o.b. export price (FCU),
 QE_c = quantity of exports,
 tq_c = rate of sales tax (as share of composite price inclusive of sales tax),
 PQ_c = composite commodity price (including sales tax and transaction costs),
 QQ_c = quantity of goods supplied to domestic market (composite supply),
 $YIF_{\text{gov } f}$ = factor income or income from factor f , and
 $\text{trnsfr}_{\text{gov row}}$ = transfers from RoW.

⁵³ 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. In Ethiopia direct tax from factors, “value-added taxes” on activities, activity taxes and export taxes (Tf_f , Tva_a , Ta_a , and Te_c) are excluded from the equation specifying the government revenue sources. This is because those taxes are fictional in Ethiopia.

38. Government expenditure

$$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNG} \text{trnsfr}_{i \text{ gov}} \cdot \overline{CPI}$$

$$\left[\begin{array}{c} \text{government} \\ \text{spending} \end{array} \right] = \left[\begin{array}{c} \text{government} \\ \text{consumption} \end{array} \right] + \left[\begin{array}{c} \text{transfers to domestic} \\ \text{non-government} \\ \text{institutions} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $i \in INS$ = a set of institutions (domestic and rest of the world),
 $i \in INSD (\subset INS)$ = a set of domestic institutions,
 $i \in INSDNG (= INSDNG' \subset INSD)$ = a set of domestic non-government institutions,

EG = government expenditures,
 PQ_c = composite commodity price (including sales tax and transaction costs),
 QG_c = government consumption demand for commodity,
 $\text{trnsfr}_{i \text{ gov}}$ = transfers to domestic non-government institutions, and
 \overline{CPI} = consumer price index.

SYSTEM CONSTRAINT 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.

39. Factor market⁵⁴

$$\sum_{a \in A} QF_{fa} = \overline{QFS}_f \quad f \in F$$

$$\left[\begin{array}{c} \text{demand for} \\ \text{factor } f \end{array} \right] = \left[\begin{array}{c} \text{supply of} \\ \text{factor } f \end{array} \right]$$

where

$a \in A$ = a set of activities,
 $f \in F (= F')$ = a set of factors,

QF_{fa} = quantity demanded of factor f from activity a , and
 \overline{QFS}_f = quantity supplied of factor.

40. Composite commodity markets⁵⁵

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

$$\left[\begin{array}{c} \text{composite} \\ \text{supply} \end{array} \right] = \left[\begin{array}{c} \text{intermediate} \\ \text{use} \end{array} \right] + \left[\begin{array}{c} \text{household} \\ \text{consumption} \end{array} \right] + \left[\begin{array}{c} \text{government} \\ \text{consumption} \end{array} \right] + \left[\begin{array}{c} \text{fixed} \\ \text{investment} \end{array} \right] + \left[\begin{array}{c} \text{stock} \\ \text{change} \end{array} \right] + \left[\begin{array}{c} \text{trade} \\ \text{input use} \end{array} \right]$$

where

$a \in A$ = a set of activities,
 $c \in C$ = a set of commodities (also referred to as c' and C'),
 $h \in H (\subset \text{INSDNG})$ = a set of households,

QQ_c = quantity of goods supplied to domestic market (composite supply),
 $QINT_{ca}$ = quantity of commodity c as intermediate input to activity a ,
 QH_{ch} = quantity of consumption of marketed commodity c for household h ,
 QG_c = government consumption demand for commodity,
 $QINV_c$ = quantity of fixed investment demand for commodity,
 $qdst_c$ = quantity of stock change, and
 QT_c = quantity of commodity demanded as transactions service input.

⁵⁴ This equation imposes equality between the total quantity demanded and the total quantity supplied for each factor. All demand variables are flexible while the supply variable is fixed. The factor wage, WF_f , is the equilibrating variable that assures that this equation is satisfied: an increase in WF_f raises the wage paid by each activity $WF_f \cdot \overline{WFDIST}_{fa}$, which is inversely related to the quantities of factor demand, QF_{fa} . 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.

⁵⁵ This equation imposes equality between quantities supplied and demanded of the composite commodity. The composite commodity supply, QQ , derives demands for domestic marketed output, QD , and imports, QM . The market-clearing variables are the quantities of import supply, for the import side, and the two interrelated domestic prices, PDD and PDS , for domestic market output.

41. Current account balance for rest of the world (in foreign currency)⁵⁶

$$\sum_{c \in CM} p w m_c \cdot Q M_c + \sum_{f \in F} t r n s f r_{r o w f} = \sum_{c \in CE} p w e_c \cdot Q E_c + \sum_{i \in INSD} t r n s f r_{i r o w} + \overline{F S A V}$$

$$\left[\begin{array}{c} \text{import} \\ \text{spending} \end{array} \right] + \left[\begin{array}{c} \text{factor} \\ \text{transfers} \\ \text{to RoW} \end{array} \right] = \left[\begin{array}{c} \text{export} \\ \text{revenue} \end{array} \right] + \left[\begin{array}{c} \text{institutional} \\ \text{transfers} \\ \text{from RoW} \end{array} \right] + \left[\begin{array}{c} \text{foreign} \\ \text{savings} \end{array} \right]$$

$c \in CM (\subset C)$ = a set of imported commodities,
 $c \in C$ = a set of commodities (also referred to as c' and C'),
 $c \in CE (\subset C)$ = a set of exported commodities (with domestic production),
 $f \in F (=F)$ = a set of factors,
 $i \in INS$ = a set of institutions (domestic and rest of the world),
 $i \in INSD (\subset INS)$ = a set of domestic institutions,
 $i \in INSDNG (=INSDNG' \subset INSD)$ = a set of domestic non-government institutions,

$p w m_c$ = c.i.f. import price in FCU (foreign-currency) units,
 $Q M_c$ = quantity of imports of commodity,
 $t r n s f r_{r o w f}$ = factor transfers to RoW,
 $p w e_c$ = f.o.b. export price (FCU),
 $Q E_c$ = quantity of exports,
 $t r n s f r_{i r o w}$ = institutional transfers from RoW, and
 $\overline{F S A V}$ = foreign savings (FCU).

⁵⁶ The current-account balance, which is expressed in foreign currency, imposes equality between the country's spending and its earning of foreign exchange. Foreign savings is fixed; the (real) exchange (EXR) serves the role of equilibrating variable to the current-account balance. The fact that all items except imports and exports are fixed means that, in effect, the trade deficit also is fixed. There is also an alternative closure for external balance; exchange rate may be fixed and foreign savings unfixed.

42. Government balance⁵⁷

$$YG = EG + GSAV$$

$$\left[\begin{array}{c} \text{government} \\ \text{revenue} \end{array} \right] = \left[\begin{array}{c} \text{government} \\ \text{expenditures} \end{array} \right] + \left[\begin{array}{c} \text{government} \\ \text{savings} \end{array} \right]$$

where

YG = government revenue,
 EG = government expenditure, and
 $GSAV$ = government savings.

43. Direct institutional tax rates⁵⁸

$$\overline{TINS}_i = \overline{tins}_i \cdot (1 + \overline{TINSADJ} \cdot \overline{tins01}_i) + \overline{DTINS} \cdot \overline{tins01}_i, \quad i \in INSDNG$$

$$\left[\begin{array}{c} \text{direct tax} \\ \text{rate for} \\ \text{institution } i \end{array} \right] = \left[\begin{array}{c} \text{base rate adjusted} \\ \text{for scaling for} \\ \text{selected institutions} \end{array} \right] + \left[\begin{array}{c} \text{point change} \\ \text{for selected} \\ \text{institutions} \end{array} \right]$$

where

$i \in INS$ = a set of institutions (domestic and rest of the world),
 $i \in INSD (\subset INS)$ = a set of domestic institutions,
 $i \in INSDNG (= INSDNG' \subset INSD)$ = a set of domestic non-government institutions,

\overline{TINS}_i = rate of direct tax on domestic institutions i ,
 \overline{tins}_i = exogenous direct tax rate for domestic institution i ,
 $\overline{TINSADJ}$ = direct tax scaling factor (=0 for base),
 $\overline{tins01}_i$ = 0-1 parameter with 1 for institutions with potentially flexed direct tax rates, and
 \overline{DTINS} = change in domestic institution tax share (=0 for base).

⁵⁷ The government balance imposes equality between current government revenue and the sum of current government expenditures (not including government investment) and savings. Savings may be negative. For the government balance, flexible government saving 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 government savings and scaled direct tax rates for selected institutions.

⁵⁸ This equation defines the direct tax rates of domestic non-government institutions. Government savings is the endogenous variable that clears the government balance.

44. Institutional savings rates⁵⁹

$$\overline{MPS}_i = \overline{mps}_i \cdot (1 + \overline{MPSADJ} \cdot \overline{mps01}_i) + \overline{DMPS} \cdot \overline{mps01}_i \quad i \in \overline{INSDNG}$$

$$\left[\begin{array}{c} \text{savings} \\ \text{rate for} \\ \text{institution } i \end{array} \right] = \left[\begin{array}{c} \text{base rate adjusted} \\ \text{for scaling for} \\ \text{selected institutions} \end{array} \right] + \left[\begin{array}{c} \text{point change} \\ \text{for selected} \\ \text{institutions} \end{array} \right]$$

where

$i \in \overline{INS}$ = a set of institutions (domestic and rest of the world),
 $i \in \overline{INSD} (\subset \overline{INS})$ = a set of domestic institutions,
 $i \in \overline{INSDNG} (= \overline{INSDNG}' \subset \overline{INSD})$ = a set of domestic non-government institutions,

\overline{MPS}_i = marginal propensity to save for domestic non-government institution,
 \overline{mps}_i = base savings rate for domestic institution i ,
 \overline{MPSADJ} = savings rate scaling factor (=0 for base),
 $\overline{mps01}_i$ = 0–1 parameter with 1 for institutions with potentially flexed direct tax rates, and
 \overline{DMPS} = change in domestic institution savings rates (=0 for base).

45. Savings-investment balance⁶⁰

$$\sum_{i \in \overline{INSDNG}} \overline{MPS}_i \cdot (1 - \overline{TINS}_i) \cdot \overline{YI}_i + \overline{GSAV} + \overline{EXR} \cdot \overline{FSAV} = \sum_{c \in C} \overline{PQ}_c \cdot \overline{QINV}_c + \sum_{c \in C} \overline{PQ}_c \cdot \overline{qdst}_c$$

$$\left[\begin{array}{c} \text{non-govern-} \\ \text{ment savings} \end{array} \right] + \left[\begin{array}{c} \text{government} \\ \text{savings} \end{array} \right] + \left[\begin{array}{c} \text{foreign} \\ \text{savings} \end{array} \right] = \left[\begin{array}{c} \text{fixed} \\ \text{investment} \end{array} \right] + \left[\begin{array}{c} \text{stock} \\ \text{change} \end{array} \right]$$

where

$i \in \overline{INS}$ = a set of institutions (domestic and rest of the world),
 $i \in \overline{INSD} (\subset \overline{INS})$ = a set of domestic institutions,
 $i \in \overline{INSDNG} (= \overline{INSDNG}' \subset \overline{INSD})$ = a set of domestic non-government institutions,
 $c \in C$ = a set of commodities (also referred to as c' and C'),

\overline{MPS}_i = marginal propensity to save for domestic non-government institution,
 \overline{TINS}_i = rate of direct tax on domestic institutions i ,
 \overline{YI}_i = income of institution i (in the set \overline{INSDNG}),
 \overline{GSAV} = governmentsavings,
 \overline{EXR} = exchange rate (LCU per FCU),
 \overline{FSAV} = foreign savings (FCU),
 \overline{PQ}_c = composite commodity price (including sales tax and transaction costs),
 \overline{QINV}_c = quantity of fixed investment demand for commodity, and
 \overline{qdst}_c = quantity of stock change.

⁵⁹ This equation defines the savings rates of domestic nongovernment institutions. \overline{DMPS} is flexible, permitting \overline{MPS} to be adjusted by a uniform rate for selected (one or more) nongovernment institutions.

⁶⁰ This equation states that total savings and total investment have to be equal. Total savings is the sum of savings from domestic nongovernment institutions, the government, and the rest of the world, with the last item converted into domestic currency. Total investment is the sum of the values of fixed investment (gross fixed capital formation) and stock changes. The flexible variable, \overline{DMPS} , performs the task of clearing this balance.

46. Total absorption⁶¹

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

$$\left[\begin{array}{l} \text{total} \\ \text{absorption} \end{array} \right] = \left[\begin{array}{l} \text{household} \\ \text{market} \\ \text{consumption} \end{array} \right] + \left[\begin{array}{l} \text{household} \\ \text{home} \\ \text{consumption} \end{array} \right] + \left[\begin{array}{l} \text{government} \\ \text{consumption} \end{array} \right] + \left[\begin{array}{l} \text{fixed} \\ \text{investment} \end{array} \right] + \left[\begin{array}{l} \text{stock} \\ \text{change} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),
 $h \in H$ (\subseteq INSDNG) = a set of households,
 $a \in A$ = a set of activities,

$TABS$ = total nominal absorption,
 PQ_c = composite commodity price (including sales tax and transaction costs),
 QH_{ch} = quantity of consumption of marketed commodity c for household h ,
 $PXAC_{ac}$ = producer price of commodity c for activity a ,
 QHA_{ach} = quantity of household home consumption of commodity c from activity a for household h ,
 QG_c = government consumption demand for commodity,
 $QINV_c$ = quantity of fixed investment demand for commodity, and
 $qdst_c$ = quantity of stock change.

47. Ratio of investment to absorption

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

$$\left[\begin{array}{l} \text{investment} \\ \text{absorption} \\ \text{ratio} \end{array} \right] \cdot \left[\begin{array}{l} \text{total} \\ \text{absorption} \end{array} \right] = \left[\begin{array}{l} \text{fixed} \\ \text{investment} \end{array} \right] + \left[\begin{array}{l} \text{stock} \\ \text{change} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),

$INVSHR$ = investment share in nominal absorption,
 $TABS$ = total nominal absorption,
 PQ_c = composite commodity price (including sales tax and transaction costs),
 $QINV_c$ = quantity of fixed investment demand for commodity, and
 $qdst_c$ = quantity of stock change.

⁶¹ Total absorption is measured as the total value of domestic final demands, which equals GDP at market prices plus imports minus exports.

48. Ratio of government consumption to absorption

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

$$\left[\begin{array}{l} \text{government} \\ \text{consumption-} \\ \text{absorption} \\ \text{ratio} \end{array} \right] \cdot \left[\begin{array}{l} \text{total} \\ \text{absorption} \end{array} \right] = \left[\begin{array}{l} \text{government} \\ \text{consumption} \end{array} \right]$$

where

$c \in C$ = a set of commodities (also referred to as c' and C'),

$GOVSHR$ = government consumption share in nominal absorption,

$TABS$ = total nominal absorption,

PQ_c = composite commodity price (including sales tax and transaction costs), and

QG_c = government consumption demand for commodity.

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 for closures the first alternative is investment-driven closure, where saving adjusts 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. 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).

DECLARATION

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

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