THE QUEST FOR GROWTH IN DEVELOPING COUNTRIES: AN ANALYSIS OF THE EFFECTS OF FOREIGN AID ON ECONOMIC GROWTH

Daniel Chris Khomba

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The Quest for Growth in Developing Countries: An Analysis of the Effects of Foreign Aid on Economic Growth

Daniel Chris Khomba

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I, Daniel Chris Khomba, hereby certify that this thesis, which is approximately 68,876 words in length, has been written by me, and that it is the record of work carried out by me and that it has not been submitted in any previous application for a higher degree.

I was admitted as a research student in September 2013 and as a candidate for the degree of PhD Economics in September 2013; the higher study for which this is a record was carried out in the University of St. Andrews between 2013 and 2016.

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Address for correspondence:

School of Economics & Finance
University of St. Andrews
St. Andrews
Fife, UK
KY16 9AL

Email: dck2@st-andrews.ac.uk

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Abstract

Large quantities of foreign development assistance continue to flow to many developing countries. At the same time, most of the aid-receiving countries have stagnated and become even more aid-dependent. This grim reality provokes vigorous debate on the effectiveness of aid. Despite the voluminous research on aid effectiveness, clear evidence to support the view that development aid stimulates economic growth remains scant.

This thesis intends to extend the existing literature on foreign aid and economic growth. First we re-examine results from cross-country studies to provide new insights on the lack of robustness of results from this approach. We further explore and deepen the observation that cross-country results are fragile, particularly when the number of countries in the sample changes. Secondly, we study the impact of district-level aid disbursement on the growth of average nighttime light density in Malawi. We use two plausibly exogenous determinants of within-country aid allocation to isolate the causal effects of aid. The results show a robust and quantitatively significant effect of aid flows in stimulating growth of light density. We find a hump-shaped growth response over three years. Finally, the thesis presents a theoretical model that explores how aid affects economic growth and welfare in an economy with subsistence constraints. The main results from this analysis are; (i) productive aid has higher long run growth and welfare effects than pure aid (ii) the rate of convergence depends crucially on how close the initial conditions are to the subsistence level (iii) while growth effects are maximised when all the aid is allocated to productive aid, we find that optimal welfare is reached when some proportion of aid is also allocated to pure transfers.

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Abbreviations

2SLS	Two-Stage Least Squares
AMP	Aid Management Platform
CES	Constant Elasticity of Substitution
DAC	Development Assistance Committee
DfID	Department for International Development
DMSP	Defense Meteorological Satellite Programme
DPP	Democratic Progressive Party
EMIS	Education Management Information Systems
FDI	Foreign Direct Investment
FISP	Farm Input Subsidy Programme
GDP	Gross Domestic Product
GIS	Geographic Information System
HIPC	Highly Indebted Poor Countries
HLFs	High Level Forums
ICRG	International Country Risk Guide
IDA	International development Agency
IES	Intertemporal Elasticity of Substitution
IMF	International Monetary fund
IV	Instrumenta Variable
LDCs	Least Developed Countries
MCP	Malawi Congress Party
MDGs	Millenium Development Goals
MGDS	Malawi Growth and Development Strategy
MoAFS	Ministry of Agriculture and Food Security
MoEST	Ministry of Education, Science and Technology
MPs	Members of Parliament
NGDC	National Geographic Data Centre
NLGFC	National Local Government Finance Committee
NOAA	National Oceanic and Atmospheric Administration
NSO	National Statistical Office
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OEEC	Organisation for European Economic Co-operation
OLS	Ordinary Least Squares
PP	Peoples Party
PSIP	Public Sector implementation Programme
PWT	Penn World Tables
SDGs	Sustainable Development Goals
SGP	Stone-Geary Preferences
SSA	Sub Saharan Africa
SWAp	Sector Wide Approach
UDF	United Democratic Front
USAID	United Stated Agency for International Development
WDI	World Development Indicators

Chapter 1

Introduction

"It is ironic that the volume of aid is declining just as the environment for effective aid is improving. By increasing financial assistance to poor countries . . . , we could help hundreds of millions of the poorest people in the world to improve their lives, and the lives of their children."

David Dollar, (World Bank's News Release, 1998).

1.1 Foreign Aid and Economic Growth in Developing Countries: An Overview

Since 1960, over US$2.4 trillion[1] of foreign development aid has been transfered from the developed world to Least Developed Countries (LDCs). During the 1990s however, there was a notable declining trend in aid flows to developing countries. At the time David Dollar gave the above quote, official development assistance (ODA) had declined from about US$91.8 billion in 1991 to about US$72 billion in 1998. The end of the Cold War in particular had resulted in a marked reduction in foreign development assistance, as the objectives for giving aid also shifted.

Over the last decade, however, international financial flows to low income countries, particularly in Sub Saharan Africa region, have grown six-fold and averages about 18% of GDP, (GDI (2012))[2]. In 2012 alone, over US$133 billion of ODA was disbursed to developing countries. Additionally, aside from the increase in flows of development assistance to least developed countries, from the late 1990s and into the 21st Century, the international community also intensified efforts in improving the environment for making aid more effective. International agreements have been put in place setting out initiatives

[1]Source: OECD Statistics (http://stats.oecd.org/qwids)
[2]German Development Institute Annual Report (2012)

for increasing donor coordination, to strengthen recipient countries' capacity in developing and implementing national strategies and reducing or eliminating aid conditionality to improve alignment with country development goals. Further commitments have been agreed to manage resources for improving results from aid initiatives as well as developing comprehensive systems for monitoring and evaluation of the intended impact of aid.

Despite the increase in aid flows and the renewed emphasis and attention to improving the environment for effective aid, the experience with economic growth within the LDCs (particularly in SSA nations) remains deeply disappointing, with falling average per-capita incomes and in many developing countries escalating poverty levels. Easterly (2001) points out that the median per capita growth of output in developing countries was 2.5% between 1960 and 1979 while between 1980 and 1999 it declined to 0.0%. In essence many developing countries stagnated between 1980 and 1999. Furthermore, from the 1990's, least developed countries have experienced increasing marginalisation, inequality, poverty and social exclusion. The number of countries classified by the World Bank as LDCs doubled from the list compiled in 1979 to 49 countries by 2001, with a number of African countries experiencing negative economic growth rates in the 1980s and 1990s (White (1992)).

Thus, while declining aid flows to developing countries may indeed be a matter of concern, recent experience does not offer much evidence to support Dollar's view that increasing financial flows would lead to improving livelihood for generations of poor people in least developed countries either. Scaling up of ODA has prospects for a better future for developing countries, but it certainly also continues to raise serious challenges for policy makers and academia alike. Heller (2005) and Gupta et al. (2006) identified a checklist of some of the policy challenges that they argue will determine the success of scaling up aid flows, and hence require concerted analysis and assessment, along with lessons learnt from past experiences. These challenges include, among others, managing the macroeconomic effects of scaling up aid and its effect on the competitiveness of recipient countries, preventing aid dependency and developing an exit strategy, management of fiscal and monetary policy and the delivery of public services, strengthening domestic institutions and governance structures and reducing corruption.

Donor perspectives on and motivations for giving development assistance have changed

significantly over time. In the 1960s and 1970s it was provided to assist in state building as many developing nations gained independence from their colonial rulers. It then gained momentum during the Cold War era when development cooperation, and foreign aid in particular, was used to '*buy*' elites and form alliances and thus influence affairs in third world countries. Developmental goals of aid were at the time a secondary or incidental outcome.

The primary reason for financial flows to Least Developed Countries (LDCs) in recent times is "*to spur economic growth that will generate development so that poverty, one of the worst problems facing human race today, can be reduced*," Sachs et al. (2004). Sub-Saharan Africa, the most impoverished region in the world, is perhaps unsurprisingly the most financially aided region in the developing world. In the last two decades, the rhetoric for aid has increasingly shifted towards addressing challenges of under-development and extreme poverty that induces human suffering including hunger and starvation, lack of proper shelter/dwellings and inability to afford basic education. These culminate into health conditions that have come to be termed 'diseases of poverty' such as chronic malnutrition, HIV/AIDS, Malaria etc.

The new direction was further intensified in the new millennium by the events of 11th September, 2001 (terrorist attacks on New York and the Pentagon) as the industrialized world realized the increasing significance of developing countries to global security. For example, several developing countries in Asia and Africa have served as staging points for terrorism and other threats. It has been recognized that persistent poverty and under-development leaves LDCs in a very vulnerable position that is easily exploited by extremist organizations.[3]

Consequently, there have been intensified efforts by the donor community in mobilizing resources for development aid, with volumes of aid to developing countries surging since the turn of the millennium.[4] The Millennium Development Goals were created to provide a framework agreed by all countries as well as leading aid agencies and development institutions to galvanize unprecedented efforts to meet the challenges faced by the

[3]While some evidence has found little direct link between poverty or education and participation in terrorism, Krueger and Maleckova (2003) find that poverty may indirectly affect terrorism through the link between economic conditions and proclivity to incidence of civil conflict and wars.

[4]A more detailed view on the trends in international development assistance is provided in the next section.

world's poorest communities.[5] Having reached the target date in 2015, Heads of State and Government and High Representatives gathered at the Third International Conference on Financing for Development in Addis Ababa (Ethiopia) in July 2015 for the *Addis Ababa Action Agenda* where the Sustainable Development Goals (SDGs) were agreed to replace the elapsed MDGs. Building on previous agreements of development financing,[6] the SDGs[7] are an enhanced framework to mobilise resources for the fight against extreme poverty and strengthen universal peace.

The grim reality facing the international development policy arena with regards to scaling-up of aid amidst seemingly ever increasing levels of economic malaise, extreme poverty and very low economic growth rates has raised a lot of concerns over the effectiveness of foreign transfers and their ability to promote sustainable growth and development. Questions like "What is effective aid?" and "Does aid work or not?" have become a source of substantial debate among academic researchers, policy makers and aid practitioners alike over the past 7 decades.

The objective of this thesis is to contribute to the literature on the impact of foreign aid and economic growth; to do this we conduct have a critical analysis of the existing literature and identify some of the main challenges contributing to the never-ending debate about the effects of aid. Since we discuss the existing literature in detail in the forthcoming chapters, we do not go deeply into the literature review in this introduction, instead the remaining sections of this chapter present some background analysis of the effect of aid on growth, the definitions of aid and how this affects measurements of aid, the evolution of the notion of aid and some trends in aid flows.

[5]The eight Millennium Development Goals (MDGs) range from halving extreme poverty rates to halting the spread of HIV/AIDS and providing universal primary education, all by the target date of 2015.

[6]Including the Monterrey Consensus in 2002, the Paris Declaration in 2005 and the Doha Declaration in 2008

[7]Sustainable Development Goals framework has increased the targeted key areas from 8 in the MDGs to 17, including ending poverty, hunger, improving health and well-being as well as the quality of education and strengthening peace, justice and institutions.

1.2 The Effect of Aid on economic growth in developing countries

The extent to which foreign aid can impact on the growth rate of output is still a matter of great controversy. Over the years, the assessment of the effectiveness of aid has been conducted based on different underlying theoretical growth models and econometric approaches, using both microeconomic and macroeconomic evidence. The results from such different approaches have also been just as different. In particular it is observed that when microeconomic approaches are employed, often by assessing directly the economic rate of return of individual aid financed projects or in recent years by using randomised trials, the results indicate some considerable success for the effectiveness of foreign aid. The most comprehensive evaluations in this approach have been done by the World Bank's Independent Evaluation Group (IEG), through rigorous country assessment of World Bank financed projects (World Bank (2008)) and report positive and significant effects of aid. Further, Banerjee and Duflo (2009) discuss in more detail the evidence and contribution from randomised field experiments which also provide positive effects of aid from microeconomic evidence.

On the other hand, the evidence from macroeconomic approaches to the evaluation of aid's impact on economic growth and development is at best conflicting. Some scholars such as Sachs et al. (2004) argue for increased financial flows to developing countries to uplift such economies from poverty traps and and lead them to the end of poverty. Others such as Burnside and Dollar (2000) take a cautious approach recommending that more aid is beneficial but only if allocated to countries with 'good' policies. At the same time, Rajan and Subramanian (2008) conclude that it is difficult to discern any systematic effect of foreign aid on economic growth and Moyo (2009) argues for complete cessation of aid flows to Africa.

Mosley et al. (1987) labeled this contradiction as the micro-macro paradox and offered three explanations for its causes, pointing to some of the weaknesses of the macroeconomic approach to assessing the impact of aid. The first explanation regards inaccurate measurement of aid effectiveness, the second pertains to the fungibility of aid in the public

sector[8] and the last explanation is potential negative effect of aid on investment and hence on output. Furthermore, White (1992) claims there are some genuine reasons for not expecting effects of aid on growth in the aggregate, giving some further explanations for the existence of the micro-macro paradox including problems as a result of over-aggregation across countries in cross-country studies.

From 1990s, new growth theory emerged recognising that physical capital accumulation could no longer be regarded as the only source of economic growth[9]. This approach reignited the aid effectiveness literature by focusing on the interaction between foreign aid and other factors in the recipient countries such as policies, institutional capacity and other geophysical features. Much of the empirical assessment of the impact of aid on growth since then has regarded the effect of stable macroeconomic environment including international trade regimes, property rights, quality of institutions including public services as well as political and social stability and how these factors affect the effects of foreign aid. Probably the most popular empirical study that argues for the positive effects of aid conditional on sound macroeconomic management and good quality institutions is the study by Burnside and Dollar (2000). The findings of this study[10] prompted many development partners to reconsider the role of aid and its strategies in spurring sustainable economic growth and development.

In general, the results of aid effectiveness assessments have been largely influenced by the lack of a unanimously accepted complete theory of the aid-growth relationship that can guide the direction of empirical evaluation. As a result, the persisting elusiveness of robust empirical evidence that can support aid effectiveness has often been attributed to the macroeconometric methodologies for cross-country analysis. In addition, the prior analyses of aid effectiveness failed to include such as the issues the heterogeneous nature of the developing world. Different stages of economic development and wide cultural diversity makes state and institutional capability vary significantly from one country to another. This has brought doubts over the results from cross-country studies about the effect of aid on economic growth.

[8] Aid fungibility means that a government can increase resources through the aid inflows, to increase spending, fund tax cuts, or reduce the fiscal deficit (reducing future tax). This would cause a negative impact of aid on growth (World Bank, 1998).

[9] see Easterly (1999) and Easterly and Levine (2001).

[10] An earlier version of this study conducted in 1997 formed the main basis for the World Bank's Policy Research Report: Assessing Aid (1998)

1.3 Brief Recap of Foreign Aid

Foreign Aid in Perspective

Development assistance has now accumulated over seven decades of experience, growing into an international operation transferring massive amounts of resources to developing countries and employing multitudes of people in many agencies and organizations around the world. From modest origins in the nineteenth century, the concept of aid grew through various stages, becoming established in the post-World War II and Cold War eras and playing a significant role in political development of the third world during the wave of independence in the 1960s and transition to liberal democracies in the 1990s.

Over the years, there have been notable changes in the objectives and strategies for aid; institutions involved (rise of multilateral institutions in the 1970s and Non-Governmental Organizations (NGOs) in the 1980s and 1990s); types of aid (from food aid to financial programme aid) as well as further changes in the size, composition and allocation of aid to developing countries. This section gives a brief recap of the background to the notion of foreign development assistance, discussing issues related to the definition and measurement of aid, an overview of the evolution of aid and a look at the trends and patterns in aid flows.

1.3.1 Definition of Aid

It is now a common practice in the literature to define foreign aid by considering its intended purpose, realising that aid for different purposes will probably have different impact on development. For instance, aid given to promote economic reforms or for infrastructure development would be expected to have short run and possibly greater influence on growth than military aid (without ignoring the possible indirect effects that military aid may have on long run development). In light of this, distinction is made between two broad categories of aid:

a) *Humanitarian/Relief aid* referring to financial flows, material donations or logistical assistance mainly provided in response to natural or man-made humanitarian crises with the primary aim of saving lives, preventing or alleviating bodily harm and suffering as well as maintaining human dignity.

b) *Development aid (non-humanitarian aid)* is given in a manner that can reasonably be expected to promote development, understood to be improvements in human well-being and alleviation of poverty, whether achieved through economic growth, social, environmental and political development or other means.

When conducting aid effectiveness analysis, only development aid is considered in the literature. Development aid in itself takes many different forms, as such there is some degree of ambiguity in the literature on the terminology for foreign aid, and its measurement. For some authors, development aid comprises all financial flows from donor countries and institutions to developing countries including official loans and grants, trade financing military grants etc. while others only consider aid to mean grants and concessional loans.

What has become the conventionally accepted definition of development aid in the literature and the development community, not least in terms of its size and influence, is ODA, introduced in the 1970's by the Development Assistance Committee (DAC) of the Organization for Economic Co-operation and Development (OECD). As per this definition, ODA comprises all official flows (financial or otherwise) disbursed from bilateral donors or multilateral institutions to developing countries listed on the DAC 'List of Aid Recipients' for the primary purpose of promoting economic development and social welfare.

According to the OECD, in order to be classified as ODA, flows should satisfy the following criteria: (i) they must be administered by the official sector of the donor country (ii) have as a primary objective the promotion of economic development and social welfare and (iii) must be given on concessional terms with a grant element, i.e. an implicit subsidy included on the loan of at least 25% of the face value of the loan, calculated as the ratio of the grant equivalent part of the loan to the face value of a concessional loan and discount rate of 10%. In addition to financial flows, ODA also includes technical assistance or technical co-operation costs, however it does not include grant, loans/credits or equipment for military or peace-keeping purposes and nuclear energy (unless for civilian use). Transfer payments to private individuals, donations from the public, commercial loans and foreign direct investment (FDI) are also not considered as part of ODA.

It has become common in the literature to treat ODA and development aid (or indeed 'foreign aid' in general) as one and the same. This is misleading as over the years the

activities of NGO's and other faith/charitable organizations have increased and contribute quite significantly to societies' economic empowerment and social development in many developing countries. By definition, this is part of development aid but is not classified as ODA.

The OECD approach to defining and measuring official development aid has some shortcomings beginning with, perhaps unsurprisingly, that it includes 'too little.' By excluding among others contributions by NGOs, faith based organizations and other charity institutions, ODA's cash-flow-based measurement leaves out increasingly important efforts and the impact that these institutions are playing in the developing world. Further, in a continually evolving global environment, donors are providing more efforts in terms of guarantees, callable capital etc. These are not classified as ODA but play important role in mobilizing investment for development particularly in present times when many developing countries require huge loans and equity, rather than grants, to boost infrastructure and finance economic growth (Lomoy (2013)).

On the other hand, other scholars feel that ODA includes 'too much,' arguing that it accounts for much more than the actual money that goes into developing countries budgets. Chang et al. (1998) argue that ODA does not present an accurate measure of the true value of foreign aid flows by, among others, over-representing loans with high concessionality and under-representing loans with low concessionality; as well as the inclusion of official technical assistance (TA) grants with their full value, using constant discount and interest rates instead of actual market rates and not accounting for credit risk. Other scholars have pointed to the inclusion of administrative costs, refugee costs etc. as further sources of distortion to ODA's measurement of development aid.

Chang et al. (1998) claim that conventional net ODA has overstated the real aid flows by 25 to 30 percent over the last few years. They suggest an alternative approach to ODA in the form of Effective Development Assistance (EDA), which comprises exclusively grants and the grant shares of official loans, calculated on a basis of actual interest rates. While some of the arguments raised by this study are legitimate, others are quite problematic and lead to underestimation of the actual values of aid, for instance the exclusion of technical assistance.

The foregoing discussion points to an aspect that a researcher must be aware of when conducting aid effectiveness analysis, defining the scope and measurement of aid being considered in the analysis. As is conventional in the literature, this research will use ODA as the preferred measure of development aid. Despite the noted shortcomings, ODA remains the only systematically and best-recorded means available for assessing the efforts the 'traditional' donors make to support development.

1.3.2 Evolution of Aid

The notion of 'Foreign Aid' as known in the modern era is a post-World War II phenomenon. In the aftermath of WWII, the international economic system had collapsed, and war-ravaged Europe faced a critical shortage of capital and an acute need for physical reconstruction. The response to this was probably the most successful aid program ever implemented, the European Recovery Program, popularly known as the Marshall Plan. It was a bilateral financial assistance programme from the US to Europe, at the peak of which the USA transferred some 2-3 per cent of its national income to help restore Europe (approximately 20-30 times the level of foreign assistance as a share of national income that the US provides today). During the four years that the plan was operational (1948-1951) the US donated over $13 billion (equivalent of $148 billion in 2013 reflecting currency inflation)[11] in economic and technical assistance for the recovery of European countries that had joined the Organization for European Economic Cooperation (OEEC), an organization which later became the Organisation for Economic Cooperation and Development (OECD).

The success of the Marshall Plan fueled highly optimistic expectations of the future effectiveness of aid. The focus turned to developing countries beginning with the World Bank's first loan to Colombia in 1950 and the passing of the United States Act for International Development (1950) that established the USA's foreign policy to assist poor countries around the world (Wolf (1960) and Ohlin (1970)). Channing et al. (2014) points out that post-war Europe, unlike most developing countries today, was well endowed with skilled labour, had well established institutional frameworks and operated at the leading edge of technology (used before and during the war). After the war, the fundamental missing

[11] see Schain (2001)

element for rapid recovery of Europe was capital, which foreign aid successfully provided.

Most importantly however, the post war period saw the institutionalization of key multilateral organizations in the context of foreign financing/assistance. The World Bank and International Monetary Fund (IMF) formed at the Bretton Woods Conference in 1944 to secure global economic and financial stability and face the problem of escalating poverty in the world by providing capital to development programmes that promote sustainable economic growth. The OECD was formed in 1948 to promote good policy practices in market economies to achieve sustainable economic growth in the process of economic development that will improve the economic and social well-being of the people[12].

In the decades after WWII, the notion of foreign financing/assistance has evolved as the focus shifted from the recovering economies in Europe; coming of age during the Cold War era (1960s-1980s) when aid was used to support client/allied states; to the present day when the primary focus is achieving sustainable development. Table (1.B.1) in Appendix (1.B) gives a brief overview of the key developments in the background to foreign aid that have taken place since the end of WWII[13].

While the need for foreign aid as a moral obligation of the rich to the poor has always existed from earlier times, two important factors that have at various stages influenced the discourse of foreign aid policy in the modern era are political factors and the process of development thinking. Development thinking has been more complicated and non-linear in nature where as key geopolitical influences on international aid have been the Cold War, the collapse of the Soviet Union, events of the September 11 and most recently the emergence of China as a global power and a major player in international aid.

During the 1950s and 1960s, foreign aid spending shifted from Western Europe and Japan to U. S. military allies in the Middle East and Asia and to poor countries in sub-Saharan Africa and South Asia. Donor ideology and focus during this period was to stop newly independent nations from "going to the other side (communist side)"and to promote peace in the Middle East. Notably, with regards to economic growth theory, it was at the time of Rosenstein-Rodan's "big push theory" (see Rosenstein-Rodan (1943)), Rostow's

[12]The United Nations is another key post-WWII institution worth mentioning in the history of aid.

[13]Table modified and amended from Hjertholm and White (2000) and updated using Channing et al. (2014).

"stages of economic growth" (see Rostow (1960)) and the "two-gap model" of Chenery and Strout (1966). They argued, each in their different ways, that the main constraint to economic development was capital accumulation, and supplementing domestic savings was the role of aid. Also, it was recognized that there were sufficiently strong market failures and externalities in most of the emerging countries such that the government and central planning had to play a key role in managing the investment and aid process in the recipient country.

In the 1970s, aid flows rose as regional 'development banks' and multilateral organization, particularly the World Bank's International Development Association (IDA) [14] increased activities. Support for state-led initiatives continued, however there was a shift from targeting overall growth through productive sectors to poverty reduction and social welfare development. Furthermore, the demand for development cooperation gained momentum in the the 1960s and 1970s fueled by a number of developing nations gaining independence. It was realised at the time that there was a group of poorer countries with economic disincentives that lay not only in the profound poverty of their people but also from weaknesses in their institutional and human resource capacities often compounded by their geophysical handicaps.

The 1980's experienced significant events that had impact on foreign aid policy, beginning with the OPEC oil shock in 1979 to the fall of the Berlin wall (1989) and the collapse of the Soviet Union (1989-91) while conservative administrations took power in the USA (Ronald Reagan), UK (Margaret Thatcher), and Germany (Helmut Kohl). Against this background, there was decisive shift in the aid doctrine, shifting from the statist approach towards support to market based approach to achieving development. Further, the balance of payments crisis in the late 1970s and the financial crisis in the early 1980s that resulted in global economic instability strengthened the criticism against the statist and inward looking import substitution strategies, resulting in a shift towards macroeconomic reforms and market liberalisations.

This was the era of "structural adjustment" programmes (SAPs). Country policies which included promotion of trade, development of financial systems and promotion of market-oriented reforms, were seen as key to restructuring macroeconomic policies in order to

[14] Which increased its operations under the 'soft loan window' to provide loans to developing countries

achieve economic stabilisation and growth. Aid transfers took the form of budget support and/or debt cancellation conditioned on policy reforms following the tenets of the 'Washington Consensus[15].' Another important development during this period was the rise of non-governmental organizations (NGO) as agents in foreign aid delivery and bilateral donors agencies, such as United States Agency for International Development (USAID) and UK's Department for International Development (DfID) became further removed from the implementation of foreign assistance projects and began to channel their resources through NGOs.

The end of the Cold War in the 1990s affected international aid in three ways: (i) countries from Eastern Europe and former Soviet Union re-emerged as recipients (ii) with the war over, poverty reappeared as the driving ideology behind aid, partly due to the heavy criticism of the structural adjustments policies[16] and the rapid deterioration of socio-economic conditions in Eastern Europe and former Soviet Union states as highlighted in the World Bank's *World Development Report (1990)*[17] and (iii) serious consideration to governance and human rights issues in developing countries. These factors saw some preferred recipients becoming less so while in many countries aid was withdrawn on the basis of the perceived "low quality" of governance, unlike in the Cold War era when donors did not give much consideration to internal governance matters in recipient countries. This resulted in a reduction in aid spending during the 1990s.

The new millennium began with the Millennium Summit of the United Nations (UN) General Assembly held in New York (USA) in September, 2000 at which world leaders from all 189[18] UN member states and a further 23 international organizations adopted and made a commitment to achieve the Millennium Development Goals (MDGs), which included 8 goals and 18 targets. The second major event that affected aid in the new millennium was 11th September, 2001 terrorist attacks on New York City and the Pentagon. Other than fighting poverty, there was a significant shift in donor perspectives (especially the US) upon the realisation that developing countries played a critical role in global security as several countries in Asia and Africa were being used as staging points

[15]Williamson (2000) provides a more detailed history of the Washington Consensus.

[16]See UNICEF funded reports such as Grant (1990) "The State of World's Children" and Cornia et al. (1987) "Adjustments with a Human Face."

[17]see Bank (1990)

[18]At the time, there were 189 UN member states, there are currently 193 members.

for terrorist activities, and hence the need for more cooperation with governments in developing countries to assure global security. For instance, in 2002 President George W. Bush promised $4.5 billion in aid to Afghanistan.[19]

The major influence on the evolution of aid in the new millennium has emanated from the efforts of the United Nations through a series of high level forums on aid; the first International Conference on Financing for Development (ICFD) was held in Mexico in 2002 where the Monterrey Consensus was agreed and charted an action plan for a global response to the challenges of financing for development with the goal to eradicate poverty, achieve sustained economic growth and development, advancing towards an 'inclusive and equitable' global economic system. The Paris High Level Forum on Aid Effectiveness held in France in 2005 followed the Monterrey meeting and here the Paris Declaration was agreed. The Monterrey consensus and the Paris Declaration set out the road map for conduct of both donors and aid recipients in the administration of development aid in order to maximise its effectiveness and impact.

The two conferences highlighted the role of both private investment and official development assistance and acknowledged that the poorest countries cannot really be expected to attract large inflows of private capital because they lack the basic conditions (infrastructure and human capital). They addressed a number of areas of financing for development:

a) mobilizing international resources for development including foreign direct investment and other private flows.
b) improving international trade as an engine for development.
c) increasing international financial and technical cooperation for development.
d) addressing systemic issues: enhancing the coherence and consistency of the international monetary, financial and trading systems in support of development.
e) advocating for recipient countries to lead the development efforts in their countries through their own development strategies and policies and that donor activities should be harmonised and aligned to support the priorities outlined the country development strategies.

Since the Paris Declaration, further agreements and declarations on financing for development have agreed to build on the agreements of the two first meetings. The Accra

[19] http://www.voanews.com/a/a-13-a-2002-10-11-29-bush/391996.html

Agenda for Action agreed in Ghana in 2008 to strengthen and deepen implementation of the Paris Declaration on Aid Effectiveness drawing from strong evidence of what is and is not working [20]. The Doha Declaration was made at a meeting in Qatar in 2008 to reaffirm the Monterrey Consensus and its holistic approach, recognising that mobilizing financial resources for development and the effective use of all those resources are central to the global partnership for sustainable development. The most recent high level forum for financing for development was held in 2015 in Addis Ababa, Ethiopia where the Addis Ababa Agenda for Action was agreed and most crucially set the platform for the Sustainable Development Goals (SDGs) which were agreed upon by Heads of State and Government at the UN headquarters in New York, USA in 2015.

In most recent times, two more important factors have emerged that play a significant role on the state of aid beginning with the financial crisis of 2008, which has had severe impact on developing countries. The World Bank projected that among other effects, developing economies would face between $270-$700 billion financing gap as a result of the crisis, about 20% fall in foreign direct investment and also deteriorating export revenues as a result of falling commodity prices and further falls in private financial flows, remittances and access to credit.[21] The cumulative impact of the crisis implied that official development assistance assumed an even greater importance to developing economies not only to curb the impacts of the crisis but also to ensure continued progress towards achieving the MDGs. However, the impact of the crisis on the developed economies implied that many donor governments would face serious challenges in meeting their commitments, many cutting their aid budgets.

The second factor is emergence of new donors particularly China's[22] rapid rise into an economic and political power, much to the benefit of Sub-Saharan Africa region; China now represents more than 20 per cent of SSA's trade, up from just 2.3 per cent in 1985. Most importantly however, China has increased its aid to developing countries as a strategy for idealism and strengthening diplomatic and political ties with the developing world. In 2011, the Information Office of the Chinese State Council, for the very first time, issued

[20] Gathered primarily from a 2008 monitoring survey and an evaluation exercise on the implementation of the Paris Declaration

[21] see World Bank's *World Development Report (2009)*

[22] Other emerging donors, that are relatively on a smaller scale compared to China, include India and Russia

the White Paper on 'China's Foreign Aid,' reporting that China's financial resources for foreign aid have increased rapidly, averaging 29.4 per cent annual growth from 2004 to 2009. By the end of 2009, China had provided a total of 256.29 billion Yuan (approximately $41.5 billion) in aid to foreign countries (Africa's share accounted for 45.7% of this total). This rapid increase in Chinese influence particularly in Africa has become an international focus and drawn concerns from traditional donors from the West who criticise Chinese aid because for failing to promote democracy, equitable and sustainable development, and environmental preservation in these countries and loss of ability to influence behaviour of aid recipients regarding human rights and economic reforms because of China's policy of providing foreign assistance without conditions.

1.3.3 Trends in net ODA flows

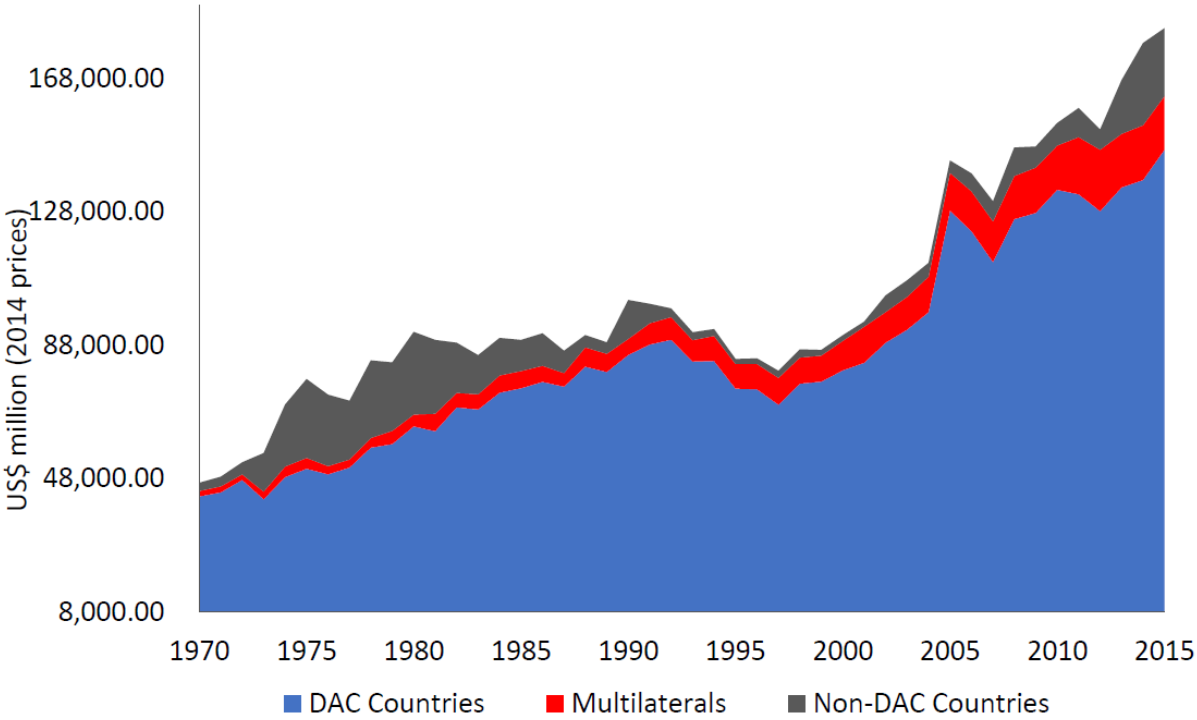
In this section, we take a look at the trends in flow of aid to developing countries. As stated earlier, in this thesis we use ODA as defined by the OECDs Development Assistance Committee (DAC). The data used comes from the World Bank's (*World Development Indicators (2016)*) and the OECD's online database.

Figure 1.3.1 below presents the trend in official development assistance to developing countries (at constant 2014 US$ prices and exchange rates), indicating a rise from a modest US$46.7 billion in 1975 to US$183.0 billion in 2015. While the figure indicates a clear upward trend in net flows to developing countries, there have been periods when aid flows have stagnated or indeed experienced a downward trend. For instance, having risen from US$46.7 billion in 1970 to US$92.0 billion in 1980, the trend flattened and averaged about US$89.0 billion between 1981 and 1989. Generally, a similar trend can be observed in other forms of capital flows to developing countries during this period, to a large extent as a result of the global recession that affected donor countries towards the late 1980s (Temple (2010)).

The decline trend was more noticeable in the 1990s, as shown by the trend in net ODA per capita in figure 1.A.1 in the appendix; net ODA per capita declined from US$32.64 in 1990 to about US$18.82 by 2000.[23] Aggregate flows declined from US$101.5 billion in

[23]Net ODA per capita data obtained from World Bank's World Development Indicators, and reported in current US$ prices and exchange rates

Figure 1.3.1: Trends in Official Development Assistance (current prices)



Notes: Data obtained from OECD website (http://stats.oecd.org/BrandedView.aspx?oecd_bv_id=dev-data-en&doi=data-00072-en#).

1991 to US$80.2 billion in 1997. The main reason for the downward turn in aid flows to developing countries during this period was the end of the Cold War, which changed the geopolitical state of the world and most developed countries decreased their foreign aid from their budgets. Another reason was the eruption of the Gulf War that resulted in rising fuel prices. For some donors, such as Italy, Sweden and Finland who had been running huge fiscal deficits, they faced increasing domestic pressure on their budgets.

In some cases, declines in official development assistance would be compensated by increase in private flows; however there are times when both ODA and private flows would expand/contract at the same time. For instance, both official aid flows and private flows (mainly bank credit) expanded rapidly in the 1970s (private flows rose from US$48.1 billion in 1970 to US$99.5 billion in 1980).[24] In the 1980s official aid virtually stagnated while private flows declined significantly (see figure (1.A.2)). As mentioned earlier, from 1991 to 1997 there was a sharp decline in official aid inflows, however, it was compensated with a strong expansion in private capital inflows to developing countries, including

[24]Data from OECD Statistics, at constant US$2014 prices and exchange rates

both equity and non-equity flows; total private flows rose from US$54.7 billion in 1992 to US$136.1 billion in 2000.

Since 2000, official development assistance increased rapidly particularly within the framework of the Millennium Development Goals (MDGs) which were agreed upon in the Millennium Declaration agreed by members of the United Nations in 2000. The MDGs set a range of objectives to be met by 2015[25], which required large amount of financial support to developing countries.

Other than the rapid increase in aid flows, the period after 2000 also experianced some shifts in aid delivery including preference for direct budget support (payment through government budgets) pooling of resources from multiple donors for sector-wide support (SWAps) in areas such as health and education and expansion of program aid relative to traditional project-based aid. Many of these were in line with recommendations agreed under the Paris Declaration in 2000.

On the supply side, Japan had been the largest donor of aid to developing countries, in volume terms, from the early 1990s till 2001 when the United States became the largest donor. Japan's aid had dropped by nearly US$4 billion, partly due to sharp depreciation of Japanese yen.

The United States remains the world's largest aid donor in terms of volume (provided US$30.1 billion in 2012 and have disbursed about US$273 billion in the last decade); Germany, the United Kingdom and France have in the last 5 years substantially increased their aid disbursements (see table 1.3.1) and have leapfrogged Japan who before then used to be the second major donor. Germany disbursed US$13.8 billion, followed by the UK (US$13.7 billion), France (US$12.8 billion) while Japan disbursed about US$10.7. As a trend, net flows from the United States peaked in 2005 when they disbursed US$31.7 billion and have been declining since relative to the total aid flows from DAC members; on the other hand, combined aid flows from EU member countries have been steadily increasing.

[25]Compared to 1990, the MDGs aim to halve the proportion of people whose income is less than $1 a day, and the proportion of people who suffer from hunger; achieve universal primary education; empowerment of women; reduce under-five mortality by two-thirds; reduce maternal mortality by three-quarters; intesnify the fight against HIV/AIDS, malaria, and other diseases; halve the proportion of people without sustainable access to safe drinking water and basic sanitation.

Table 1.3.1: Net ODA by DAC donors (US$ million)

Donor	2000-02	2003-05	2006-08	2009-11	2012-15
Australia	7,046.48	7,406.79	10,168.38	11,927.81	17,600.35
Austria	2,887.95	3,558.92	5,529.63	3,591.27	5,026.07
Belgium	4,987.04	6,924.44	6,870.35	8,678.31	9,456.93
Canada	9,813.18	12,007.93	13,969.27	14,971.96	19,176.12
Czech Republic	183.11	472.82	607.48	647.76	866.78
Denmark	9,303.71	7,930.96	8,428.48	8,885.46	11,819.13
Finland	2,190.98	2,841.37	3,362.74	4,267.34	6,052.38
France	23,984.63	32,303.89	33,109.69	38,676.84	45,523.26
Germany	25,951.08	30,320.30	39,556.68	40,412.81	65,775.38
Greece	1,250.95	1,335.23	1,622.78	1,431.17	1,144.85
Iceland	43.62	65.33	123.55	104.96	146.54
Ireland	1,463.81	2,002.08	3,305.44	2,786.93	3,338.21
Italy	9,771.49	12,761.05	13,389.44	10,740.90	14,928.88
Japan	31,431.30	29,706.96	28,519.06	25,392.12	38,516.85
Korea	1,144.05	1,905.12	2,126.67	3,828.32	7,435.44
Luxembourg	860.07	1,025.76	1,268.61	1,327.92	1,699.40
Netherlands	17,192.83	16,754.67	19,590.08	19,294.26	23,803.78
New Zealand	875.11	1,045.91	1,283.97	1,345.05	1,976.75
Norway	9,727.75	11,406.51	12,437.90	14,197.57	20,370.89
Poland	144.11	478.56	1,060.16	1,192.97	1,907.58
Portugal	1,591.65	2,184.76	1,536.88	1,864.79	1,902.08
Slovak Republic	56.01	159.34	243.83	234.31	354.19
Spain	8,633.86	9,303.61	15,753.06	16,259.95	8,224.11
Sweden	9,554.56	11,101.07	14,688.07	15,843.00	25,679.45
Switzerland	5,333.17	6,856.04	7,044.07	8,259.78	13,604.39
United kingdom	21,239.50	29,288.65	34,634.19	43,128.58	73,325.11
United States of America	45,033.48	77,505.63	80,290.59	95,778.85	127,325.65

Source: OECD (2016), Net ODA (indicator). (https://data.oecd.org/oda/net-oda.htm)

Although aggregate trends in net ODA flows to developing countries present an upward trend, these flows are smaller than they used to be, relative to gross national incomes of the donor countries. Since the 1970s net ODA flows have shrunk by more than a quarter relative to the GNI of donor nations.

Geographically, Sub-Saharan Africa (SSA) continues to be a high priority region since the 1970s, with over a third of total ODA being disbursed to countries within this region, as shown in table (1.3.2). This rapid increase in aid to SSA from the 1970s followed donors' reorientation of the objectives of aid towards poverty reduction.

Bilateral donors, such as the UK white paper 'More Aid for the Poorest' in 1975, explicitly advocated for SSA region as the main target for aid since it is the region with the largest

Table 1.3.2: Total ODA received per region (US$ millions)

	1970-79	1980-89	1990-99	2000-09	2010-14
Europe	**223.998**	**497.945**	**1382.261**	**2541.037**	**2610.144**
Africa	**2632.961**	**8504.859**	**13557.6**	**20905.21**	**30254.84**
North of Sahara	722.935	1996.935	2993.47	1822.865	1927.15
South of Sahara	1856.307	6330.03	10077.35	18394.96	26961.53
America	**797.278**	**2515.072**	**4494.898**	**5060.591**	**6878.65**
North & Central America	312.11	1506.558	2145.3	2224.906	3390.312
South America	433.394	891.001	1855.719	2370.667	2906.598
Asia	**3861.329**	**7472.279**	**11948.41**	**20156.23**	**24712.73**
Far East Asia	1555.175	2855.44	5974.884	5152.833	4293.238
South & Central Asia	1629.81	2820.435	3462.596	6770.102	13745.24
Middle East	646.742	1728.732	2345.82	7793.853	5832.694
Oceania	**516.053**	**1038.942**	**1460.453**	**954.646**	**1759.576**
All developing countries	**8713.44**	**22891.8**	**39011.6**	**62280.89**	**92409.65**

Source: OECD (2016), Net ODA (indicator). (https://data.oecd.org/oda/net-oda.htm)

segment of the world's poorest nations.

Another important region for donors is the East Asia and Pacific region, albeit the fact that the share of total aid to the region has been declining in the last two decades, in part due to the success and growth of a number of countries in the region such as Singapore, Korea, Malaysia and the Peoples Republic of China who have since emerged from being recipients to establishing themselves as donors; per capita ODA to East Asia and Pacific region peaked in early 1990s and has been declining since. In the 1990s, countries from Eastern Europe and former Soviet Union states emerged as another high priority destination for aid, rising sharply from US$5.5 ODA per capita in 1990 to about US$17.4 by 2000, and the region still receives more ODA (in per capita terms) than all other regions other than Sub-Saharan Africa.

1.3.4 Structure of the thesis

As mentioned earlier, the main objective of this thesis is to contribute to the literature on foreign aid and economic growth. To achieve this objective we begin by presenting a brief review of the existing literature in chapter 2. This chapter gives a review of the

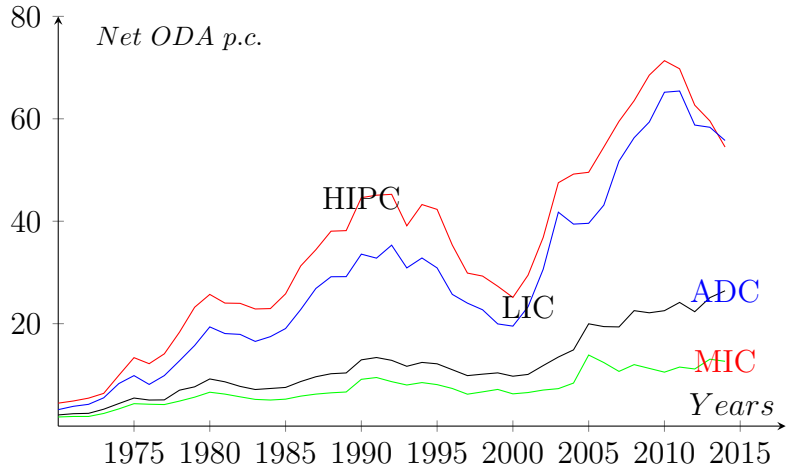
developments in growth theory that affected our understanding of how aid can promote growth. We also review how empirical approaches to measuring the effects of aid changed along with the theoretical developments. Chapter 3 critically investigates the most commonly used approach in aid effectiveness studies, namely the cross-country approach to growth empirics. The chapter brings some new insights on how some of the shortfalls of this approach affect the results from aid-growth studies.

After discussing the cross-country aid-growth evidence, we proceed in chapter 4 to use a single country approach to conduct an empirical investigation into the effects of aid. There is limited evidence of the effects of aid at the sub-national level, and so this chapter attempts to expand that strand of aid effectiveness literature. A version of this Chapter is co-authored with Dr Alex Trew and presented in Khomba and Trew (2016); it is based on the analysis conducted for this chapter including the empirical strategy and the data used. In chapter 5, we develop a theoretical analysis of the effects of aid in a model that accounts for subsistence consumption and public capital. The main concern about this chapter is how subsistence constraints and productivity enhancing public capital affect private capital accumulation.

Appendix

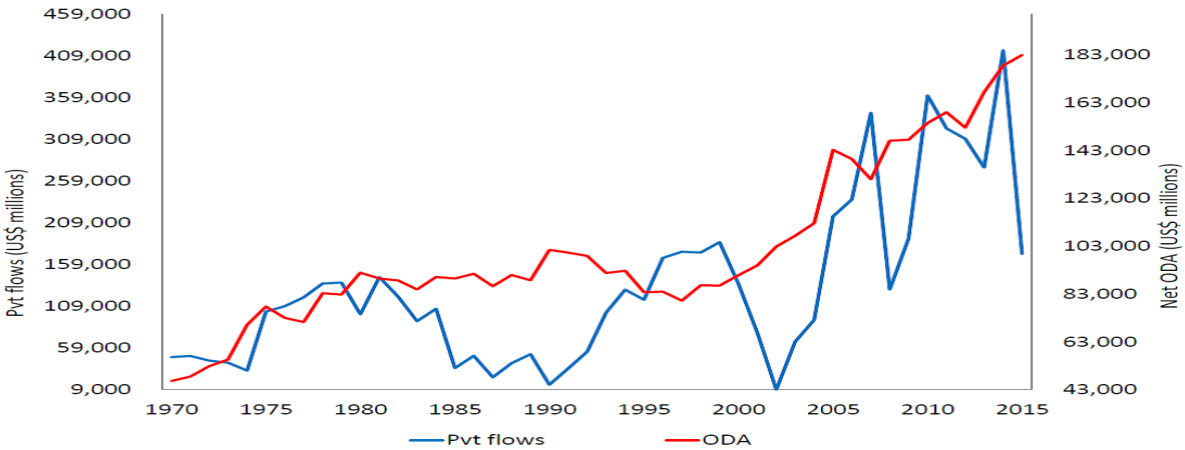
1.A Figures

Figure 1.A.1: Trend for net ODA per capita, (constant 2014 US$)



Notes: The graph shows trends in aid per capita to different income classifications of countries. HIPC is for Highly Indebted Poor Countries, LIC for Low Income Countries, MIC for Middle Income Countries and ADC is for All Developing Countries

Figure 1.A.2: Trends in net private flows (constant 2014 US$ prices)



Notes: Data obtained from OECD website (http://stats.oecd.org/BrandedView.aspx?oecd_bv_id=dev-data-en&doi=data-00072-en#).

Table 1.B.1: Overview of the key developments in the history of foreign aid

1.B Tables

Decade	Institutions	Donor Ideology	Focus	Types of Aid
1940s	Marshal Plan and UN system (including World Bank, IMF)	Planning and stopping the spread of communism	Reconstruction of Europe	ERP based programme aid
1950s	USA, with Soviet Union, United Nations and World Bank	Anti-communist, with reasonable state role	Community Development Movement	Food aid and projects
1960s	Establishment of bilateral programmes and regional development banks (including ADB, AfDB and IDB)	Increased state support in productive sectors; meeting basic needs	Productive sectors (e.g. green revolution); infrastructure	Technical assistance and budget support; project aid from multilateral donors
1970s	Expansion of multilateral donors (especially World Bank, IMF and Arab-funded agencies)	Continuation of 1960s; emphasis on meeting basic livelihood needs	Poverty reduction (focus on agriculture, health and education sectors)	Import support; significant fall in food aid
1980s	"Washington Consensus" and rise of NGOs from mid-1980s	Market based Structural Adjustment Programmes (SAPs)	Macroeconomic reform and liberalization; social welfare development	Financial and structural adjustment budget support; debt relief; project aid from NGOs
1990s	Eastern Europe and FSU become recipients rather than donors; emergence of corresponding institutions (EBRD)	Return to focus on state and political institutions	Political and economic transition; governance and human rights; poverty reduction	Sector support especially at the end of the decade; project support
2000s	Bilateral aid agencies expanded aid flows (especially USA, establishment of MCC) and surge in private aid (remittances)	Performance based aid allocation	Millennium Development Goals (MDGs), country based poverty reduction strategies (PRS), HIV/AIDS	Continued sector support and programme support in the early years, move towards budget support and programme aid, debt relief under HIPC
2010s	Bilateral and multilateral aid agencies, USA, China	Continued performance aid allocation, strengthening state financial performance	MDG's, PRS	Programme aid, technical assistance, general budget support, infrastructure development

Chapter 2

Literature Review

Theoretical and empirical literature that attempts to examine the potential causal relationship between foreign aid and economic growth has followed the progress in the development of economic growth accounting in general. Classical (Ricardian) theories of growth emphasized the role of physical capital accumulation. Modern theories place key role in such factors as information, institutions, etc. in explaining the differences in economic performance of different countries. This chapter provides a review of the existing aid effectiveness literature, beginning with a review of the theoretical literature in section 2.1 and then the empirical evidence in section 2.2.

2.1 Review of the theoretical literature on aid-growth nexus

2.1.1 Financing gap models (aid-savings-investment-growth)

For years, the theoretical framework for assessing the potential impact of aid on economic growth was based on the so called 'financing gap' models. These theories asserted that the growth process depends on the ability to surpass the constraints regarding the accumulation of physical capital. Investment was perceived as the key to economic growth. Since one of the main characteristics of developing countries is their limited capacity to generate savings due to very low per capita incomes, foreign financing capital flows (in the form of aid) fills the *savings gap* leading to higher investment and output growth. Rosenstein-Rodan (1961) were the first to use this approach when they calculated the amount of aid required by developing countries for them to achieve certain levels of growth.[1]

[1]The calculations were criticized for being over-optimistic and that they were built on questionable assumptions.

The most popular framework used in the financing gap models was the Harrod–Domar (HD) model (see Harrod (1939) and Domar (1946)), which showed how growth in developing countries was constrained by insufficient savings, limiting their ability to raise adequate capital for investment. In this framework, foreign aid provided a channel to fill the 'savings gap' allowing for acceleration of capital accumulation and hence enabling growth.

The underlying analytical framework of the HD model was the assumption of excess labour, scarce capital and a Leontief production function (implying a stable linear relationship between capital and growth in the short to medium term). Substitution of factor inputs was not allowed and the key scarce growth factor was physical capital. Saving, both domestic and foreign, impact on growth through accumulation of capital. In the model, the marginal product of capital is constant and the production function, expressed by equation (2.1.1) below, exhibits constant returns to scale:

$$Y(t) = f(K(t)) \Rightarrow Y(t) = cK(t) \tag{2.1.1}$$

where $Y(t)$ is aggregate output, K(t) is aggregate capital and t is a time subscript; from the production function, the marginal product of capital, c is

$$\frac{\partial Y(t)}{\partial K(t)} = c$$

In a closed economy aggregate saving, $S(t)$, is a constant fraction, s, of output $Y(t)$. Assuming a small closed economy (without trade and external capital flows) saving are entirely accumulated from gross output and must equal investment, $I(t)$ so that

$$S(t) = sY(t) = I(t) \tag{2.1.2}$$

Change in the stock of capital comes from investment and depreciation (wear and tear for existing capital). Assuming a constant capital depreciation rate, δ, the capital accumulation equation is expressed as:

$$K(t+1) = K(t) + I(t) - \delta K(t)$$

$$\Rightarrow K(t+1) - K(t) = I(t) - \delta K(t)$$

The growth rate of capital is defined as $g_K = \frac{(K(t+1)-K(t)}{K(t)}$. Using the expression for $K(t+1)$ expressed above, capital growth can be re-written as

$$g_K = \frac{K(t+1) - K(t)}{K(t)} = \frac{I(t) - \delta K(t)}{K(t)} = \frac{I(t}{K(t)} - \frac{\delta K(t)}{K(t)} = \frac{I(t)}{K(t)} - \delta$$

From the production function, $K(t) = Y(t)/c$, hence

$$g_K = c\frac{I(t)}{Y(t)} - \delta = ci(t) - \delta \tag{2.1.3}$$

where $i(t) = \frac{I(t)}{Y(t)}$ is the investment ratio. From equation 2.1, the growth rate of GDP, g_Y, is defined as

$$g_Y = \frac{(Y(t+1) - Y(t)}{Y(t)} = \frac{cK(t+1) - cK(t)}{cK(t))} = \frac{K(t+1) - K(t)}{K(t)} = g_K$$

Therefore

$$g_Y = ci(t) - \delta \tag{2.1.4}$$

In a closed economy the investment ratio and the saving rate are equal; however if the economy is open to external transfers of such as foreign aid, the relationship between savings and investment can be expressed as

$$I(t) \equiv S(t) + A(t) \tag{2.1.5}$$

where $A(t)$ is the total inflow of foreign resources. Since we are only interested in aid, $A(t)$ comprises only ODA, but in general it may represent even other foreign financing such as capital flows to the private sector, foreign direct investment (FDI) and other forms of foreign flows.

Expressing equation 2.1.5 as a fraction of output gives the investment ratio expressed in terms of domestic savings and foreign resources:

$$\frac{I(t)}{Y(t)} \equiv \frac{S(t)}{Y(t)} + \frac{A(t)}{Y(t)} \Rightarrow i(t) = s(t) + a(t)$$

where the small letters indicate proportions to GDP. Early literature assumed that aid has no impact on other foreign inflows and hence the marginal effect of aid on investment became

$$\frac{\partial i(t)}{\partial a(t)} = \frac{\partial s(t)}{\partial a(t)} + 1$$

clearly showing the macroeconomic role of aid on domestic savings and how it in turn affected the investment ratio. Based on this framework, empirical studies analysed aid using the simple equation

$$s(t) = \beta_0 + \beta_1 a(t)$$

where β_0 is the marginal saving rate and β_1 represents the impact of aid (as a ratio of output) on the saving rate. In addition to the savings gap, other types of gaps that characterise developing countries have been identified over the years; for example, Chenery and Strout (1966) extended the traditional HD model into a two-gap model by adding

the *trade gap*; they argued that low levels of exports limit the amount of foreign exchange that can be used to import capital goods. Bacha (1990) and Taylor (1993) introduced the *government revenues gap* pointing to the limited capacity of governments to collect sufficient tax revenues for financing public investment as another gap that aid fills.

The Harrod-Domar framework (or the gap models in general) received heavy criticism, however, while they are no longer popular in the academic literature, their foundations and development strategy implications are easy to apply and hence have survived as a development policy for policy makers. The main criticism of the application of the gap models arose from later economic growth accounting frameworks (particularly the neo-classical growth models such as Solow Model) that found little evidence, in the long run, to support the positive link between growth rate and accumulation of physical capital and investment as postulated by the gap model framework. With regards to aid effectiveness, the model assumptions implied that aid goes to investment one for one (Easterly (1999)), in contrast a huge literature on aid has found that aid is highly fungible.[2] The gap models also treated aid as being permanent, implying that developing countries would only achieve growth targets conditional on persistent generosity of donors; and if aid is withdrawn, the investment and growth would fall back to the initial levels (Blackburn and Forgues-Puccio (2011)). Further, the results from this framework were not supported by empirical findings; as will be reviewed in the following section, empirical studies based on the 'gap' models could not support the theoretical findings, in many cases finding a negative relationship between foreign aid and domestic savings.

2.1.2 Poverty trap models (the Big Push)

Sachs et al. (2004) re-ignited the arguments that most developing countries (especially in SSA region) are caught up in a "poverty trap," a geographically rooted vicious circle of poverty driven by low agricultural productivity, heavy disease burdens and state of relative isolation. The notion of poverty traps itself goes as far back to the works of Thomas Malthus in the late 18th century. In the 1950s, the idea was revived by Nurkse (1953) when discussing the 'vicious circle of poverty' model and Nelson (1956) in the

[2]For detailed analysis of the fungibilty of aid, Pack and Pack (1990), Feyzioglu et al. (1996), Feyzioglu et al. (1998) Easterly and Rebelo (1993) are among many scholars that have conducted extensive analysis of the issue of fungibility of aid

'theory of low-level equilibrium trap."

Poverty traps are self-reinforcing inefficient steady states at low levels of per capita incomes resulting from both market and institutional failures. Collier (2007) identified four significant mechanisms that lead to poverty traps in which the world's poorest societies are caught up; internal conflict traps, natural resources traps, land locked by bad neighbour trap and bad governance traps.

The underlying framework of poverty trap models is the neoclassical growth theory, with threshold effects and non-linearities, suggesting that for some reason an economy may exhibit multiple long run equilibria that are history dependent, depending on the start-off points. Thus countries with similar structural characteristics but different initial conditions may face different (good or bad) long run economic growth experiences, and these are particularly bad for poor countries and hence the justification for a 'big push' to release them from the bad equilibrium. Key to the transition from the classical to the neoclassical models was the emergence of the concept of the individual consumer who maximizes utility in the same manner that firms seek to maximize profits. Individuals make their choices based on preferences, which can be optimized on rational basis, among possible outcomes of their economic activities.

The Solow-Swan Model

The most commonly used framework in the big push models is the Solow[3]-Swan[4] growth theory (which has become the traditional starting point for review of modern proximate growth theory, and is most popularly known merely as the 'Solow growth model'). The model is built on four variables: output (Y) referring to total amount of production of final good; capital (K) corresponding to 'machines and structures' used in production; labor (L) referring to hours of employment or number of employees. Finally, technology (A) has no specific measure and is used merely as a shifter of the production function; it is assumed in this model (and in neoclassical growth models in general) to be a freely available non-excludable and non-rival good (Acemoglu (2009*a*)).

[3]Solow (1956)
[4]Swan (1956)

Households and Production In its basic framework, the model considers a closed economy in discrete time with an infinite horizon and a unique final good. For simplicity the model assumes a homogeneous representative household/agent so that the demand and labour sector of the economy behave as a single household. The Solow model does not explicitly model the household's optimisation decision so few assumptions are made about the households behaviour, other than that they save a constant fraction, $s \in (0, 1)$, of their disposable income.

Other than households, the other key participants in the Solow model are firms. Again, for simplicity the model assumes firms to be homogeneous, implying a representative firm that faces a representative or aggregate production function for the final good given as:

$$Y(t) = F(A(t), K(t), L(t)) \tag{2.1.6}$$

where t is a time index and the variables $Y(t)$, $K(t)$, $L(t)$ and $A(t)$ are as defined earlier. The production function F is assumed to be twice differentiable and for all values of $K > 0$ and $L > 0$, the function has positive but diminishing marginal products for both factor inputs K and L i.e.$F_K \equiv {}^{\partial F}/_{\partial K} > 0$; $F_L \equiv {}^{\partial F}/_{\partial L} > 0$ and $F_{KK} \equiv {}^{\partial^2 F}/_{\partial^2 K} < 0$; $F_{LL} \equiv {}^{\partial^2 F}/_{\partial^2 L} < 0$[5] (i.e. the production function satisfies the Inada Conditions). Furthermore, F is linearly homogeneous i.e. exhibits constant returns to scale in K and L.

Endowments, Market Structure and Market Clearing To be in a position to determine the allocation of resources within the economy, initial stocks of the factor inputs must be specified and the owners of such endowments. The benchmark model assumes that markets are competitive and both households and firms are price takers, each pursuing their own objectives and prices clear markets. In this economy, households own factors of production; they own all labour which they supply to firms inelastically (endowment of labour equals population, $\bar{L}(t)$) and is supplied at any non-zero rental price, $w(t)$, hence the labour market clearing condition is expressed as

$$L(t) = \bar{L}(t)$$

Households also own the capital stock of the economy and rent it to firms at a rental price of capital $R(t)$. The capital market clearing condition is that demand for capital

[5]To conserve on notation, we refer toF_K to represent the partial derivative of the production function with respect the particular factor input, in this example F_K means the partial derivative of F with respect capital input; F_{LL} therefore represents the second partial derivative of the production function with respect to labour input

by firms, represented by $K(t)$ must equal supply of capital by households, represented by $\bar{K}(t)$. Thus the market clearing condition in the capital market is expressed as

$$K(t) = \bar{K}(t)$$

The initial endowment of capital to the representative household is therefore $K(0) > 0$, which is assumed to be a predetermined amount. As machines used in production lose some of their value to wear and tear, capital is assumed to depreciate at an exponential rate $\delta \in (0, 1)$, so that out of a unit of capital in each period, only $1 - \delta$ remains in the next period.

Firm Optimisation and Equilibrium The representative firm in the model seeks to maximise its profits subject to rental prices of the production factors so that for a given level of technology, $A(t)$, the profit maximization problem of the representative firm is given by the following equation

$$\max_{\{K(t)>0;L(t)>0\}} F(K(t), L(t), A(t)) - R(t)K(t) - w(t)L(t) \tag{2.1.7}$$

Households maximize utility from consumption of the final good in the current period, whilst saving some of their present income for future use.

The Solow model assumes competitive markets, hence in the competitive equilibrium the representative firm maximizes profits while factor markets clear. This implies demand for the production factors K(t) and L(t) must equal their supply and also that the representative firm makes zero profits. This argument, together with the assumption of differentiability of F, implies that in equilibrium, the factor prices must equal the marginal products of the factors, i.e.

$$w(t) = F_L(A(t), K(t), L(t))$$

$$R(t) = F_K(A(t), K(t), L(t))$$

From the assertion of zero profits for firms, it implies therefore that the equilibrium condition is

$$Y(t) = F(K(t), L(t), A(t)) = w(t)L(t) + R(t)K(t) \tag{2.1.8}$$

The fundamental law of motion of the Solow model

Use of capital in production results in depreciation, at an exponential rate, and therefore over time the accumulation of capital in the Solow model can be expressed as

$$K(t+1) = (1-\delta)K(t) + I(t) \tag{2.1.9}$$

where $I(t)$ is investment in new capital. From the national income accounts (without government spending), in a closed economy setting, the total amount of final goods is either consumed or saved to finance investment, thus

$$Y(t) = C(t) + I(t)$$

where $C(t)$ is consumption. Households save a predetermined constant fraction, s, of their income. In the closed economy benchmark, aggregate savings must equal total investment, i.e.:

$$S(t) = I(t) = Y(t) - C(t);$$

$$S(t) = sY(t)$$

where, as already stated, $s \in (0,1)$ and implying that households consume the remaining $1-s$ of their income

$$C(t) = (1-s)Y(t)$$

Combining the savings equations described above with the production function (equation (2.1.6)) then in the equilibrium state where supply is equal to demand, the law of capital of motion (equation (2.1.9)) can be re-written to give the *fundamental law of motion* of the Solow–Swan growth model, expressed as:

$$K(t+1) = sF(A(t), K(t), L(t) + (1-\delta)K(t) \tag{2.1.10}$$

or derived in continuous time by following similar steps into

$$\dot{K}(t) = sF(A(t), K(t), L(t) - \delta K(t)$$

where$\dot{K}(t) = {}^{\partial K(t)}/_{\partial t}$. Using the property of constant returns to scale of the production function, and defining $k(t)$ as the capital-labour ratio, the continuous time fundamental law of the Solow model can be expressed in per capita terms as

$$\dot{k}(t) = s[Af(k(t))] - (n+\delta)k(t) \tag{2.1.11}$$

where $n = \dot{L}(t)/L(t)$; derived from population growth expressed as $L(t) = \exp(nt)L(0)$.

Equation (2.1.11) illustrates how capital accumulates in the Solow framework: the left hand side represents capital deepening while $(n+\delta)k(t)$ is the capital widening term indicating the investment (savings) per unit of worker required to hold the capital-labour

ratio constant. Thus, in the steady state, $sAf(k(t)) = (n + \delta)k(t)$; and as long as $sAf(k(t)) > (n + \delta)k(t)$ in the economy output per worker will grow.

Sachs et al. (2004) (and proponents of the poverty trap models) point to three main arguments why in developing countries savings are always less than capital widening ($sAf(k(t)) < (n + \delta)k(t)$), and hence they are caught in a poverty trap of very low level output per worker;

a) Low levels of capital in poor countries may result from low marginal productivity of capital which leads to a disincentive to invest. This may arise from low state of human development and poor infrastructure.

b) With low income per capita, impoverished households on a predominantly subsistence living may have little inclination to save since they are already struggling to meet basic needs as such the saving rate is likely to be very low or even negative.

c) Fertility rates in poor countries tend to be high with socio-economic motives for child bearing (parents rely on children to support the family from early age) implying big family sizes relying on low incomes, the rapid population growth works to prevent capital accumulation.

The 'Big Push' proponents argue that the solution lies in aid to provide a massive initiation of a temporary "big push" in investment that will move the countries to a certain threshold of capital at which the underlying productivity of capital is high enough to stimulate investment or where household incomes will be high enough to allow for them to undertake savings or indeed help the economies grow to a critical level of development before mortality rates are low enough (and the opportunity cost of child-bearing is high enough) to induce reduction in family size (Blackburn and Forgues-Puccio (2011)), i.e. a threshold at which standard forces of competitive theory can take hold.

Scholars that lobby for aid using the neoclassical framework thus argue that temporary (though lasting for sufficiently long enough period) but large enough infusion of aid can help developing economies to 'jump' from the low income per capita equilibrium level where savings are less than the capital widening to a higher level equilibrium (in terms of per capita incomes) where sustained growth is achievable with improved saving rate allow-

ing for capital accumulation. Sachs (2001) identified three channels into which foreign aid goes: (a) households for emergency situations, (b) government to finance public investment, and (c) private businesses (for example, farmers) through micro-finance programs and other schemes to finance private investment.

In the benchmark closed economy framework, investment is entirely financed by savings through the capital accumulation equation expressed by equation (2.1.11). To allow for inflow of foreign aid we assume a small open economy that receives some foreign aid, $A(t)$ which goes directly into helping capital accumulation for the representative agent. The capital accumulation equation will now be augmented with aid per capita, $a(t) = {}^{A(t)}/_{L(t)}$, and is now expressed as

$$\dot{k}(t) = s[Af(k(t))] + a(t) - (n + \delta)k(t) \tag{2.1.12}$$

While the fundamental arguments in the poverty traps models have provided a strong premise for pro-aid lobbyists, many scholars remain unconvinced that aid is necessary or sufficient for sustainable long run economic growth and development. The very notion of poverty traps is a contentious empirical debate, some scholars arguing that their existence is explicit and that in the long run the distribution of the world's income is distinctly bimodal, characterised by the rich and the poor (see Bloom et al. (2003), Quah (1996) and Quah (1997)). Other authors find little evidence to support the existence of poverty traps caused by low levels of savings or productivity (see Kraay and Raddatz (2007) and Azariadis and Stachurski (2005)).

2.1.3 Endogenous Growth and Fundamental Determinants of Growth

Endogenous growth models

The capital accumulation models reviewed so far treated the main factors that generate economic growth to be exogenous, i.e. in both cases savings is an exogenously determined constant fraction of household incomes. Additionally, in the Solow model technology is also treated as an exogenous factor. Hence these models are often referred to as exogenous growth models.

In the mid-1980s, scholars became dissatisfied with the accounts of exogenous growth frameworks in determining growth, largely upon the realization that empirical evidence did not support the conditional convergence prediction from Solow growth model i.e. that countries with low per capita incomes grow faster than those with higher incomes. It became apparent that poor countries were on average not converging, and in many cases they were becoming worse off. Furthermore, the assumption of constant saving rate is also at odds with reality; otherwise, for instance, a prior announcement of a looming huge increase in income taxes would have no impact on households savings decisions. Scholars recognised that systematic analysis of cross-country differences in incomes and world economic growth process required models in which the factors that are seen to generate growth, such as technology, are endogenised and that theory can provide analytical explanations for the differences and rationale behind choices in these factors.

A new school of growth models had emerged, the endogenous growth theory; the basis of this school of thought lies in the earlier works of Arrow (1962) and Uzawa (1965). Endogenous growth was re-ignited in the 1980s by the works of Romer (see Romer (1986)), which considered a model with increasing returns to scale and the most commonly used endogenous growth model in the literature, Rebelo's AK model (see Rebelo (1991)). Rebelo's growth model explained cross-country heterogeneity in growth experiences as a result of cross-country differences in government policy. Growth is endogenous due to other capital goods that can be produced without the effect of factors that cannot be accumulated.

The major outcome of the new wave of growth models was that they emphasized that externalities from physical and human capital accumulation could induce sustained steady-state growth (Romer (1986) and Lucas (1988)) and the endogenisation of steady state growth (Romer (1990) and Grossman and Helpman (1991)). The technical mechanism of the endogenous growth models will not be reviewed in detail here,[6] however, they also furthered the inclination that steady state growth is less related to physical capital accumulation and show that the growth process involves a more complex set of interdependent factors including human capital and information.

[6]In Chapter 5 of the thesis, we discuss a version of the endogenous growth model in more detail and show how foreign aid can play a key role in economic growth in such a framework

Fundamental determinants of growth

In the proximate growth models (both endogenous and exogenous models) differences in income per capita are explained by different paths of capital accumulation: in the Solow model they are explained by differences in saving rates; in Ramsey-Koopmans model (not reviewed in this section but covered in greater detail in Chapter 5) variation in output growth is explained by differences in preferences or properties of technology (Acemoglu et al. (2005).

From the mid-1990s however, fundamental determinants models began to gain prominence. These models argued that differences in incomes across countries can be explained by variation in some fundamental factors such as breakup of nations, origins and rate of change of institutions (political, legal and economic) etc. These factors influence the direction of public choices, investment in physical and human capital, technology and production by shaping incentives of key economic actors in the economy.[7] In part, the new growth models were aided by new cross-national data sets that allow empirical tests of hypotheses on comparative economic systems and institutions and their relation to economic growth and development.

This wave of growth theories and empirics emphasizes deeper or fundamental determinants that generate variation in growth, such as the influence of history (path dependency), ethno-linguistic fractionalisation, and the numerous political and economic barriers to reform; factors that were necessarily ignored in proximate economic growth models. The new 'political economy' growth models focus on the role of such factors as the quality of governance, the origins of the legal system, ethnic diversity, social cohesion, democracy, corruption, political barriers, and institutions in general and their interaction with other variables such as foreign aid in influencing the economic growth process.

Correspondingly, the literature on aid effectiveness embraced the new developments in economic growth accounting; firstly in the early 1990s many scholars started to explicitly treat aid as an endogenous factor for developing countries. Endogeneity of aid stems from a number of factors including reverse causation between foreign aid and economic growth; for instance more aid is by construction given to poor (low income) countries

[7]Extensive work on the effect of institutions on growth has been done by Daron Acemoglu, see for example Acemoglu and Johnson (2003), Acemoglu et al. (2005), Acemoglu (2009*b*) and Acemoglu (2009*a*).

or countries undergoing economic crisis, creating a spurious negative correlation between aid and growth. Conversely, more aid may be given to countries that have successfully carried out institutional reforms, thus one would expect a positive correlation between aid and growth.

The focus of aid effectiveness literature has therefore shifted towards understanding the interaction between aid and these fundamental factors, investigating how the interaction affects aid allocation policies and consequently growth. Theoretical as well as empirical aid effectiveness literature has burgeoned in the last two decades that offer detailed insight into the interaction of aid with institutions in general, ethnicity, corruption and political factors and how these influence a country's growth path.

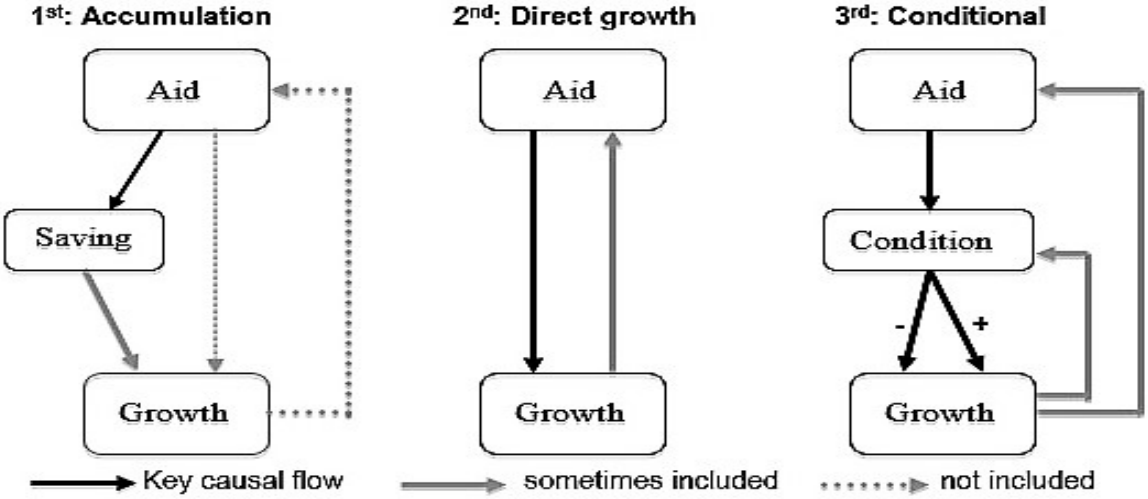
2.2 Summary of the Existing Empirical Literature on Aid Effectiveness

The past six decades have witnessed a huge outpouring of empirical studies on the effectiveness of aid. Hansen and Tarp (2000) conducted a meta study on cross-country aid effectiveness studies involving 97 empirical macroeconomic studies involving 131 growth regressions and introduced a common classification of the previous empirical aid effectiveness literature, distinguishing them into three generations of aid studies[8].

The first two generations of aid effectiveness literature were based on the notion that accumulation of physical factors would lead to growth while the third generation emphasized conditional interaction of aid and policy variables, asserting that aid will only lead to growth in economies with favourable or good policy environment. Figure 2.2.1 gives a causal structure in the three generations of aid, which we now look at in turn.

[8]Moreira (2005), Doucouliagos and Paldam (2009) and Doucouliagos and Paldam (2013) also conduct extensive survey of aid effectiveness using this classification.

Figure 2.2.1: Causal structure of the three generations of empirical aid and growth link



Notes: Figure from Doucouliagos and Paldam (2008)

2.2.1 Capital accumulation models: 1st and 2nd generation studies

Aid-savings-growth: 1st generation studies The first generation empirical studies started in the early 1970s based on the theoretical workhorse framework of the Harrod-Domar model (and later Chenery and Strout's Two-Gap model) in which the saving rate and later balance of payments were the key constraints to growth. Foreign aid was perceived only as an exogenous increment to a recipient country's net capital stock, thus each dollar of aid was seen to translate into an increase of a dollar of net savings[9] and thus finance capital accumulation that eliminated the binding gaps. The key assumption in the first generation studies was a linear relationship from aid to capital (Hansen and Tarp (2000)) and output growth can only be achieved through capital accumulation, which in the model is a function of gross savings.

The basic empirical model specification of this generation of studies can be expressed by a regression of aid on either savings or investment, taking the form[10]:

$$s_i(t) = \alpha + \beta a_i(t) + \gamma_j c_i'(t) + \mu_i(t)$$

or

$$inv_i(t) = \alpha + \beta a_i(t) + \gamma_j c_i'(t) + \mu_i(t)$$

[9]Note that in the early generation studies, aid was not seen as a component of national income, thus fungibility of aid for consumption was not envisaged (Hansen and Tarp (2001)).

[10]Specification from Doucouliagos and Paldam (2009)

where i is an index for countries; t is an index for time period (in most studies this represents an average over a number of years, for instance average over 4 years); j is an index for control variables; α is a constant; $s_i(t)$ is savings for country i at time t; $inv_i(t)$ represents investment (both savings and investment are expressed as a fraction of aggregate output (GDP/GNI)); β is a parameter that measures the aid effect on savings/investment; $a_i(t)$ represents aid as a share of GDP/GNI; $c_i'(t)$ is a vector of j control variables which include, among others, initial per capita incomes, consumption, investment/savings (investment in the savings equation or domestic savings in the investment equation); $\mu_i(t)$ is residual term.

The first generation studies derived some reasonable conclusions on the potential for aid to affect growth. The key finding from the studies reviewed in Hansen and Tarp (2000) was that there was little robust evidence to suggest aid increases the saving rate.

Aid-investment-growth: 2nd generation studies The second generation of studies asserted a more direct link between foreign aid and economic growth, alluding that the first generation (aid-savings link) was an indirect way of looking at the direct causal relation that exists between aid and growth. The second generation was initiated by Papanek (1973), who argued that the aid effectiveness debate should not focus on the aid-savings channel; rather the focus should be on the impact of aid on the different components of growth. In his study, aid was not treated as a fraction of savings, but rather as a separate financing component for investment, others being domestic savings and also other sources of foreign financing such as foreign direct investment (FDI) and found a positive link from aid to growth.

A typical linear regression model from the second generation would take the form:

$$g_i(t) = \alpha + gdp_i(t-1) + s_i(t) + f_i(t) + \beta a_i(t) + \gamma_j c_i'(t) + \mu_i(t)$$

where $g_i(t)$ represents output growth, $gdp_i(t-1)$ is initial GDP, $s_i(t)$ is domestic savings, $f_i(t)$ is other foreign transfers including FDI and other private inflows; all the other parameters and variables used are defined as in the first generation regressions above. Control variables in this model include population growth, human capital development, terms of trade, inflation, real effective exchange rates, budget deficits etc.

The second generation studies found a positive link between aid and investment, which

is consistent with the typical result from first generation studies. Furthermore, evidence from the second generation suggest, in a coherent way, a positive link between aid and growth whenever a positive link between investment and growth exists.

Empirical results from the capital accumulation models were mixed, though the reduced form regressions of the second-generation offered more consensus on the evidence of a positive link between aid and growth, finding a clear enhancing role of aid on investment. Table1 below shows the empirical results from a survey of the empirical literature within the capital accumulation models (1st and 2nd generation) from the 1960s to 2010:

Table 2.2.1: Conclusions from the surveyed 31 cross country regressions

Impact of Aid	Savings Regressions	Investment Regressions	Growth Regression
Positive	3	27	51
Negative	33	1	4
Not statistically significant	19	2	37
Total (177)	55	30	92

Contemporary advocates of the capital accumulation school use modified versions of the initial rationale for foreign aid. Sachs (2005) argues that the basic mechanics of capital accumulation in poor countries result into a poverty trap where there is no personal savings while rising population and capital depreciation leads to a fall in capital per person and a negative growth rate of per capita incomes leading to a vicious circle of falling incomes, savings and investment. Sachs et al. (2004) argues that ODA to governments, especially to finance public investment and to the private sector through micro-finance programmes to finance private investment, helps jump-start the process of capital accumulation, economic growth, and raising household incomes.

Arndt et al. (2010) uses the Rubin Causal Model[11] applied at the macro level in their assessment of the existence of an aid-growth link, via savings, in 85 aid receiving developing countries for the period 1960 to 2000. They concluded that aid remains an important tool for enhancing development in poor countries, having found positive and robust causal effect of aid on growth. Dalgaard et al. (2004) re-examines the effectiveness of foreign aid theoretically, using a standard OLG theoretical model and empirically employing OLS and 2SLS techniques using Burnside and Dollar (2000) dataset (four year averages of 56 LDCs from 1970-200). The OLG model shows that aid inflows will in general affect long-

[11]See Rubin (1974)

run productivity while the empirical analysis finds that aid has been effective in spurring growth through public investment, but the magnitude of the effect depends on climate-related circumstances. In the meta survey conducted by Hansen and Tarp (2000), out of the 32 analyses that used the reduced form Barro-type regressions, 23 found robust positive aid-growth links (their results are even more impressive given the simplicity of the reduced form equations and also the quality of data relied on), while the remaining 9 had insignificant but positive coefficients.

The majority of accumulation models of aid and growth studies suggested a positive impact of aid. Nonetheless, from an early stage there were critics who while agreeing with the nobility of the intentions behind aid, asserted that foreign aid would constitute merely 'a waste of money'. They argued that aid programmes contribute to failure of development efforts by propagating rent seeking and corruption that enhances economic inequality (Friedman (1958), Little and Cliffold (1965) and Bauer (1971)). In a highly cited paper Mosley et al. (1987) performed a series of regressions of aid on growth and could not confirm, for any continent, a significant and positive relationship of aid on growth[12] that micro level data from World Bank project performance data might suggest, resulting to the famed Micro-Macro Paradox in aid effectiveness. Easterly (2001) used time series data to test the "financing gap" models in which aid improves investment and growth. Using OLS estimation on 88 aid receiving countries covering the period 1965-1995, he found that in only 6 countries was there any positive association between investment and overseas development assistance (ODA), while results from regressing direct link between ODA and growth rate of per capita GDP indicated that in 1 country only was there a significant positive link between the two variables.

In the literature survey reported in table 2.2.1 above on how aid affects savings, investment and growth, in over 60% of the empirical studies, the results found a significantly negative relationship from aid to savings (in only 3 studies was a positive and significant link between aid and savings found) casting doubts on the notion that aid increases savings on a one to one basis and providing huge empirical evidence against the pro-aid view based on factor accumulation.

In general, the capital accumulation models found some evidence to suggest that foreign

[12]When other determinants of growth such as saving rates and export growth are held constant.

aid promotes growth. The second-generation studies in particular found coherently a positive relationship between foreign aid and economic growth. Nevertheless, they faced a lot of criticism due to a number of factors:

a) Empirical results from most of the studies (particularly first generation studies) suggested a negative relationship between aid and domestic savings, thus contradicting with the main premise based on which the models are built.
b) The assumption that there is no fungibility of aid, that foreign aid is only directed to growth inducing investment is also not justified. In reality, there is a lot of evidence to suggest high levels of fungibility of aid (aid being used to supplement national consumption), as first explained by Griffin and Enos (1970) who contested that unless the marginal propensity to save for the recipient countries is equal to 1, then a part of the aid will be allocated to consumption[13] among others. Furthermore, arising from the Barro-type regressions, in the presence of fungibility of foreign aid, there is a considerable crowding out effect of aid on domestic savings, as aid is taken to increase public consumption thus making it harmful for growth (Doucouliagos and Paldam (2009)).
c) The second generation studies introduced the problem of potential endogeneity of aid; that poorly performing nations receive more aid for the very reason of poor growth performance and hence there are no inconsistencies between low growth and high aid inflows (Mosley et al. (1992)). When there is good growth performance for a while, per capita incomes improve and donors transfer less aid.

2.2.2 Conditional growth models: 3rd generation studies

Much of the research on the impact of aid on economic growth conducted since the late 1990s falls within the third generation of studies. This group of studies is premised on the fundamental determinants of growth and analyses cross-national variation in economic growth by focusing on the role of institutions (legal, socio-political and economic) in both donor's as well as recipient's aid allocation policies and how these affect economic growth. Furthermore, this generation is motivated by the availability of better data from developing countries as well as progress in conducting more sophisticated econometric analysis that allows for estimation of changes across and within countries over time.

[13]See also Boone (1996), McGillivray and Morrissey (2000), Isopi and Mavrotas (2009) and Feyzioglu et al. (1996)

This wave of studies became more popular especially since the publication of the World Bank study '*Assessing Aid (1998)*' which recommended a rethinking of aid and gave prominence to the concept of aid conditionality/selectivity in an attempt to improve the policy environment in aid-receiving countries. The main feature of this generation of aid effectiveness literature was the idea that there exists an interaction between aid and institutions/policies in the recipient nations that is crucial in making aid effective i.e. aid is seen to work in good policy countries and not work in bad policy ones. The implicit conclusion of the World Bank Report and the paper by Burnside and Dollar (1997)[14] on which the Report is based, is that aid is very fungible and so aid can only reduce poverty through economic growth if there are good policies in place.

The third generation also places explicit emphasis on understanding and addressing endogeneity of aid which arises, as already alluded to earlier, from reverse causality. Endogeneity of aid poses a significant challenge when analysing the impact of foreign aid as it makes estimating the response of growth to variation in foreign aid difficult. The fundamental problem is that aid is allocated to countries based on individual country characteristics, rather than being a random allocation. This not only makes simple correlations in the econometric analysis uninformative, but they also render regression approach highly problematic that even a systematic approach to choosing control variables will not solve the identification problem.

In the econometric analysis, measures of economic policy, political and institutional variables in the regression analysis were introduced alongside the traditional macroeconomic growth controls. In the literature, these policies include fiscal performance, market liberalization, trade openness, monetary policies etc. The studies used panel data estimation for a number of years covering a large number of countries; the data usually includes many indicators of trade and economic activity for developing countries. The use of panel data also gave the new growth models the convenience of accounting for country specific effects (Roodman (2007*a*) and Moreira (2005)).

A typical third generation regression equation takes the form:

$$g_i(t) = \alpha + gdp_i(t-1) + s_(i)t + \beta a_i'(t) + \zeta z_i't + \omega a_i(t) z_i(t) + \gamma_j c_i'(t) + \mu_i(t) \qquad (2.2.1)$$

[14] A later version of this research was published as Burnside and Dollar (2000) in the American Economic Review, hence for the remainder of the thesis we will be citing the published version.

where, other than the notation already used in the regression models of the first two generations, $gdp_i(t-1)$ is initial GDP, $a_i'(t)$ is a vector of aid variables including aid itself (as a share of GDP/GNI), the square of aid and in other studies different lags of aid. $z_i'(t)$ is a vector of conditional variables,[15] the most commonly used in the literature being policy index (measures of macroeconomic policies that affect output growth). $a_i(t)z_i(t)$ is the interaction term included as another way of capturing non-linearity in the aid-growth relationship other than introduction of a squared aid term.

Aside from the controls included in the second generation models, this generation of studies includes as explanatory variables (treated to be exogenous) factors such as initial income levels, measures of institutional quality, measures of ethnic fractionalisation, measures of the frequency of assassinations, interaction between ethnic fractionalisation and assassinations, M2 as a fraction of GDP (in some studies including lags of M2), geographical region dummies etc. In equation (2.2.1), these are captured by $c_i'(t)$.

Boone (1996) stimulated the conditional aid effectiveness debate; using panel data for 91 countries covering the period 1971-1990, the study investigated the impact of aid on investment, consumption and measures of well-being and examined whether aid effectiveness was conditional on the political regime. His results indicated that foreign aid leads to increases in government consumption rather than increasing investment or benefiting the poor, and also that there was no evidence to suggest that the impact aid varies with different forms of regime.

In perhaps the most cited work of this generation (about 4517 citations according to Google Scholar (as of Oct 2016)), Burnside and Dollar (2000) conducted panel growth regressions using data for the period1970 -1993 from 56 aid receiving developing countries, examining the relationship between foreign aid, policies and growth of per capita GDP and found that aid has a significant and robust positive relationship with growth in countries that have good fiscal, monetary and trade policies. In response to early critics of Burnside and Dollar (2000) study, in Burnside and Dollar (2004), they used a different dataset focusing mainly on the 1980s and 1990s for 42 low income countries and found

[15]Unlike the earlier generations, this group of studies also explored potential non-linearities in the aid-growth nexus, so that the regression analysis includes a quadratic aid term. There are strong reasons behind the expectation of non-linearity between aid and growth; in the literature the most cited include recipient country's limited absorption capacities (Hadjimichael et al. (1995)) while Durbarry et al. (1998) further refers to the optimal borrowing and the incidence of Dutch disease problems

similar results: that aid has a robust causal effect on growth of output per capita in economies where there is a good policy environment.

Some of the strongest aid critics in recent times such as Easterly (2003, 2008) and Moyo (2009) maintain that due to the lack of accountability in the aid delivery mechanism as well as rampant corruption in the recipient countries, foreign aid has done more bad than good. It has left recipient countries in a vicious cycle that fosters corruption, interference in the rule of law, establishment of civil institutions and protection of civil liberties. This creates an environment where foreign investment is untenable and coupled with low domestic savings, it retards growth, reduces job opportunities and hence escalating poverty. Thus they argue against the findings of the third generation studies; that even in economies with good policy environment, there is little evidence to suggest that aid has had a positive effect on the growth of per capita output.

Cross-country analysis remains the popular approach to estimating the growth effects of aid flows in developing countries. Despite this, the literature has long recognised the appropriateness of country-specific studies over cross-country studies in analysing the growth effects of aid (Pack and Pack (1990); White (1992)). There is growing recommendations in recent literature suggesting that better results on the determinants of economic growth can better be achieved by conducting detailed single country analysis (Rodrik (2003)). Cassen (1994) and Lloyd et al. (2001) discussed and concluded that using single-country approach, rather than cross-country approach, in analysing macroeconomic effects of aid on growth might be a more appropriate strategy and could lead to more robust evidence on the causal relationship between foreign aid and economic growth.

2.3 Summary

So far, we have presented a brief background to the notion of aid, its evolution since the Marshall Plan and shown the trends in flows for the four decades. We then reviewed the existing literature showing how developments in economic growth theory in general have affected the way we perceive the role of aid and how that in turn affects empirical assessment of the potential effects of aid on growth.

Despite the voluminous literature on aid, the question about the possible effects of aid

continues to generate considerable debate. Much of the existing cross-country evidence in the literature is conflicting at best. On the other hand, there is limited evidence of the effects of aid below the national level. Therefore there remains much to be learnt about the impact of aid on economic growth by focusing on country-specific approaches that can shed more light on how economic growth is affected by foreign transfers.

With this in mind, in this study we first re-examine the existing empirical evidence from cross-country studies in the next Chapter; we discuss in detail some of the challenges with cross-country analysis and how it affects aid-effectiveness results. We also run some robustness tests on some of the influential results derived using this approach. After this, we aim to contribute to the literature on aid effectiveness by providing some evidence using an approach that has not been utilised much in macro-level aid studies. In particular, we conduct a detailed single country analysis in Chapter 4, using evidence from the Republic of Malawi.

Chapter 3

Revisiting Cross-Country Evidence on Aid and Growth

Abstract

This chapter provides a critical re-examination of the existing evidence on the aid-growth nexus. We consider the results from cross-country aid effectiveness studies and investigate the factors that contribute to their lack of robustness. Drawing on the aid-policies-growth literature initiated by Burnside and Dollar (2000), the chapter expands on the robustness checks conducted by Easterly et al. (2004) using a reconstructed dataset of 81 countries for the period 1970 to 2013. Our results reaffirm the fragility of cross-country aid-growth results, particularly when the set of countries in the sample changes. Additionally, the chapter also investigates the evolution of the link between aid and growth over time. The results here show that the relationship has in general weakened over time, however for low income countries it became stronger between 1990 and 2013. Finally, the analysis goes on to examine the effect of currency crises on the impact of aid on growth, finding evidence to suggest currency crises dampen the effect of aid on growth by about 0.5 percentage points.

3.1 Introduction

The most commonly used approach in growth empirics in general, and aid effectiveness literature in particular, is cross-country panel data regressions. The proliferation of longitudinal data analysis in cross-country regressions has resulted from a number of factors. These include availability of better datasets in both developed and developing countries; better and more accurate inference of model parameters (resulting from blending of inter and intra-individual dynamics) since panel data has more degrees of freedom and encom-

pass more variability than mere cross-section or time series data. Additionally, panel data regressions also have greater capacity to control for the impact of unobserved or omitted variables and uncovering dynamic relationships (Hsiao (2007)).

Despite this, the approach has attracted considerable criticism, particularly pertaining to the interpretation of its results with regards to growth theories (see Temple (2000), Durlauf (2009) and Mankiw et al. (1995)). In this chapter we conduct a further investigation into cross-country analysis in aid effectiveness literature; we examine some of the key concerns about the use of cross-country approaches in aid-growth regressions and how they may affect estimated results. While the discussion is based on aid-growth studies, some of the issues analysed are common in cross-country growth empirics in general.

After discussing the key issues pertaining to the cross-country approach, the chapter will proceed by investigating further the stability of results from empirical cross-country aid-growth studies. In this regard, we will conduct robustness checks on results from one of the influential studies that used this approach. Burnside and Dollar (2000) (for the rest of the chapter, this study is referred to as BD) key finding, that aid causes faster economic growth in countries with good macroeconomic policies, provoked a generation of aid effectiveness studies; much of the debate and research on aid effectiveness conducted since 2000 has been centered around the links between aid, policies and growth. We will therefore extend one of the robustness checks conducted on the BD results and use this to illustrate some of the issues discussed with regards to the use of cross-country approach in aid effectiveness studies.

The final part of the chapter will seek to estimate the evolution of the relationship that exists between aid and long run growth. Studies in the existing literature have examined the average effects over long periods of time, but it is unlikely to be the case that this relationship has remained constant throughout such long periods. The lack of evidence unraveling the possible evolution of the link between aid and growth has given the motivation behind the endeavor in this study.

3.2 Contemporary aid-growth empirics: An analysis of cross-country aid-growth regressions

In this section, we take a critical look at the cross-country approach (and its application in aid-growth literature) which has become a hallmark of contemporary empirical growth economics. Cross-country regressions are sometimes seen as a means to deal with the controversy that has often surrounded empirical work on growth; widespread distrust of the often contradictory results from empirical growth investigation. The cross-country approach is thus an attempt to unite growth theory and econometrics (Temple (1999)).

From the 1980's, the approach took the form of cross-sectional regression with the growth rate of sample of countries, averaged over a long period of time on the left-hand side and regressed with a set of variables on the right-hand side that are expected to determine that growth, also averaged over a the same period. As more data became available and economists begun to construct datasets that reveal time-series experiences of countries, the focus shifted from cross-sections to panel data analysis. With advances in econometric methodologies, panel estimation allowed to capture both cross-sectional and time series variation in growth experiences across countries.

A typical empirical growth analysis in recent times chooses a sample of countries and runs dynamic panel-data regressions over long periods of time with countries' growth rates and a set of control variables. The variables on the right-hand side differ across studies, and hence interpretation of results from the cross-country approach also differs, nonetheless the basic structure remains the same. Cross-country growth regressions became more widespread in the 1990s following Barro (1991*a*), Mankiw et al. (1992) and for aid effectiveness literature Boone (1996) and Burnside and Dollar (1997).

3.2.1 Data limitations

Availability and quality

The starting point of our review of cross-country regressions pertains to data, its availability and quality to support rigorous research. This is primarily because the resurgence of empirical growth regressions in the early 1990's was largely facilitated by construction

of large datasets covering the second half of the twentieth century. In particular, the Penn World Table (PWT)[1] (see Heston and Summers (1991)) initially developed to compare income levels across countries (Temple (1999)) and the World Bank's World Development Indicators (WDI)[2] created new opportunities for cross-country research.

No matter the econometric techniques employed, weaknesses in available data pose a crucial constraint to empirical growth research. The effect of data limitations on the results from cross-country growth studies and their interpretation may be more serious than generally believed. Firstly, while the main datasets, PWT and WDI, have over the years managed to incorporate more countries and years, they are still bedevilled by missing data especially for the earlier years. Since a typical cross-country regression estimation essentially covers a long period of time, missing data limits both the longitudinal scope and the cross-sectional breadth e.g. Burnside and Dollar (2000) have six four-year averages over the period 1970-1993 and include only 56 countries out of a possible 170 at the time. Limited cross-sectional coverage diminishes the extent to which researchers can address problems such as measurement error and parameter heterogeneity (Temple et al. (2005)) and also leaves estimations open to selection bias (Trew (2006)). Further, the practice of averaging over four-year periods leaves such regressions prone to be affected by cyclical factors which are hard to control for (Rajan and Subramanian (2008)).

While the new data sets, the Penn World Tables in particular, have been welcome addition to the set of data available to analysts and contain some of the best international data available for many purposes, data quality issues still persist which affect the results and conclusions drawn from cross-country studies[3]. The quality of data across countries vary significantly and the PWT rankings reflect the domestic quality differences in national income accounts. Table (3.2.1) reports the cross-country comparison of data quality in PWT version 5.6 (which along with PWT mark 6.1 are the most commonly used versions of the PWT (Johnson et al. (2013))).

[1]The PWT contain a set of key economic time-series based on national accounts for a large number of countries and covering a long period of time. The first version (see Heston et al. (1980)) contained 119 countries and covered the years 1950–1977. Updates to the PWT tables have added more countries and more years; the latest version of the dataset (see Feenstra et al. (2015)) contains data on 182 countries for the period 1950-2014.

[2]The WDI is the primary collection of development indicators for the World Bank. They are compiled from national, regional and global estimates. Currently the WDI contains data for 217 economies covering the period 1960-2015.

[3]For a detailed analysis on the Penn World Tables see Temple (1999), Dawson et al. (2001) and

Table 3.2.1: PWT state of development vs data quality

	PWT data quality rating				
Stage of development	A	B	C	D	Total
Industrial countries	18	5	1	0	24
Developing countries	1	19	43	32	95
Total	19	24	44	32	119

The table contains cross-classification of countries by stage of development and data quality for countries in the PWT mark 5.6. Table adopted from Johnson et al. (2013).

The lower the country is ranked in data quality, the more measurement error its data are likely to contain. As the table shows, 75 of the 95 developing countries, who are the priority targets for most aid flows, are ranked C or D. Chen and Nordhaus (2011) reports that the margins of error that correspond to the data quality ranks are 10 percent, 15 percent, 20 percent and 30 percent respectively. The effects of systematic measurement error on growth regressions have been well documented in the literature (see Temple et al. (2005) and Johnson et al. (2013)). Data quality significantly impacts on the estimated relationship between economic growth and its expected determinants (such as aid and financial depth).

Measuring economic growth and aid

For empirical growth studies to provide accurate estimation of growth determinants, it is obviously imperative that economic growth itself be measured as accurately as possible. Unfortunately, this is one of the daunting tasks in empirical growth research. Gross domestic product (GDP) remains the most commonly used measure of economic growth, primarily because it is probably the most recorded and hence most readily available measure of output. The best (and most commonly used) sources of this data for cross-country analysis are PWT and WDI. As has already been shown, there are concerns about measurement error with data from these databases, particularly for developing countries.

To illustrate the extent of measurement error in PWT, Johnson et al. (2013) compare version 6.2 and 6.1 (released in 2006 and 2002 respectively) by calculating the the top and bottom 10 performers in Africa based on data from the two versions. Six countries do not make the lists from both versions for the top performers, while eight countries do

Johnson et al. (2013)

not feature on both lists of the bottom performers[4]. Equatorial Guinea actually switches from top performing in version 6.1 to bottom performing in version 6.2. Dawson et al. (2001) go further to claim that the link between output volatility and income growth in PWT data is entirely explained by measurement error in annual GDP. Similar concerns about measurement error in estimating economic growth apply when using World Bank and IMF datasets (Henderson et al. (2012)).

Temple (1999) also alludes to the point that growth rates obtained from PWT are usually different from rates implicit in countries' national accounts since PWT rates are weighted based on average of international prices rather than nominal shares used in domestic national accounts. Nuxoll (1994) suggest that since domestic prices reflect the trade-offs agents face, using economic growth rates from national accounts data may be ideal. However, for most developing countries with low data gathering capacity, national accounts are unreliable.

As already mentioned in section (2), when it comes to aid effectiveness literature using GDP as a measure of economic growth presents another problem; it narrows the scope for measuring the impact of foreign aid. While by OECD definition, which is the standard definition in the literature, ODA implies flows with the explicit purpose of promoting economic growth and development, ODA funds a broad spectrum of programmes whose impact can not adequately be captured by variation in GDP. Stiglitz et al. (2010) discusses this aspect in greater detail; they argue that there is an increasing gap between what is captured by GDP and what counts for common people's economic performance.

Similar concerns crop up when one considers measurement of aid. In section (1.3.1), we touch upon the point that different definitions of aid may alter the scope and measurement of aid. The most commonly used measure of international aid flows is ODA as defined by OECD; and even this remains controversial as a measure of aid. As the international community responds to the ever-expanding range of global concerns[5], the underlining objectives for ODA have evolved over the years as have the tools of delivery from mere loans and grants to debt relief, financial market facilities, guarantee schemes etc. While

[4]The table adopted from Johnson et al. (2013) can be found as table (3.C.1) in the appendix.

[5]Geopolitical factors were the driving force during the Cold War era, compassionate ethics followed the end of Cold War as aid objectives became more people-centered than growth-oriented (Severino and Ray (2009)). Since the turn of the century, conflict prevention and management after the 9/11 attacks and global pandemics (SARS, Ebola etc) have become priority agenda items.

all this revolution occurs, it has had surprisingly little effect on how aid is measured (see Severino and Ray (2009)) which may imply measurement error in the current measure of ODA in the literature and that it does not give a true reflection of aid flows.

Additionally, just as the PWT tables are for growth, the WDI are the standard source for ODA data. Caunedo and DiCecio (2010) uses data revisions in WDI between 2007 version and 2010 version to illustrate the inconsistencies that are a potential source of measurement error in WDI database. Using GDP data from the two versions, they show that the US is six times richer than China in 2005 in the 2007 version while the 2010 version implies the US was ten times richer in the same year.

These issues bring into question the usefulness of results from cross-country aid effectiveness studies when there is high likelihood the key variables of interest (aid and growth rates) are both riddled with measurement errors.

Measurement error/attenuation bias

Measurement error is widely recognized as an important source of bias in aid-growth regressions (Rajan and Subramanian (2008) and Brückner (2013)). Classical measurement error is when a variable of interest, either explanatory or dependent variable, has some measurement error independent of its true value. The discussion so far points to potential errors in measuring both per capita output and aid. To illustrate how measurement error can affect the estimated effects of aid on growth, let us assume a simple linear aid-growth relationship given as:

$$\Delta y_i = \beta_0 + \beta_1 a_i + \mu \tag{3.2.1}$$

where Δy_i and a_i are the true values of output growth and aid respectively. We are however only able to observe, with some error, some estimated values $\widehat{\Delta y_i} = \Delta y_i + \epsilon$ and $\widehat{a_i} = a_i + \upsilon$.

A) *Measurement error in the dependent variable*: When the dependent variable is measured with error, then equation (3.2.1) becomes $\Delta y_i = \beta_0 + \beta_1 a_i + \nu$ where $\nu = \mu + \epsilon$. OLS estimation assumes that the random error term μ is uncorrelated with the covariates, which leaves the measurement error, ϵ. Generally, ϵ is also assumed to be uncorrelated with the covariates[6] which implies ν is also uncorrelated with both a_i and y_i. This in turn

[6]Even if we assumed that ϵ is correlated with the covariates, all that is captured in the estimate of

implies that OLS estimation of equation (3.2.1) is still unbiased and consistent. Thus measurement error in Δy_i does not bias the estimated slope coefficient of a_i i.e. estimated $\widehat{\beta_1} = \beta_1$.

However, OLS estimation of (3.2.1) also assumes that $var(\mu) = \sigma_\mu^2$; since the error term in the regression is now ν, then variance will be $var(\nu) = var(\mu + \epsilon) = \sigma_\mu^2 + \sigma_\epsilon^2 > \sigma_\mu^2$. Measurement error in Δy_i increases the variance of OLS regression wich in turn implies larger standard errors which may lead to finding no significant effect on the dependent variable. Measurement error in y_i hence diminishes the ability of OLS estimation of equation (3.2.1) to detect real effect of changes in a_i, i.e. it increases errors in making inference from OLS estimation (Wooldridge (2013))

B) *Measurement error in the independent variable*: A more interesting case is when the explanatory variable (a_i) is measured with error. In this case, equation (3.2.1) becomes $\Delta y_i = \beta_0 + \beta_1 \widehat{a_i} + \psi$ where $\psi = \mu - (\beta * \upsilon)$. OLS asumes that μ is uncorrelated with a_i, however in the presence of measurement error in $\widehat{a_i}$, a_i is no longer uncorrelated with the new error term ψ (through its correlation with υ) creating an endogeneity bias. Standard assumption is that υ is uncorrelated with the observed $\widehat{a_i}$ as such both error terms are uncorrelated with the observed $\widehat{a_i}$ so that $E(\mu - \beta_1 \upsilon | a_i) = E(\psi) = 0$. As a consequence, OLS estimate $\widehat{\beta_1}$ also remains unbiased and consistent; however, just as the case in A) above $var(\mu) \neq var(\psi)$ implying inferences from OLS estimation may be affected.

Of major concern in the case of measurement error in the explanatory variable is what is termed as the *clasical errors-in-variables (CEV)* problem where the measurement error is assumed to be uncorrelated with the unobserved true value a_i so that

$$cov(a_i, \upsilon) = E(a_i \upsilon) - E(a_i)E(\upsilon) = 0 \Rightarrow E(a_i \upsilon) = 0$$

Since we have $\widehat{a_i} = a_i + \upsilon$:

$$cov(\widehat{a_i}, \upsilon) = E(\widehat{a_i} \upsilon) - E(\widehat{a_i})E(\upsilon) = E(a_i \upsilon + \upsilon^2) = E(\upsilon^2) = \sigma_\upsilon^2 \neq 0$$

This implies that the covariance between the $\widehat{a_i}$ and the measurement error (υ) is not zero, but equal to the variance of the measurement error. The significance of this is that the OLS estimation of equation (3.2.1) when $\widehat{a_i}$ is measured with error will have a negative bias[7] (β_1 is always drawn towards 0) and hence $\widehat{\beta} < \beta$ This called attenuation bias.

the intercept β_0 which is hardly ever of any concern.

[7]This is shown in more detail in the appendix 3.A.

There is not much that a researcher can really do about measurement error in the dependent variable, the remedy for this is to collect more data since more observations imply a better estimator of variance, and consequently reduces errors in inferences (**?**). The standard approach to address the problem of measurement error in the explanatory variable (and in particular CEV) is to employ instrumental variable estimation.

3.2.2 Narrow scope of measuring aid effectiveness

One of the major challenges that has posed a lot of difficulty in estimating the success of aid on economic growth (and development in general) has been coming up with an appropriate measure of success. The most common measure of aid success in the literature is on its effect on the growth of national output, traditionally measured using GDP. Since GDP data is readily available for many countries, it makes for a handy measure in cross-country comparison. Despite its popularity in use, GDP does not capture all aspects of economic growth and development. Most importantly, development aid is often targeted at a range of programmes and activities whose effects may not be easily captured by short-run GDP changes. Thus using GDP as the sole success measure narrows the scope of the effects of aid.

Furthermore, GDP based measures have also been conflated to measure economic well-being, in the aid effectiveness literature. A recent report by the Commission on Measurement of Economic Performance and Social Progress (compiled in 2010 by Stglitz, Sen and Fitoussi (see Stiglitz et al. (2010))), has noted the need to devise better measures of economic performance. Among others, change in GDP at the macro level fails to capture changes in quality of products and services that is vital to capture real incomes and real consumption. GDP also fails to reflect the distribution of incomes and account for income measures from non-market activities. Since development aid is aimed at 'reducing poverty (or synonymously, improving well-being)' using per capita GDP in aid effectiveness research may be tractable, but it is inadequate as a measure of performance and narrows the scope of aid. There is thus a need to derive more encompassing measures of income growth, that reflect improvements in living standards, on which recipient countries' performance can be assessed.

Some studies in the literature have begun to use alternative indices, such as the Human

Development Index (HDI) developed by the United Nations Development Programmes (UNDP), the Physical Quality of Life Index (PQLI) developed in the 1970s by the Overseas Development Council and most recently, the Multidimensional Poverty Index (MPI) from Oxford Poverty and Human Development Initiative (OPHI). These alternative measures have been developed as better and more encompassing proxies of well-being by incorporating income (GDP based) measures with other social indicators such as life expectancy, adult literacy etc. However, these alternatives (especially the popular HDI) have also faced some criticism, from inadequacy in composition, to data errors resulting from data updating and changing formulas and lacking year to year comparability due to changing weights on a yearly basis and their assessment of development differently in different income groups. Thus the need still remains to find better alternative measures on which to gauge the success of aid on raising economic well-being.

3.2.3 Model uncertainty

A key motivation for recent cross-country growth studies has been to determine which set of factors are effective in promoting economic growth. The starting point for most cross-country studies is the application of Solow's neoclassical growth model (Solow (1956)) and its extensions which propose the *proximate* growth determinants including technology, population and capital (both physical and human capital). Developments in the theory of endogenous growth as well as advancements in data availability such as the PWT, which made available multi-country growth data, fueled the renewed interest in cross-country growth studies[8].

In as much as the proximate determinants have been shown to have considerable explanatory powers for growth differences across countries, there is growing recognition that there are other deep lying factors that also have a critical role in explaining cross-country growth differences. Thus beyond the proximate determinants, economic growth research has shifted focus to the *fundamental* sources of growth (such as institutions, geo-political factors, colonial origins etc) across countries to understand cross-country differences. This has been done within the framework of new growth theories that suggest proxy variables that can be used in empirical estimation, in most cases in the form of Barro (1991*a*) type

[8]Seminal studies by Kormendi and Meguire (1985), Barro (1991*b*) and Mankiw et al. (1992) pioneered the resurgence of cross-country growth analysis.

regressions.

A key feature of the new growth theories is that one theory does not preclude the potential causal role of others (Durlauf and Brock (2001)), thus while most studies include the same proximate determinants of growth, the fundamental sources of growth vary from one study to another. There is no agreement as to which variables are really important to growth and as such the list of potential sources is open-ended and non-exhaustive. Further, nearly as many variables proposed have been shown to be fragile in that their statistical significance vanishes when a different set of right-hand explanatory variables is added (Temple (1999)). With such a large set of potential explanatory variables, and with no *a priori* basis for identifying the appropriate set of explanatory variables outside the proximate determinants (Durlauf (2009)), results of empirical growth studies are sensitive to model selection and may be misleading.

With the proliferation of potential sources of growth and low number of countries[9], it hard to run an empirical growth regression that encompasses all possible growth determinants. Hence, model uncertainty has become a significant problem for cross-country growth regressions and has resulted to lack of robustness for its results. Nonetheless, despite the immense challenges posed by model specification, it is generally neglected in empirical growth studies. Detailed discussion on the approaches to dealing with model specification can be found in Temple (2000) and Durlauf and Brock (2001).

3.2.4 Endogeneity

Another commonly acknowledged problem with cross-country growth literature is that the right-hand side variables of interest may themselves not be exogenous. In most cases, this is caused by reverse causation (simultaneity) implying a high probability that explanatory variables are jointly endogenously determined with growth, measurement error and omitted variables. Endogeneity makes establishing causal effects of growth difficult as it becomes hard to separate causes and correlations.

In aid effectiveness studies, endogeneity was noted as early as the 1970s when Papanek (1972, 1973) argued that a needs based allocation of aid may be responsible, at least

[9]Which is made even smaller as a result of data limitations as discussed already.

in part, for the observed negative correlation between aid and savings. Despite this early recognition, not until the 1990s was the issue of endogeneity of aid comprehensively considered in econometric analysis of the impact of aid. The works of (Boone (1994, 1996)) inspired the third generation of aid effectiveness literature which took particular interest in addressing the endogeneity of aid.

There is now a lot of literature pointing to the challenges of endogeneity in aid effectiveness literature[10]. The ability for research to identify the separate exogenous effects attributable to aid on growth is hampered by the possible existence of a causal link from growth to aid. The expectation that growth can cause aid is rather obvious: more aid is given to low per capita income countries or countries undergoing periods of slow growth, hence a negative relationship between growth and aid. On the other hand, if a country makes some reforms and starts to grow, that potential for growth attracts aid and hence a positive relationship from growth to aid.

For example, a typical empirical aid-growth equation would be expressed as:

$$g_i(t) = \beta_g(0) + gdp_i(t-1) + \beta_{ga}a_i'(t) + \beta_{gx}x_i'(t) + \mu_i(t) \tag{3.2.2}$$

where $g_i(t)$ is the growth of per capita GDP, $gdp_i(t-1)$ is initial level of log GDP per capita, $a_i'(t)$ is a vector of aid variables, $x_i'(t)$ is a vector of other explanatory variables that affect economic growth and $\mu_i(t)$ is an error term. The assumption under OLS estimation would be that $cov(a_i, \mu_i) = 0$; however endogeneity violates this assumption, so that $cov(a_i, \mu_i) \neq 0$.

Endogeneity of aid implies that OLS estimator of the effect of aid on growth will be biased (as we showed when discussing CEV). The standard approach used to deal with endogeneity problem in the literature is to deploy instrumental variables. These are variables that cannot materially affect growth through any channels other than through the explanatory variable (IV) of interest. IV approach involves two-stage estimation; in the example above, the first-stage regression is a regression of aid on the chosen instruments.

$$a_i(t) = \beta_a(0) + \beta_{az}z_i'(t) + \epsilon_i(t)$$

where $z_i'(t)$ is a vector of exogenous variables and $\epsilon_i(t)$ is a well behaved error term, other variables as defined in equation 2.14. The above equation is assumed to satisfy OLS (Gauss Markov) assumptions and the instruments ($z_i'(t)$) are also assumed to be

[10]see Roodman (2007*b*), Rajan and Subramanian (2008) and Arndt et al. (2010)

uncorrelated with the regression error term from equation (3.2.2):

$$Cov(z_i(t), a_i(t)) \neq 0$$

$$Cov(z_i(t), \mu_i(t)) = 0$$

Since $z_i(t)$ is uncorrelated with μ, $\beta_a(0)+\beta_{az}z_i'(t)$ is uncorrelated with μ. We do not know what the values of $\beta_a(0)$ and β_{az} so that $\beta_a(0) + \beta_{az}z_i'(t)$ cannot be calculated, however we have estimated them using the first stage OLS regression. Thus the first stage of IV approach uses OLS estimation to obtain predicted values of aid, $\widehat{a_i(t)} = \widehat{\beta_a(0)} + \widehat{\beta_{az}}z_i'(t)$ where $\widehat{\beta_a(0)}$ and $\widehat{\beta_{az}}$ are the OLS estimates. The second stage then is an OLS regression of $g_i(t)$ on $\widehat{a_i(t)}$; the resulting estimators from the second stage are known as "Two Stage Least squares" (TSLS or 2SLS) estimators, $\widehat{\beta_a^{2SLS}(0)}$ and $\widehat{\beta_{az}^{2SLS}}$, and are consistent estimators of $\beta_g(0)$ and β_{ga}.

The success of research in estimating the causal effect of aid on growth using this method almost boils down to identifying good instruments to address endogeneity, and results for various studies have differed due to the differences in the identification strategy. The problem however is that there is a shortage of such variables to be used as 'good instruments'. As the new growth theories have suggested, a vast number of variables can be shown to determine growth as such it is difficult to identify those that are not only highly correlated with the endogenous variable of interest but at the same time excludable from the growth regression (Temple (1999)).

As a result, there has been growing concerns that many of the instruments used in widely cited existing literature are weak, and in some cases invalid[11]. Temple et al. (2005) argue that the applications of instrumental variables in economic growth empirics has been undermined to a greater degree by the failure to address the issue of validity of instrumental variables, while Acemoglu (2009*b*) and Rodrik (2004) observed that there is growing use of 'instruments without theory.' The table 3.2.2 below is an example of instruments used in some of the widely cited papers on aid effectiveness:

Rajan and Subramanian (2008) argue that most of the instruments in the above table are weak, while some are not valid. For instance, the economic motivation for such variables as Egypt dummy, lag of policy, lag of arms imports may be difficult to understand, moreover,

[11]See Bazzi and Clemens (2013), Acemoglu (2009*b*) and Temple et al. (2005)

Table 3.2.2: Instrumental variables used in the existing literature

BD	**HT (2001)**	**CRB (2011)**	**RS (2008)**
Arms imports	Arms imports	Arms imports	Arms imports
Egypt dummy	Egypt dummy	Egypt dummy	Egypt dummy
Colonial origin dummies	Colonial origin dummies	Colonial origin dummies	Colonial origin dummies
Population	Population	Population	Population
Assassinations	Assassinations	Assassinations	Assassinations
Ethnic fractionalization	Ethnic fractionalization	Ethnic fractionalization	Ethnic fractionalization
Policy	Policy	Policy	Policy
Lag arms imports	Lag policy	Lag policy	
	Lag aid	Lag aid	

Notes: (i) BD - Burnside and Dollar (2000); HT (2001) - Hansen and Tarp (2001); CRB (2011) - Clemens et al. (2012); RS (2008) – Rajan and Subramanian (2008); (ii) Table modified from Rajan and Subramanian (2008)

use of lags of endogenous variables (in this case lag of aid) in econometric analysis is that they are not exogenous and run the risk of serial correlation with the dependent variable. Bazzi and Clemens (2013) also points to the fact that in almost all studies, population (or log of) is the main instrument used, accounting to about 90% of the instrumentation power. The problem is that there is reasonable literature that suggests that population is itself correlated to growth, defeating its use as an instrument.

3.2.5 Cross-country heterogeneity

Another major drawback of cross-country panel regression estimation is that it fails to capture potential heterogeneity in the relationship between aid and growth across countries. Panel data estimation has managed to mitigate omitted variables bias by accounting for unobserved country-specific effects and have the potential to address the problem of endogeneity through instrumental variables. However, they still implicitly assume that the effect of aid on growth is the same across countries. This is highly unlikely as the productivity of aid is affected by specific characteristics of each different aid beneficiary, for example post conflict situation or vulnerability to external shocks.

Morrissey et al. (2007) observes that despite the fact there is now a considerably large empirical literature on the potential effects of foreign aid on growth, there is rather surprisingly very few country-specific studies conducted. They argue that since countries are heterogeneous with many factors that promote and constrain growth to varying magnitude across countries, it is not surprising that it is difficult to explain cross-country

variations in growth, hence results vary. Cross-country studies are only able to highlight what appears to be important in general or on parameter averages (Temple (1999)); there is need for analytical country studies that will help to understand the growth process, and which factors are most important, in individual countries.

3.3 Aid, policies and growth

Albeit the many challenges with cross-country approach in growth studies, buoyed by advancements in empirical estimation methodologies particularly panel data techniques and the availability of more complete datasets than ever before, it is still increasingly being used in empirical growth research. For aid effectiveness literature, Boone (1996) was the first to exploit this data, using 96 countries between 1971 and 1990 and found no correlation between aid and investment, concluding that aid programmes have not been engendered or correlated with the basic ingredients that cause growth[12].

Since then, a voluminous empirical literature has examined the link between aid and growth; the standard approach involves estimating the average long run effects using four or five year averages in a panel set up that covers a long period of time. The continued use of cross-country regressions in aid-effectiveness literature gives the motivation behind the analysis in this chapter; to investigate further and re-examine the existing evidence and provide some more insight as to the possible explanations for the mixed results that continue to be derived from cross-country growth regressions.

Probably the most popular strand of empirical aid effectiveness studies in the last two decades has been the 'policy selectivity' strand. BD (in particular its earlier version, Burnside and Dollar (1997)) sparked a generation of literature on the conditional relationship between aid and growth through their key finding, that "...aid has a positive impact on economic growth in developing countries with good fiscal, monetary and trade policies but has little effect in those with bad policies, (pp 874)" proposing that donors should direct aid resources to such countries. The study has in one way or the other motivated the bulk of aid growth literature since the late 90s; its results ignited an intense reaction amongst scholars and policy makers alike.

[12]Clemens et al. (2012) notes that Boone's regressions with the full sample show a positive and significant relationship between aid and investment.

The policy selectivity[13] findings from BD have been challenged by a number of studies including Hansen and Tarp (2001), Easterly et al. (2004) (henceforth referred to as ELR), Dalgaard and Hansen (2001)and Lensink and White (1999). Studies that reacted to the findings of Burnside and Dollar conducted some useful variations and extensions to the empirical model used by BD; for instance by introducing additional controls or using alternative forms of non-linear specifications. Due to the importance of the policy selectivity result in recent aid effectiveness literature, BD study is the starting point of our re-examination of the existing aid-growth evidence; in the following sections, we conduct some robustness tests to their results using our reconstructed dataset.

After the robustness checks, we discuss other dimensions used to challenge the BD results. In that respect, we touch on specification issues, instrumentation strategies and inclusion of time lags. The intense reaction that the BD study revealed a number of weaknesses with regards to the preferred specification that may better explain the lack of robustness of their results. Particularly, empirical results from Durbarry et al. (1998), Hansen and Tarp (2001), and Lensink and White (1999) showed that modeling diminishing returns to aid through inclusion of a polynomial effect of aid[14] could improve BD results. Moreover, Dalgaard et al. (2004) and Clemens et al. (2012) question the instruments used, especially the inclusion of population as an instrumental variable. Finally, some studies consider the inclusion of lags of aid either as an instrument or indeed as an explanatory variable in the growth regression. In later sections of this chapter, we consider these views and analyse how their inclusion improve empirical results from BD.

3.3.1 Robustness checks on aid, policies and growth

The policy selectivity results from BD study attracted considerable debate. Studies questioned the identification of which policies are crucial in making aid work (Hudson et al. (2001) and Hudson and Mosley (2001)); instruments used to identify the causal effects of aid (Dalgaard and Hansen (2001) and Dalgaard et al. (2004)); and some studies challenged the robustness of the results finding them to be sensitive to model-specifications

[13]Policy selectivity refers to notion that allocation of aid is "selective", with more aid being allocated developing countries with "good policies".

[14]As already discussed in the previous chapter, there are a number of theoretical motivations for inclusion of a polynomial effect of aid including Dutch disease considerations and lack of absorptive capacity in recipient countries.

(see Hansen and Tarp (2000, 2001)). These studies tested the robustness of BD results by conducting making variations and extensions to the original BD specification.

Unlike these studies, ELR conduct a simple test by not deviating from BD model specification. Rather, they only added new data to the original BD dataset by increasing the number of sampled countries and also extending the sample period. Their analysis found that when new data was added, the aid-policy interaction term was no longer statistically significant i.e. they could not find evidence that aid promotes growth in good policy environments.

Our robustness checks adopt the ELR methodology and extend the longitudinal and cross-sectional scope. We add even more observations to the dataset by extending the sample further, taking advantage of new data available since their study. To do this, in this chapter we reconstruct the dataset used by ELR[15] and then extended the countries covered from 62 to 81 while the sample period is increased by 16 years to 2013, thus the sample period in our analysis is from 1970-2013 compared to 1970-97 in ELR. Additionally, the availability of broader and updated coverage of the International Country Risk Guide institutional quality data allowed expanding the dataset further. As a result of the data updates, the reconstructed dataset does not match exactly with the original ELR dataset, but correlations between their variables and the dataset in this study are all above 0.93 (see table 3.C.2 in the appendix). Table (3.C.3) in appendix (3.C) shows the differences between the datasets used in BD, ELR and our reconstructed dataset.

Maintaining BD preferred specification, ELR uses Barro-type growth regression on GDP growth of total aid (*Aid*) provided to a country, as a percentage of the country's GDP; an index of the quality of policy environment (*Policy*) and an aid-policy interaction term ($Aid * Policy$). The model also includes a large set of country level controls common to the aid effectiveness literature. These include log of initial GDP per capita level; a measure of financial depth; measures of ethno-linguistic fractionalisation; rate of political assassinations and an index of the quality of institutions. The policy index is constructed from measures of inflation, budget balance and the Sachs-Warner openness index[16].

[15]Original dataset and code for replication of ELR results is available freely on AidData website: http://aiddata.org/replication-datasets

[16]Constructed by Sachs and Warner (1995) and later corrected and extended by Wacziarg and Welch (2003)

In order to maintain comparability of the reconstructed dataset used in this chapter and the results of our analysis with those of the original studies (both BD and ELR), we begin the analysis by replicating the results from BD as well as the ELR, and analyze the factors that can be attributed to the break in the results between the two papers. To achieve this, we restrict our sample to exactly match the samples in the two initial studies and run exact regressions using that sample with our reconstructed dataset, the results of which are reported in table (3.3.1). The results reported here refer to BD preferred specification that uses two samples; the first one includes all developing countries and the other includes only low-income countries and it also excludes some influential observations and outliers. The Hadi-method[17] of identifying and eliminating outliers is used in this study, just as ELR.

Table 3.3.1: Replication of BD and ELR results, using 2SLS

	ELR dataset				DK dataset			
	BD		ELR		BD		ELR	
	1	2	3	4	5	6	7	8
Variables	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Aid	-0.3232	-0.2422	-0.4943	-0.1603	-0.1107	-0.1473	-0.4431	-0.0912
	(0.3596)	(0.2587)	(0.5287)	(0.5890)	(0.1489)	(0.4587)	(0.5111)	(0.3193)
Aidpolicy	0.1763*	0.2526**	0.0115	-0.2023	0.1770*	0.2561**	0.0125	-0.2041
	(0.1047)	(0.1210)	(0.2124)	(0.3005)	(0.0940)	(0.1321)	(0.2204)	(0.2781)
Initial GDP	-0.9074	-0.8318	-0.8685*	-1.2144**	-0.8255	-0.7454	-0.2614	-0.7776
	(0.6508)	(0.7741)	(0.4899)	(0.5783)	(0.5929)	(0.7591)	(0.5288)	(0.5034)
Ethnic fractionalization	-0.7251	-0.6716	-0.4724	-0.7447	-0.7393	-0.7767	-0.3196	-0.6872
	(0.8119)	(0.8439)	(0.7435)	(0.8720)	(0.7625)	(0.8275)	(0.7528)	(0.8392)
Assassinations	-0.4141	-0.7600*	-0.2862	-0.6929*	-0.4229	-0.7535*	-0.3636	-0.9254**
	(0.2650)	(0.4447)	(0.2534)	(0.3956)	(0.2669)	(0.4544)	(0.2415)	(0.3597)
Ethnassass	0.7138	0.6338	0.0112	0.6901	0.7525*	0.9453	0.1039	1.0405
	(0.4451)	(0.9030)	(0.6225)	(0.8518)	(0.4460)	(0.8839)	(0.6322)	(0.7949)
SSA	-1.2893	-2.1128***	-1.2166**	-1.2036*	-1.2881*	-1.8540***	-1.1792*	-1.3781**
	(0.8424)	(0.7270)	(0.6051)	(0.6454)	(0.7292)	(0.6686)	(0.6212)	(0.6164)
E.Asia	1.1508**	1.4580**	1.1330**	1.0092	0.9221*	0.6973	1.4623***	1.2254**
	(0.5642)	(0.7120)	(0.5128)	(0.6910)	(0.5591)	(0.6689)	(0.5115)	(0.5918)
ICRG	0.6649***	0.8449***	0.3228***	0.3752**	0.6267***	0.7713***	0.2572**	0.2819*
	(0.1761)	(0.1930)	(0.1231)	(0.1468)	(0.1744)	(0.1935)	(0.1248)	(0.1450)
M2 lagged	0.0172	0.0248	0.0085	0.0141	0.0195	0.0280*	0.0109	0.0222
	(0.0157)	(0.0170)	(0.0118)	(0.0135)	(0.0147)	(0.0162)	(0.0139)	(0.0160)
Policy	0.7359***	0.5911	1.1076***	1.6129***	0.9259***	1.1361***	0.8874***	1.3606***
	(0.1981)	(0.3782)	(0.2504)	(0.5288)	(0.1890)	(0.3381)	(0.2005)	(0.3587)
Observations	270	184	345	236	274	185	347	238
R-squared	0.384	0.4719	0.304	0.3463	0.3356	0.411	0.3801	0.3965
No. of countries	56	40	62	44	56	40	62	44
AR F-test (p-value)	0.0070	0.0081	0.0099	0.0001	0.0069	0.0199	0.0019	0.0017
KP Wald F-Stat	9.76	11.76	10.722	7.7	10.88	9.0722	10.212	9.29
Hansen J (p-value)	0.214	0.233	0.202	0.0711	0.214	0.1681	0.202	0.3409

*Notes: The table presents original regression results of BD(2000) (columns 1and 2) and ELR(2003) (columns 3and 4) estimated using ELR(2003) dataset and the replication of the same results (column 5 and 6 for BD(2000) and columns 7and8 for ELR(2003) estimated using our reconstructed dataset. Dependent variable in all estimations is growth rate of real per capita GDP. For each set of results, the first column has results for the full sample (all developing countries in the study) while the second column has results for low income countries sample. Instruments used in all IV regressions are listed in table (3.C.3) in the main text. In all regressions, outliers are excluded, following BD(2000)'s approach. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

In the table, columns 1-4 present BD and ELR results derived using the original ELR dataset while columns 5-8 has the similar results derived using our reconstructed dataset.

[17]see Hadi (1994)

Columns 1 and 2 have BD results while columns 3 and 4 have ELR results, corresponding to BD regressions 5 and 8 in tables 4 and 5 of BD and tables 1 and 2 of ELR, respectively. The results using our constructed dataset are also presented in the same format (BD results in columns 5 and 6 while ELR results in 7 and 8). Columns 1,3,5 and 7 have results for all developing countries for each sample while 2,4,6, and 8 has results for low-income countries sample only. As can be seen, the results from our reconstructed dataset are close to the results from both studies.

After reproducing the results from the original studies, we now expand the sample first by extending the period from 1997 to 2013. This is an extension of 4 four-year periods, taking the total number of periods from 7 in ELR to 11 using our dataset. After that, we increase the number of countries from 62 to 81 countries. Taking into account both the longitudinal and cross-sectional expansion, our dataset has increased the sample from 356 observations in 62 countries covered by ELR to 477 observations in 81 countries. Table (3.C.4) in appendix (3.C) lists the countries covered in ELR and those used in our full sample.

Time series extension

The first of our robustness tests in this section is to increase the sample period. Longitudinal extension from 1997 to 2013 alone increases the number of observations to 433 across the 62 countries that were in ELR sample of developing countries, while the sample for low income-countries increases to 248 observations from 236 in ELR. Since the cross-sectional sample composition remains unchanged, there are 44 low income countries and 18 middle income countries. Table (3.3.2) presents results of regressions using the preferred specifications for the two samples. The first four columns contain results for all developing countries while the last four columns have results for specification that includes only low-income countries.

As the table reveals, longitudinal extension of the data does not alter the results from ELR much. The coefficient for interaction term (Aidpolicy) remains negative and statistically insignificant in almost all regressions, except the IV regression for low income countries with outliers reported in column 6 when the coefficient is still not significant but positive.

Table 3.3.2: Results from 2SLS regressions using time series extension of ELR dataset

	Dependent variable: Annual real per capita GDP growth rate							
	All developing countries				Low income countries only			
	1	2	3	4	5	6	7	8
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Aid	0.1116	-0.0475	0.0433	-0.0686	-0.0252	-0.0833	0.0125	-0.1035
	(0.0965)	(0.2258)	(0.1079)	(0.2155)	(0.1228)	(0.2622)	(0.1408)	(0.2455)
Aidpolicy	-0.1221	-0.1253	-0.1017	-0.1049	-0.1142	0.0699	-0.1912	-0.2066
	(0.0652)	(0.0821)	(0.0663)	(0.0855)	(0.0841)	(0.0797)	(0.1449)	(0.1699)
Initial GDP	-0.4293	-0.318	-0.3489	0.2713	-0.133	-0.18	-0.1221	-0.198
	(0.2921)	(0.3074)	(0.3082)	(0.3258)	(0.4619)	(0.4719)	(0.4638)	(0.4750)
Ethnic fractionalization	-0.2769	-0.45	-0.19	-0.2121	0.9671	1.1178	1.0107	1.145
	(0.6095)	(0.6419)	(0.6080)	(0.6107)	(0.9409)	(0.8907)	(0.9413)	(0.8971)
Assassinations	-0.4607**	-0.4626**	-0.4475**	-0.4354**	-0.7175	-0.6772	-0.7526*	-0.6766
	(0.2060)	(0.2016)	(0.2022)	(0.1983)	(0.4413)	(0.4322)	(0.4521)	(0.4432)
Ethnassass	0.5789	0.5547	0.5629	0.5108	0.5991	0.5052	0.6835	0.5053
	(0.3926)	(0.3854)	(0.3895)	(0.3858)	(0.8871)	(0.8670)	(0.9041)	(0.8836)
SSA	-1.5973**	-1.2893	-2.2374***	-1.8578***	-1.2881*	-2.1967***	-1.4697**	-1.4127**
	(0.7497)	(0.8424)	(0.7006)	(0.6827)	(0.7292)	(0.7073)	(0.6966)	(0.6982)
E.Asia	0.0152*	0.0142*	0.0167**	0.0159*	0.0771**	0.0791**	0.0754**	0.0783**
	(0.0085)	(0.0083)	(0.0084)	(0.0082)	(0.0374)	(0.0357)	(0.0374)	(0.0359)
ICRGE	0.6395***	0.6649***	0.8441***	0.7720***	0.6267***	0.7971***	0.7669**	1.6317*
	(0.1768)	(0.1761)	(0.2052)	(0.2041)	(0.1744)	(0.2062)	(0.3022)	(0.8788)
M2 lagged	1.9744***	1.8973***	1.8206***	1.7295***	1.6973**	1.4537	1.7417**	1.4011
	(0.3708)	(0.3667)	(0.3666)	(0.3635)	(0.7297)	(0.8987)	(0.7607)	(0.8781)
Policy	0.9604***	0.9645***	1.0448***	0.9604***	1.2036***	1.1908***	1.2226***	1.1694***
	(0.1892)	(0.1803)	(0.1885)	(0.1780)	(0.3877)	(0.3797)	(0.3908)	(0.3823)
Observations	*433*	*433*	*423*	*423*	*291*	*291*	*286*	*286*
R-squared	*0.2828*	*0.2794*	*0.2747*	*0.2747*	*0.2873*	*0.2895*	*0.2868*	*0.2878*
No. of countries	*62*	*62*	*62*	*62*	*44*	*44*	*44*	*44*
AR F-test (p-value)	.	*0.00272*	.	*0.0019*	.	*0.107*	.	*0.092*
KP Wald F-Stat	.	*11.03*	.	*9.47*	.	*11.47*	.	*10.95*
Hansen J (p-value)	.	*0.112*	.	*0.11*	.	*0.13*	.	*0.124*

*Notes: The table presents results from regression after time series extension of the ELR dataset, from 1997 to 2013. Dependent variable is annual growth rate of per capita GDP; Results reported in columns 1 - 4 are for sample with all developing countries while in columns 5 and 8 are results for sample with only low-income countries. First two columns in each set of results (1, 2, 5 and 6) has results for estimation that includes outliers while the last two columns (3,4,7 and 8) have results for specifications that omit outliers using the Hadi method of identifying and eliminating outliers. Instruments used in all IV regressions are listed in table 1 in the main text. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Figure (3.B.1) in appendix (3.B) shows a partial scatter plot of the original ELR sample and the partial scatter plot obtained after the longitudinal extension of the dataset; as shown, the relationship between per capita growth and aid*policy stays negative (similar to ELR) after the time series extension of the dataset.

Cross-sectional expansion of sample

The next test is to increase the number of countries in the sample, while maintaining ELR study period, i.e. from 1970 to 1997. The cross-sectional expansion increases the number of observations to 381 from 345 for all developing countries sample and to 248 observations from 236 for low-income countries only. The total number of countries in the sample increases from 62 in ELR to 81 in our sample; low-income countries increase slightly, from 44 to 48 countries while there is a significant increase in the number of middle-income countries, from 18 to 33 countries. The results of regression estimation

using the extended sample (in terms of number of countries) are presented in table 3.3.3.

Table 3.3.3: Results from 2SLS regressions using cross-sectional extension

	Dependent variable: Annual real per capita GDP growth rate							
	All developing countries				Low income countries			
	1	2	3	4	5	6	7	8
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Aid	0.1555	0.0832	-0.1193	-0.2066	0.0762	0.0927	-0.1082	-0.181
	(0.1059)	(0.2543)	(0.1374)	(0.4098)	(0.1449)	(0.2719)	(0.1683)	(0.3559)
Aidpolicy	0.1005*	0.1384**	0.1767*	0.2424**	0.0886	0.0627	0.1054	0.1353
	(0.0681)	(0.0685)	(0.0984)	(0.1225)	(0.0800)	(0.0985)	(0.1001)	(0.1194)
Initial GDP	-0.43327	-0.5158	-1.8516**	-2.0335*	-0.5236	-0.6478	-1.8758**	-2.0157*
	(0.4757)	(0.5326)	(0.8704)	(1.1725)	(0.5233)	(0.5863)	(0.9054)	(1.0973)
Ethnic fractionalization	-0.4333	-0.5786	-0.8665	-0.8795	-0.3513	-0.3309	-0.9217	-0.9295
	(0.7129)	(0.7431)	(1.0292)	(0.9876)	(0.7203)	(0.7161)	(1.0393)	(0.9944)
Assassinations	-0.3436	-0.349	-0.8395*	-0.8440**	-0.3347	-0.332	-0.8535*	-0.8453**
	(0.2410)	(0.2348)	(0.4323)	(0.4186)	(0.2396)	(0.2335)	(0.4423)	(0.4267)
Ethnassass	0.0947	0.1044	0.8509	0.8695	0.0882	0.0815	0.8944	0.8813
	(0.6933)	(0.6722)	(0.8607)	(0.8284)	(0.6868)	(0.6708)	(0.8850)	(0.8510)
SSA	-1.3567**	-1.4566**	-1.3132**	-1.4697**	-1.7789**	-2.2184**	-1.6881**	-2.1935**
	(0.6194)	(0.6259)	(0.6161)	(0.6966)	(0.7319)	(0.8700)	(0.6991)	(0.8649)
E.Asia	1.7764***	1.8959***	1.6317*	1.7682***	1.6317*	1.6862***	1.5321***	1.7389**
	(0.4335)	(0.3768)	(0.8788)	(0.3754)	(0.8788)	(0.3726)	(0.4864)	(0.7187)
ICRGE	0.648***	0.9702***	0.642***	0.790**	0.691*	0.7229**	0.6465**	0.7691**
	(0.2419)	(0.2280)	(0.2404)	(0.2599)	(0.4624)	(0.3922)	(0.3777)	(0.4624)
M2 lagged	0.0583	0.1178	0.027	0.1194	0.0138*	0.0705*	0.0155*	0.0705*
	(0.0925)	(0.0983)	(0.1033)	(0.1026)	(0.0082)	(0.0367)	(0.0081)	(0.0367)
Policy	1.0256***	1.0911***	1.6898***	1.8708***	1.1230***	1.0824***	1.7202***	1.8360***
	(0.1898)	(0.1905)	(0.4349)	(0.4689)	(0.1923)	(0.1868)	(0.4443)	(0.4698)
Observations	*381*	*381*	*373*	*373*	*248*	*248*	*244*	*244*
R-squared	*0.2848*	*0.283*	*0.2717*	*0.2715*	*0.2968*	*0.2945*	*0.2978*	*0.2968*
No. of countries	*81*	*81*	*81*	*81*	*48*	*48*	*48*	*48*
AR F-test (p-value)		*0.0186*		*0.00713*		*0.0158*		*0.0116*
KP Wald F-Stat		*10.46*		*9.19*		*11.99*		*10.34*
Hansen J (p-value)		*0.282*		*0.272*		*0.246*		*0.205*

*Notes: The table presents results from regression after cross-sectional extension of the Easterly et all dataset, the number of countries in the sample increases from 62 to 81. Dependent variable is annual growth rate of per capita GDP; Results reported in columns 1-4 are for sample with all developing countries while in columns 5-8 are results for sample with only low-income countries. First two columns in each set of results (1, 2, 5 and 6) has results for estimation that includes outliers while the last two columns (3,4,7 and 8) have results for specifications that omit outliers using the Hadi method of identifying and eliminating outliers. Instruments used in all IV regressions are listed in table 1 in the main text. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Interestingly, while the results for longitudinal extension did not alter ELR findings much, as the table (3.3.3) shows, the results from cross-sectional extension significantly differ from ELR results. Results for the sample with all developing countries in particular show evidence of a positive and robust link between aidpolicy interaction term and growth rate of per capita GDP. Considering the IV results for the preferred specification (without outliers), the observed significant positive effect of aid conditional on good policies similar to BD finding. With a standard deviation of 0.1909 for aid, using the preferred specification in column 4, a standard deviation increase in the log of aid causes an 4.6% increase in per capita GDP growth per year, conditional on good policies. The results show that the coefficient for low income countries is positive but not statistically significant. Thus for low income countries, the evidence from cross sectional extension of the sample does not support the existence of a causal effect of aid on growth conditional on good policies.

To see this clearly, partial scatter plots for BD sample and the partial scatter plot for the dataset (with all countries) obtained after cross-sectional extension of ELR are shown in figure (3.B.2) of the appendix (3.B). Unlike after longitudinal extension, the relationship between per capita growth and aid*policy becomes positive after the cross-sectional extension of the dataset and resembles that for BD study.

Full sample (both longitudinal and cross-sectional extension)

Before discussing the above results, let us first tie up everything together in this set of robustness tests by bringing both the longitudinal and cross-country expansions into one same sample, such that we now consider the full sample. In total, we have a sample of 81 countries covering the period 1970-2013, making up to 477 observations for the all developing countries while the number of observations for sample with low income countries only increases to 321 from 236. The results from the regressions using this sample are reported in table (3.3.4).

As the table reveals, when both time series and cross-sectional extension of the sample is implemented we observe that the coefficient for the interaction term is positive and statistically significant at 5% level (for IV regressions of all developing countries sample). With a standard deviation for log aid of 0.2967 the coefficient implies that conditional on good policies, a standard deviation increase in the log of aid causes a 3.7% increase in per capita GDP growth per year. When we consider only low income countries, we observe the coefficient for log aid in the preferred specification is weakly significant. Thus while we observe, on average, a strongly significant positive causal effect of aid conditional on good policies across all developing countries when we consider only low income countries sample the estimated coefficient is only weakly significant.

3.3.2 Discussion

So what do the results from the above tests say about link between aid and economic growth? The key finding from the above tests is that the results from cross-country studies investigating the effect of aid conditional on good policies are sample dependent. This is actually nothing new, a number of cross-country aid effectiveness studies have

Table 3.3.4: Results from 2SLS regressions using the full DK sample

	Dependent variable: Annual real per capita GDP growth rate							
	All developing countries				Low income countries			
	1	2	3	4	5	6	7	8
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Aid	-0.0828	-0.4772*	-0.1237	-0.5007*	-0.0666	-0.3543	-0.0666	-0.3543*
	(0.1309)	(0.2648)	(0.1297)	(0.2903)	(0.1297)	(0.2321)	(0.1297)	(0.2321)
Aidpolicy	0.0735	0.1517**	0.0890*	0.1247**	0.1541	0.2375	0.1036*	0.1314*
	(0.0579)	(0.0563)	(0.0419)	(0.0582)	(0.5931)	(0.6094)	(0.0635)	(0.0712)
Initial GDP	0.0204	-0.0146	-0.4041	-0.5046	-0.5665	-0.8721*	-0.4929	-0.9935*
	(0.5041)	(0.5379)	(0.3428)	(0.3777)	(0.5026)	(0.5275)	(0.5124)	(0.5808)
Ethnic fractionalization	-0.1137	-0.1993	-0.281	-0.4091	-0.1633	-0.2231	-0.1112	-0.247
	(0.6485)	(0.6832)	(0.6277)	(0.6627)	(0.8239)	(0.8157)	(1.1262)	(0.8233)
Assassinations	-0.3161**	-0.3364**	-0.3173**	-0.3278**	-0.5735***	-0.7238*	-0.7239*	-0.6741*
	(0.1477)	(0.1508)	(0.1494)	(0.1500)	(0.2112)	(0.3890)	(0.3874)	(0.3732)
Ethnassass	0.4791*	0.4868*	0.4716	0.4578	0.5977	0.4554	0.4556	0.4435
	(0.2887)	(0.2936)	(0.2863)	(0.2873)	(0.7648)	(0.8459)	(0.8396)	(0.7756)
SSA	-1.1909**	-1.2883**	-1.2658**	-1.1830**	-1.7296**	-1.7295**	-1.7803**	-1.7207**
	(0.5410)	(0.5361)	(0.5426)	(0.5598)	(0.7699)	(0.7597)	(0.7374)	(0.7043)
E.Asia	1.3206**	1.0475**	0.9170*	0.9559**	1.0124**	0.8913*	0.8100*	1.1076*
	(0.5606)	(0.4933)	(0.4946)	(0.4788)	(0.4929)	(0.4871)	(0.4684)	(0.6600)
ICRGE	0.2673**	0.2586**	0.3166***	0.3064***	0.3867**	0.3827**	0.2945**	0.2962**
	(0.1225)	(0.1194)	(0.1010)	(0.1002)	(0.1659)	(0.1597)	(0.1433)	(0.1396)
M2 lagged	1.7565*	1.9458**	1.5749*	1.7412*	1.1541	1.1744	1.1736	1.1747
	(0.9883)	(0.9787)	(0.9503)	(0.9353)	(2.4984)	(2.7091)	(2.6175)	(2.7086)
Policy	0.8924***	0.7910***	0.8492***	0.7588***	0.9436***	1.0091***	0.9436***	1.0091***
	(0.1527)	(0.1629)	(0.1295)	(0.1463)	(0.1792)	(0.2667)	(0.1792)	(0.2667)
Observations	*477*	*471*	*462*	*456*	*321*	*317*	*315*	*311*
R-squared	*0.3388*	*0.3391*	*0.3406*	*0.339*	*0.3764*	*0.3631*	*0.3764*	*0.3631*
No. of countries	*81*	*81*	*81*	*81*	*48*	*48*	*48*	*48*
AR F-test (p-value)		*0.00073*		*0.00032*		*0.0103*		*0.0103*
KP Wald F-Stat		*11.61*		*9.27*		*10.443*		*9.312*
Hansen J (p-value)		*0.1522*		*0.1819*		*0.249*		*0.267*

*Notes: The table presents regression results for estimation using the full sample (after both longitudinal and cross-sectional expansion of ELR sample) covering the period from 1997 to 2013 over 81 countries, 48 of which are low income countries. Dependent variable is annual growth rate of per capita GDP; Results reported in columns 1-4 are for sample with all developing countries while in columns 5-8 are results for sample with only low-income countries. First two columns in each set of results (1, 2, 5 and 6) has results for estimation that includes outliers while the last two columns (3,4,7 and 8) have results for specifications that omit outliers using the Hadi method of identifying and eliminating outliers. Instruments used in all IV regressions are listed in table 1 in the main text. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

already come to this conclusion[18]. However, these studies do not elaborate in detail how or what is different about the samples that explains the variation in empirical results from cross country aid studies. In this study, we make an attempt to do that.

We argue here that the main reason for the variation in results across different samples may be the composition in terms of the level of per capita incomes across different countries (i.e. the number of middle income or low income countries that are included in the sample). Particularly, we observe that the higher the number of middle income countries in the sample relative to low income countries, the higher the likelihood of a positive causal link between aid and growth (and in the case of the current discussion, a positive link between output per capita growth and the aidpolicy interaction).

[18]Easterly et al. (2004), Hansen and Tarp (2001), Channing et al. (2014) and Dalgaard et al. (2004) are among some of the studies that have noted that results from cross-country aid-growth regressions are dependent to a greater extent on the sample used.

To illustrate this argument, let us first examine the original ELR results and determine how the results are affected by sample composition (in terms of country income classification) as they extend the BD sample. In the full sample, they expanded BD sample by increasing the number of countries (from 56 to 62) and the one four-year average period (from 1993 to 1997).

Table 2 of ELR presents coefficients of aidpolicy for alternative regressions using different samples. The results presented in that table shows that when they use their data for BD sample of countries and BD period (1970-1993), their findings are similar to BD i.e. positive and significant effect of aid on growth conditional on good policies. Further, when they apply only longitudinal expansion without altering the sample of countries, they also find a positive coefficient for the interaction term.

On the other hand after applying cross-sectional extension of the BD dataset, table 2 of ELR shows that all regressions that involved the full sample with 62 countries resulted in statistically insignificant and, in the case of low income country samples, negative coefficients. It becomes clear that the significant break in the regression results between ELR and BD begins to be observed once cross-sectional extension is done; longitudinal extension alone, which leaves the country composition unchanged, does not alter the BD results much.

Now lets examine how ELR extension affects the composition of BD sample; of the 6 extra countries added on to make ELR, 4 countries (Uganda, Papua New Guinea, Myanmar and the Republic of Congo) are low income countries while only 2 countries (South Africa and Jordan) are middle income countries. Thus ELR extension implies they used a sample with more low income countries relative to middle income countries compared to BD sample.

Similarly, when we further extend ELR sample to reconstruct the dataset used in this chapter, we also observe that longitudinal extension does not alter the results much while cross-sectional extension has a significant effect on the estimated results. The results in table (3.3.2) shows that when we conduct only longitudinal extension of ELR data (increase 4-year average periods from 7 to 11), the results do not change much. We find no evidence of a causal effect of aid on growth (and almost all coefficients are negative).

However, when cross-sectional expansion of the sample is implemented (increasing the number of countries from 62 to 81 while leaving the sample period the same as ELR), we observe a significant variation in the results. As shown in table (3.3.3) the preferred specification, using all developing countries, shows positive and significant effect of aid on growth. For low income countries sample, the results show no relationship between aid and growth, but the coefficient remains positive. The results for regressions using our full sample (after both longitudinal and cross-sectional expansion) also show a positive coefficient for all countries while the estimated coefficient for aid*policy becomes weakly significant for the low income sample.

For further examination, we conduct more experiments with different samples including sample for middle income countries and low income countries separately. The results for these regressions are reported in table 3.3.5[19]. As our results show, the higher the number of middle income countries in the sample, the higher the likelihood for a positive and statistically significant aid link between aid and growth conditional on good policies. Moreover, when we run regressions using only the 33 middle income countries, the results not only show a statistically significant and positive coefficient for the interaction term, but also for the coefficient for aid implying that even without considering the policy conditions, short run effects of aid on growth can be observed in middle income countries.

Table 3.3.5: 2SLS regressions with alternative samples

	All developing countires		Low income countries	
	Aid	Aid*Policy	Aid	Aid*Policy
ELR(2003) data (62 countries, 1970 - 97)	-0.4943	0.0115	-0.1603	-0.2023
	(0.5287)	(0.2124)	(0.5890)	(0.3005)
ELR(2003) years, BD's sample (56 countries 1970 - 97)	0.1568	0.3763*	0.1247	0.4721
	(0.1522)	(0.2348)	(0.2273)	(0.5123)
ELR(2003) data, middle-income countries only (1970 - 1997)*	1.3162	0.3424*		
	(1.7925)	(0.2192)		
ELR(2003) data, low-income countries only (1970 - 1997)*			-0.0034	-0.1259
			(.12560)	(.10640)
DK data, Easterly et al sample extended by adding only low income countries (1970 - 1997)	-0.0197	-0.102	-0.048	-0.1075
	(0.2624)	(0.1012)	(0.2376)	(0.1134)
DK data, Easterly et al sample extended by adding only middle income countries (1970 - 1997)	0.1573*	0.3366**	-0.1248	-0.1259
	(0.0930)	(0.1365)	(0.2503)	(0.1064)
DK data, low-income countries only (1970 - 2013)			-0.0142	-0.2646
			(0.1256)	(0.3541)
DK Data, middle-income countries only (1970 - 2013)	0.6017**	0.3732**		
	(0.3353)	(0.1255)		

*Notes: Results from the preferred specification using alternative samples. DK data refers to the dataset that has been reconstructed for this study. Robust standard errors in parentheses, ***p<0.01, ** p<0.05, * p<0.1*

[19] A more detailed presentation of this table is in the appendix in table (3.C.5)

Notably, our extension of ELR increases the number of middle income countries in the reconstructed sample from 18 to 33; low-income countries increase by only 4 from 44 to 48[20]. It is therefore unsurprising, on the basis of the current discussion, that our results for the full sample find the coefficient of the interaction term to be positive and significant.

The foregoing discussion points to the view that when low income countries are added to the sample (as did ELR), it increases the likelihood of getting results that find no evidence of the effects of aid on growth. The study suggests two reasons why the sample composition, in terms of the number of low income countries and middle income countries included, may affect the coefficient for aid and/or the interaction term with aid in cross-country studies.

The first argument is that it may be more difficult to detect short run effects of aid on growth in low income countries than in middle income countries. The argument stems from the observation that with low per capita incomes and often high income inequality, a vast majority of the population in LIC live in impoverished conditions, many of whom live below the international poverty line ($1.90/day). In such countries, most of the aid is likely to be targeted at assisting these people on a subsistence livelihood to survive rather than to "grow (increase their incomes)". Thus, in low income countries aid targeted at these populations may make a difference between households having two meals per day instead of one, or moving society from total illiteracy to acquiring very basic literacy and numeracy (that still leaves most of the labour force unskilled). Aid funded interventions therefore do help improve livelihood, but the impact would hardly be captured in short run variation of per capita income growth. The implication from this then is that it makes per capita income growth (the dependent variable in cross-country growth regressions) less sensitive to variation in aid. Increasing the number of the 'less sensitive' countries in the sample then reduces the average sensitivity of the whole sample to changes in aid, hence the average effect in such sample is often found to be statistically not significant.

For middle income countries on the other hand, the situation is different. The proportion of population in impoverished conditions is relatively lower as such aid may be easily

[20]Increasing more middle income countries was actually not done by design. It is highly likely that most of the low income countries with adequate data to be included in the samples were already included in the original papers, hence the cross-sectional expansion could only be meaningfully achieved by increasing more middle income countries.

targeted towards growth inducing investments, thus it is easier to capture the short run impact of changes in aid on per capita incomes. Thus for middle income countries, the growth rate of per capita incomes is more sensitive to changes in aid than is the case for low income countries. Increasing the number of middle income countries in a sample therefore increases the average sensitivity of the entire sample, and so increases the likelihood of having statistically significant coefficient for aid.

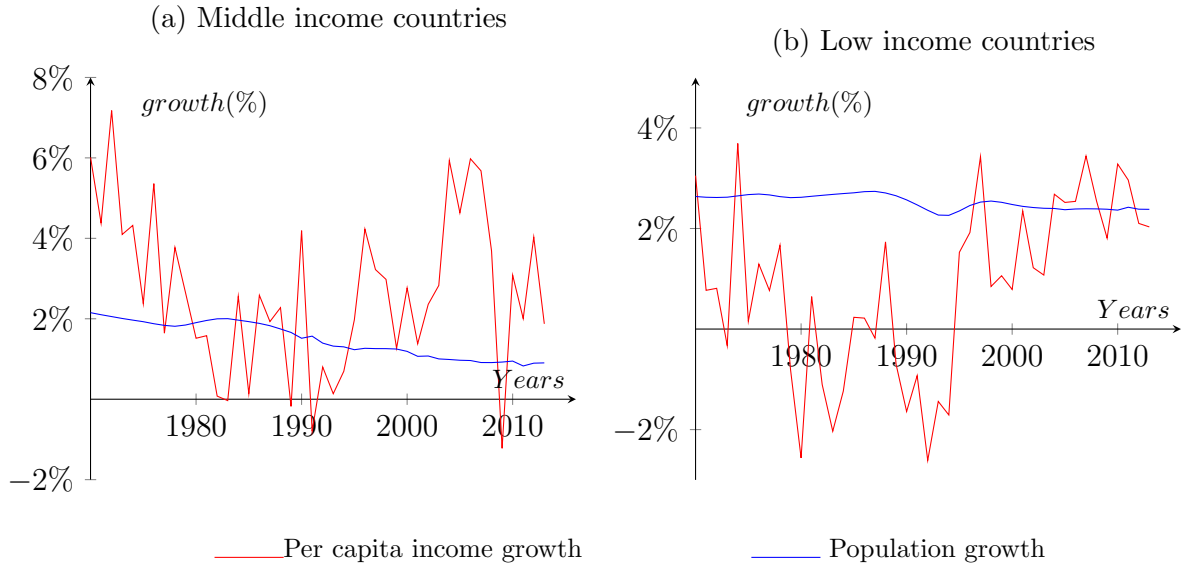
This argument may be related to theoretical as well as empirical growth studies on threshold effects, poverty traps[21] and subsistence consumption[22]. The key message from such studies is that countries below a certain threshold level of per capita incomes are caught in a vicious circle of poverty that is deep rooted in their history, resulting from geographic factors, low capital productivity, poor infrastructure and institutions. For low income countries per capita incomes are often significantly below international poverty thresholds. Poverty is so acute households are engaged only in subsistence consumption, barely satisfying basic needs, and hence unable to or less willing to substitute consumption intertemporally, preferring to consume now to survive. The implication from this is that low income countries often have a higher marginal propensity to consume out of the aid that they receive rather than allocate it to income enhancing investments. Aid may therefore only help low income countries increase consumption which would still increase welfare, but its effects may not be readily captured in growth of income per capita in the short run.

The second suggestion as to why the composition of countries matters is that low income countries may have a high likelihood of a negative relationship between per capita incomes and aid. Over the sample period, the average trends for the two variables have taken opposing directions. This negative relationship, even though it may not necessarily be causal, can drive the sign of the coefficient for aid in the cross-country regression. Low income countries often have high population growth rates; in most cases, these countries have population growth higher than real income growth. Figure 3.3.1 compares income growth and population growth for middle-income countries (panel a) and low-income countries (panel b) for the period 1970 to 2013 (GDP growth is represented the solid line while population growth rate is represented by the dashed line).

[21]see Azariadis and Stachurski (2005) and Sachs et al. (2004)

[22]This is analysed in more detail later in chapter 5; see Steger (2000) and Kraay and Raddatz (2007)

Figure 3.3.1: Annual GDP and population growth rates: low income and middle income countries (1970-2013)



As can be seen, for most of the period population growth is higher than the rate of growth of real incomes in low income countries. For the full sample used in this study, the arithmetic average population growth in low income countries is 2.53% while income growth is about 1.01%. Since population grows faster than real GDP, then over the sample period per capita incomes have been declining on average, thus there is declining trend in real per capita income growth[23] . On the other hand, during the same period unprecedented levels of foreign resources have been transferred to low income countries, such that the ratio of aid to real GDP is an increasing trend. As a result of these opposite trends for per capita income growth and aid, the correlation between the two is negative. Increasing the number of low-income countries in a sample increases the likelihood that the average sample correlation between aid and income growth is also negative.

When we consider middle-income countries, we observe that real incomes grow faster than population, as shown in figure 3.3.1. The arithmetic average growth of income for middle income countries in the full sample is 2.681% while population growth rate for the same period is 1.486%. Hence, with incomes growing faster than population, average per capita incomes have been increasing during the sample period. While middle income countries receive relatively lesser aid when compared to low income countries, nonetheless, the trend in aid transferred to middle income countries has also been increasing. Therefore, there

[23]Sachs et al. (2004) also make a similar observation regarding the trend in per capita incomes in low-income countries merely on the account of high population growth vis a vis output growth

is a positive correlation between real income growth and aid in middle income countries. Increasing the number of middle income countries in a sample thus drives the sample average correlation between aid and income growth to be positive, hence the likelihood of a positive coefficient for aid increases.

So, middle income countries face limited subsistence constraints as such they are able to allocate adequate enough aid resources to growth inducing investments; at the same time, they have a pre-existing positive correlation between the trend in aid and that for growth. It is therefore not surprising that samples with more middle income countries often results in positive and statistically significant coefficients for aid and/or aid*policy. The opposite is true for low income countries, whose results often are negative and statistically not significant coefficient estimates.

3.4 Specification issues

3.4.1 Policy selectivity or diminishing returns

Other than fragility of BD results as a result of extreme sample dependency as shown, Dalgaard and Hansen (2001) further asserts that BD results may have suffered from mis-specification of the empirical econometric model. BD estimate a non-linear specification, however with their explicit emphasis on the impact of macro policy on aid effectiveness, they explore policy selectivity effects by using an aid-policy interaction term to capture non-linearities in their specification.

BD motivate their choice of policy selectivity by arguing that unlike the proposition from neoclassical growth model that poor countries should have higher returns to capital and a faster transition to the steady state, poor infrastructure and production technology, imperfect capital markets and most crucially institutions and policy distortions tend to lower the returns to capital and reduce the transition to the steady state. They thus argue that aid will have a greater impact on growth rates in an environment with the least policy distortions, and there-in lies the motivation for interacting aid with a policy index.

A number of studies have since suggested an alternative specification of the non-linear

relationship between aid and growth; these studies explore the possibility that aid inflows have diminishing returns on the recipient economy. Dalgaard et al. (2004) and Lensink and White (1999) provide theoretical analysis that explains why beyond a certain threshold of aid, it may become detrimental rather than beneficial to recipient economy's growth. Theoretical arguments for possibility of diminishing returns proposed in aid-growth literature include negative effects of aid-financed public capital (Griffin and Enos (1970)), Dutch disease problems and capacity constraints (Durbarry et al. (1998)), absorptive capacity constraints (Ghura et al. (1995)) and inappropriate technology as well as institutional destruction (encourage inward-looking and/or corrupt government policies) from aid inflows (Lensink and White (1999)).

An easy way to capture diminishing returns in econometric modeling is adding quadratic term of the variable of interest, which results in the parabolic shape for non-linear relationship between two variables (Wooldridge (2013)). Adding a quadratic term is similar to including an interaction (as in BD with aid*policy), the coefficient of the quadratic term interpreted as the interaction effect of a variable on itself. In aid-growth studies, it captures the idea that the effect of additional units of aid decreases (just as diminishing returns) such that beyond some level, it would have negative effects on growth. Empirical results from Ghura et al. (1995), Durbarry et al. (1998) and Hansen and Tarp (2001) among others find evidence that when a quadratic term is included in the empirical specification, the estimated model finds significant effects of aid, even without taking into account interaction with policy.

There is no conclusive theoretical basis on the choice between using policy selectivity through an interactive term or diminishing returns using a polynomial effect or indeed a combination of both in the same model, thus the preferred specification is a hypothesis that can be tested empirically and chosen at the researcher's discretion. Hansen and Tarp (2000) argue that a complete model must include the following five terms: aid, aid squared, policy, policy squared and the interaction term (aid policy)[24] which make a complete, second order, polynomial response space in the policy dependent aid growth relationship. Thus a more complete specification would look like:

[24]BD actually include a further variable; the interaction between aid squared and policy. Perhaps a fuller model would include six variables rather than the five included in Hansen and Tarp (2000).

$$g_i(t) = \alpha + \vartheta X_i(t) + \beta_1 A_i(t) + \beta_2 A_i(t)^2 + \beta_3 P_i(t) + \beta_4 P_i(t)^2$$
$$+\beta_5 A_i(t) P_i(t) + \beta_6 A_i(t)^2 P_i(t) + \epsilon_i(t) \tag{3.4.1}$$

where all variables are as already defined, $P_i(t)$ is a policy index and β denotes constant parameters estimated. BD set $\beta_2 = \beta_4 = 0$ and in their preferred specification $\beta_6 = 0$ while Hansen and Tarp (2000) set $\beta_6 = 0$. When Hansen and Tarp (2000) tested the model using the full specification (albeit excluding $\beta_6 A_i(t)^2 P_i(t)$) and they find statistical evidence to support diminishing returns i.e. $\beta_4 = \beta_5 = 0$ and $\beta_1 \neq 0$, $\beta_2 \neq 0$, $\beta_3 \neq 0$. To assess empirically the effect of the choice between either the policy interaction term or a polynomial effect of aid, on the estimated impact of aid on growth, we estimate the empirical model expressed in equation 5 using our full sample. The results of this estimation are reported in table 3.4.1.

All regressions do not include influential observations (outliers). In all estimations, variables that are functions of aid are modeled as endogenous regressors. The first three columns in the table give results for the full sample with all 81 countries, while the last three have results for sample with low income countries only. Equations 1 and 4 use the full model specification with all 6 variables in equation (3.4.1) above included; as the results reveal policy squared, aid-policy interaction and aid squared-policy interaction are all found to be statistically insignificant, in contrast to the findings of BD but in support of the findings of Hansen and Tarp (2001) and Dalgaard and Hansen (2001).

In equations 2 and 5 we omit the three statistically insignificant policy variables (and their interaction with aid) from regressions 1 and 4. It is evidently clear that omitting the three variables, aid-policy, aid square-policy and policy squared, does not affect the regression 1 and 4 results; both aid and aid squared remain statistically significant. Furthermore, the Wald test for joint exclusion of the three variables has p-values that are very high, thus we cannot reject the null that the omitted variables do not have significant effect on the growth model estimated.

Finally, in equations 3 and 6 we omit aid square and aid square-policy interaction term, we get contrasting results. The coefficient for aid becomes statistically insignificant while the aid policy interaction term is only weakly significant, being statistically significant only

Table 3.4.1: 2SLS regressions with different specifications using reconstructed dataset

	Dependent variable: Annual real per capita GDP growth rate					
	All developing countries			Low income countries		
	1	2	3	4	5	6
Aid	1.9871*	1.2164**	-0.3775	0.9624*	0.4342*	-0.3793
	(1.0825)	(0.4853)	(0.2442)	(0.4403)	(0.1553)	(0.1455)
Policy	0.5448***	0.9532***	0.7139***	1.7888**	0.9512***	0.9463***
	(0.2105)	(0.1057)	(0.1304)	(0.8198)	(0.1307)	(0.2342)
Aid square	-0.2774***	-0.1663**		-0.2024**	-0.1083**	
	(0.0682)	(0.0668)		(0.0966)	(0.0511)	
Policy square	0.0851			-0.045		
	(0.0524)			(0.0928)		
Aidpolicy	0.6185		0.1393*	-0.8714		-0.1022*
	(0.3903)		(0.0825)	(1.2905)		(0.0649)
Aidsq.policy	-0.0914			-0.1255		
	(0.0673)			(0.1942)		
Initial GDP	-0.7011	-0.5838	-0.5314	-0.9419*	-0.851	-0.8447
	(0.4322)	(0.3941)	(0.3802)	(0.5667)	(0.5304)	(0.5319)
Ethnic fractionalization	-0.8188	-0.6205	-0.4507	1.1581	0.6426	0.6625
	(0.7542)	(0.7280)	(0.6677)	(1.2068)	(0.8689)	(0.8382)
Assassinations	-0.3498**	-0.3697**	-0.3289**	-0.5292	-0.6177	-0.6203
	(0.1606)	(0.1580)	(0.1489)	(0.4626)	(0.3978)	(0.3967)
Ethnassass	0.467	0.5385*	0.4668	0.4846	0.4411	0.4453
	(0.3035)	(0.2975)	(0.2862)	(0.8339)	(0.7834)	(0.7822)
ICRGE	0.1979	0.1815	0.3001***	0.3128*	0.3551**	0.3592**
	(0.1231)	(0.1244)	(0.1004)	(0.1669)	(0.1488)	(0.1447)
M2 lagged	2.5188**	1.9602*	1.9254**	-0.6269	0.115	0.1232
	(0.9864)	(1.0106)	(0.9376)	(1.8580)	(1.5794)	(1.6318)
SSA	-0.6414	-0.6766	-1.1309**	-2.3020***	-2.0939***	-2.1127***
	(0.7188)	(0.7191)	(0.5683)	(0.7152)	(0.6353)	(0.6303)
E.Asia	0.4979	0.2368	0.6804	0.2057	0.731	0.7594
	(0.5357)	(0.5482)	(0.4889)	(0.9381)	(0.6385)	(0.6384)
Observations	*397*	*397*	*397*	*221*	*221*	*221*
R-squared	*0.2723*	*0.2487*	*0.3389*	*0.2854*	*0.362*	*0.3636*
No. of countries	*81*	*81*	*81*	*48*	*48*	*48*
AR F-test (p-value)	*0.0005*	*0.0009*	*0.0008*	*0.11*	*0.121*	*0.231*
KP Wald F-Stat	*9.64*	*10.95*	*11.27*	*8.097*	*11.02*	*9.93*
Wald test (p-values)		*0.921*	*0.013*		*0.986*	*0..017*
Hansen J (p-value)	*0.104*	*0.117*	*0.083*	*0.414*	*0.222*	*0.229*

*Notes: The table presents instrumental variable growth regression results for estimation using the full sample covering the period from 1997 to 2013 over 81 countries, 48 of which are low income countries. Dependent variable is annual growth rate of per capita GDP, all regresions include time dummies for each period in the sample; Results reported in columns 1-3 are for sample with all developing countries while in columns 4-6 are results for sample with only low-income countries. Instruments used in all regressions are listed in table 1 in the main text. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

at 10% level, and the magnitude of the coefficient diminishes substantially. Moreover, the Wald test p-values imply strong inclination to reject the null that the omitted variables are not significant. This result too conforms to the findings of Dalgaard and Hansen (2001).

Additionally, note in the table that in all specifications that includes aid squared, the coefficient is not only significant but also that it is always negative, which also gives

evidence to the notion of diminishing returns with respect to levels of aid. It is also worth noting that in all regressions, the coefficient for policy is strongly significant at any conventional level of significance. Thus while there may be a heated debate in the literature on the rationale and significance of interacting aid with policy index, there is no question as to the importance of good policies on growth[25].

3.4.2 Outliers

Another issue that has attracted scrutiny for BD results pertains to the treatment of outliers. Outliers are observations whose values are unusual and significantly away from the rest of the data or the sample mean. Often referred to as *leverage points*, their presence tends to pull OLS coefficients which distorts the estimated results (Temple (2000)). Since panel-data (or cross-section) analysis aim at explaining what is happening in the majority of the sample, outliers imply that the results may in fact be driven by a minority of observations i.e. results of the whole sample are influenced by observations on the extremes of the distribution (Temple (1998)).

The especial interest in outliers in the context of BD results stem from that their preferred growth regressions only begin to show significant relationship between aid and policy when outliers are excluded. When they use specification that includes outliers, they find that the interaction between aid and policy is insignificant. In BD, they identified the 5 'big outliers' which affected their results. ELR used the Hadi method of identifying outliers and in their analysis, they identify between 5-11 influential observations; in the sample used to run the robustness checks in this chapter, we used the same methodology and identified between 4-15 outliers.

There are different ways of dealing with outliers and these also affect estimated results differently. In the case of BD they used the most commonly used approach which is typically mechanical dropping of the outliers. This approach is often problematic since it may lead to invalid statistical conclusions and may also ignore valuable information (Leamer (1978)). Nonetheless, it is widely applied in cross-sectional and panel data regressions. Since the robustness checks in this chapter maintained BD methodology, we

[25] As for the definition and measurement of what constitutes 'policy', that is another debate in the literature that is beyond the scope of this analysis. A detailed analysis of the problems with the policy index as applied in BD can be found in Lensink and White (2000).

also used this approach in our regressions.

Temple (2000) discuss in detail the problem of outliers in growth regressions and provide some alternative strategies of addressing outliers. These include least trimmed squares estimator that allows a within-model estimator that is robust to outliers. Durlauf and Brock (2001) further suggest modeling errors as drawn from a mixed distribution so as to allow the density for model errors to accommodate outliers.

3.4.3 Lags

An issue that has been considered in the literature is the impact, and hence inclusion of lags of aid in aid-growth regressions. There are two ways in which lags have been used in aid-growth regressions: the first is to use lags as independent regressor in the growth model and the second is to use lags as instrumental variables for identification of the causal effects of aid.

In this analysis, we will use the full sample and observe the impact of inclusion of lags in the estimated growth model. Firstly, using the preferred specification (as of BD and ELR), we will add the first and second lags of aid as explanatory variables; we will then use the same specification but instead of using lags as growth determinants, we will add the first two lags of aid to the list of instruments stated in table 3.C.3.

Including lagged values of aid as an independent regressor allows for aid to affect rate of growth of per capita incomes in future periods. The motivation behind inclusion of lags is that quite often aid is recorded at the time of disbursement, but it may take some time before the intended interventions funded by aid can cause an impact on per capita incomes. As such one would expect that the effects of aid on economic growth would not be limited to the single disbursement period only, but that aid disbursed in one period would also affect growth in subsequent periods. Surprisingly however, despite the fact that quite a lot of studies acknowledge this possibility, few studies[26] take into account the effect of lags in their preferred model specifications, so that the existing aid effectiveness literature does not adequately address the question of how the lag structure should be used. One of the reasons put forward as to why few studies include lags of aid

[26]Hudson and Mosley (2001) and Moreira (2005) take some time and attempt to deal with the treatment of lags as endogenous regressor in aid-growth regressions.

as determinants of growth in aid-growth regressions is the difficulty in determining just how much time lapse can be accounted for econometrically (Moreira (2005)).

The results of this estimation are reported in tables 3.4.2; the table only show only coefficients for aid, aid-policy interaction and the two lags included, but the estimated equations include all the controls as used in all the estimations that use the preferred specification. Also note that when we include lagged values of aid, some of the observations are lost, hence the total number of observations declines as the number of lags increases.

Table 3.4.2: 2SLS regression results for estimation with lags as explanatory variables

	Dependent variable: Annual real per capita GDP growth rate			
	All developing countries		Low income countries	
	1	2	3	4
Aid	0.8682**	0.9706**	0.7782**	1.2538***
	(0.3823)	(0.4823)	(0.3762)	(0.4741)
Aidpolicy	0.1701**	0.1960**	-0.0839	-0.0757
	(0.0731)	(0.0829)	(0.0758)	(0.1053)
1st lag of aid	0.583**	0.6942*	0.6834**	1.1027***
	(0.3301)	(0.4105)	(0.3007)	(0.3891)
2nd lag of aid		-0.1668		-0.0085
		(0.2031)		(0.2697)
Observations	*408*	*357*	*228*	*200*
R-squared	*0.2735*	*0.2794*	*0.3178*	*0.2713*
No. of countries	*81*	*81*	*48*	*48*
AR F-test (p-value)	*0.000474*	*0.000875*	*0.0124*	*0.000133*
KP Wald F-Stat	*10.82*	*11.89*	*8.25*	*9.97*
Hansen J (p-value)	*0.11*	*0.178*	*0.211*	*0.14*

*Notes: The table presents instrumental variable growth regression results for estimation using the full sample covering the period from 1997 to 2013 over 81 countries, 48 of which are low income countries. Dependent variable is annual growth rate of per capita GDP, all regressions include time dummies for each period in the sample; Results reported in columns 1and 2 are for sample with all developing countries while in columns 3 and 4 are results for sample with only low-income countries. Instruments used in all regressions are listed in table 1 in the main text. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

The results in table 3.4.2 show that when we include either the first lag only or both the first and second lags to the empirical model, the coefficient for aid becomes strongly significant for all developing countries as well as for low income countries only, independent of presence (or lack of) good policies. Additionally, in all estimations, the first lag of aid is found to be statistically significant, suggesting that it has substantial impact on the current growth rate of real per capita GDP.

Rather than using lags of aid as independent regressors in the empirical growth model,

most studies use lags of aid as instruments in their effort to identify the causal effects of aid on economic growth[27]. Dalgaard et al. (2004) argue that BD (and other studies that follow their identification strategy) rely on time invariant dummy variables such as dummies for Egypt, Franco-zone and Central American countries, while the other key instrument (population) varies slowly over time. The implication of this is that the link between the instruments and aid is largely a cross-country correlation that leaves the time series variation of aid unexplained. They argue that this can easily be achieved by the inclusion of lags.

The second rationale for using past values of aid as a solution to the identification problem is proposed by Hansen and Tarp (2001) who argue that past aid allocations are a decent determinant for current allocations because aid donations are often fairly persistent over time so that previous realizations of aid have strong explanatory power with regards to current aid flows. Further, Dalgaard and Hansen (2010) contend that past realizations of aid are unlikely to be affected by current growth and there is reasonable cause to suspect that current growth is correlated with past values of aid conditional on current aid flows.

The results of our regression analysis with lags as instruments are presented in table 3.4.3. As shown, they suggest that using lagged values of aid as instruments significantly improves the identification strategy, in agreement to the findings of Hansen and Tarp (2001) and Dalgaard et al. (2004).

Columns 5 and 7 have results with the addition of only the first lag to the set of instruments (as in table 3.C.3) while columns 6 and 8 have results for addition of the first and second lags. It is evident from the result that including the second lag does not alter the results, thus just as we observed when we used lags as explanatory variables, in our case the second lag is found to be unimportant in the model. Furthermore, including previous values of aid as instruments improves BD findings: in all estimations the coefficient for aid*policy is now very strongly significant. Note also that F-Stat ranging between 30.27 and 80.05; and Anderson-Rubin p-values far less than 0.01 (except column 7) attest to the joint strength of the instruments. This is a substantial improvement from the weak identification reported in tables (3.3.4 and 3.4.2). Note however that $p-values$ less than

[27]Ghura et al. (1995), Hansen and Tarp (2001), Clemens et al. (2012) and Dalgaard et al. (2004) all use the first lag of aid as an instrumental variable.

Table 3.4.3: 2SLS regression results for estimation with lags as instrumental variables

	Dependent variable: Annual real per capita GDP growth rate			
	All developing countries		Low income countries	
	5	6	7	8
Aid	-0.2398	-0.2767	0.0046	-0.0005
	(0.1843)	(0.2026)	(0.1477)	(0.1497)
Aidpolicy	0.1841***	0.2092***	-0.1782***	-0.1778***
	(0.0660)	(0.0657)	(0.0701)	(0.0727)
Observations	*408*	*357*	*228*	*200*
R-squared	*0.2739*	*0.279*	*0.361*	*0.3746*
No. of countries	*81*	*81*	*48*	*48*
AR F-test (p-value)	*0.000857*	*0.00254*	*0.0154*	*0.000349*
KP Wald F-Stat	*80.05*	*78.12*	*30.27*	*30.01*
Hansen J (p-value)	*0.0668*	*0.103*	*0.019*	*0.00418*

*Notes: The table presents instrumental variable growth regression results for estimation using the full sample covering the period from 1997 to 2013 over 81 countries, 48 of which are low income countries. Dependent variable is annual growth rate of per capita GDP, all regressions include time dummies for each period in the sample; Results reported in columns 5 and 6 are for sample with all developing countries while in columns 7 and 8 are results for sample with only low-income countries. Instruments used in all regressions are those listed in table 1 in the main text PLUS the first lag of aid for columns 5 and 7 and the first and second lags of aid for columns 6 and 8. Robust standard errors in parentheses, p*** p<0.01, ** p<0.05, * p<0.1*

0.05 for the Hansen J-test imply that over-identifying restrictions are rejected, raising questions about the joint validity of the instruments used.

The key assumption to using lags of aid as an instrument is that they do not correlate with current growth rate i.e. they are excludable from the estimated growth model. While it may indeed be the case that past values of aid do not matter to current growth conditional on current levels of aid, there is considerable reason to expect that such past realizations would have a direct effect on current growth rates, as already discussed. Clemens et al. (2012) also state that while studies that use lags of aid as instruments almost always test for validity of the instruments and correlation with residuals, most existing tests for this correlation have low power to reject the null hypothesis of no serial correlation, leaving a high possibility that the coefficient on aid will be substantially biased by invalid instruments.

So, from the evidence presented there is strong argument for inclusion of lags in empirical aid-growth models; when lags are included as explanatory variables they are a strong determinant of current growth and the coefficient for aid, at least in our case, becomes strongly significant than in the case without lags. On the other hand, when lags of aid

are used as instrumental variables, as has been found by other studies, they substantially improve the identification strategy. The choice between using previous realizations of aid either as predictor variables or as instruments rests on the ability of the researcher to show empirically that using a particular specification, lags of aid are correlated (or not) with the residual in the growth model. In our case, using BD/ELR preferred specification, that is clearly not the case since the results in table (3.4.2) indicate statistically significant coefficient of the first lag of aid which would make it invalid as an instrument, thus employing the lag as an instrument may lead to bias in the estimated coefficients resulting from use of an invalid instrument.

3.4.4 Instruments

Identifying good instruments that can help isolate the causal portion of a particular relationship being observed (such as finance, trade and foreign aid as strong determinants of growth) continues to be a challenging task. There is an extensive literature employing quite innovative ways in the search for good instruments. When it comes to the aid-growth nexus, common variables proposed include geo-political factors, regional dummy variables, and some consider historical events that could affect aid allocation today such as colonial relationships between aid donors and recipient countries. Perhaps the two most commonly deployed instruments in identification strategies are recipient country's population size and lagged values of aid.

We have already mentioned studies by Hansen and Tarp (2000, 2001), Dalgaard et al. (2004) and Clemens et al. (2012) who all find strong evidence that inclusion of lagged values of aid significantly improves on the instrumentation strategy used by BD, whose instruments are listed in table 3.C.3. The use of lagged values of aid as instruments has become quite popular in recent studies since Hansen and Tarp (2000). Bazzi and Clemens (2013) conduct a more comprehensive analysis of commonly used instrumental variables in empirical growth regression and warn that there are a number of serious factors that can have important consequences on the strength of lagged values of endogenous variables when used as instruments including the choice of number of lags that can be included as instruments.

Other than the use of past values of aid as instruments, perhaps the most commonly

used instrument is the aid recipient's population size. It is not too hard to imagine why population would be an attractive instrument; recipient country's population size is popularly recognised in the aid effectiveness literature as one of the strong predictors of allocation of aid. The argument for using population as an instrument in cross-country studies is that many growth regressions do not generally find population scale effects (Rose (2006) and Easterly (2008)). However, as Deaton (2010) shows, there is empirical evidence of numerous channels through which population size can affect short run growth. Such evidence falsifies the exclusion condition necessary for population to be a valid instrument. Thus while it satisfies the relevance condition, population may fail to meet the exclusion condition for choice of instruments.

According to Bazzi and Clemens (2013), using population as an instrument is a case of having a strong instrument that is also the least valid. Many studies that test the robustness of Burnside and Dollar results acknowledge the strong doubts about the validity of the instruments used in the identification strategy (Dalgaard et al. (2004), Hansen and Tarp (2001)), however they merely attempt to improve the identification strategy by proposing additional instruments[28]. Clemens et al. (2012) shows that almost all instrumentation power[29] of studies that use population as an instrument essentially derives from inclusion of the "otherwise invalid" instrument. To illustrate this point, they correct the model specification by removing population from the set of instruments, however, their only focus is on what happens to the strength of the identification strategy; they show that when population and other variables interacted with population are removed from the first stage and only included in the second stage (of 2SLS regression), the instrumentation power of the strategy diminishes dramatically. In this analysis, we are interested in analyzing how this apparent model misspecification affects the conclusions drawn with regards to the impact of aid on growth. Thus unlike Clemens et al. (2012), we are interested to see if correcting the specification by removing population from the set of instruments and adding it to be among the independent country controls significantly alters the estimated coefficients.

Table 3.4.4 presents results of the regression when we use population as a second stage

[28]These studies all introduce lags of aid as an additional instrument to improve the identification strategy

[29]This is often measured using Cragg and Donald (1993) F-statistic as well as Kleibergen-Paap F-statisics both of which indicate the joint strength of instruments used for identification.

Table 3.4.4: Results of regressions with population in second stage of 2SLS

	Dependent variable: Real per capita GDP growth rate					
	BD		ELR		DK sample	
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	1	2	3	4	5	6
Aid	0.2166	0.9297*	0.7326*	0.754*	0.0178**	0.0159*
	(0.1455)	0.4807	(0.4517)	0.4432	(0.0073)	(0.0096)
Aidpolicy	0.2078**	-0.2706***	0.2418*	-0.2404*	0.1446**	-0.1434**
	(0.0974)	(0.0856)	(1.1292)	(0.1266)	(0.0708)	(0.0757)
Initial GDP	-0.054	-0.1498	0.5728	0.9961	-0.4043	0.3728
	(0.5936)	(0.5967)	(0.8593)	(0.8693)	(0.3578)	(0.5262)
Population	0.3562**	0.3379**	0.6058**	0.6372**	0.3205**	0.3266***
	(0.1579)	(0.1595)	(0.2746)	(0.2845)	(0.1255)	(0.1581)
Ethnic fractionalization	-0.6665	-0.8017	-0.3314	-0.18	-0.5314	-0.5015
	(0.7804)	(0.7742)	(0.7377)	(0.7750)	(0.6281)	(0.6442)
Assassinations	-0.5142**	-0.5050*	-0.5385*	-0.5049**	-0.3792**	-0.4111**
	(0.2606)	(0.2639)	(0.2863)	(0.2540)	(0.1587)	(0.1608)
Ethnassass	0.8728*	0.8760**	0.4455	0.3419	0.5554*	0.6070**
	(0.4439)	(0.4435)	(0.7157)	(0.7024)	(0.3005)	(0.2990)
SSA	-1.4577*	-1.2103	-1.3361**	-1.0945*	-0.8834	-0.7028*
	(0.7850)	(0.7739)	(0.6183)	(0.6443)	(0.5597)	(0.3645)
E.Asia	0.8729	0.6236	0.7018	1.0419*	0.4906	0.6715*
	(0.6247)	(0.6094)	(0.6045)	(0.5691)	(0.4797)	(0.3660)
ICRGE	0.5618***	0.5363***	0.2892**	0.2492**	0.3039***	0.3667**
	(0.1853)	(0.1855)	(0.1226)	(0.1260)	(0.1017)	(0.1504)
M2 lagged	0.0167	0.0143	-0.008	-0.0107	1.459	0.0141
	(0.0139)	(0.0134)	(0.0138)	(0.0174)	(0.9300)	(0.0135)
Policy	0.8555***	1.0496***	1.3325***	0.8176***	0.8885***	0.8633***
	(0.2160)	(0.2021)	(0.3317)	(0.2279)	(0.1331)	(0.2781)
Observations	*270*	*184*	*345*	*236*	*456*	*311*
R-squared	*0.4093*	*0.4719*	*0.3212*	*0.3463*	*0.4108*	*0.359*
AR F-test (p-value)	*0.0841*	*0.1103*	*0.0817*	*0.1287*	*0.0955*	*0.1398*
KP Wald F-Stat	*8.129*	*3.448*	*4.16*	*2.111*	*6.932*	*4.41*
Hansen J (p-value)	*0.298*	*0.2675*	*0.281*	*0.1711*	*0.1931*	*0.2178*

*Notes: The table presents results from IV regressions in which population has been removed from the set of instruments and included as one of the second stage country controls. All specifications uses the replicated dataset and the dependent variable is growth rate of per capita GDP. Columns 1 and 2 has results using Burnside and Dollar (2000) sample while columns 3 and 4 has results using Easterly and Levine (2003) sample. The results shown in columns 5 and 6 are for specification using our full sample; In each set of results, the first column has results for all developing countries in the sample while the second column has results for the sample with low income countries only. In all regressions, outliers are excluded. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

control variable rather than an instrument applied only in the first stage regression. The first two columns of the table present results from regressions using preferred specification and sample from BD; similarly, in columns 3 and 4 we test the impact of the change in specification using ELR sample and the last two columns (5 and 6) have results for regressions using our reconstructed sample. As the table shows, in all the specifications tested, there is evidence that population is a good predictor of growth, with the coefficient statistically significant at 5% level in almost all the regressions. Most importantly however, when we control for population in the second stage, there is some reasonable improvement in the significance of not only the aid*policy variable but also the coefficient

for aid itself.

Even when we use ELR sample, our results indicate that when we correct for the model misspecification using their sample, the coefficient for aid*policy becomes weakly statistically significant (at 10% significance level). When we consider results for our full sample, there is also improvement particularly for the low-income sample. Our full sample results in table 3.3.4 showed that in low-income countries, aid variable independently has a statistically zero effect on growth while the aid*policy interaction term was weakly significant. The IV estimate without outliers was significant at 10% level. When we include population in the second stage, the 2SLS coefficient for aid becomes significant at 10% while the aid*policy variable is significant at 5% level.

It should be noted here that just as Clemens et al. (2012) point out, removing population from the set of instruments without proposing any alternative instruments substantially weakens the identification strategy. The weak identification F-test statistics decline from 11.76 and 7.7 for the replicated BD and ELR results respectively to 3.448 and 2.111 while for the full sample results, the F-test statistic falls from 9.27 to 6.932 for the sample with all developing countries while for low-income country sample the test statistic declines from 9.312 to 4.41. Thus, while correcting the model specification has desirable effects on the estimated coefficients of interest, the substantial deterioration of the instrumentation strategy, as measured by the weak identification F-statistics in table (3.4.4), means the results from the estimation with population as a second stage country control still need to be treated with a good measure of caution.

3.5 Evolution of the Impact of Aid on Growth

The aid effectiveness literature already acknowledges that the impact of aid on growth varies considerably across countries[30]. However, not much analysis has been done that examines how the aid-growth relationship may have evolved over time; this is the motivation behind this part of the paper. The closest attempt made in analysing the effect of aid across time horizons was made by Rajan and Subramanian (2008); in their study they estimate the average effect of aid on growth by using sample for the periods 1960-2000, 1970-2000, 1980-2000 and 1990-2000.

[30]See Easterly (2008) and Rajan and Subramanian (2008).

In this section we adopt a different approach from Rajan and Subramanian (2008) to estimate the effect of aid on growth over time horizons. Rather we adopt an approach used in a similar analysis by Rousseau and Wachtel (2011) who examine the evolution of the impact of financial deepening on growth and reveal that the relationship between finance and economic growth has experienced a significant weakening over time. We re-examine the cross-country evidence and attempt to assess the evolution of the link between aid and growth across time. We also provide some possible explanations as to what factors may be attributed to such evolution.

In the previous section, our analysis used Burnside and Dollar's empirical specification, with explicit emphasis on the interaction between aid and policy. Here we take a different approach; we adopt Dalgaard et al. (2004) specification to examine the evolution of the relationship between aid and growth. There are two key differences between the two specifications; firstly, the model in Dalgaard et al. (2004) does not rely on the influence of policy on marginal effect of aid on growth (they still include policy and aid*policy variables in some regressions). Instead they explore the importance of non-policy or non-political structural characteristics of aid effectiveness by adding to the set of country controls a time invariant variable in the form of the fraction of land in the tropics. This is motivated from Sachs (2001) and Sachs (2003) who show that geographical factors such as the fraction of land in the tropics (and its associated persistent tropical challenges including persistent diseases) or being landlocked significantly influences the rate of growth of per capita GDP.

Another key difference with BD (2003) specification is that Dalgaard et al. (2004) attempt to improve the identification strategy by introducing additional instrumental variables. In particular they add the first lags of aid, aid squared, aid*policy and aid*fraction of land in tropics, which they show significantly improves the IV results. There are two advantages for adopting this specification; firstly, it provides further robustness checks to our earlier analysis (about model misspecification in BD study). Secondly, even after we take out population as an instrument from Dalgaard et al. (2004), weak identification F-statistic remain high, implying that the instruments remain jointly excludable. Nevertheless, even this specification has some weaknesses especially with regards to doubts over the use of lagged values of endogenous variables as instruments.

We begin with the empirical growth model as expressed by equation (3.2.2). Table (3.5.1)

contains results from baseline cross-sectional growth regressions for aid using our reconstructed dataset; thus it covers 81 countries for the whole sample period (1970 to 2013) and two sub – periods. Regressions 1 and 2 are for all developing countries and low income countries only samples respectively, for the whole period (1970-2013). They show strong correlation, on average, between aid and growth.

Table 3.5.1: OLS growth regressions with pure cross sectional data

	Dependent variable: Real per capita GDP growth rate					
	1970-2013		1970-1989		1990-2013	
	OLS	OLS	OLS	OLS	OLS	OLS
	1	2	3	4	5	6
Aid	0.2662**	2.2541***	0.9016***	2.5568*	0.3502*	3.3314***
	(0.8531)	(0.9142)	(0.2843)	(1.4322)	(0.1648)	(1.0997)
Aid*Policy	0.0375	0.0956*	-0.0266	0.1644	0.056	0.1199*
	(0.0438)	(0.0531)	(0.1455)	(0.1156)	(0.0493)	(0.0697)
Initial GDP per capita (log)	-0.0933	-0.3511	-0.2033	-0.357	-0.0446	-0.3807
	(0.3902)	(0.4734)	(0.6200)	(0.5926)	(0.3792)	(0.7470)
Population (log)	0.6968***	0.5761*	0.5921**	0.1888*	0.6128**	0.5692**
	(0.2235)	(0.3342)	(0.2336)	(0.1144)	(0.2323)	(0.2793)
Land in tropics(%)	-1.0681**	-3.5218***	-0.6586	-3.1093**	-0.9245	-1.9744
	(0.4273)	(0.9877)	(0.6629)	(1.3352)	(0.6297)	(1.5023)
Aid*Tropics	-0.4803	-3.2662***	-0.9275	-2.2281*	-0.3796	-3.3086*
	(0.3501)	(1.1428)	(0.7352)	(1.4911)	(0.6697)	(2.1083)
Ethnic fractionalisation	0.3664	0.5459	-0.4365	0.8683	1.049	-0.4836
	(0.6172)	(0.7891)	(0.8704)	(1.0014)	(0.9115)	(1.4247)
Assasinations	-0.2051	-0.4758	-0.5863	-0.9081	-0.1059	-0.495
	(0.1657)	(0.3741)	(0.4543)	(0.6216)	(0.1342)	(0.5004)
Ethn*Assas	-0.1805	-0.1403	0.6257	0.6251	-0.3385	-0.0192
	(0.5786)	(0.8523)	(1.0641)	(1.1857)	(0.4696)	(1.3567)
Institutions	0.3259***	0.2544*	0.3529**	0.2949*	0.2171	0.1965
	(0.1044)	(0.1380)	(0.1362)	(0.1560)	(0.1420)	(0.2591)
M2/GDP (lagged)	-0.9256	-1.3524	-0.3265	0.7478	-0.8339	-1.0949
	(0.8769)	(1.5597)	(1.7310)	(2.6782)	(1.2435)	(2.2848)
Policy	1.3781***	1.3038***	0.9608***	0.5981**	0.7873***	0.8192***
	(0.3010)	(0.3323)	(0.2352)	(0.2979)	(0.2239)	(0.2199)
EAsia	2.3516***	1.9846***	1.2332*	1.6108**	1.6757**	1.5737*
	(0.4802)	(0.6301)	(0.6469)	(0.7971)	(0.7941)	(0.8360)
SSA	-2.1650***	-2.2350*	-1.2671**	-1.6471***	-1.6316**	-1.7803**
	(0.7205)	(1.1312)	(0.5619)	(0.6174)	(0.6353)	(0.6909)
Observations	*562*	*329*	*307*	*178*	*254*	*151*
R-squared	*0.2244*	*0.2618*	*0.3106*	*0.3501*	*0.1947*	*0.2307*
Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*

*Notes: The table presents results of OLS regressions using pure cross sectional data of 81 countries; columns 1 and 2 covers the whole sample period (1970-2013), the second panel with columns 3 and 4 covers the first segment of the sample period (1970-89) and the final segment (columns 5 and 6) covers the remaining sample period (1990-2013). The first column of each segment is for regressions with the full sample and the other is for low income countries only. All regressions do not include outliers but include time period fixes effects. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.*

Regressions 3 and 4 cover the sub period from 1970-1989 which is roughly similar time periods covered in BD and most of the studies that followed in the early 2000s, including Dalgaard et al. (2004). The results for this sub-period are largely consistent with the findings of Dalgaard et al. (2004); generally a strong correlation between aid and growth, with the aid coefficient statistically significant at 1% for the full sample with all developing

countries. For the sample with low-income countries only, the coefficient relationship is not as strong during the period; the aid coefficients are significant only at 10% level.

In contrast, the when we consider regressions 5 and 6 (covering 1990-2013), there is a significant change in the relationship aid and growth: the aid coefficient for the full sample is no longer as strongly significant, only at 10%. On the other hand for low income countries sample, we observe a change in the opposite direction – the correlation is stronger with coefficients significant at 1% level.

The cross sectional results presented so far do not imply causation between aid and growth, however, a glance at the coefficient estimates for the two sub periods begins to give a some picture: there is contrasting evolution in the correlation between aid and growth among middle income countries and low income countries. Particularly, the coefficients for aid in the growth regression for low-income countries had a weak association with growth on average for the period between 1970 – 89, with coefficients significant only at 10% level while the relation is stronger in the subsequent period (1990 – 2013) and coefficients are statistically significant at 1% level. On the other hand, when the sample includes middle – income countries, the relationship is strong in the first sub period; coefficients are statistically strong at 1% for the 1970 – 89 sub sample while in the second sample the coefficients are only significant at 10% level.

As is standard in empirical growth literature, to examine the causal effect of aid on growth we estimate the baseline model with a panel of 4 year averages and employ instrumental variable approach using two-stage least squares (2SLS)[31] methodology. Instruments used are lags of aid, aid square, aid*policy, aid*land in tropics and arms imports; regional dummy variables for Central American countries, Franc zone countries and a dummy for Egypt. All IV regressions include time fixed effects.

Table 3.5.2 presents the results of instrumental variable regression and indicate a strong causal effect of aid on growth when the entire sample period is used. Estimated aid coefficients are statistically significant at 5% level for all developing countries sample while low income countries sample estimates are significant at 1% level. As mentioned

[31]Take note that there is a slight difference between our instruments and the instruments in Dalgaard et al. (2004) in that we do not use population an instrument, rather we include it in the second stage as one of the country controls.

Table 3.5.2: 2SLS results using 5-year averages panel data (1970-2013)

	Dependent variable: Real per capita GDP growth rate							
	1970-2013			1970-89			1990-2013	
	2SLS	2SLS		2SLS	2SLS		2SLS	2SLS
	1	2		3	4		5	6
Aid	0.3262**	3.8176***		0.9956**	2.2260*		0.2773*	3.4269***
	(0.1687)	(1.0904)		(0.4635)	(1.4812)		(0.1842)	(1.0104)
Aid*Policy	0.0721	0.2254***		-0.0848	0.1168		0.0924*	0.2013***
	(0.0562)	(0.0595)		(0.1462)	(0.1250)		(0.0551)	(0.0535)
Initial GDP per capita (log)	-0.0954	-0.2837		-0.2395	-0.4769		-0.1359	-0.2011
	(0.4083)	(0.4526)		(0.6476)	(0.6190)		(0.3579)	(0.6362)
Population (log)	0.3161**	0.3076**		0.3278**	0.2281**		0.4957**	0.4622**
	-0.1477	-0.1522		-0.15	-0.0895		-0.2071	-0.2149
Land in tropics(%)	-1.2429***	-3.7574***		-1.3010*	-4.3415***		-1.2656**	-2.3388*
	(0.4170)	(0.9045)		(0.6774)	(1.3254)		(0.5853)	(1.3313)
Aid*Tropics	-0.4654	3.6044***		-0.9353	2.9532*		-0.0714	-3.8756*
	(0.3613)	(1.1033)		(0.6866)	(1.5231)		(0.6974)	(2.2080)
Ethnic fractionalisation	0.2082	0.5493		-0.2413	1.6525*		0.8554	-0.3495
	(0.6256)	(0.7595)		(0.8897)	(0.9636)		(0.9257)	(1.4107)
Assasinations	-0.2687*	-0.4671		-0.9647**	-1.0264		-0.111	-0.4667
	(0.1615)	(0.3815)		(0.3976)	(0.6335)		(0.1334)	(0.5213)
Ethn*Assas	0.1864	-0.1466		1.5844**	0.9962		-0.2083	0.2808
	(0.3662)	(0.8636)		(0.6549)	(1.2046)		(0.4922)	(1.4146)
Institutions	0.3390***	0.2395*		0.2925**	0.2333		0.2983**	0.1754
	(0.1119)	(0.1375)		(0.1464)	(0.1642)		(0.1477)	(0.2604)
M2/GDP (lagged)	-0.9971	-0.6977		-3.4827	-1.7624		-0.5036	-0.3981
	(1.0321)	(2.0136)		(2.3037)	(3.2229)		(1.4988)	(3.0950)
Policy	0.7125***	0.7350*		0.9259***	1.1361***		0.5599***	0.7591**
	(0.1962)	(0.3725)		(0.1890)	(0.3381)		(0.1886)	(0.2965)
EAsia	2.3998***	2.0675***		1.0742*	1.4867*		1.4926*	1.0907
	(0.4691)	(0.6197)		(0.6440)	(0.8378)		(0.8172)	(1.0350)
SSA	-1.1181**	-1.5534**		-0.1546	-1.4879**		-2.0848***	-2.0382*
	(0.5534)	(0.6065)		(0.8465)	(0.7370)		(0.7059)	(1.1332)
Observations	*497*	*288*		*271*	*156*		*227*	*134*
R-squared	*0.2568*	*0.3188*		*0.3464*	*0.4044*		*0.2586*	*0.3184*
AR F-test (p-value)	*0.0149*	*0.0012*		*0.0027*	*0.0071*		*0.0003*	*0.0099*
KP Wald F-Stat	*22.35*	*22.63*		*17.82*	*17.54*		*14.56*	*27.51*
Hansen J (p-value)	*0.287*	*0.423*		*0.126*	*0.103*		*0.185*	*0.102*
Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*

*Notes: The table presents results of IV regressions using a panel of 5 year averages for the full sample; columns 1 and 2 cover the whole sample period (1970-2013), columns 3 and 4 cover the first segment of the sample period (1970-89) and columns 5 and 6 have results for the final segment of the sample period (1990-2013). The first column of each segment is for regressions with the full sample and the other is for low income countries only. All regressions do not include outliers but include time period fixes effects. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.*

earlier and noted by Dalgaard et al. (2004), the instrumentation strategy used in the IV approach arguably has some weaknesses, particularly with regards to use of lagged values of the endogenous variables (in this case aid). In our estimations, the Anderson Rubin p-values attest to the joint significance of the instruments used, implying that the instruments used (including lag of aid) are uncorrelated with the error term in the structural model.

Most importantly, the IV results also point to significant difference in the coefficient estimates between the two sub periods; the effect of aid is strong for the full sample in the

first sub period and substantially weakens in the second sub period. On the other hand, the coefficients for low income countries' sample indicate a reverse transformation whereby coefficients are statistically weaker in the first sub period but in the second sub period they show a stronger correlation. Furthermore the magnitude of the effect of increase in aid is also higher during the second period for low income countries compared to the first sub period.

The IV regression results suggest that, on average, the marginal causal effect of aid for both the full sample and for low income countries only is statistically strong across the entire period (1970 – 2013). When the period is divided into two sub periods however, results suggest that the average effect for the full sample is stronger between 1970-1989 and significantly weakens between 1990-2013, on the other hand when only low income countries are considered, the effect is weaker in the initial period and gets stronger in recent time periods.

To understand better what is happening to the effect of aid over time, we further subdivide the sample period into 5 year periods; from 1970 to 2013 there are nine 5-year cross sections. We then use instrumental variable approach and estimate the effect of aid for each 5 year period. Table 3.5.3 presents a summary of the coefficient estimates from the IV regressions; the table only shows only the aid coefficients but the estimated equations include all the controls as used in table 3.5.2 above.

The top section of table 3.5.3 has results for the full sample while the lower section contains results for estimation with only low income countries. Starting with the full sample estimates, the coefficient for aid (as a percentage of real GDP) is genarally positive and strongly significant at between 1970-89, except for the period 1980 and 1984 when the coefficient becomes statistically insignificant (and negative). Between 1990 and 2013, the estimated coefficients are mostly positive but only weakly significant (except 1995-99 (negative coefficient); 2005-09 significant at 5%). In general, there is a clear decline in the strength of the relationship between aid and growth across time for the full sample.

Coefficients for low income countries only on the other hand exhibit a reverse transformation; the estimated coefficients for periods 1970-1989 are generally negative and weakly significant (at 10% level) or altogether insignificant. From 1990-2013 however, the es-

Table 3.5.3: Summary of 2SLS growth regressions with individual 5-year cross sections

	Dependent Variable: Real per capita GDP growth rate								
	Full sample: All developing countries								
	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	2010-13
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Aid	0.9508***	0.6361**	-0.3458	2.4710**	0.7959*	-0.4911*	0.1451	0.0164**	0.7211*
	(0.3094)	(0.2091)	(0.7852)	(0.9811)	(0.4619)	(0.2398)	(0.6964)	(0.0082)	(0.3536)
Observations	*158*	*144*	*125*	*133*	*129*	*120*	*130*	*124*	*91*
R-squared	*0.271*	*0.3515*	*0.4779*	*0.5642*	*0.3478*	*0.4819*	*0.3621*	*0.3162*	*0.2794*
Number of countries	*81*	*81*	*81*	*81*	*81*	*81*	*81*	*81*	*81*
AR F-test (p-value)	*0.0192*	*0.0011*	*0.0162*	*0.0029*	*0.0111*	*0.0412*	*0.0117*	*0.0213*	*0.0155*
KP Wald F-Stat	*14.021*	*17.901*	*10.139*	*16.711*	*11.103*	*23.411*	*27.837*	*15.1*	*22.809*
Hansen J (p-value)	*0.233*	*0.237*	*0.0979*	*0.143*	*0.113*	*0.0452*	*0.2012*	*0.0711*	*0.315*
Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*

	Low income countries only								
	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	2010-13
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Aid	-1.8158*	1.1376	-0.5508	-0.1917*	0.6755*	-1.2715**	2.7353**	1.4293***	2.1494*
	(1.1081)	(2.5980)	(0.4832)	(0.1137)	(0.3490)	(0.6553)	(1.5070)	(0.4498)	(0.9957)
Observations	*71*	*73*	*61*	*69*	*70*	*62*	*68*	*62*	*51*
R-squared	*0.4413*	*0.5359*	*0.5193*	*0.7287*	*0.5039*	*0.6625*	*0.6297*	*0.3512*	*0.4111*
Number of countries	*48*	*48*	*48*	*48*	*48*	*48*	*48*	*48*	*48*
AR F-test (p-value)	*0.0318*	*0.0199*	*0.0144*	*0.0146*	*0.0313*	*0.0217*	*0.033*	*0.0085*	*0.0102*
KP Wald F-Stat	*12.24*	*12.31*	*12.61*	*15.14*	*16.3*	*13.86*	*12.1*	*17.42*	*10.15*
Hansen J (p-value)	*0.268*	*0.27*	*0.568*	*0.183*	*0.45*	*0.383*	*0.514*	*0.484*	*0.269*
Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*

*Notes: The table contains a summary of coefficient estimates for aid variable from 2SLS regression of growth rate of per capita GDP using 5-years averages. The top panel reports estimates for the full sample of 81 countries while the results for low-income countries' sample (48 countries) are in the bottom panel. All regressions do not include outliers, but their inclusion does not significantly alter our results. Instruments used in all estimations are: aid, aid squared, aid*policy and aid*land in tropics (all lagged one period), Franco-zone dummy, Egypt dummy, Central American countries dummy, arms imports (lagged) and arms imports*policy. Robust stand errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.*

timated coefficients on average positive strongly significant (at least 5% level) in most periods other than the period 1990-94 when it is significant at 10% and 1995-99 has a negative coefficient. In contrast to the scenario with the full sample, we find that for low income countries the relationship between aid and growth is stronger in the later sub periods than it was in the earlier ones.

3.5.1 Discussion

We now take a closer look at the results we have unearthed in this section and attempt to provide some possible explanations. We propose two possible explanations for the observed evolution of the effect of aid.

(i) Shift in focus and flow of aid

We begin by exploring the effect of changes in donor policy and perspectives and how those shifts have influenced allocation of aid during the sampled period. Particularly, we take a historical review of how aid has evolved since 1970, the year which also coincides with the adoption by the UN General Assembly a resolution that "each advanced country should

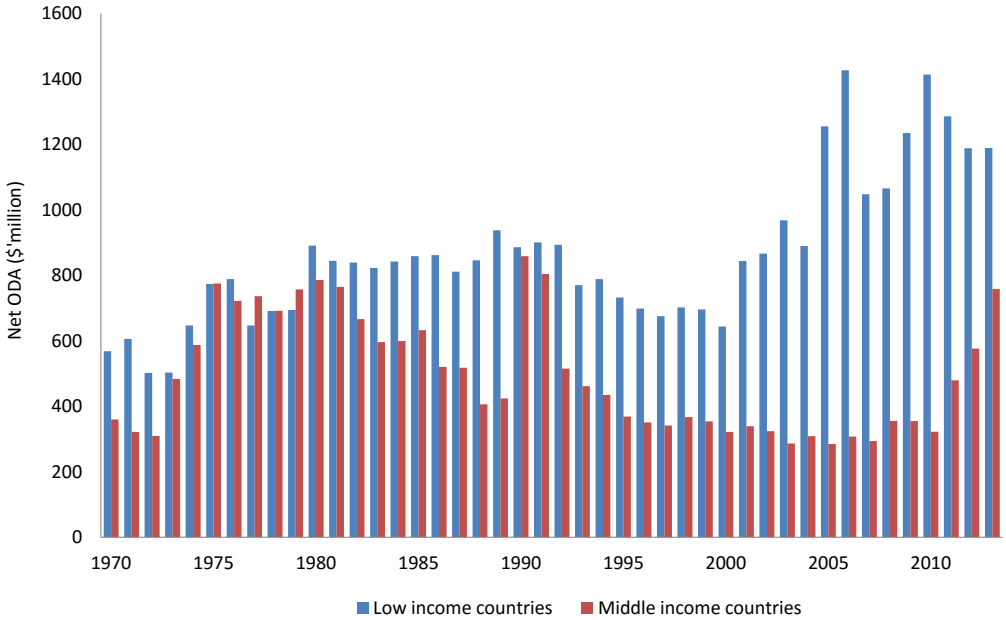
progressively increase its official development assistance" and "exert its best efforts to reach a minimum net amount of 0.7% of its gross national product at market prices by the middle of the decade". Importantly, it was an era when the primary focus for aid shifted towards poverty reduction and improvement of social welfare by targeting overall growth through identified growth sectors. At the same time, the role of multilateral organisations particularly the World Bank's International Development Association (IDA) increased significantly to become the lead institution driving the aid apparatus for traditional donors including Development Assistance Committee (DAC) countries.

Between 1970 and 1980 increased donor commitment to providing development assistance saw overall levels of aid to all developing countries increase substantially, led by the IDA's Soft Loan Window. From 1980 however, as terms of trade continued to deteriorate (aftermath of the 1970s BOP crisis) with severe effects particularly for low income countries, there was growing consensus that more foreign assistance was required by the poorest countries. As a way of increasing aid resources to low income countries, donor countries began to relocate aid resources from middle income countries to the poorest countries, as reported in the World Bank's World Development Report (1986): "relocating concessional aid from middle-income to low-income countries has become as important as increasing the overall amounts." Figure 3.5.1 shows the trend in disbursement of net ODA for low-income and middle income countries.

Allocations to middle income countries picked up between 1989 and 1992; however as efforts to combat absolute poverty in the poorest countries gathered momentum, more relocation of resources from middle income countries ensued and in 1993 DAC donors revised the list of ODA eligible countries to exclude some 'higher-income' countries. From the turn of the millennium, led by the Millennium Development Goals (MDGs) framework, international development efforts further embraced the fight against absolute poverty, thus more focus of external assistance towards low-income countries.

Apart from the shift in aid resources towards low-income countries, the growing focus on the poorest countries also led to important review of the entire aid apparatus. This included a re-look at aid delivery and implementation of aid programmes, review of coordination with recipient countries and among donors all with the primary aim of maximizing the returns from aid. From the 1990s, an international aid effectiveness movement began

Figure 3.5.1: Net ODA disbursements (1970-2013)



Source: World Banks World Development Indicators. http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators

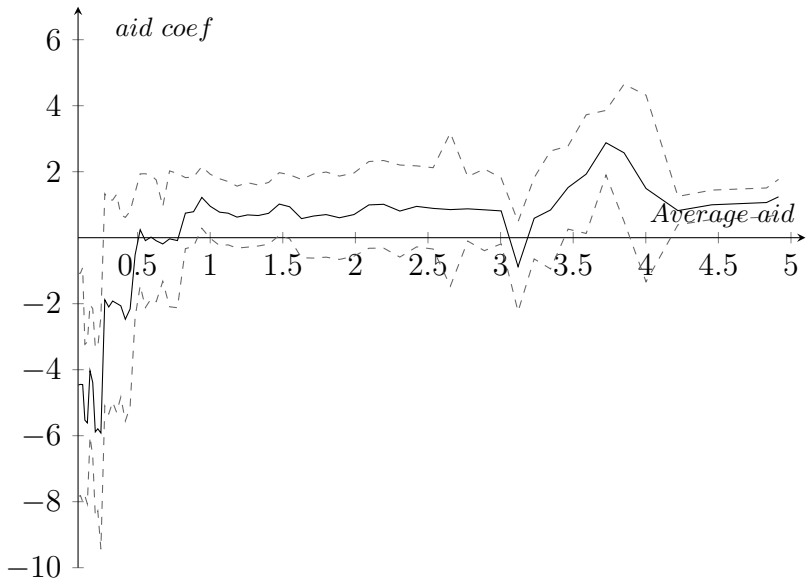
taking shape; donor countries and aid agencies began to realize that their many different approaches and requirements were imposing huge costs on developing countries and making aid less effective and hence began efforts to work with each other, and with developing countries, to harmonize their work and maximize aid's impact. High Level Forums (HLFs) on aid effectiveness heightened the movement for effectiveness of aid, from the first International Conference on Financing for Development (Monterrey Consensus) in 1998 and the Paris Declaration on Aid Effectiveness in 2005, Accra Agenda for Action in 2008 to the Fourth High Level Forum on Aid Effectiveness held in Busan, Korea in 2011 and the United Nations Sustainable Development Summit (2015). Throughout these forums, the primary focus remains making foreign assistance work better in the poorest countries of the World.

To illustrate more closely how the levels of foreign aid relative to the size of the recipient economy affect the relationship between aid and growth, we use rolling regression technique to investigate the relationship between the level of aid and its impact using IV panel regression. To do this, the sampled countries are ordered by the ratio of aid to GDP, then regression analysis is run beginning with the first 20 countries with the lowest levels of aid to GDP ratio and then one by one additional countries (with relatively higher

ratio) will be rolled in and one country (with the lowest ratio) will be rolled out. Hence, each regression comprises the same sample size of 20 countries. In so doing, the rolling regression technique also allows us to analyze the effect of aid on growth among countries with relatively similar aid dependence.

Figure (3.5.2) presents the results from the rolling regressions, showing the evolution of aid coefficients from IV estimation of 20-country samples for the period 1970-2013. The horizontal axis plots the average aid (% of GDP) among the 20 countries in the sample at each point of analysis while the vertical axis plots the resultant coefficients; the solid line is the estimated coefficients while the dashed lines reflect the 95% confidence interval.

Figure 3.5.2: Evolution of the effect of aid in 20-country window (1970-2013) for all developing countries (full sample)



As the figure depicts, the effect of aid starts to be strong when the aid to GDP ratio is around 0.5% and appears to get stronger as the ratio increases. Further, as the ratio increases the coefficients (averaging between 1 and 1.5) are in general positive and strongly significant, which is consistent with the results from Dalgaard et al. (2004).

In terms of composition, the aid/GDP ratio for almost all middle-income countries ranges within 0.09 – 1.5%. Low income countries are mostly those who are more aid dependent, with their aid/GDP ratio over 1%, for some individual countries such as Liberia this is as high as 10.6%.

To illustrate more clearly how the relationship between aid and growth has evolved among

the two sub samples (middle income countries and low income countries), we use the same 20-country window rolling regressions technique on each separate sub sample. In the same format as figure (3.5.2) above, figure (3.B.3) in the appendix has two graphs; the first (graph a) shows the coefficients for estimation of middle income countries only for the period 1970-89 while the second (graph b) has the same countries for the period 1990-2013. Figure 3.B.4 on the other hand has similar graphs as figure (3.B.3) but now for low income countries, the first (a) for the period 1970-89 and the second (b) for 1990-2013.

The two figures (3.B.3 and 3.B.4) express more succinctly what we have observed in the results. In Figure 3.B.3, the coefficient for aid is mostly positive in both graphs, which agrees with the observation that the correlation between aid and growth for middle income countries is predominantly positive. There is also evidence of a statistically significant causal relationship between aid and growth between 1970 and 1989, especially once the average aid/GDP ratio reaches about 0.6%. In graph (b) on the other hand reveals a relatively weaker relationship between aid and growth during the entire period (1990-2013). This further enhances the observed results reported in the top panel of table 3.5.3, that the strength of the causal relationship between aid and growth seems to have waned over the years. Note also that between 1970-89, average aid relative to GDP for middle income countries ranges from 0.13% to 3.83% while for the period 1990-2013 the range falls down to between 0.1% and 1.5%, a clearly substantial decline in the amount of aid disbursed to middle income countries, relative to the size of the economies.

In figure 3.B.4, the transformation of the effect of aid is more notable. In graph (a), the relationship between aid and growth is mostly negative appears to be statistically weak. Again, this is in line with the observed results reported in table 3.5.3. In graph (b), there is a significant change in the reported coefficients for aid. As shown, the relationship between aid and growth is now predominantly positive and appear to be strongly significant. Thus there is evidence from graph (b) of a strong positive causal link between aid and growth between 1990 and 2013. Furthermore, contrary to the trend for middle income countries, the graphs in figure 3.B.4 indicate a substantial increase in the amount of aid to low income countries, with the range of aid/GDP ratio increasing from between 0.7% and 3.22% in graph (a) to between 0.97% and 7.56% in graph (b). Such an increase in the flow of aid to low income countries relative to the size of their

economies may have contributed to the strong link between aid and growth during the second period.

ii) Effect of debt crises

Another possible explanation for the transformation in the effect of aid is the effect of debt crises, which a number of countries in the sample experienced at different stages over the sample period. Debt crisis involves the inability of countries to meet their liabilities when they are due, including repeated suspension of debt repayments, bilateral agreement or unilateral decision to significantly reduce debt repayments. Examples of severe debt crises include the 1980's crisis, which affected middle-income countries of Latin America and the 1990s Highly Indebted Poor Countries (HIPC) crisis that affected impoverished nations especially in Sub Saharan Africa.

While the situation in these two crises were slightly different[32], they have similar a effect on the relationship between aid and growth. Firstly, debt burden reduces the net level of aid to a country which affects the flow of resources available to the country in the present and in future, if expected large debt servicing discourages future investment. Secondly, debt burden may affect the macroeconomic policy environment, which in turn affects the interaction with aid and hence may dampen the impact of aid on growth.

To examine the impact of sovereign debt crises on the effect of aid, we identify and separate the episodes of debt crises and run the regression analysis on non-crisis sample. To identify the episodes, we have used the identification and dating from Reinhart and Rogoff (2008, 2009) for sovereign debt crises. A 5-year country observation is characterized to be a crisis period if the country experienced a crisis at any time during the period. Out of the 81 countries in the sample, 47 countries were in crisis at some point during the sample period. Table (3.5.4) shows the number of countries that experienced the debt crisis at any point during each 5-year period; table (3.C.6) has the list of countries and years that experienced an a debt crisis between 1970-2013.

[32]HIPC crisis was characterized not only by very high debt levels but also poor economic performance, unlike the Latin American crisis when the countries affected were mostly middle income countries who were still performing reasonably well and secondly unlike the Latin American countries who made net transfers abroad during the crisis, HIPCs still received net positive foreign transfers during the crisis period and after made possible by increased concessional financing and grants from bilateral governments and other multilateral donors.

Table 3.5.4: Number of countries in debt crisis during 5 year periods (1970-2013)

	1970-74	**1975-79**	**1980-84**	**1985-89**	**1990-94**	**1995-99**	**2000-04**	**2005-09**	**2010-13**
Debt crisis	2	10	30	15	13	9	14	8	1

Notes: The table presents data on the number of countries that experienced episodes of debt crisis at some point during the stated period. Crises identified using data from Reinhart and Rogoff (2008, 2009).

Table (3.5.5) contains results of the IV regression of 5-year panel data using the baseline specification, with the inclusion of a dummy variable that takes the value 1 if a country experienced a crisis during that period and 0 otherwise (as defined above). This enables the estimated coefficients to vary with the incidence of crises. Using the same format as table (3.5.2); the first 2 regressions are for the entire sample period (1970-2013), regressions 3 and 4 for 1970 -1989 sub period and regressions 5 and 6 for 1990-2013 sub period. As before, all regressions include time period fixed effects.

The results in table (3.5.5) show the impact of debt crises on the coefficients of aid; in all estimations the coefficients are all positive and strongly significant, unlike the estimated coefficients reported in table (3.5.2) which does not account for the impact of crises. Importantly, unlike in table (3.5.2) regressions when the relationship appeared to weaken with time for the full sample, when we account for the episodes of debt crises, the relationship between aid and growth remains relatively strong over both sample periods; aid coefficients for the second sub period are statistically significant at 5%. Similarly, the relationship between aid and growth for low income sample in the baseline was relatively weak in the first sub period; when we account for crises, the relationship is stronger during the same period, with coefficients significant at 5% level.

Notably, in all regressions the interaction between aid and crisis is strongly significant at 1% level and negative; when a country experiences a debt crisis, the effect of aid on growth reduces significantly. Particularly, during episodes of debt crises the coefficient for aid is often negative as can be seen in table (3.5.3) for early to mid 1980s during the Latin American crisis and in the late 1990s during the HIPC crisis. Additionally, the magnitude of the influence of debt crises is higher in the first sub period than in the second. We think this is the case because the countries mostly affected by the debt crisis between 1970 and 1989 were middle income countries. As mentioned earlier, the burden of the 80s debt crisis was more severe as the affected countries made net payments abroad hence the effect of the crisis may have been more adverse. In contrast, the HIPC crisis

Table 3.5.5: Results from 2SLS regressions using 5-year average panel data, by crisis status (1970 - 2013).

	Dependent Variable: Real per capita GDP growth rate					
	1970-2013		1970-1989		1990-2013	
	1	2	3	4	5	6
Aid	0.5096***	3.0511***	0.8307***	2.7725**	0.566**	4.7929**
	(0.1138)	(1.0828)	(0.2585)	(1.3392)	(0.2490)	(2.3336)
Aid*Policy	0.0511	0.1328**	-0.0848	0.1884**	0.1412**	0.1416**
	(0.0550)	(0.0534)	(0.1462)	(0.0578)	(0.0687)	(0.0687)
Aid*DebtCrisis	-0.5857**	-0.9530*	-1.2954***	-1.2780***	-0.529***	-0.441***
	(0.2486)	(0.3524)	(0.4486)	(0.4395)	(0.1130)	(0.0940)
Initial GDP per capita (log)	-0.3347	-0.5026	-0.3813	-0.6525	-1.2969	-0.2972
	(0.4702)	(0.4248)	(0.5700)	(0.5079)	(1.2756)	(0.7560)
Population (log)	0.1503**	0.1233**	0.609*	0.3744**	0.140*	0.164**
	(0.0678)	(0.1383)	(0.3795)	(0.1341)	(0.0752)	(0.0760)
Land in tropics(%)	-0.8949**	-3.3543***	-1.0509*	-3.5205***	-0.821***	-0.699***
	(0.4478)	(0.9139)	(0.5733)	(1.2985)	(0.1610)	(0.1750)
Aid*Tropics	-0.6998**	2.8810***	-0.9816***	2.2485*	-0.302*	-0.284*
	(0.2807)	(1.1020)	(0.1942)	(1.3402)	(0.2050)	(0.1828)
Ethnic fractionalisation	0.5209	0.8675	-0.0561	1.9645**	-0.247	-0.1836
	(0.6483)	(0.7935)	(0.8801)	(0.8505)	(0.8233)	(1.1081)
Assasinations	-0.1025	-0.5168	-0.4646	-1.0442*	-0.3399**	-0.4490*
	(0.1813)	(0.3353)	(0.4949)	(0.5342)	(0.1530)	(0.2679)
Ethn*Assas	-0.4305	-0.3637	0.4045	0.6464	0.6892	0.6338
	(0.6010)	(0.8512)	(1.0940)	(1.0967)	(0.9599)	(0.9030)
Institutions	0.3513***	0.2814**	0.4058***	0.2565	0.3734***	0.3787***
	(0.1060)	(0.1418)	(0.1415)	(0.1580)	(0.1375)	(0.1402)
M2/GDP (lagged)	-0.8525	-1.9881	-3.1345*	-2.3417	-3.1825	-2.3417
	(0.8736)	(1.5028)	(1.7718)	(2.6918)	(2.4922)	(2.6918)
Policy	0.8628***	0.6426**	1.0167***	0.6951**	0.5599***	0.7591**
	(0.2714)	(0.2898)	(0.2026)	(0.3060)	(0.1886)	(0.2965)
EAsia	2.3998***	2.0675***	1.4003**	1.5330*	0.513**	0.532**
	(0.4691)	(0.6197)	(0.6637)	(0.8270)	(0.2040)	(0.2410)
SSA	-1.1181**	-1.5534**	-1.5940**	-1.8743***	-1.126***	-1.235***
	(0.5534)	(0.6065)	(0.6457)	(0.6178)	(0.1200)	(0.1430)
Observations	*562*	*329*	*307*	*178*	*256*	*151*
R-squared	*0.5725*	*0.4673*	*0.2731*	*0.344*	*0.455*	*0.353*
AR F-test (p-value)	*0.00896*	*0.01968*	*0.0036*	*0.0132*	*0.0183*	*0.0019*
KP Wald F-Stat	*21.813*	*42.327*	*38.45*	*37.3*	*27.2*	*29.88*
Hansen J (p-value)	*0.805*	*0.862*	*0.243*	*0.176*	*0.623*	*0.415*
Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*

*Notes: The table presents results of IV regressions using a panel of 5 year averages for the full sample; columns 1 and 2 cover the whole sample period (1970-2013), columns 3 and 4 cover the first segment of the sample period (1970-89) and columns 5 and 6 cover the remaining sample period (1990-2013). The first equation in each segment is for regressions with the full sample while the other is for low-income countries only. All regressions include time period fixes effect and do not include outliers. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.*

experienced in the 1990s and early 2000s mainly affected low income countries; despite their debt burden they still enjoyed positive net foreign inflows as such the impact on their resource flows may not have been as adverse.

3.6 Conclusion

The chapter set out to re-examine the existing empirical evidence on the causal relationship between aid and growth. We analyse the some of the influential evidence from cross-country aid effectiveness literature, using the aid-policies-growth strand of aid effectiveness literature that has become popular in recent years. Our results provide further explanations behind the observed lack of robustness of the results cross-country studies. We show that sample composition, with respect to the number of low-income and middle income countries included, may affect the estimated effect of aid. We also discuss a number of specification issues that may affect the results of cross-country aid-growth regressions.

In section 3.5 we investigate the evolution of the effect of aid on growth over time. When we use our full sample, we find that the relationship between aid and growth has been diminishing between 1970 and 2013. When we divide the sample into low income countries only and middle income countries only, we observe that for low income countries the relationship was weaker between 1970 - 1990 and got stronger between 1990-2-13. On the other hand, for middle income countries we find the reverse to be true; the relationship was stronger between 1970-1990 but got weaker since 1990. We then go further to analyze some of the possible explanations for such differences in the effect of aid over time; beginning by analyzing the effect of changes in the levels of aid to the two groups of countries and how this may have affected the impact of aid on growth in the respective country groups. The chapter also finds that incidence of debt crises may be responsible for the observed evolution; when debt crises are taken into account, the relationship appears to be more robust and stable over time for both samples.

Appendix

3.A Classical Errors-in-variables (CEV)

We have $\widehat{a_i} = a_i + \upsilon$ and:

$$cov(\widehat{a_i}, \upsilon) = E(\widehat{a_i}\upsilon) - E(\widehat{a_i})E(\upsilon) = E(a_i\upsilon + \upsilon^2) = E(\upsilon^2) = \sigma_\upsilon^2 \neq 0$$

The formula for β_1 is

$$\begin{aligned}
p\lim \beta_1 &= \frac{cov(\Delta y_i, a_i)}{var(\widehat{a_i})} \\
\Rightarrow p\lim \beta_1 &= \frac{cov(\beta_0 + \beta_1\widehat{a_i} + \mu - \beta_1\upsilon, \widehat{a_i})}{var(\widehat{a_i})} \\
&= \frac{\beta_1 var(\widehat{a_i}) - \beta_1 cov(\widehat{a_i}, \upsilon)}{var(\widehat{a_i})} \\
&= \beta_1\left(1 - \frac{cov(\widehat{a_i}, \upsilon}{var(\widehat{a_i})}\right) \\
&= \beta_1\left(1 - \frac{\sigma_\upsilon^2}{var(\widehat{a_i})}\right)
\end{aligned}$$

However, note that $var(\widehat{a_i}) = var(a_i + \upsilon) = \sigma_{a_i}^2 + \sigma_\upsilon^2$;

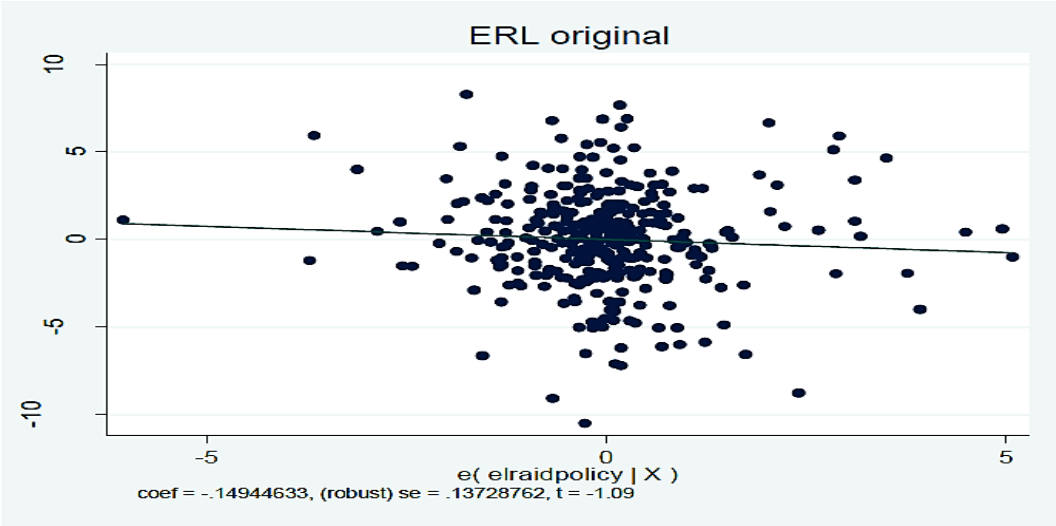
Therefore

$$\begin{aligned}
p\lim \beta_1 &= \beta_1\left(1 - \frac{\sigma_\upsilon^2}{\sigma_{a_i}^2 + \sigma_\upsilon^2}\right) \\
\Rightarrow p\lim \beta_1 &= \beta_1\left(\frac{\sigma_{a_i}^2}{\sigma_{a_i}^2 + \sigma_\upsilon^2}\right)
\end{aligned}$$

The expresion $\frac{\sigma_{a_i}^2}{\sigma_{a_i}^2 + \sigma_\upsilon^2}$ is always less than one, as a result the OLS estimator of β_1 is always drawn closer to 0 hence attenuation bias.

3.B Figures

Figure 3.B.1: Partial scatter of aid*policy using ELR original and its extended dataset



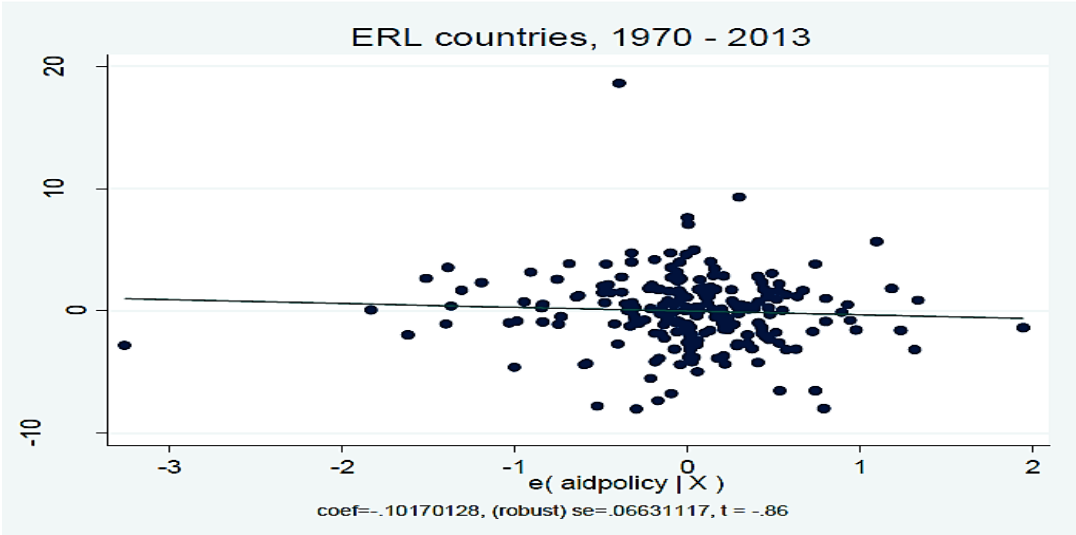
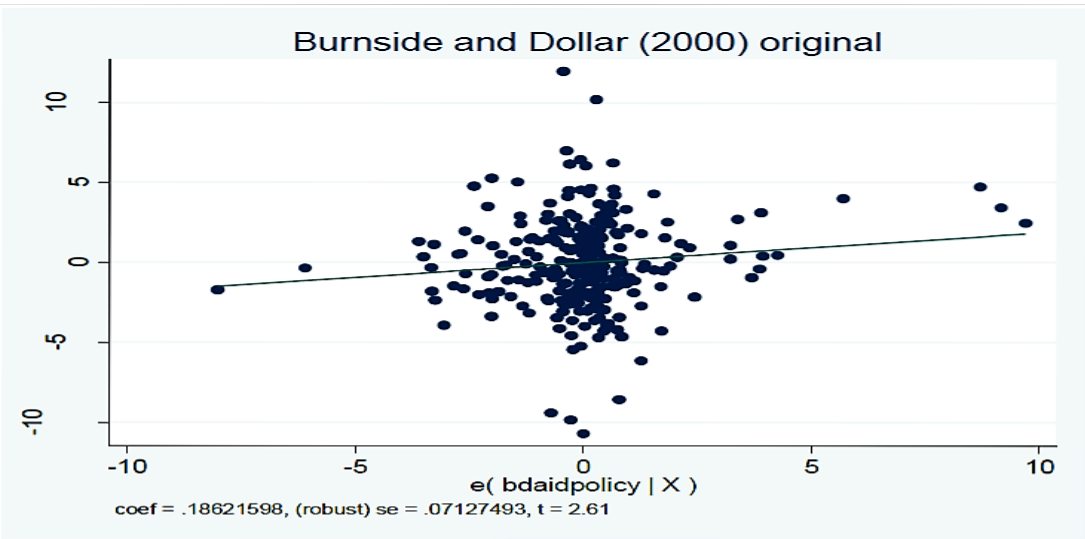


Figure 3.B.2: Partial scatter of aid*policy for BD original and ELR cross-sectionally extended dataset



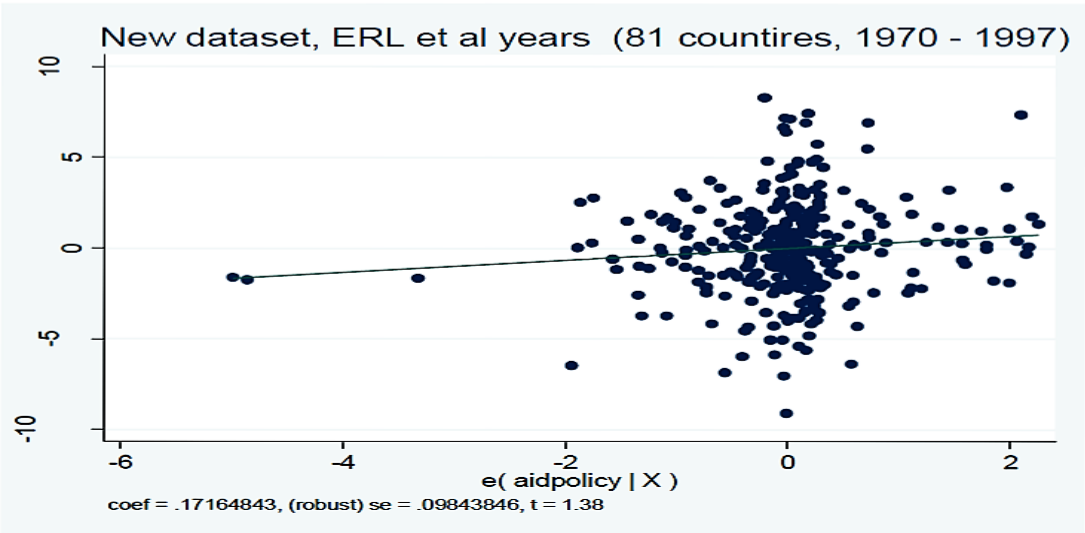
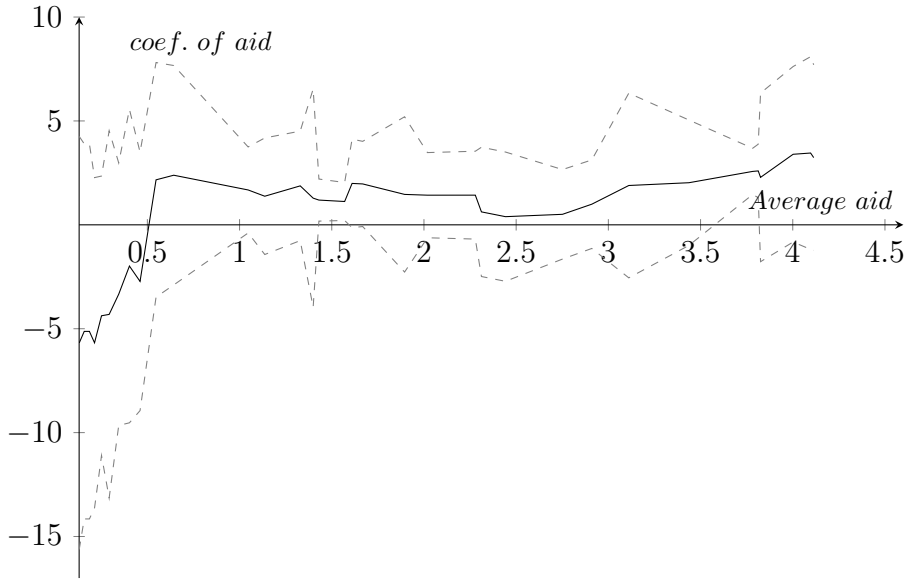


Figure 3.B.3: Evolution of the effect of aid in 20-country window (1970-2013): Middle income countries

(a) 1970-1989



(b) 1990-2013

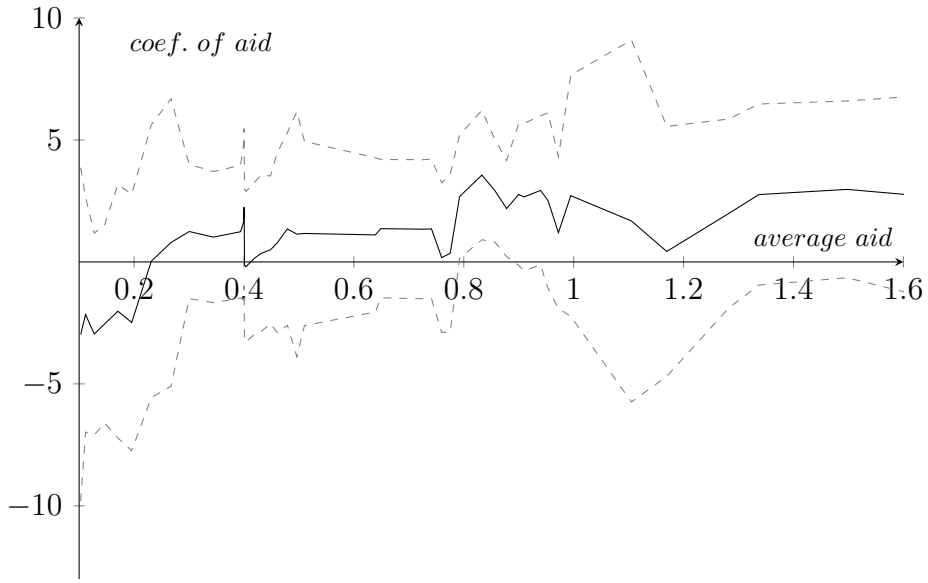
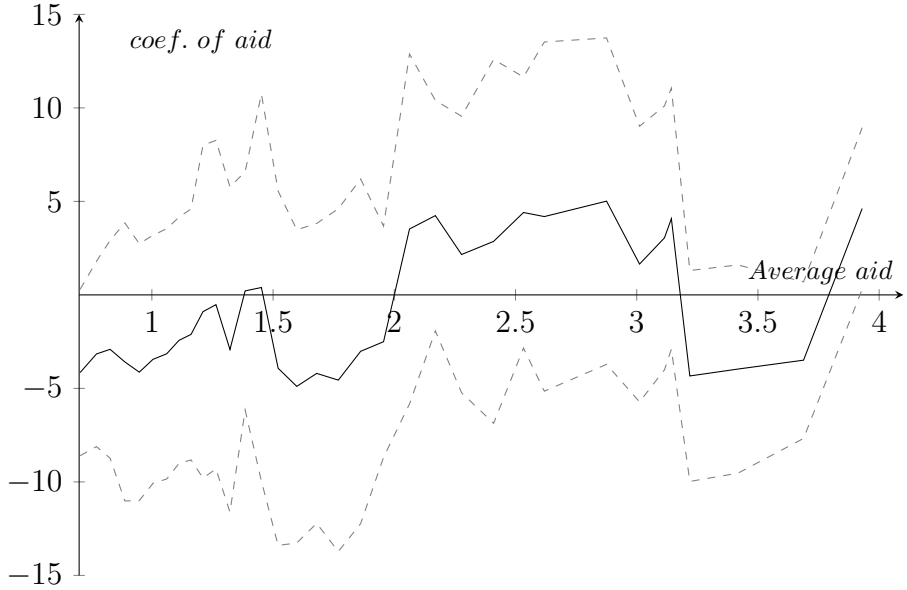
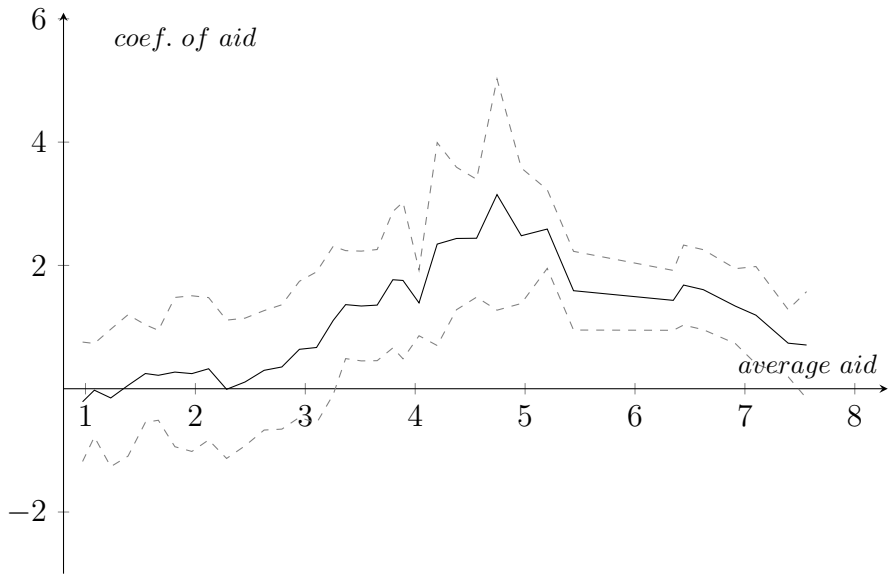


Figure 3.B.4: Evolution of the effect of aid in 20-country window (1970-2013): Low income countries

(a) 1970-1989



(b) 1990-2013



3.C Tables

Table 3.C.1: Comparison of average growth rates in African countries (1975-1999)

PWT 6.2		PWT 6.1		
Country	Growth (%)	Country	Growth (%)	Countries not on both lists
Top 10 countries				
Botswana	4.5	Botswana	5.1	Malawi
Equi. Guinea	4	Cape Verde	4.7	Equi. Guinea
Cape Verde	3.7	Mauritius	4.3	Ethiopia
Egypt	3.7	Egypt	3.7	Mali
Mauritius	3.7	Tunisia	2.5	Uganda
Lesotho	3.5	Uganda	1.7	Congo, Rep
Tunisia	2.7	Morocco	1.7	
Mali	2	Lesotho	1.5	
Ethiopia	1.6	Congo, Rep	1.5	
Morocco	1.6	Malawi	1.2	
Bottom 10 countries				
Gabon	-2.6	Equi. Guinea	-2.7	Chad
Zambia	-2.1	Mozambique	-2.4	Cote d'Ivoire
Madagascar	-1.9	Zambia	-1.8	Gabon
Togo	-1.7	Comoros	-1.6	Guinea-Bissau
Guinea-Bissau	-1.4	Madagascar	-1.4	Mauritania
Comoros	-1.2	Cote d'Ivoire	-1.4	Namibia
Niger	-0.7	Niger	-1.3	Nigeria
Nigeria	-0.5	Mauritania	-1.3	Togo
Chad	-0.5	Togo	-1	
Mozambique	-0.4	Namibia	-0.9	

The table is adopted from Johnson et al. (2013) and contains the top and bottom 10 performing countries in Africa using PWT 6.1 and PWT 6.2 GDP data for the period 1975 and 1999.

Table 3.C.2: Correlations between ELR data and our reconstructed dataset

Variable	Correlation with ELR	Data Source	Notes
Aid	0.966	World Bank's World Development Indicators (WDI)	For period 1975 - 1995, data from Chang et al (1998). Data for 1970 - 1974 and 1996 - 2013 exptrapolated using the correletion between EDA and net ODA, and converted to 1985 prices using using Import Unit Value Index.
Per capita GDP growth	0.951	World Bank's World Development Indicators (WDI)	Average annual growth rate of per capita GDP.
Initial GDP per capita	0.993	Alan Heston, Robert Summers and Bettina Aten (2012), updated using GDP per capita growth rate	Natural log of GDP per capita for the first year of the 4-year period; also in constant 1985 prices.
Population	1.000	World Banks WDI	Natural log
M2/GDP	1.000	World Banks WDI	Lag of M2/GDP
Assassinations	0.997	Banks (2002), updated with CNTS data	The rate of political asassinations
Ethnic fractionalisation	1.000	Easterly (2003) updated using CNTS data	Probability that two individuals belong to different ethnic groups
Institutional quality	1.000	Updated PRS Groups ICRGE dataset	As in Easterly et al (2003), 1980 values used for periods pre-1980.
Budget surplus	0.957	World Banks WDI	
Inflation	1.000	World Banks WDI	Calculated as the natural log of 1 + the average annual inflation rate
Sachs - Warner Index (openness)	0.971	Updated from Minoiu and Reddy (2007) and extended using Wacziarg and Welch (2003).	
Arms imports	0.982	World Banks WDI, updated using CNTS data	

Notes: The table shows correlations of the variables in the dataset used in this study and the corresponding variables in ELR; all variables are arithmetic averages over time and are aggregated over 4 year periods

Table 3.C.3: Description of samples used in BD, ELR and DK Sample

	BD Sample	ELR Sample	DK Sample*
Sample period	1970-94	1970-97	1970-2013
Number of countries	56	62	81
Total observations	270	345	477
IV used	Population	Population	Population
	Poulation*Policy	Poulation*Policy	Poulation*Policy
	Population square*Policy	Population square*Policy	Population square*Policy
	Initial income square*Policy	Initial income square*Policy	Initial income square*Policy
	Initial income*Policy	Initial income*Policy	Initial income*Policy
	Arms imports (lagged)	Arms imports (lagged)	Arms imports (lagged)
	Arms imports*Policy	Arms imports*Policy	Arms imports*Policy
	Egypt dummy	Egypt dummy	Egypt dummy
	Central America dummy	Central America dummy	Central America dummy
	Franco-Zone dummy	Franco-Zone dummy	Franco-Zone dummy

*Notes: Since the robustness checks in this section (section 3) maintain the original specification, then all the 2SLS results presented in the section uses the instruments listed in this table. In subsequent sections when specifications and instruments used may change, such changes will be stated accordingly. * DK Sample refers to the reconstructed sample used in this study.*

Table 3.C.4: List of countries in ELR and DK full sample

Easterly, Roodman and Levine (2003)			DK full sample			
Low income countries		Middle income countries	Low income countries		Middle income countries	
Algeria	Myanmar*	Argentina	Algeria	Mauritania	Argentina	Panama
Botswana	Nicaragua	Brazil	Bangladesh	Morocco	Barbedos	Peru
Bolivia	Niger	Chile	Benin	Myanmar	Botswana***	Phillipines
Burkina Faso	Nigeria	Colombia	Bolivia	Nepal	Brazil	South Africa
Cameroon	Pakistan	Costa Rica	Burkina Faso	Nicaragua**	Chile	Swaziland
Congo, Dem. Rep.	Papua New Guinea*	Gabon	Burundi	Niger	Columbia	Trinidad and Tobago
Congo, Rep.*	Paraguay	Guatemala	Cameroon	Nigeria	Costa Rica	Turkey
Cote d'Ivoire	Philippines	Jamaica	Chad	Pakistan	Dominican Republic	Uruguay
Dominican Republic	Rwanda	Jordan*	Congo, Dem Rep	Papua New Guinea	Ecuador	Venezuela
Egypt	Sri Lanka	Malaysia	Congo, Rep	Paraguay	Egypt***	
El Salvador	Senegal	Mexico	Cote d'Ivore	Rwanda	El Salvador	
Ethiopia	Sierra Leone	Peru	Ethiopia	Senegal	Fiji	
Gambia, The	Somalia	South Africa*	Gambia, The	Sierra Leone	Gabon	
Ghana	Tanzania	Syrian Arab Republic	Ghana	Somalia	Guatemala	
Guyana	Thailand	Trinidad and Tobago	Guinea Bissau	Sri Lanka	Honduras***	
Haiti	Togo	Turkey	Guyana	Sudan	Hungary	
Honduras	Tunisia	Uruguay	Haiti	Syria	Indonesia***	
India	Uganda*	Venezuela	India	Tanzania	Iran	
Indonesia	Zambia		Kenya	Thailand	Jamaica	
Kenya	Zimbabwe		Lesotho	Togo	Jordan	
Korea, Rep.			Liberia**	Tunisia	Korea, Rep.	
Malawi			Madagascar	Uganda	Malaysia	
Mali			Malawi	Zambia	Mauritius	
Morocco			Mali	Zimbabwe	Mexico	

Notes: As classified in BD, middle income countries are those that, in 1970, had real per capita GDP of greater than $1900 (at constant 1985 prices). Countries that were not included in BD ** Countries that had real per capita GDP greater than $1900 in 1970, but are not classified as middle income because their per capita income level shrank below $1900 by 1982 *** Countries with 1970 real per capita GDP less than $1900 but are classified as middle income countries because the levels significantly increased to greater than $1900 by 1982.*

Table 3.C.5: 2SLS regressions for growth of real GDP per capita, using alternative samples

		All developing countires		Low income countries	
		OLS	2SLS	OLS	2SLS
Easterly et al data (62 countries, 1970 - 97)	Aid	0.1961	-0.4943	0.2218	-0.1603
		(0.2620)	(0.5287)	(0.2851)	(0.5890)
	Aid*Policy	-0.1494	0.0115	-0.2036	-0.2023
		(0.1373)	(0.2124)	(0.1617)	(0.3005)
	Observations	345	345	236	236
Easterly et al data, Burnside and Dollar countries (1970 - 97)	Aid	0.1494	0.1568	0.1247	0.1247
		(0.1498)	(0.1522)	(0.2273)	(0.2273)
	Aid*Policy	0.3016	0.3763	0.4011*	0.4721
		(0.2112)	(0.2348)	(0.2219)	(0.5123)
	Observations	310	310	207	207
Easterly et al data, middle-income countries only (1970 - 1997)*	Aid	1.4136	1.3162		
		(1.3956)	(1.7925)		
	Aid*Policy	0.5129	0.3424*		
		(0.6940)	(0.2192)		
	Observations	92	92		
DK data, Easterly et al sample extended by adding only low income countries (1970 - 1997)	Aid	-0.0022	-0.0197	-0.036	-0.048
		(0.1270)	(0.2624)	(0.1555)	(0.2376)
	Aid*Policy	-0.1242	-0.102	-0.1404	-0.1075
		(0.0868)	(0.1012)	(0.0905)	(0.1134)
	Observations	108	108	268	268
DK data, Easterly et al sample extende d by adding only middle income countries (1970 - 1997)	Aid	0.052	0.1573*	-0.0034	-0.1248
		(0.1028)	(0.0930)	(0.1256)	(0.2503)
	Aid*Policy	0.2814*	0.3366**	-0.1446*	-0.1259
		(0.1547)	(0.1365)	(0.0808)	(0.1064)
	Observations	416	416	177	177
DK data, low-income countries only (1970 - 2013)	Aid			-0.0833	-0.0142
				(0.2622)	(0.1256)
	Aid*Policy			-0.1099	-0.2646
				(0.0997)	(0.3541)
	Observations			298	297
DK Data, middle-income countries only (1970 - 2013)	Aid	0.8871***	0.6017**		
		(0.2639)	(0.3353)		
	Aid*Policy	0.2971*	0.3732**		
		(0.1513)	(0.1255)		
	Observations	231	228		

*Notes: Results from the preferred specification using alternative samples. DK data refers to the dataset that has been reconstructed for this study. Robust standard errors in parentheses, ***p<0.01, ** p<0.05, * p<0.1*

Table 3.C.6: List of countries and years of crisis

Country	Year	Country	Year
Africa		**Americas**	
Algeria	1991	Argentina	1982, 1989, 2002 - 2005, 2013
Cameroon	2004	Bolivia	1980, 1986, 1989
Congo (DR)	1979	Brazil	1983, 1986 - 1987, 1990
Cote d'Ivoire	1983, 2000	Chile	1972, 1974, 1983
Egypt	1984	Costa Rica	1981, 1983, 1984
Gabon	1995 - 2000	Dominican Republic	1975 - 2001, 2005
Ghana	1979, 1982	Ecuador	1982, 1984, 2000, 2008
Kenya	1994, 2000	El Salvador	1981 - 1996
Liberia	1989 - 2006	Guetemala	1989
Madagascar	2002	Guyana	1982
Morocco	1983, 1994, 2000	Honduras	1981
Nigeria	1982, 1986, 1992, 2001, 2004	Jamaica	1978
Rwanda	1995	Mexico	1982, 1983, 1987
Sierra Leone	1997 - 1998	Nicaragua	1979
South Africa	1985, 1989, 1993	Panama	1983, 1987 - 1989
Sudan	1991	Paraguay	1986 2003
Tunisia	1986	Peru	1970, 1976, 1978
Zimbabwe	2000, 2006	Trinidad and Tobago	1989
		Uruguay	1983, 1987, 1990
Asia		Venezuela	1982, 1990, 1995 - 1997 - 2004
Iran	1992		
Jordan	1989	**Europe**	
Myanmar	1984, 1987, 2002	Turkey	1978, 1982
Phillipines	1983		
Sri Lanka	1980, 1982, 1996		
Thailand	1997		

Chapter 4

Shedding Light on Aid in Malawi: An Analysis of the Effects of Aid on Growth Using Evidence from Malawi*

Abstract

This chapter examines the impact of foreign aid flows on the growth of average nighttime light density at the district-level in Malawi. We use geo-coded data for aid funded projects in Malawi covering 28 administrative districts for the period 1999-2013 period. To isolate the causal effects of aid, the identification strategy employed exploits two exogenous determinants of within-country aid allocation. The first is ethnic affinity of a district with the current President and the second is the portion of Parliamentarians in a district that are susceptible into induced political defections from a political party with which they won the Parliamentary seat to join the ruling President's party. Using these instruments, alone or together, we identify a robust and quantitatively significant role for aid flows in causing higher growth in light density. We find a hump-shaped growth response over the course of three years. Bilateral aid appears to be better in causing growth than multilateral aid while grants have more impact than loans.

*An edited version of this Chapter is presented in Khomba, Daniel C. and Alex Trew 2016, *'Aid and Growth in Malawi'*, University of St Andrews School of Economics and Finance, Discussion Paper number 1612

4.1 Introduction

Large sums of development assistance continue to flow to less developed countries from international development institutions, regional bodies and individual country agencies; between 2000 and 2014, net ODA of about US$1.2 trillion was disbursed by donor countries, of which US$528.7 billion went to the Least Developed Countries (LDCs).[1] Despite this, there is still scant clear evidence to support the hypothesis that development assistance stimulates economic growth.[2]

The persistence of inconclusive evidence of aid's causal effect on sustainable economic growth has often been attributed to methodological weaknesses in assessing the aid-growth relationship. In the previous chapter, we discussed some of the challenges, particularly with regards to empirical cross-country studies commonly used in the existing literature.

Since the allocation of aid may be related to the growth rate of the recipient country, it is necessary to isolate exogenous variation in aid to establish a causal connection. Identification problems continue to plague our understanding of the role of aid in causing growth, leaving the debate largely unresolved. The standard approach to addressing endogeneity in growth regressions is the instrumental variable approach however, as already discussed in Chapter 3, identifying strong instruments has proved to be a challenging task.

A recent contribution by Galiani et al. (forthcoming) develops a country-level instrument for aid allocation across recipient countries based on the crossing of International Development Association's (IDA) threshold for receiving concessional aid. They argue that other donors tend to reinforce this threshold so that aid inflows in general decline three years after the income threshold.[3] The study finds an economically and statistically significant role for aid in causing economic growth.

Though Galiani et al. (forthcoming) rely on plausibly excludable variables, they do not vary below the recipient-country level. The implicit assumption, inherent in cross-country

[1]Data reported in constant 2014 prices and obtained from OECD's Development Co-operation report 2015.

[2]See for example Boone (1996), Rajan and Subramanian (2008), Doucouliagos and Paldam (2009), Dalgaard and Hansen (2010) and Dreher and Lohmann (2015).

[3]Dreher et al. (2013) argue that a potential problem with Galiani et al. (forthcoming) instrument is that it may arguably be correlated with growth since a countries rate of growth of incomes may be influenced by other factors other than aid at the time of crossing the IDA's threshold which may not be controlled for.

approach, is that once the recipient country receives foreign aid it efficiently allocates the aid resources to ventures that increase per capita output. Aid is not uniformly distributed within a country, however. It is well established in the literature that often times recipient countries do not allocate foreign aid receipts optimally to raise per capita incomes.[4] The internal allocation of received transfers by the recipient government has a direct influence on the effectiveness of foreign aid. Cross-country approach to analysing aid effectiveness ignores this key aspect. Given the importance of urbanization and industrialization to growth, it could be informative to examine the disaggregated aid disbursement pattern and the spatially proximate consequences for growth.

To address challenges associated with the cross-country approach to examining the effects of aid we conduct a more comprehensive single country analysis, focusing on evidence from the Republic of Malawi. Dreher and Lohmann (2015) argue that a possible reason behind the lack of robustness in the existing empirical literature may be its focus on country-level rather than regional-level changes in incomes. They purport that while development assistance may increase per capita incomes of its beneficiaries in a targeted region, such changes may not be sufficient enough to be measurable at the national level. Therefore, while foreign aid's impact on aggregate incomes may be hard to capture systematically at the country level, they could be more readily discernible at a disaggregated level.

As alluded to earlier, unlike cross-country studies, sub-national level analysis allows the researcher to account for internal allocation of aid resources. For example, a country may have a lack of education infrastructure in general but the level of need will vary across different subnational regions. Maximising the impact of aid implies that most aid be allocated to the regions with the greatest need; if aid funded education infrastructure is allocated based on political or ethnic considerations, then some regions may be allocated disproportionate projects when they do not have the most need. Dionne and Dulani (2013) suggest that it is altogether possible that a country will receive a lot of aid funded projects and yet its impact may not be seen at the national level outcomes related to such projects, even if measurable outputs (i.e. number of classrooms, number of teacher's houses) increases. Subnational allocation based on factors other than need may hence be

[4]Temple and van de Sijpe (2015) suggest that foreign aid often translates into higher consumption rather than investment while Deaton (2013) and Temple et al. (2015) argue that aid is unlikely to change the recipient country's aggregate investment rate.

another reason why previous studies have found little impact of foreign aid.

Single country sub-national level analysis of growth determinants has for a long time been hampered by a number of bottlenecks: firstly, the standard outcome measure for effects of aid in the literature is per capita GDP (or GNI), which is difficult to measure at sub-national level. Secondly, a similar problem arises when one considers measures of sub-national allocation of aid. Official development assistance, the traditional measure of aid, is also better recorded at country level rather than at sub-national level.

This study makes use of two key datasets made available in recent years that enable comprehensive analysis of the effects of aid below the national level: the first is nighttime light data which is used to proxy economic activity. There is growing literature that suggests nighttime light images as a proxy for output growth and welfare and correlate well with other GDP based measures of economic growth that are commonly used in empirical growth accounting exercises[5]. The second set of data is on sub-national allocation of foreign aid projects which comes from Malawi's Aid Management Platform (AMP).[6]

To establish the causal effects of aid in Malawi, the study develops a novel instrumental variable strategy which exploits the Presidential powers to influence the disbursement of aid through the Malawi development budget. The first instrument is *ethnic affinity* which is measured as the proportion of a district's population that is co-ethnic with the ruling President. The second instrument is *political switching* measured as the proportion of Members of Parliament (MPs) in a district that defect from the party with which they won their Parliamentary seat to join the party of the ruling President. Unlike the measures in the existing literature, the two instruments employed in this study vary considerably over the sampled time period (along with political shifts in Malawi); they make for powerful and plausibly excludable instruments. Our use of these instruments is related to recent work on political favoritism. Hodler and Raschky (2014) document the existence of regional favoritism in 126 countries through a leader's birthplace. They find a positive interaction between aid and birthplace which they interpret as aid exacerbating the extent of favouritism.

[5]See Henderson et al. (2012) Michalopoulos and Papaioannou (2013), Lowe (2014) and Storeygard (2014).

[6]Detailed description of the data and its sources will follow in subsequent sections of the chapter.

Using each of these instruments, and both combined, we find economically and statistically significant evidence on the effectiveness of aid in causing growth (as proxied by the log change in nighttime light intensity) The growth impact of aid is quantitatively significant and robust to a number of controls. We show that the effect on growth is hump-shaped (with a peak at a lag of one year). Aid for agriculture and education projects is the most beneficial while multilateral aid appears to be less effective than bilateral aid.

An analysis of political and ethnic favoritism in resource allocation at the local level is conceptually appealing particularly in the context of African states, where political identification and ethnicity are strong factors in governance. A growing literature following Alesina and Dollar (2000) has found a role for political influence in both the distribution of aid and in diminishing its effectiveness in generating development[7]. Additionally, ethnic considerations is another important driver for allocation of foreign aid, particularly in Africa. As noted by Francois et al. (2015), ethnicity is the cornerstone of political organization in sub-Saharan Africa; Posner (2005*b*), Wrong (2009),Francois et al. (2015) and Hodler and Raschky (2014) are just but a few of the studies that find evidence of ethnically determined allocation of resources (including development aid) to regions that are ethnic origins for political leaders.

Before proceeding, it is worth sparing a moment to address a few issues pertaining to the use of favouritism, both politically and ethnically, to instrument for aid. The first relates to how the instruments are attached more to aid and not other discretionary expenditures which may also affect economic growth. That is, in many countries the aid budget is only a small portion of the total discretionary budget being influenced by the political elite. Favoritism may thus capture the allocation of non-aid spending and bias the measured effect of aid on growth. The critical feature here is that aid should comprise the largest proportion of the government's investment expenditures (through the development budget). The second issue concerns exogeneity of the identification strategy proposed in this study. For instance, regions that vote for a particular leader may do so with the expectation of returns – co-ethnic support for a President may be on the back of explicit campaign promises of post-election investment. The final problem regards the most commonly used measure for ethnic favouritism in the literature, namely birthplace

[7]See Minoiu and Reddy (2010), Heady (2008), Jablonski (2014) and Dunning (2004)

of the incumbent leader. Using this measure alone limits the spatial and time variation of the possible instrument in countries where Presidents can remain incumbent for extended periods.

4.1.1 Why Malawi?

A number of features of Malawi over the period 1999–2013 help us address these concerns. First, aid comprises a substantial portion of the budget controlled by the President. Over our period of study, aid is 73% of development expenditures in Malawi (data from Ministry of Finance's Annual Financial Statements). Other than the development budget, the bulk of other departmental budgets comprise recurrent expenses which are office running expenses including salaries and wages, interest payments on public debt, procurement of goods and services, payment of pensions and gratuities etc. There is limited scope for the president to exert discretion on the allocation of these budgets across districts; the allocation of transfers to districts is determined by the National Local Government Finance Committee (NLGFC) - a quasi-governmental institution mandated with effective mobilization, equitable distribution and efficient utilisation of financial resources in local councils). Second, we show that votes in Malawian elections are not historically along ethnic lines. Third, the political environment over our study period is particularly volatile with three different Presidents and three different ruling parties. As a result, we have substantial variation over time in both of our instruments.

Additionally, to allay any concerns about external validity, it is worth mentioning some documented country examples that show the instrumentation strategy employed in this study is not only valid in Malawi, but in other countries as well, particularly in the Sub Saharan Africa (SSA) region. Wrong (2009) documents on ethnic favoritism in Kenya from 1978 to 2002 under President Daniel Arap Moi and from 2003 to 2013 under President Mwai Kibaki. Between 1978 and 2002, the Rift Valley Province and surrounding areas of the Kalenjin ethnic group, Moi's ancestral origin, received disproportionate amounts of aid while Government positions were also dominated by people from the same ethnicity. When Mwai Kibaki of the Kikuyu ethnic group took over in 2003, he appointed a Kikuyu dominated government and the areas around Kiambu region where the Kikuyu people are settled enjoyed ethnic and regional favoritism, receiving large scale foreign aid and

other public resources. Posner (2005*b*) suggest that there is evidence that Presidents in Zambia direct donor aid or relief food to their ancestral regions and appoint members of his ethnic group into key government positions; President Fredrick Chiluba channeling more aid to Kitwe region while Levi Mwanawasa to Mfulira region. Jablonski (2014) documents evidence of development aid being allocated to politically strategic regions to influence votes.

4.1.2 Related Literature and contribution

There is an important gap in the aid effectiveness literature - the lack of empirical macroeconomic evidence at the sub-national level; many times this gap has been attributed to the dearth of available macroeconomic data at that level as well as methodological challenges in establishing causal effects of aid at the local level (Dreher and Lohmann (2015)). However, increasing data availability in recent years at sub-national level have made such studies possible. In particular, AidData's and selected recipient countries' geo-coding of aid funded projects as well as the growing popularity of nighttime light data being used as proxy for macroeconomic measures of economic activity at the local level have presented an opportunity for further research of the aid-growth link. Still, with the exception of Dreher and Lohmann (2015) who analyse the impact of World Bank projects across various sub-national levels in 130 countries, as well as Rajlakshm and Becker (2013) and Dionne et al. (2013) who both focus on evidence from Malawi, there is gap which this study intends to help fill.

The main contribution of the study in this chapter is related to the existing body of literature on aid effectiveness. Cross-country studies have used instruments such as population size (Burnside and Dollar (2000); Rajan and Subramanian (2008)), geographic factors (Dalgaard et al. (2004) or bilateral relationships (Bjornskov (2013)). However, these approaches suffer from possibly direct effects on growth (see Bazzi and Clemens (2013); Dreher et al. (2013)). Temple and van de Sijpe (2015) studies the consequences of aid for macroeconomic ratios. They find that aid increases consumption and has an impact on investment with a lag. Galiani et al. (forthcoming) uses a convincingly excludable instrument and identifies a sizeable impact of aid on real per capita growth.

Dreher and Lohmann (2015) recently made efforts to examine the aid-growth relationship

at the regional level. They use light intensity data as well as geo-coded data for World Bank funded projects covering 478 first-level administrative regions (regions that are governmental units directly below the state) and 8400 second-level administrative regions (regions that are directly below the first level) in 130 countries over the 2000-2011 period. Their main identification strategy[8] interacts the Galiani et al. (forthcoming) instrument and Nunn and Qian (2014) strategy that uses a region's probability to receive aid. Their results failed to find any significant causal effect on regional growth of average nighttime light for estimation using their full sample. However, when they classify their countries according to continents and income-status (results reported in table 6 of their paper), they find a significant positive effect of total aid on growth for Sub-Saharan Africa (SSA) and Least-developed countries (LDCs).

Few studies have adopted a within-country approach to study the effect of aid in Malawi; however, these studies focus on aid's impact on sector level outcomes rather than aggregate economic growth. Rajlakshm and Becker (2013) investigates the allocation and effectiveness of geo-coded aid projects from 30 agencies in Malawi over the 2004-2011 period. Their focus is on aid to the health sector, water and sanitation sector and the education sector; they investigate the effect of sectoral aid to sector level outcomes for each of the three sectors (disease severity for health, diarrhea incidence for water and primary school enrollment for education). They find that aid reduces disease severity, incidence of diarrhea and increases school enrollment.

Another study focusing on aid in Malawi is conducted by Dionne et al. (2013) who also use co-ethnicity with the ruling president to understand the allocation of aid across Malawian districts. Their results found limited impact of aid in infant survival and primary school attendance.

Our study is also related to the literature on the ethnic and political distribution of resources in African countries. Following Alesina and Dollar (2000), a growing literature has found a role for political influence in the distribution of aid (see, for example Jablonski (2014), Dunning (2004), Heady (2008), and Wright (2010)). Another blossoming strand of aid literature finds that ethnicity plays a crucial role in the distribution of resources

[8]They also conduct the analysis withBrückner (2013) strategy that instrument aid with rainfall and international commodity price shocks.

(including development aid) in Africa. Studies such as Posner (2005*b*), Wrong (2009), Francois et al. (2015) and Hodler and Raschky (2014) find evidence for the importance of ethnicity in both the distribution of aid and in diminishing its effectiveness in generating development

The study in this chapter builds on the insights from these studies and applies them to the particular context of Malawi to motivate the instruments used here to isolate the causal effects of of foreign aid on economic growth, which is proxied by the log change in nighttime light density at the district level (average light intensity per square kilometer).

Lastly, the study is also related to a voluminous literature that assesses the link between aid resources, corruption and economic growth. Studies such as those by Svensson (2000), Alesina and Weder (2002),and Blackburn and Forgues-Puccio (2011), among many others, have found that corruption compromises the impact of aid and hence impedes economic growth. This paper hypothesises that since legal and oversight institutions are systematically weakened to allow for easy consolidation of powers through (mis)allocation of resources, it inevitably creates an environment where corruption thrives.

The rest of this chapter is organized as follows. We discuss Malawi's background and context in Section 4.2. In Section 4.3 we introduce the data and develop our empirical strategy in section 4.4. Section 4.5 presents our main results while section 4.6 offers some robustness checks. Section 4.7 considers the effect of aid by project and funding type as well as investigating the dynamic effects of aid. Finally, Section 4.8 offers some concluding remarks.

4.2 Background and Context

Malawi is a landlocked country located in South Eastern Africa with population estimated at 17.2 million in 2015 (up from 3.6 million in 1960). With limited natural resources, about 85% of the population lives in rural areas and relies on small-scale subsistence farming on maize, the country's staple food, making it amongst the poorest countries in the world. The 2015 United Nations Human Development Index (HDI) ranked Malawi 173 out of 186.

Malawi has historically suffered from extreme poverty, poor health and volatile economic growth. Nearly half (47.8%) of Malawian children under five years of age are malnourished according to stunting data.[9] About 70.9% of the population live below the $1.90/day (2011 PPP) international poverty line[10]. The World Bank/International Monetary Fund (IMF) 2014 Global Monitoring Report postulates that if per capita consumption in every country in the World grew by 4%, coupled with unchanged income distribution in each country, global poverty would reduce to 3% by 2030, but Malawi is one of only six countries that would still have poverty rates of over 30% of the population[11].

4.2.1 Malawi's economic performance

Malawi is predominantly an agrarian economy; the agriculture sector accounts for about 30% of GDP, employs over 80% of the labour force, and represents about 85% of all exports – the major export crop being tobacco, which accounts for about 53% of all export revenues (World Bank Country Review, 2013). Table 4.2.1 shows a summary of some socio economic indicators for Malawi. The agricultural sector comprises two main sub sectors – smallholder sub sector which contributes about more than 70% of agricultural yield and the estates sub sector contributing less than 30%. The smallholder sector is predominantly engaged in maize (main staple food) production for subsistence purposes on small pieces of customary land holdings.

Since attaining independence in 1964, the Malawian economy has been dominated by a centralised State-regulated economic system in which economic growth patterns are influenced mainly by activities financed by the State. This is largely because the private sector has been underdeveloped, particularly in the early years (1964-1980) when the private sector was almost non-existent. As a result, the Government took up development planning and its involvement has since remained critical in the economy to date.

With limited natural resource endowment for the economy to rely on, it is hardly sur-

[9]Which is high even when compared to other developing countries in Sub-Saharan Africa (39.9%), and low income countries around the world.

[10]Comparative indicators from World Bank data (2014) (`http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators`) and the UNDP's Human Development Index (2015) (`http://hdr.undp.org/en/countries/profiles/MWI`, `http://data.worldbank.org/indicator/SH.STA.STNT.ZS?locations=MW`) .

[11]The other five countries are Burundi, the Democratic Republic of Congo (DRC), Haiti, Madagascar and Zambia.

Table 4.2.1: Selected socio-economic indicators for Malawi (1970-2015)

		1970	1980	1990	2000	2010	2015
Population	Population ('000)	4,603.74	6,163.23	9,409.00	11,193.23	14,769.82	17,215.23
	Population growth (annual %)	2.63	2.91	3.64	2.81	3.03	3.07
	Rural population (% of total population)	93.95	90.95	88.44	85.39	84.46	83.73
Economy	GDP per capita growth (annual %)	-2.12	-2.47	1.92	-1.24	3.68	-0.16
	Inflation, consumer prices (annual %)			11.82	29.58	7.41	21.25
	Agriculture, value added (% of GDP)	43.97	43.73	45.00	39.54	31.92	29.30
	Industry, value added (% of GDP)	17.46	22.54	28.89	17.92	16.40	16.15
	Services, etc., value added (% of GDP)	38.56	33.72	26.11	42.54	51.68	54.55
Trade	Imports of goods and services (% of GDP)	39.16	38.80	33.42	35.33	34.86	33.83
	Exports of goods and services (% of GDP)	24.25	24.84	23.78	25.60	22.79	28.11
Health	Life expectancy at birth, total (years)	40.51	44.74	43.77	44.08	56.84	
	Mortality rate, infant (per 1,000 live births)	207.70	151.80	142.50	103.50	57.50	43.40
	Mortality rate, under-5 (per 1,000 live births)	347.00	256.70	242.40	174.40	90.90	64.00
	Prevalence of HIV, total (% of population ages 15-49)			8.80	16.60	11.70	
Education	Gross enrollment ratio, primary (%)		63.36	73.12	135.97*	136.75*	
	Gross enrolment ratio, secondary (%)		15.53	16.10	30.22	33.06	
	Gross enrolment ratio, tertiary (%)		0.47	0.53	0.33	0.69	

Notes: Data from World Bank Data (http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators#), Malawi National Statistical Office (NSO) reports and UNESCO Institute for Statistics (http://data.uis.unesco.org/Index.aspx?DataSetCode=EDULIT_DS&popupcustomise=true&lang=en).
** The gross enrollment ratio can be greater than 100% as a result of grade repetition and entry at ages younger or older than the typical age at that grade level.*

prising that the agriculture sector has been central in development planning in post-independence Malawi, driven primarily by the availability of abundant fertile land[12] and cheap labour.

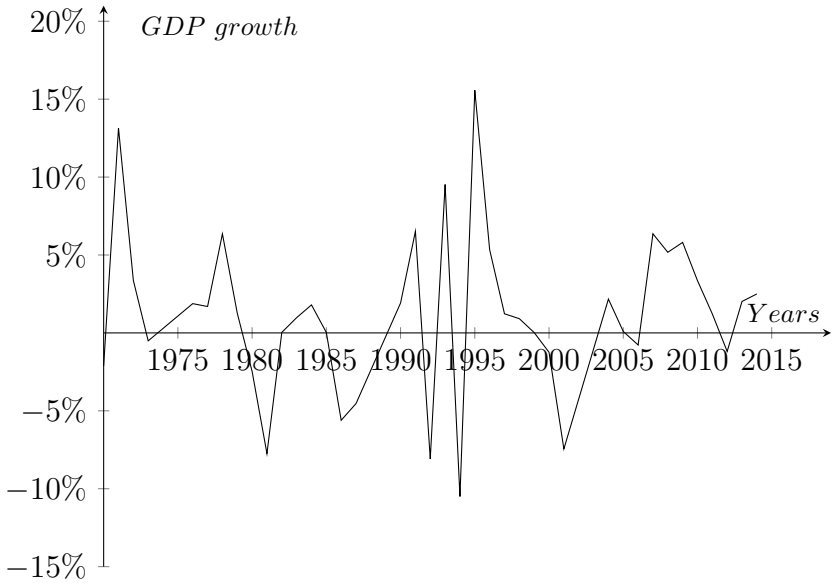
Chirwa and Odhiambo (2016) suggest that inconsistencies in the implementation of economic policies and reforms in Malawi have played a critical part in influencing the growth performance of the Malawian economy. Figure (4.A.3), adopted from Chirwa and Odhiambo (2016), provides an overview of development policies and reforms implemented in Malawi between 1970 - 2011. Figure 4.2.1 below shows growth of GDP per capita since independence:

Between 1964 and 1974, export led growth through commercialised estate farming[13]. The country experienced broad economic stability with sustained rapid real GDP growth averaging about 7%, low and stable inflation as well as stable interest rates. However, the dual agricultural policy propagated unequal distribution of land and incomes and

[12]At least between 1970-1999, land was still an abundant resource. In recent years, rapid population growth has exerted a lot of pressure on arable land. At the same time, due to over-use and poor farming methods, its fertility has diminished over time making it less productive, as a result agricultural performance has also been declining in recent years

[13]A dualistic agriculture policy was implemented in which the commercialised estate sector produced tobacco (main cash crop), coffee, sugarcanes and tea for export while low inputs and low productivity smallholder sector produced maize for food and provided cheap source of labour for the commercial farms (Devereux (2002))

Figure 4.2.1: Trend of Malawi's per capita GDP (1970 – 2010)



hence was unsustainable in the long run. Furthermore, in the late 1970s, a number of problems hit the Malawi economy which threatened the sustainability of the economy's performance including oil shocks that hit the global economy in 1974 and 1979, falling global commodity prices, and rising government budget deficit[14]

By 1981, the Malawi economy was in a recession with real GDP growth rate estimated at about -5.2%. To address the economic slump, with advice and support from the World Bank and the IMF, the Malawi Government undertook stabilisation programmes (SPs) under structural adjustments programmes (SAPs) in the 1980s. These involved public policy reforms[15] aimed at restructuring the economy to lay a basis for sustainable long term economic growth and development and restore the economy's external equilibrium. The reforms managed to stabilise the economy with real GDP growth averaging about 3.1% between 1980-84 and 1986-90[16].

[14]Other significant factors during the late 70s included escalation of civil war in Mozambique which blocked access to the ports of Nacala and Beira for Malawi's imports (and exports) increasing transport costs and hence exerting further inflationary pressure on Malawi; price controls by the State led to price inflexibility resulting in inefficiencies in production; and narrow export base due to state-imposed crop diversification restrictions. (Kydd and Christiansen (1982)).

[15]Major reforms included in SAPs involved export diversification, reform of parastatals, liberalization of prices controlled by Ministry of Trade and Industry, tax reforms (Chirwa and Muhome-Matita (2011)), relaxation of import controls, liberalisation of smallholder agricultural produce marketing and the production of cash crops by smallholder farmers particularly burley tobacco and privatisation of state owned enterprises as Government continued to limit its intervention in the market economy (Chirwa (2003)).

[16]The economy was still susceptible to external shocks, and during the recovery period the economy suffered major setbacks including the surge in the war that had erupted between Malawi and Mozambique in 1984 resulting in the complete closure of access to Nacala and Beira and another nose – dive in terms of trade that drove the dollar value of exports down by over 20% (World Bank Report, 1984).

In the early 1990s, political instability, major drought in 1992 and 1994 and increasing import costs that shot through to the consumer price index (CPI) led to a reversal of the trend in output growth; real GDP growth rate was estimated at -7.3% in 1992 and -10.2% in 1994 while inflation peaked at 83% in 1995. During the late 1990s, political stability was restored and most importantly the economy had fully liberalized[17] Between 1996 and 1999 the economy grew steadily, averaging about 7% real GDP growth.

The roller-coaster trend in growth continued into the 21st century; performance in the early 2000s was adversely affected by huge fiscal deficits, domestic borrowing (led to interest rate rising to as high as 54% in 2000) crowding out private investment, spread of HIV/AIDS exerting pressure on public resources and poorly planned structural transformation as the economy attempted to diversify away from over-reliance on agriculture which only resulted in low agriculture yield. By 2002, the economy was on the edge of an abyss, GDP growth rate was estimated to be around -4.9%.

Between 2004-2009 the government exhibited sincere efforts to improve governance and economic management and received substantial financial support from development partners[18]. The significant boost in government's fiscal position allowed the government to initiate a lot of public investment particularly transport infrastructure and agriculture market structures (Malawi Budget Statement (2010)). The economy managed to stabilize; inflation reduced significantly, annual CPI estimated at 11.4% in 2005 and averaged about 8.1% between 2007 and 2009; GDP growth rates averaged 7.8% between 2005 and 2009 (*2010 Financial Statement by Malawi Ministry of Finance*).

From 2010, Malawi's economic performance begun to regress; governance issues[19] led to temporary freeze of all direct budget support in 2010. The ceasure of inflows of aid, coupled with declining tobacco exports due to deteriorating terms of trade as a result of falling international prices plunged the economy into a critical forex crisis for long periods between 2010 and 2012. For an economy that heavily relies on imports, the forex shortage

[17]Financial sector programme allowed for entry of new private banking institutions while the central bank, the Reserve Bank of Malawi (RBM), was given more autonomy in formulation of monetary policy and supervision of the financial sector

[18]Staff Monitored Programme (2004); the extended Poverty Reduction and Growth Facility (2005); the Highly Indebted Poor Countries (HIPC) completion stage (2006) - under the HIPC and Multilateral Debt Relief Initiatives (MDRI) almost all of Malawi's external debt was cancelled; and the Exogenous Shock Facility (2008)

[19]Characterized by abuse of civil rights, increasing corruption and disregard for the rule of law

had serious ramifications; the government was unable to import basic necessities including medical supplies and fuel; real output growth reduced from 9% in 2010 to 1.4% in 2011.

Other than the aggregate economic picture described above, Malawi's post-independence trajectory had resulted into more profound structural challenges:

- Rapid population growth in general and increasing rural population density in particular leading to declining freehold customary land holdings for smallholder farming: Over the 50 years after independence, Malawi's overall population has more than quadrupled, rising from close to 3.96 million people in 1964 to over 17.22 million in 2015. At the same time, the rural population had grown on average by about 3.1%, severely limiting the land base within Malawi. (Booth et al. (2006)).
- Rapid environmental degradation: With arable land under so much pressure, encroachment into other land that is not suitable for farming increased significantly and rampant deforestation ensued as people sought more land. It is estimated that between 1972 and 1990, Malawi's forest cover declined by 41%, and has been reducing on average by 2.8% annually (Booth et al. (2006)).
- Lack of productivity enhancing measures: Agricultural research and extension services collapsed in the mid 1990s leaving rural farmers with little information and knowledge on modern methods of enhancing productivity. Irrigation is almost nonexistent while access to credit and investment, required for more sophisticated farm machinery and management techniques necessary to circumvent the environmental challenges, is highly politicized and very limited.

Role of aid in Malawi's economic performance

Malawi's economic performance, like most Sub-Saharan African countries, has historically been highly vulnerable to severe weather conditions, fluctuating terms of trade, very narrow exports base (concentrated in few primary commodities, mainly tobacco) and weak regional connectivity and trade facilitation.

Nevertheless, while the exogenous economic shocks as well as geopolitical events have often contributed significantly to the deterioration of living standards in Malawi, they

have only made worse a process of economic decline already deeply rooted in domestic problems. Structural challenges continue to plague the country including inadequate energy and water supplies, narrow access to finance, a largely unskilled labour force, high income inequality, high transportation costs.

The Government sector has played a significant hand in Malawi's economic performance. Adoption of unsustainable agricultural policies, destructive State-intervention in the market economy; inefficient, wasteful and unsystematic public investments as well as weaknesses in the management of public finances, leading to massive budget deficits, have compounded to the country's economic vulnerabilities.

Chirwa and Odhiambo (2015) conduct a detailed analysis of the development policies adopted by the Malawi Government and how that affected various stages of Malawi's economic performance since 1970. In their study they examine the various development plans and reforms and identify the key drivers for growth. The main factors identified include accumulation of physical capital (in key sectors such as agriculture, transport, education and health); development of human capital; international trade; inflation and the real exchange rate.

So, what then has been the role for aid in influencing these key drivers for economic performance in Malawi? Foreign development assistance has been important to post-independence Malawi for a number of reasons:

Source of State revenues:
Given the low tax base, and the susceptibility to domestic supply and external demand shocks, Malawi government constantly struggles to raise sufficient domestic revenues to adequately finance required levels of public goods/services and finance investment. Foreign aid fills a critical gap in government fiscal framework and hence presents an additional source of revenue. Table 4.2.2 presents a brief summary of Malawi government fiscal performance between 2000 and 2013.

As shown, development assistance has contributed on average 40% of the government revenue over the last decade. Further, foreign aid constitutes most of the resources categorized as development expenditures in Malawi, averaging about 70% during the same period.

Table 4.2.2: Brief summary of government fiscal performance (in million Malawi Kwacha)

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Total Budget	23,041	40,320	44,027	45,262	56,545	91,887	128,705	139,209	183,884	251,356	267,151	307,695	300,094	480,593
Recurrent	14,505	29,134	33,042	32,824	41,108	68,379	95,849	91,396	115,289	193,499	195,390	222,643	229,899	376,990
Development	8,536	11,186	10,985	12,438	15,437	23,508	32,856	47,813	68,595	57,857	71,761	85,052	70,195	103,963
Source of funding	23,041	40,320	44,027	45,262	56,545	91,887	128,705	139,209	183,884	251,356	267,151	307,695	300,094	480,593
Donor contribution	16,058	13,172	10,645	20,928	38,218	30,352	60,215	57,449	71,829	88,381	92,082	84,334	44,991	175,765
Domestic revenues	6,103	20,442	22,606	22,144	18,014	53,676	67,682	78,451	103,093	135,731	171,135	212,574	242,476	296,625
Net Financing	880	6,706	10,776	2,190	313	7,859	808	3,309	8,962	27,244	3,934	10,787	12,627	8,203
Aid (% total budget)	**70%**	**33%**	**24%**	**46%**	**68%**	**33%**	**47%**	**41%**	**39%**	**35%**	**34%**	**27%**	**15%**	**37%**
Development Budget	8,536	11,186	10,985	12,437	15,437	23,508	32,856	47,813	68,595	57,857	71,761	85,052	70,195	103,963
Donor Funded	6,566	9,117	8,806	9,852	12,322	20,346	28,864	40,683	53,986	44,079	43,292	31,625	28,216	72,416
GoM Funded	1,970	2,069	2,179	2,585	3,115	3,162	3,992	7,130	14,609	13,778	28,469	53,427	41,979	31,547
Aid (% Dev budget)	**77%**	**82%**	**80%**	**79%**	**80%**	**87%**	**88%**	**85%**	**79%**	**76%**	**60%**	**37%**	**40%**	**70%**

Notes: Data sourced from Financial Statements prepared by the Ministry of Finance, and denominated in Malawi's local currency, Malawi Kwacha, (US$1 = MWK424.9 in 2014)

Note that the contribution of donor resources falls significantly in 2011 and 2012. This was a result of temporary withdrawal of most of development assistance to Malawi amid concerns of declining governance, human/civil rights and freedoms as well as escalating corruption and economic mismanagement of public resources.

Aid revenues help the Government in a number of ways: helps reduce fiscal deficits that help stabilise interest rates by reducing domestic borrowing. This improves private capital accumulation. Additionally, aid resources helps finance much needed public investments.

Accumulation of physical capital:

Despite major advances in growth theory[20], investment remains a key economic growth determinant. Malawi's economic growth performance since the 1970s has been driven by the accumulation of physical capital, through the rapid expansion of investments in key sectors of the economy, particularly transport, education, health and agriculture (Malawi Government (1998), Malawi Government (2006)).

By enabling government expand public investment, aid directly enhances physical capital accumulation; investment in social sector such as health and education fosters development in human capital, another key driver for growth identified by Chirwa and Odhiambo (2015).

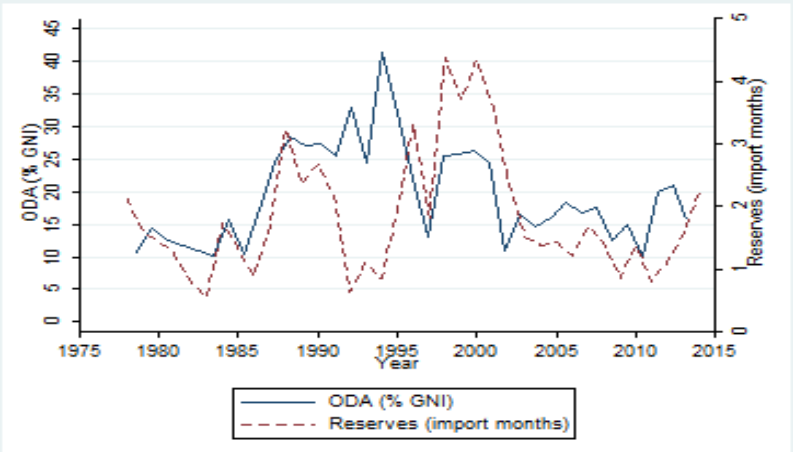
Source of foreign exchange:

Malawi economy has historically been dependent on imports which comprise on average 36% of GDP between 1960 and 2015; manufacturing goods form the largest component of imports, however other fundamental goods and services also make up a significant pro-

[20]We conduct detailed review of growth theory in section (2.1)

portion including food imports (average 15%) and fuel (average 11%).

Figure 4.2.2: Trends in net ODA (% of GNI) and total reserves (months of import)



Source: World Bank's World Development Indicators.

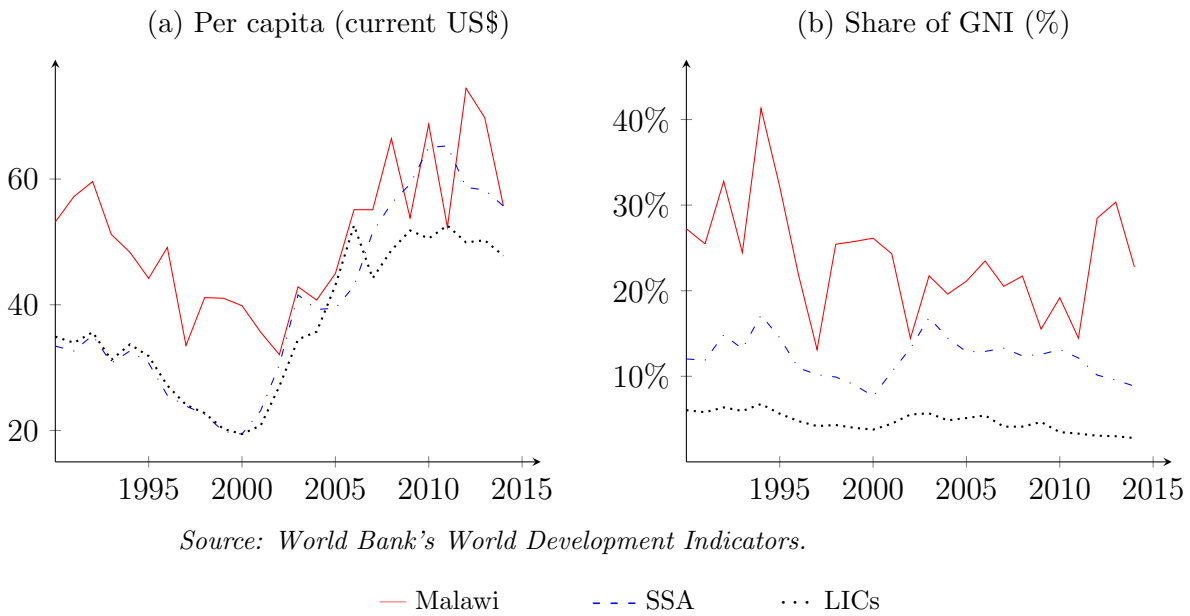
With near non-existent mining and an underdeveloped tourism industry, Malawi has a very narrow agro-based export base that is often vulnerable to weather shocks and deteriorating terms of trade for its key export goods (tobacco, tea and coffee). Generating adequate foreign exchange to meet ever-increasing import demand is a huge challenge. Since aid is often given in form of currency, it serves as a significant source of foreign exchange requirements necessary for importation of capital goods and technology that can spur growth. Figure (4.2.2) shows trends in net ODA (% of GNI) and total reserves (in months of imports) for Malawi between 1975 and 2015.

4.2.2 Trends in Malawi's foreign aid

Malawi is one of the most heavily aid dependent countries in the World; it has received development assistance from over 30 multilateral and bilateral development partners[21] averaging 40% of government budget between 1970 and 2013. Figure (4.2.3) depicts aid per capita (panel a) and aid as a share of GNI (panel b) for Malawi against other regions. As can be seen, the trend in per capita aid follows that of other low income countries (especially since 2003) however, since it is one of the poorest, aid as a share of income is relatively high.

[21]Malawi's main development partners include the United States of America (includes United States Agency for International Development (USAID)), the United Kingdom (includes Department for International Development (DfID)), the World Bank, the Global Fund, the European Union (EU), and in recent years, China.

Figure 4.2.3: Net aid to Malawi and other regions



Source: World Bank's World Development Indicators.

Aid to Malawi is skewed towards a few sectors (mainly social sectors), with the top six beneficiary sectors receiving over 80% of total aid given to Malawi. The main beneficiary sectors are health, education, agriculture and economic governance[22] (see table 4.2.3). General budget support is the most preferred mode of aid, which gives the government control over allocation of the aid resources amongst its 28 administrative districts. Budget support in this sense includes unconditional grants, conditional project support, sector wide approach (SWAp) pooled funds and programme support.

Table 4.2.3: Aid disbursement by Sector (2009 - 2011) ($'000)

	2009	**2010**	**2011**
Health	254,020	191,781	298,199
Economic governance	181,824	224,472	126,612
Education	73,383	101,906	167,677
Agriculture	67,446	115,583	79,729
Transport infrastructure	44,381	61,242	99,245
Water and Sanitation	27,364	70,429	89,305
Total Aid Received	**807,430**	**995,394**	**1,022,399**

Source: Malawi Aid Atlas (2010/11)

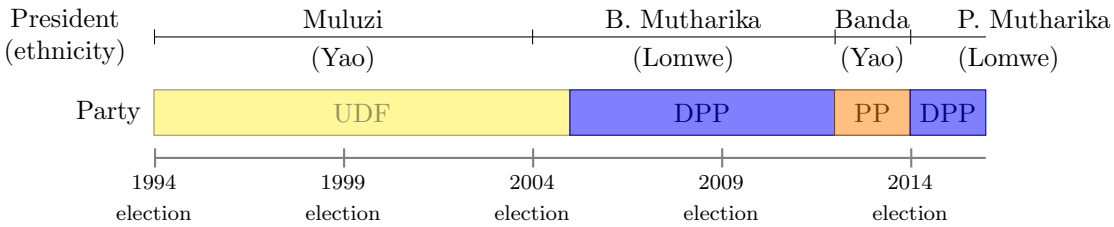
4.2.3 Politics and Government spending Malawi

Malawi is divided into 28 administrative districts, with the capital city in Lilongwe. It attained independence from British colonial administration in 1964 with Dr Hastings Ka-

[22]Economic governance includes programmes undertaken to stabilize the economy through efficient public finance and economic management reforms as well as building public sector capacity.

muzu Banda its President. Following independence from British colonial administration in 1965, Malawi was for nearly three decades a one-party State. This was characterised by a rigid authoritarian regime with all state and government powers concentrated within the Presidency. In 1993 Malawi voted to become a multi-party democracy and since had its President and Parliament elected every 5 years. Figure (4.2.4) shows a timeline of recent events in Malawi politics; as can be seen, elections held regularly have resulted in change in President and party.[23]

Figure 4.2.4: Timeline of recent Malawian politics



This study covers the period 1999 to 2013, a period that saw 3 presidents at the helm in Malawi. Bakili Muluzi was Malawi's first democratically elected president; he took over power from Dr. Hastings Kamuzu Banda in 1994, winning the election with 47% of the votes. His party, the United Democratic Front (UDF) also acquired majority seats in Parliament. He was re-elected for a second term of office in 1999, winning by 52% of votes and the UDF consolidating the majority in Parliament. While there was reasonable economic performance, the second term was marred by corruption and gross economic mismanagement characterized by increasing fiscal deficits and inflation.

Bakili Muluzi was replaced in 2004 by Dr. Bingu wa Muntharika, elected as a UDF candidate and won 36% of votes, however the UDF had lost majority in Parliament. In 2005, Dr. wa Muntharika ditched the UDF and formed his own party, the Democratic Progressive Party (DPP). This represented a regime change, albeit without a public poll, as the DPP assumed power from the UDF that won the election in 2004.

Dr. Muntharika gained popular support for leaving the 'corrupt' UDF and re-introducing the Farm Input Subsidy Programme (FISP) which provided subsidized farm inputs to smallholder farmers. He was re-elected in 2009, winning with over 67% of the vote, while his DPP won 113 of the 193 Parliamentary seats. After gaining such dominance over

[23]Freedom House rates Malawi as "partly free" while according to International Country Risk Group (ICRG) the quality of government in Malawi is "typical" of a low or lower-middle income country.

the opposition, Dr. wa Muntharika started centralizing his authority by curtailing civil and press freedoms, harassing and victimizing his critcs (Dionne and Dulani (2013)). The once popular FISP became a tool for rent, favoring his co-ethnic Lomwe areas of Southern Malawi and those in other regions that were loyal to the DPP.

In 2012, following the death of Dr. Muntharika, the vice president, Dr. Joyce Banda,[24] ascended into power. Having been sidelined by Dr. wa Muntharika since re-election she had formed her own party, the People's Party (PP) in 2011, so that upon her ascendancy into presidency, another regime change occurred as the PP became the ruling party while the DPP moved to the opposition.

As in many African countries, presidentialism persists in Malawi characterized by presidential-money powers (the Big Man syndrome[25]) that undermine effective division of powers with other state functions such as Parliamentary oversight and the Judiciary. The big man syndrome is a political science term strongly associated with neopatrimonialism,[26] and refers to a system of social hierarchy characterized by the dominance of an individual or a restricted group of elites who strive to exert absolute control by making personalized use of state resources and institutions to secure the loyalty of clients and political legitimacy (Bratton and van de Walle (1997), Engel and Erdmann (2007)).

In Malawi, Booth et al. (2006) identifies two levels at which the highly personalized presidential-money powers operate to undermine separation of powers:

a) *Formal Level*: At the formal level, this is achieved in two ways: (i) the Executive arm uses its control over government resources and manipulates disbursement of budgeted resources to the Judiciary, Parliament (and its committees) as well as other constitutional bodies (Office of the Ombudsman, Human Rights Commission, Anti-Corruption Bureau) in a way that limits their effectiveness in playing the oversight role (ii) Presidential powers of appointment, into important government positions,

[24]Not related to Dr. H. Kamuzu Banda, the first President of the Republic of Malawi

[25]Francois et al. (2015) defines the Big Man syndrome as situation where one elite leader becomes a relatively unconstrained decision maker, a personalist ruler with a strong preference for sharing power and spoils with his trusted co-ethnics through the "politics of ethnic exclusion."

[26]A system in which one person or a small group of political elites in power strive for total control and dominate the state and decision making powers. It is often characterized by lack of or weakened democratic decision making mechanisms, lack of transparency , misuse of state resources and a concentrated power structure that depends on the one man in power.

are used to reward those loyal to the president and seen to advance his personal interests. The appointments are to positions in key institutions such as the Judiciary, other oversight bodies and the Civil Service.

b) *Informal Level*: Informal use of money powers to directly bribe people in key public positions with cash or other personal benefits (in terms of MPs, promise to have their constituencies favored for development initiatives), to influence their ability to act independently in interest of public welfare.

A key feature in democratic Malawi that allows rent seeking to thrive is the existence of weak governance institutions such as Parliament, the Judiciary and civil society in the face of a resource-rich executive. Institutional vulnerability inherent in the political, legal and judicial systems provides incentives for policy-makers to engage in rent seeking behavior in pursuit of personal gains. When democratic institutions are so poor, then peoples' decisions including electoral choices have little impact (Bhattacharyya and Hodler (2010)).

Neopatrimonialism implies the resources of the state become the 'patrimony' of the powerful ruler. For a country without any notable natural resources, state resources mean control over bureaucratic positions, powers to allocate rents (including foreign aid), public services and determine policies and their beneficiaries.

Important for the purposes of this study is the nature of the political system as it relates to government expenditure through the national budget. Public spending in Malawi is divided into two categories namely recurrent budget and the development budget.

Malawi Government (2009) defines recurrent expenditures simply as operational costs incurred by government ministries and departments (such as schools, hospitals, etc). They include salaries and wages, utilities, generic office supplies, interest on public debt as well as subsidies and transfers. Recurrent spending across districts is governed by the National Local Government Finance Committee (NLGFC) which plans and formulates local authorities' budget using an approved formula.

As a result of the nature of the recurrent budget, it is subject to significant oversight from public affairs institutions, civil society organizations and development partners. For

instance, payment of salaries, supply of drugs in hospitals or supply of teaching and learning materials to schools, which are all significant components of the recurrent budget, are all subject to intense scrutiny. Hence, the President has limited scope to exert influence on the allocation of the recurrent budget across districts.

Development expenditures relate to public capital investments and are incurred in support of the Public Sector Investment Programme (PSIP); the development budget provides long term public capital goods and services such as infrastructure and other investment programmes. Unlike the recurrent budget, development projects implemented in districts are not determined by the NLGFC; planning and formulation of development projects is still centralised. Allocation of development spending across districts is subject to little oversight leaving a lot of room for the political elite to exert influence.

Additionally, when it comes to public investment programmes attention is often on the national level outcomes ignoring their internal allocation. For instance when the government receives aid for construction of primary schools across the country, it is often the case that any oversight on the progress of such a programme focuses on the total number of schools built rather than whether they are being built where schools are needed most. As a result, the President has most control over the allocation of these expenditures across districts.

4.3 Data

To examine the causal effects of aid on economic growth, the study uses district level data collected for the period 1999 to 2013. The analysis includes all 28 administrative districts in Malawi,[27] however the analysis is in most specifications reduced to 24 districts because some districts were recently formed (by splitting them from other districts).[28]

Nighttime light data is used to proxy for economic activity at the district level. Research has shown that luminosity reflects human economic activity such as private consumption,

[27]Table 4.B.1 lists all the districts in Malawi

[28]Neno and Likoma districts were formed after splitting from Mwanza and Nkhatabay districts respectively. For these new districts, some data on most of the variables is missing not because they are not necessarily reported, but rather because for most of the years under study they were still being reported as part of the districts they were split from. Thus they are entirely excluded but they are subsumed as part of the parent districts. Further the two major cities of Lilongwe (the capital city) and Blantyre are also left out in most specifications.

production and government expenditures (Hodler and Raschky (2014)). Geographers (Elvidge et al. (1997), Sutton et al. (2007)) and ecologists (Doll et al. (2006)) first used light density to study urbanization. Economists Chen and Nordhaus (2011) and Henderson et al. (2012) subsequently showed that light intensity at night is a good proxy for economic activity that was traditionally measured by GDP. Recent examples of the use of luminosity include Michalopoulos and Papaioannou (2013) which studies development in Africa. The use of nighttime data in empirical growth studies has since gained prominence.

There are two key advantages of using luminosity data over the most commonly used GDP-based measures of economic activity; firstly, since it is available in the same quality for all countries,[29] it is a useful measure particularly for aid-recipient developing countries whose data is often considered of low quality[30] (Chapter 3 discusses this aspect in more detail). Secondly, it is available in the same quality at regional or lower (localized) levels, which is very novel for use when conducting a within country analysis. GDP data is simply not available at sub-national level.

Satellite data on nighttime images have been recorded every night by weather satellites at the United States Air Force (USAF) Defense Meteorological Satellite Program (DMSP) using their Operational Linescan System (OLS) sensors since the 1970's but a digital archive only begun being stored in 1992. Once recorded, the original nighttime light readings are re-calibrated by scientists at the National Oceanic and Atmospheric Administration's (NOAA) National Geophysical Data Center (NGDC) to leave mostly only man-made light[31] (Henderson et al. (2012)). A satellite-year dataset is then produced by averaging all data from all orbits of a given satellite in a given year over all valid nights.

Figure 4.3.1 depicts luminosity at the pixel level for Malawi in 1999 and 2010 against the district borders.[32] For analysis in this paper, we calculate average light density at the district level (average light intensity per square kilometer) in each year over the period

[29] Apart from countries very close to the North or South Poles

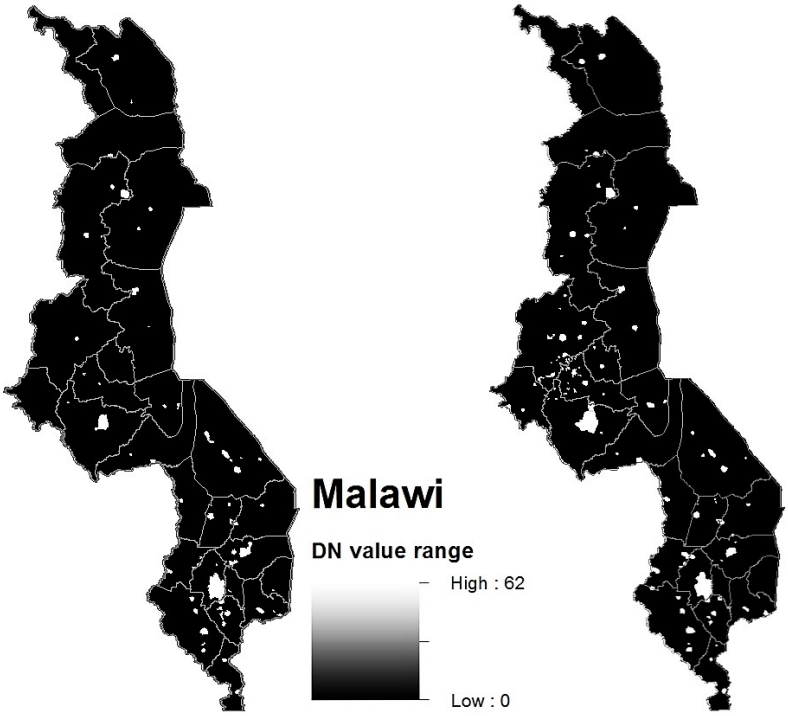
[30] This is due to poor data collection capacity and sometimes as a result of manipulation of official statistics by rent-seeking governments with poor institutions.

[31] This includes accounting for variations in sensor settings over time, removing natural anomalies such as the effect of the lunar cycle and auroral activity and removing obscures from cloud cover

[32] The light dataset is available for free at the National Geophysical Data Center's website: `http://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html` while maps for administrative districts are downloaded from DIVA-GIS, available at `http://www.diva-gis.org/gdata`

1999 to 2013.

Figure 4.3.1: Nighttime images for Malawi in 1999 (left) and 2010 (right)



The compiled dataset reports light intensity as a digital number, an integer on a scale that ranges from 0 to 63 where 0 implies no light recorded and higher digital number values imply higher light intensity recorded. Figure 4.A.4 shows an example of a zoomed-in nighttime image of Lilongwe in 2013, showing the digital number values for various locations within a pixel. Using ArcGIS software, average nighttime light data is calculated for all 28 districts from 1999 to 2013, creating a panel data of light data for 28 districts over 15 years. This dataset allows us to examine causal effects of aid on economic activities in Malawi.

It should be noted that 'growth' as measured by nighttime light data needs to be interpreted cautiously, especially when measuring at the sub-national level for low income countries. While nighttime emissions are correlated with economic activity at the ground level, it is a relatively stronger measure of population density Mellander et al. (2015). For low income countries, it is reasonable to assume that much of the aid in rural areas may not be used in light-generating activities, but could lead to a reallocation of population and activity across space. In our case, we control for this possibility by including population density as one of the district controls.

Data on foreign aid financed projects was collected from the Aid Management Platform

(AMP), managed at Malawi's Ministry of Finance (MoF) in Lilongwe. The AMP is the government's main tool for tracking and reporting progress of aid-funded activities in Malawi. The bulk of the data in the AMP comes from AidData[33] which conducted the Malawi Geocoding project, a joint venture between Development Gateway,[34] and the Robert S. Strauss Center's Climate Change and African Political Stability (CCAPS).[35] The Malawi Geocoding project was the first effort to compile comprehensive geocoded data of all donor activities in a single recipient country in Africa. Figure 4.3.2 shows a map of Malawi with locations of geocoded projects.

Figure 4.3.2: Location of geocoded projects in Malawi

Based on information reported by both donors and the Malawi Government, AidData compiled a dataset that contains projects that started as far back as 1996 up to those that started in 2011 when the geocoding exercise took place. The dataset has geocoded data on projects from over 30 donor agencies for 548 projects, representing $5.3 billion in total commitments (approximately 80% of total foreign aid to Malawi between 2000 and 2011). The AMP dataset includes projects that started after the geocoding exercise in 2012 and 2013. Thus in total the AMP data has about 623 projects representing over $7.1 billion of aid received during the period of study (about 82% of total aid during the

[33] AidData is a joint initiative of Development Gateway, the College of William and Mary and Brigham Young University providing a portal to access on over a million aid financed activities of over 90 donors from 1964 to 2011 (`http://www.aiddata.org`)

[34] `http://www.developmentgateway.org/about/Case-Studies/Geocoding-in-Malawi`

[35] CCAPS is a joint research program among the University of Texas at Austin, the University of North Texas, the College of William and Mary, and Trinity College Dublin that seeks to provide research based practical guidance for policy makers.

period).

The AMP data disaggregates cumulative project totals into annual commitments and actual disbursements of each project in a particular district, hence actual disbursements are used. A limitation of the AMP data is that it contains some projects that have not been allocated to any districts.[36] Since the empirical estimation is based entirely on a district-year units, the projects without district locations have been excluded, reducing the number of projects used in this study to 593 projects.

The study uses additional district-level controls. Data on local public expenditures was provided by the National Local Government Finance Committee (NLGFC) through Districts' Annual Budget Estimates, which contains estimates of all available financing at the district level (excluding aid since aid is managed by central government Ministries). Population data (including population of major ethnic groups in a district) was collected from the National Statistical Office's (NSO) population census reports. In particular, reports from 1998 Population and Housing Census and 2008 Population and Housing Census were used.

Data on party affiliations of Members of Parliament, as well as list of Cabinet Ministers, was collected from Parliamentary Hansards found at the Malawi National Assembly library. Rainfall data (in millimeters) was obtained from meteorological reports provided by the 22 meteorological stations that form the weather network in Malawi. Poverty rates, infant mortality, life expectancy and rate of food insecurity were all collected from various reports from the NSO.[37] Data on maize production was collected from Annual Crop Yield estimates complied by the Ministry of Agriculture and Food Security (MoAFS) while education sector data (on gross primary enrolment and number of primary school classroom buildings) is from the Ministry of Education, Science and Technology's (MoEST) Education Management Information System (EMIS) annual reports. Table 4.B.2 gives a summary of the data used in the analysis and their sources while Table 4.B.3 shows descriptive statistics of the variables in the baseline sample.

[36]They have not been allocated any geographic coordinates and are therefore classified district unallocable

[37]Particularly, reports from three rounds of Living Standards Measurement Surveys (LSMS) namely Integrated Household Survey (IHS1 in 1997-98, IHS2 in 2004-05 and IHS3 in 2010-11); another three rounds of Malawi Demographic and Health Surveys (2000, 2004 and 2010); other isolated reports such as Malawi-An Atlas of Social Statistics (2002), annual NSO's Welfare Monitoring Surveys reports (2005-2011) were used.

4.4 Empirical Strategy

This section explains the empirical strategy employed in this study. As mentioned earlier, the study obtains district level data from Malawi for the period 1999 to 2013 and conducts a within-country analysis to estimate any potential effects of aid on growth of light density. In order to test the null hypothesis that aid has no effect on the change in the log of light density in a particular district, the following growth regression is postulated:

$$\Delta light_i(t) = \beta_0 + \beta_1 light_i(t-1) + \beta_2 A_i(t) + \mathbf{X}_i'(t)\boldsymbol{\beta} + \gamma_i + \rho(t) + \mu_i(t) \tag{4.4.1}$$

where i is a district index and t a time index; $light_i(t)$ log of light density, calculated as the log of the sum of light intensity in a district,[38] $A_i(t)$ is log of total aid received. $\mathbf{X}$ denotes a vector of district time varying control variables that can affect light density and the allocation of aid. In the baseline specification, these include public expenditures,[39] population density, poverty rate and share of votes that a winning President received from a district in an election[40].

γ_i indicates district level fixed effects. Including fixed effects is crucial to overcome omitted variables bias that may otherwise arise because a district's nighttime light and/or the likelihood of a district being a birth district of a President could both depend on some unobservable district-specific characteristics. Period dummy $\rho(t)$ is a year dummy variable that controls for time varying common shocks, for example changes to light density that may occur due to improvements in satellites and their settings.

Equation (4.4.1) presents a standard empirical growth model that controls for a range of distortions that can explain district level growth performance in order to obtain robust inferences about the aid-growth nexus. In line with Barro-type empirical literature, initial

[38] Change in light density is measured as the log of light intensity in current period minus the log of light density in the previous period, i.e. $\Delta light_i(t) = light_i(t) - light_i(t-1)$

[39] Public expenditures refer to resources available to districts that exclude foreign aid. They include locally generated revenues collected by district councils, transfers from the central government for recurrent (operational) expenses etc.

[40] All the variables (unless specifically stated otherwise) are log transformed for a number of reasons. Firstly, most variables including aid and light intensity are skewed to the left (see figures 4.A.1 and 4.A.2 of the appendix), so normality is maintained by log transforming. Secondly, a number of previous studies indicate that aid has diminishing marginal returns; log transformation introduces concavity without loss of the ability to identify aid's causal effect.

light density is included to capture convergence effects.

Aside from the variable of interest, aid, the growth equation also includes as covariates indicators of development need at district level. Specifically indicators from health, education and agriculture sector are included because these sectors not only account for over 50% of total aid to Malawi but also over 50% of the government budget[41]. As such $\mathbf{X}$ also includes primary school gross enrollment rate and number of classrooms blocks in a district as variables from the education sector; life expectancy and infant mortality rate from the health sector; and estimates of production of maize (Malawi's staple food) as well as percentage of population that are food insecure from the agriculture sector.

The standard way to estimate equation (4.4.1) is to eliminate the unobservable district-specific effects and estimate the transformed equation. The estimator obtained from the above specification is likely to be biased for a number of reasons.

The first reason arises due to the high possibility that aid is not allocated to recipient districts randomly, rather it is expected to be affected by the level of economic activity in a district. In this regard aid may be disbursed to regions with lowest expected growth or to regions with the greatest potential for growth. This would cause the error term $\mu_i(t)$ to be correlated with aid, $A_i(t)$, leading to reverse causation. Secondly, since the study uses aid measured at district level at a particular time, it is likely that not all donor activities in all districts are reported on time leading to errors in the measurement of aid. Relatedly, it is also highly likely that the measure for economic activity is measured with error. These would result in attenuation bias. Finally there may be unobserved time varying variables related to both aid and economic activity that may be omitted, but make the role of aid appear significant.

In order to overcome these endogeneity problems instrumental variable approach is employed using two novel instruments. The instruments take advantage of exogenous variation in affinity of districts (ethnically and politically) with the President and relate to his discretionary powers to favor those in his/her inner circle. The study argues that these instruments are not related to economic activity (development) through other channels than through their influence on aid allocation across districts. Using these instruments,

[41]Malawi 2013/14 Malawi Financial Statement.

a model with the following system of equations is estimated using 2 stage least squares (2SLS) method:

$$\Delta light_i(t) = \beta_0 + \beta_1 light_i(t-1) + \beta_2 \widehat{A}_i(t) + \mathbf{X}_i'(t)\boldsymbol{\beta} + \gamma_i + \rho(t) + \mu_i(t) \tag{4.4.2}$$

$$A_i(t) = \theta_0 + \theta_1 light_i(t-1) + \theta_2 z_i(t) + \mathbf{X}_i'(t)\boldsymbol{\theta} + \gamma_i + \rho(t) + \epsilon_i(t) \tag{4.4.3}$$

where z is an intrumental variable. Each instrument is used individually at first, and later they are both used together. For this system of equations to be identified, each instrument has to be valid i.e. it must be relevant ($\theta_2 \neq 0$), and exogenous ($cov(\mu, \epsilon) = 0$) so that the instruments can only affect $\Delta light_i(t)$ through $A_i(t)$.

Equation (4.4.3) explores the determinants of aid allocation across districts within Malawi. Since the pioneering works of McKinlay and Little (1977) and Nissanke and Maziels (1984), a significant literature has discussed the determinants of foreign aid allocation at the country level. Alesina and Dollar (2000) found evidence that political factors in recipient countries influence in aid allocation, Ouattar et al. (2012) find that recipient needs and donor interests are important factors in aid allocation across countries.

We build on a growing literature on the determinants of aid allocation within African countries; Posner (2005*b*), Wrong (2009) and in recent years Hodler and Raschky (2014) and Franck and Rainer (2012) have all found evidence that ethnicity plays an important role in the distribution of resources (including development aid) in African states. Additionally, some studies also find that local political factors do influence distribution of aid (see Heady (2008) and Jablonski (2014)). These studies motivate our formulation of equation (4.4.3) and the instruments used in this study.

The next subsections will introduce the two instrumental variables separately and discuss their validity. An issue common to both instruments regards the nature of the discretionary powers that the President has. It is possible that other than foreign aid, the President also allocates a large portion of other State resources that may account for development at the district level. While this may be a valid concern for many countries, it is less problematic for the case of Malawi because foreign aid constitutes a significant proportion of expenditures for which the President has the most scope to exert discretion.

Due to the underdeveloped nature of the private sector in Malawi, the Government sector is the main driving sector for economic growth and development, and the key tool for resource allocation is the national budget. The budget is composed of two parts: Development Expenditures which support the Public Sector Investment Plan (PSIP) and provide funding for long term public investment goods and services such as infrastructure. Over the study period, aid contributed 73% of the development budget. As a result of the goods and services financed by the development budget[42], this portion of the public spending is under the most influence of the President.

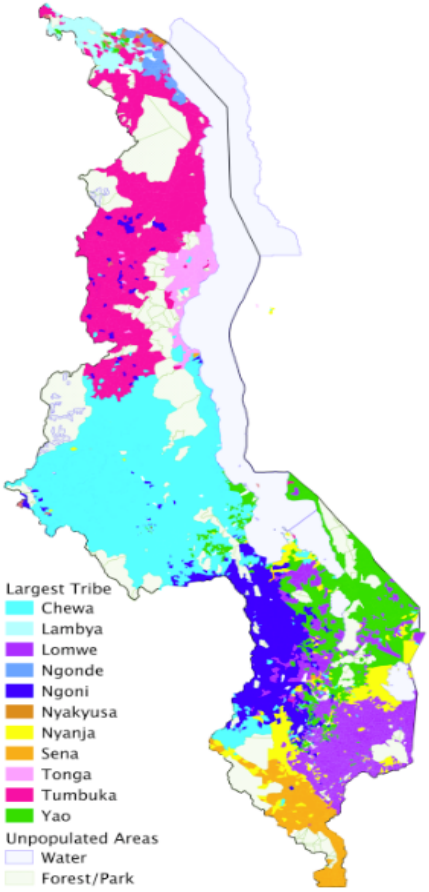
The second part of the Malawi budget is Recurrent Expenditures which are other departmental expenditure comprising mainly operational expenses incurred by government departments such as salaries, interest payments on public debt, utilities, procurement of goods and services, payment of pensions and gratuities, etc. There is limited scope for the President to exert discretion on the allocation of these expenditures across districts. Furthermore, unlike the development budget, the recurrent budget is devolved to local authorities and so allocation of transfers to districts is determined by the National Local Government Finance Committee (NLGFC) – a quasi-governmental institution mandated with effective mobilization, equitable distribution and efficient utilisation of financial resources in local councils.

4.4.1 First instrument: Ethnic Affinity

The first instrument to be used is ethnic affinity, measured as the proportion of a district's population that are co-ethnic with the sitting President. Malawi people are of Bantu origin and comprise many different ethnic groups; Malawi Human Rights Commission (2005) approximates that there are about 15 ethnic groups in Malawi. Figure (4.4.1) is a map of Malawi showing locations of the major ethnic groups.As the map reveals, the Chewa people are the largest ethnic group making up to 38.4% of Malawi's population and are mainly found in the Central Region of Malawi, the Lomwe make up about 17.6% and are found in the Southern Region, the Yao are about 13.5% and are mainly in the South Eastern part of Malawi, the Ngoni make up 11.5% found in the Central Region and the Tumbuka are about 8.8% and cover much of the Northern Region.

[42]Particularly infrastructure such as rural roads, boreholes, education infrastructure which are easily used as rents.

Figure 4.4.1: Spatial distribution of ethnic groups in Malawi



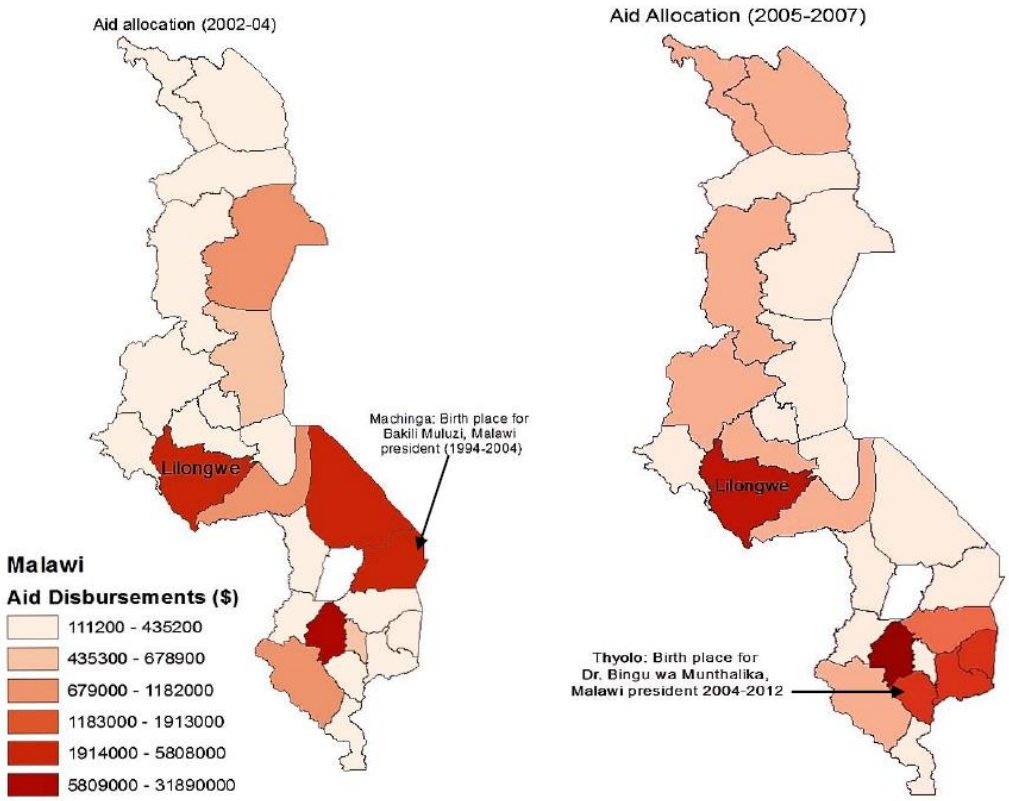
Source: Figure from Robinson (2016)

Ascension to presidency in Malawi is through public elections held once every 5 years in a first-past-the-post system. Political representatives in the presidential election can come from any district and indeed from any ethnic group. Despite the Chewa being a majority, over the study period the sitting President has been either Lomwe or Yao, as shown in figure (4.2.4).

The relevance condition requires that the instrument be a strong enough predictor of the endogenous regressor, in our case aid. There is already overwhelming evidence that indicates that disproportionate amounts of aid are allocated to incumbent president's district of birth or regions of their ancestral origins especially in Sub Saharan Africa. Franck and Rainer (2012) use data from 18 African countries for over 50 years and find significant evidence of large and widespread ethnic favoritism in allocation of aid resources. As an example of this in Malawi figure (4.4.2) shows aid allocation in Malawi between 2002 and 2004 and between 2005 and 2007, thus under two President's of different ethnic

origins.

Figure 4.4.2: Allocation of aid in the periods 2002-2004 and 2005-2005



Dr. Bakili Muluzi of Yao origin was reelected as President for Malawi in 1999 and was in power up to 2004. As the figure shows, the Yao districts of Machinga (his birth district), Mangochi and Balaka are allocated disproportionately high amounts of aid than any of the other districts. Between 2005 and 2007, when Dr Bingu wa Muntharika of Lomwe origin was President, figure 4.4.2 shows that the Lomwe districts of Thyolo, Mulanje and Phalombe received more aid than other districts.

A concern, recognised in much of the literature[43] on African political studies, is that African political behavior (particularly for Sub Saharan Africa) is subsumed in ethnicity. This implies that often voters will vote for presidential candidates that are co-ethnics with the expectation of favourable outcomes in terms of outputs from the public decision-making process, which in the case of Malawi imply disproportionate allocation of state resources. If it is the case that ethnic clientelism is indeed prevalent in Malawi's voter

[43]There is a significantly large literature indicating that ethnic clientelism is prevalent in African politics including Chabal (2009), Mozzafar et al. (2003), van de Welle (2003), Francois et al. (2015), Posner (2005*a*), Lindberg (2003).

behavior (i.e. districts supported Presidential candidates primarily along ethnic lines), then a president's ethnicity ceases to be random – a district's vote is for the candidate that will send aid their way. If the poorest districts are the ones that most vote on ethnic basis, the instrument may not be exogenous.

Despite this strongly held view of ethnicity in African electoral behavior, there are few independent surveys of voter behavior that can provide evidence to support the rationale that ethnicity is a primary factor in voter's decision making. Recent surveys on electoral results in African democracies that analyze voter behavior conclude that ethnicity itself is not a primary factor that influences voters decision. Anyangwe (2012) surveys national and provincial elections held in South Africa from 1999 to 2009 and Municipal elections held in 2011 and conclude that ethnic identity only has a marginal effect on South African voters. Carlson (2015) conduct an experiment designed to determine how voters in Uganda make their electoral choices and find that co-ethnicity on its own does not increase support for a candidate.[44]

There is growing evidence that suggest that voters are less influenced by ethnicity of individual candidates, rather they are driven by a number of different factors. Centre for Democratic Development (1999) found a high level of partisan identification rather than individual candidate ethnicity (they vote for representatives of political parties that have a stronghold in that district or region regardless of whether the candidate has ethnic origins from the same district or region). Ratsimbaharison and Marcus (2005) presents evidence from Madagascar and show that evaluative decision making which includes rational choice and prospective evaluation of political parties as the key vote determinant[45].

For Malawi, the study analyses election results from four general elections held in Malawi in 1999, 2004 and 2009 by conducting a simple regression analysis of district vote shares received by the winning Presidential candidate. We regress the winning candidate's district vote share on, among other determinants, the proportion of the winning candidates co-ethnics in a district and party identification, a dummy variable that takes the value 1

[44]Lindberg and Morrison (2008) survey voters in 2 elections in Ghana and conclude that 'an overwhelming majority of voters do not vote based on clientelism or ethnic ties but cast their votes after careful evaluation of candidates.'

[45]Other studies with evidence of partisan voting and evaluative decision making include Piombo (2005) with evidence from South Africa while Posner (2003) and Lindberg (2003) both give evidence from Zambia.

if the winner's political party is a dominant party[46] in that district, or 0 otherwise. As the results reported in table 4.4.1 reveal, ethnicity does not seem to affect the vote share that a candidate gets in the district, being found to be statistically insignificant, in the equation for district vote shares.

Table 4.4.1: Results for OLS regression of district vote share

	1	2	3	4	5	6	7
	0LS	0LS	0LS	0LS	0LS	0LS	0LS
Winner's birth district	0.1230	-0.0014	-0.0061	0.0306	0.0288	-0.0234	-0.0153
	(0.1579)	(0.1860)	(0.1803)	(0.1004)	(0.1078)	(0.1061)	(0.1116)
Population	-0.9644	-1.3619	-1.2799	-0.9059	-0.5950	-1.0814	-0.7134
	(2.1541)	(1.9110)	(2.2686)	(0.8304)	(0.8840)	(0.7984)	(0.8382)
Poverty rate	-0.0003	0.0392	0.0156	0.0038	0.0126	0.0212	0.0210
	(0.1292)	(0.1197)	(0.1427)	(0.0574)	(0.0595)	(0.0602)	(0.0603)
Northern region	0.0921	0.1035*	0.1008	0.0436**	0.0357	0.0490**	0.0395*
	(0.0636)	(0.0558)	(0.0659)	(0.0208)	(0.0247)	(0.0190)	(0.0227)
Central region	0.0403	0.0526	0.0509	0.0255	0.0184	0.0311	0.0226
	(0.0692)	(0.0610)	(0.0675)	(0.0246)	(0.0249)	(0.0233)	(0.0234)
Southern region	0.0402	0.0526	0.0508	0.0254	0.0183	0.0310	0.0226
	(0.0691)	(0.0610)	(0.0674)	(0.0246)	(0.0249)	(0.0233)	(0.0234)
Urban districts	-0.0032	0.0003	0.0003	0.0134*	0.0133**	0.0148**	0.0142**
	(0.0143)	(0.0137)	(0.0125)	(0.0068)	(0.0063)	(0.0070)	(0.0065)
City	-0.0001	-0.0000	-0.0000	-0.0001**	-0.0001*	-0.0001*	-0.0001*
	(0.0001)	(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Chewa			0.0003		-0.0074		-0.0076
			(0.0173)		(0.0101)		(0.0100)
Yao			-0.0001*		0.0000		0.0000
			(0.0001)		(0.0000)		(0.0000)
Lomwe			-0.0091		0.0047		0.0021
			(0.0184)		(0.0068)		(0.0076)
Winner's ethnic population (% district population)		0.2180	0.2346			0.0959	0.0818
		(0.1887)	(0.1958)			(0.0731)	(0.0824)
Party identification				0.4771***	0.4824***	0.4729***	0.4781***
				(0.0418)	(0.0439)	(0.0404)	(0.0428)
Observations	*360*	*360*	*360*	*360*	*360*	*360*	*360*
R-squared	*0.2606*	*0.2800*	*0.2845*	*0.8075*	*0.8124*	*0.8112*	*0.8150*
District - Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
Number of id	*24*	*24*	*24*	*24*	*24*	*24*	*24*

Notes: The table presents results of fixed effects panel regression on the share of votes that a winning candidate received during a general election (held in 1999, 2004 and 2009) from each district on ethnicity, measured as the proportion of population that is co-ethnic with the winning candidate; and party identification, a dummy variable that takes the value 1 if the winner's party is dominant in the district, and 0 otherwise. Robust standard errors in parentheses: $*p < 0.10; **p < 0.05; ***p < 0.01$.

Furthermore, the R-squared for specification with only ethnicity in the regression are between 0.26 and 0.28; when we include party identification the R-squared increases significantly and to between 0.81 and 0.82, implying that the model that includes party identification is a better fit to explain distribution of share of votes. These findings suggest that ethnicity is not the primary factor in voter's behavior in Malawi, rather party identification seems to play a more influential role.

As an example, table (4.4.2) shows vote shares received by Dr. Bingu wa Muntharika (from Lomwe ethnic group) who contested in all the elections that took place during

[46]Dominant party is determined by the proportion of parliamentary seats in the district won by the winning Presidential candidate's party. A party that is dominant in a district wins more parliamentary seats than one that is not.

the study period (in 1999, 2004 and 2009), and represented a different political party in each election. In 1999, he represented the United Party (UP) and had less than 1% vote share even in his birth district where United Democratic Front (UDF[47]) candidates won both elections getting 79% in the Presidential election. In 2004, he represented the UDF and managed higher vote share in Yao districts (80%) than the average in his co-ethnic districts including his birth district. In 2009 he represented the Democratic Progressive Party (DPP[48]) and got significantly high vote shares from Lomwe (87%) and Tumbuka districts (95%) which identified with the DPP but could only manage 26% from Yao districts since he no longer represented the UDF which the Yao identify themselves with.

Table 4.4.2: District vote shares received by Dr Bingu wa Muntharika

Election Year	Political Party	Vote share (birth district)	Avg vote share (co-ethnic districts)	Avg vote share (Chewa districts)	Avg vote share (Yao districts)	Avg vote share (Tumbuka districts)
1999	UP	0.7%	0.9/%	0.3%	0.4%	0.3%
2004	UDF	61%	51.2%	17%	80%	20%
2009	DPP	91%	87%	42%	26%	95%

Notes: UP stands for United Party, UDF is United Democratic Party and DPP is Democratic Progressive Party

The explanation for these electoral outcomes is that between 1999 and 2005, the UDF was the dominant party so that despite being predominantly a Yao (and Islamic religion) party, many other ethnic groups identified themselves with the UDF and hence would vote for UDF representatives at the expense of co-ethnics representing other political parties. The formation of DPP in 2005 shifted political powers as it became the dominant political party, and hence its candidates received the majority vote shares in 2009.

Consistent with the evidence that ethnicity is not the primary factor in voting behavior is the observation that since Malawi become a democracy, no candidate from the largest ethnic group (the Chewa) has ever won in an election. The Chewa (38.4% of population) comprise over twice as much as the population of the next biggest ethnic group (the Lomwe with 17.6%) and are also the ethnic group who are found in most other parts of Malawi other than their region of stronghold. If indeed ethnicity was a key factor in who gets elected, as believed, then Chewa candidates would have a head start just by the sheer advantage they hold population-wise over other races.

[47]The UDF party has its political foundations built along Yao ethnic group and Islamic religion. Thyolo district population and Lomwe people in general are Christians by religion, so religion could not have influenced vote outcomes in Thyolo.

[48]The DPP was formed by Dr Muntharika with its political foundations in a coalition between the Lomwe ethnic group (average 91% vote share) and Tumbuka people from Northern Malawi (averege 95% vote share)

This evidence is significant; if ethnicity itself is not a primary factor in the voting behavior in Malawi, then an ethnic group cannot form expectations as regards to the future development of their district based solely on the ethnicity of the presidential candidate they voted for since the winner may not necessarily be their co-ethnic. Since the evidence suggests that a winning candidate does not ascend to power on the back of ethnicity, then if an incumbent president directs disproportionate amounts of aid to his district of birth or region where his co-ethnics are located geographically, it is unlikely that it is in return for any political favors that he received, rather it is merely because of his desire to favor co-ethnics in aid allocation.

Finally, it is important to consider if there are any other channels through which certain aspects of ethnicity would affect the level of economic activity at the district level but are not captured within the framework of the instrument. For instance, it may be possible that certain cultural practices for a particular ethnic group are consistent with higher economic activities than other races. An example can be ethnics who require payment of dowry/bride price such as the Tumbuka and for the Ngoni tribes, as such for one to marry they (or their relatives) must be engaged in some form of economic activity that enables them to raise the dowry requirement. To eliminate any bias that may arise due to the possibility of any other channel from ethnicity to changes in the level of economic activity other than through the instrument, in the robustness checks the study also includes dummy variables for the major ethnic groups in Malawi that account for more than 85% of the population.

4.4.2 Second instrument: Political switching

The second instrument used to identify the causal effects of aid in this study is political switching, measured as the proportion of Members of Parliament (MPs) in a district that defect from the political party with which they won the Parliamentary seat to join the ruling President's party. The desire of an incumbent President to consolidate political base and strengthen control over other arms of government, particularly the Legislature, can result in favoritism in distribution of aid to attract already elected MPs from opposition parties to join their party and attain majority membership in the National Assembly. There is already evidence that finds consistent bias in aid distribution towards electorally-

strategic regions and away from opposition dominated regions (Jablonski (2014); Briggs (2012).

Political affinity is often viewed as an alternative to ethnicity in African politics.[49] This view highlights a leader's constraints in exercising full ethnic exclusion; while the president may prefer to share aid exclusively with his co-ethnics, he cannot do so freely without running the risk of losing power.[50] In order to consolidate their political base, leaders often co-opt other powerful elites from ethnic groups in regions distinct from the Presidents.

While 'co-opting' may imply cross-party coalitions, in Malawi it often takes the form of defection from one political party to officially join another party (commonly referred to as 'crossing the floor'). As in most Sub Saharan countries, once the President is in power the biggest barrier to attaining total control of state is not having majority representation in Parliament.[51] Defection is mostly induced by the promise of personal gains (i.e. public office) and a flow of aid to the defecting MPs region. Regions where the President's party is not dominant and offered limited electoral support may now get favored for aid flows.

Crossing the floor in Malawi often comes with considerable risk for the politician. First, Parliamentary procedures (derived from Section 65 of the Malawi Constitution[52]) prohibit MPs from crossing the floor. This is intended to maintain composition of Parliament close to that determined by the vote. By crossing the floor an MP risks his/her seat being declared vacant, however because of the strength of the President and weakened oversight this rarely happens in practice.[53] Nevertheless, it remains the case that as long as this

[49]See Joseph (1987), Van de Walle (2007), Arriola (2009).

[50]It is often the case that one ethnic group does not form a significantly large enough proportion of a country's population. Therefore total ethnic autonomy and exclusion may lead to other ethnic groups revolting against the ruling government or form coalitions large enough to defeat the incumbent government in an election.

[51]The President is already in charge of the Executive arm; and through appointment powers of the President into key government position, including appointments in the Judiciary, he gathers control by rewarding those loyal to him with appointments. This leaves only the Legislature where member are elected into, so if he cannot attain majority through elections, co-opting is used to acquire the required numbers.

[52]Section 65 of Constitution of the Republic of Malawi, known as the 'Crossing the Floor' section has two subsections: (i) The Speaker shall declare vacant the seat of any member of the National Assembly who was, at the time of his or her election, a member of one political party represented in the National Assembly, other than by that member alone but who has voluntarily ceased to be a member of that party and has joined another political party represented in the National Assembly. (ii) Notwithstanding subsection (1), all members of all parties shall have the absolute right to exercise a free vote in any and all proceedings of the National Assembly, and a member shall not have his or her seat declared vacant solely on account of his or her voting in contradiction to the recommendations of a political party, represented in the National Assembly, of which he or she is a member.

[53]Despite huge effort exerted by the opposition parties (UDF and MCP) to force the Speaker of the

legislation is active, crossing the floor can lead to loss of a parliamentary seat.

Secondly, defection significantly minimizes one's chances of being re-elected in the next general elections in two ways: firstly, since defection is driven by personal gain, the MPs who defect are often labeled as greedy and not representing the will of the people who elected them. It therefore comes with significant loss in reputation as a good representative for the people. Second and most crucially, as already discussed, party identification is key in voter behavior. It is therefore highly likely that an elected MP belongs to a party that has a stronghold in that district. By defecting, an MP almost certainly joins a party that does not have a stronghold in that district hence minimizes the chance to be re-elected. Of the 68 MPs that defected to the DPP in 2005, 35 MPs came from districts in the Central and Northern regions where the DPP did not hold a stronghold. Of these, 32 contested in the 2009 general elections for the DPP and 21 lost their seats.[54]

In most well established democracies incidences of floor crossing are rare, however in Africa and Southern America it is a common practice.[55] Despite the risks of defection, it has happened frequently in Malawi especially between 2005 and 2012. Table 4.4.3 provides a breakdown of the composition by party of Malawi's Parliament.

The need to consolidate political power can emerge when coups threaten, when a sitting President dies or when the ruling political party is changed without an election. This period of volatility since 2005 was the result of non-electoral events. In 2005, Dr Bingu wa Muntharika formed the Democratic Progressive Party (DPP), abandoning the United Democratic Front (UDF) on whose ticket he contested in the 2004 elections. The DPP became the ruling party and the UDF, which had won the 2004 elections, became part of the opposition. In 2011, the then Vice President Dr Joyce Banda formed a new party, the Peoples Party (PP), abandoning the DPP with which she was Dr wa Muntharika's running mate in 2009 elections. Upon Dr wa Muntharika's death in 2012, she assumed the presidency and her PP became the ruling party while the DPP moved to opposition.

National Assembly to implement section 65 and declare vacant seats of the MPs deemed to have crossed the floor, a series of court injunctions obtained by DPP members blocked the Speaker from implementing section 65 provision. During the period of study, only 5 seats were declared vacant, Banik and Chinsinga (2016)

[54]Calculated by the author from 2004 and 2009 official election results.

[55]Majola et al. (2003) gives an example of the USA where only 20 MPs have crossed the floor between 1947 and 1997. Mershon and Heller (2007) documents examples of floor crossing incidences in Germany, the United Kingdom, Canada, Brazil, Lesotho and Kenya.

Table 4.4.3: Composition of Parliament and Defections (1999 - 2013)

	Ruling party	**AFORD**	**DPP**	**MCP**	**UDF**	**RP**	**NDA**	**PPM**	**PP**	**Other**	**Ind.**	**Def.**
1999 (E)	UDF	29	–	66	93	–	–	–	–	0	5	0
2001	UDF	29	–	64	97	–	–	–	–	0	3	4
2003	UDF	30	–	64	99	–	–	–	–	0	0	9
2004 (E)	UDF	6	–	57	49	15	9	6	–	5	40	0
2005	DPP	1	74	53	37	3	0	0	–	0	25	68
2007	DPP	1	102	53	32	3	0	0	–	0	0	98
2009 (E)	DPP	1	114	26	17	0	0	0	–	3	32	0
2010	DPP	1	147	24	17	0	0	0	–	3	1	34
2012	PP	1	69	24	11	0	0	0	88	0	0	89
2013	PP	1	65	24	18	0	0	0	85	0	0	85

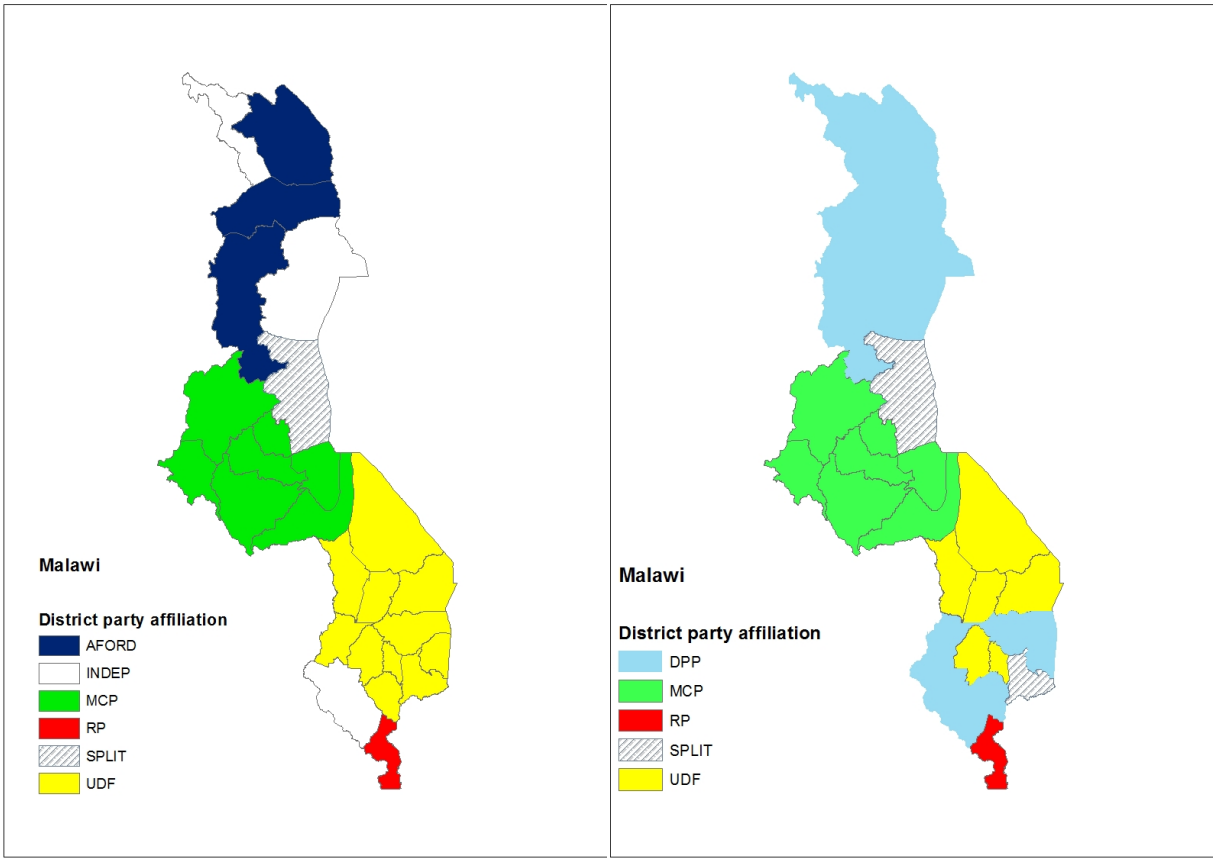
Notes: The table presents data on the composition of Parliament showing the number of seats held by each political party in the Chamber. (E) denotes a general election in that year. AFORD stands for Alliance for Democracy; DPP for Democratic Progressive Party; MCP for Malawi Congress Party; UDF for United Democratic Front; RP for Republican Party; NDA for National Democratic Party; PPM for Peoples Progressive Movement; PP for Peoples Party; Ind. is number of independent MPs; and Def. is the total number of MPs who have crossed the floor since the last elections. Entries marked '–' are years prior to the formation of the party.

An example of the impact of the reconstruction of parties through defections on aid disbursement can be shown in the period from 2004–2005. When Dr wa Muntharika abandoned the party with which he was elected president in 2004 (UDF) to form his own DPP in 2005, the DPP initially had no MPs in Parliament and had difficulties in passing policies and legislations. Through inducing defections, the DPP managed to co-opt MPs particularly from the Northern Region districts (see figure 4.4.3). As can be seen in figure (4.4.2), some of the Northern Region districts received significantly more aid than before. For the instrument to be valid, the likelihood of an MP's defection to the President's party must be unrelated with future economic growth of the constituency that they represent. Motivations for defecting may vary across defectors. In most cases, personal financial gains are the key incentive, while influential (strong veteran politicians) may be motivated by promise to hold positions of significant powers. Thus there are different types of defectors:

i) *Politically powerful MPs*: This group are veteran MPs with total control in their constituencies regardless of which party they represent and are also very influential in Parliament. Most of them have served for long periods in Cabinet positions and other positions of control, but lost such positions when the Presidency changed. For these power brokers, promise of re-appointment into the positions that accord them powers and development assistance to their districts induces their switching of parties. It is not uncommon that some politicians have crossed the floor almost at every change of government, and have kept Cabinet positions despite changes in

Figure 4.4.3: Map of political change in Malawi between 2004 and 2005

(a) Malawi political landscape 2004 (b) Malawi political landscape 2005



Notes: The figure shows the transition in district's political affiliation between 2004 (after general elections) and 2005 (when the wining president decided to form a new party). A district is said to be affiliated to a particular party if it has the largest number of MPs in the district. This transition in political affiliation occurred without a public election in 2005. MCP stand for Malawi Congress Party; AFORD is Alliance for Democracy, UDF is United Democratic Front; RP is Republican Party, DPP is Democratic Progressive Party; INDEP means the district is dominated by Independent MPs who have no party affiliation and SPLIT means there is no particular dominant party in the district.

the Presidency and ruling political parties.

ii) *Independent MPs*: Independent MPs are often people new on the political scene and are MPs who did not represent any political party in the election and won. Once elected to Parliament, they sort of become 'swing voters' in the chamber since they have no party allegiance and so are usually the first to be targeted by power-consolidating leader. They are often easily swayed by the opportunity to make quick and easy personal gains, though some may even be appointed into key positions. As the table (4.4.3) shows, almost immediately after each election, the number of independent MPs reduce rapidly to 0 in subsequent years (from 40 in 2004 and from 32 in 2009).

iii) *MPs from smaller or breakaway parties*: These are MPs from less influential parties in the Chamber which are often breakaway groups from a dominant party. For example the Table 4 shows that during 2004 election, National Democratic Alliance (NDA), which broke away from the UDF after a leadership dispute, won 9 seats and Peoples Progressive Movement (PPM) (another party formed from disputes) won 6 seats, however by 2005 when the DPP was formed and took power, they all defected and joined the new ruling party.

As a result of defection, a district/region can get favoured in aid allocation even if the district identifies with a different party. If the elected MPs in that region defect to the ruling party, then the district assumes political affinity with the President through the defected MPs[56]. Defections therefore make districts political affinity variable, and may change at any moment on grounds other than strategic or economic (at least from the districts' perspective).

4.5 Main Results

The study set out to examine the effects of foreign aid on economic activities at district level. The dependent variable in all regressions is change in the log of light density. Aside from the log of aid, all regressions include as explanatory variables the log of initial light density, the log of other public spending, log of population density, the log of rainfall and district poverty rate. All estimations also include district and year fixed effects with robust standard errors clustered at district level.

We begin by reporting results of estimation using each of the instruments separately, starting with estimation using ethnic affinity instrument, whose results are presented in table (4.5.1). For an understanding on the potential biases in estimating the effect of aid, Column 1 of the table has OLS regression results using all control variables. The OLS result suggests a positive but statistically weak relationship between the log of aid and economic growth.

[56]Note that it is also possible for defection to go the other direction (MPs with prior affinity with the President defecting to join opposition parties). In many cases this results from personal disagreements with the president. In such cases, a region that was enjoying favouritism ceases to receive preferential allocations.

Table 4.5.1: Regression results for estimation with ethnic affinity instrument

	1	2	3	4	5	6	7	8	9	10	11
	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Aid (log)	0.0637*	0.2467**	0.2460***	0.2438***	0.2530***	0.2457***	0.2462***	0.2567***	0.2568***	0.2222***	0.2695***
	(0.0338)	(0.0992)	(0.0664)	(0.0731)	(0.0680)	(0.0657)	(0.0653)	(0.0817)	(0.0794)	(0.0756)	(0.0872)
Initial light density (log)	-0.9674***	-0.9740***	-1.1155***	-1.1154***	-1.1315***	-1.1317***	-1.1315***	-1.1298***	-1.1298***	-1.1112***	-1.0297***
	(0.0739)	(0.0836)	(0.0765)	(0.0764)	(0.0737)	(0.0729)	(0.0731)	(0.0722)	(0.0726)	(0.0637)	(0.0702)
Public expenditures (log)	-0.1151*	0.0085	0.0771	0.0777	0.0783	0.0803	0.0800	0.0781	0.0780	0.0033	0.0056
	(0.0615)	(0.0566)	(0.0552)	(0.0542)	(0.0530)	(0.0534)	(0.0534)	(0.0520)	(0.0529)	(0.0633)	(0.0674)
Population density (log)	2.0102*	1.6359**	1.5571***	1.5692***	1.0738**	1.1457**	1.1108**	0.7193	0.7186	0.9616	1.1206
	(1.0225)	(0.7680)	(0.5398)	(0.5731)	(0.5299)	(0.5774)	(0.5639)	(1.1638)	(1.1453)	(1.0011)	(1.5927)
Rainfall (log)	-0.0332	-0.0916	0.0072	0.0060	0.0061	0.0040	0.0041	0.0063	0.0063	0.0483	0.0547
	(0.1052)	(0.1259)	(0.1174)	(0.1166)	(0.1178)	(0.1181)	(0.1180)	(0.1177)	(0.1176)	(0.1128)	(0.1050)
Poverty rate	0.0859	0.2078	0.2733	0.2744	0.2441	0.2392	0.2382	0.2384	0.2384	0.2618	0.1561
	(0.2079)	(0.2781)	(0.2483)	(0.2467)	(0.2531)	(0.2450)	(0.2445)	(0.2462)	(0.2461)	(0.2197)	(0.2394)
District vote share	0.0000**		0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
	(0.0000)		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Minister	0.0602			0.0072	0.0011	0.0072	0.0065	0.0029	0.0029	0.0228	0.0135
	(0.1049)			(0.0406)	(0.0399)	(0.0378)	(0.0384)	(0.0428)	(0.0424)	(0.0340)	(0.0452)
Gross primary enrolment (log)	0.8586**				0.4674	0.5259	0.5235	0.5173	0.5173	0.5501*	0.6310*
	(0.3119)				(0.4335)	(0.3518)	(0.3610)	(0.3720)	(0.3719)	(0.3211)	(0.3684)
Number of classroom buildings (log)	0.1084					-0.2144	-0.2146	-0.2700	-0.2699	0.0661	-0.3610
	(0.5553)					(0.4563)	(0.4572)	(0.4968)	(0.4989)	(0.4760)	(0.4909)
Life expectancy	0.0228						0.0021	0.0005	0.0005	0.0030	0.0288
	(0.0182)						(0.0123)	(0.0126)	(0.0121)	(0.0128)	(0.0256)
Infant mortality (log)	0.6716							-0.5423	-0.5417	-0.1693	-1.5137
	(0.9970)							(1.2613)	(1.2788)	(1.1262)	(1.3421)
Food security rate	-0.0884								0.0013	0.0113	-0.0873
	(0.0844)								(0.0794)	(0.0701)	(0.0994)
Maize production (log)	0.3848**									0.2544**	0.2870**
	(0.1441)									(0.1068)	(0.1226)
First stage effect											
Ethnic affinity		1.2250***	1.2396***	1.2932***	1.2952***	1.1736***	1.1790***	1.1570***	1.1551***	1.1453***	1.1135***
		(0.1848)	(0.1846)	(0.2224)	(0.2230)	(0.2095)	(0.2095)	(0.1942)	(0.1976)	(0.1900)	(0.2167)
Observations	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*246*
Number of id	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*26*
District-Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
Including cities	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*Y*
AR F-Test (p-value)		*0.0561*	*0.0360*	*0.0383*	*0.0361*	*0.0342*	*0.0366*	*0.0331*	*0.00707*	*0.0118*	*0.0157*
KP Wald F-stat		*12.20*	*12.25*	*11.72*	*11.78*	*11.11*	*11.17*	*11.44*	*10.86*	*11.32*	*11.37*

*Notes: The table presents results from regression of change in the log of recorded nighttime light density in each district for the period 1999 to 2013. Each observation is a district-year statistic and most explanatory variables have been transformed into natural logs. The instrumental variable used (ethnic affinity) is measured as the proportion of a district's population that belong to the incumbent president's ethnicity. Columns 1–10 do not include the two cities of Blantyre and Lilongwe while column 11 includes the two cities (two districts, namely Neno and Likoma, are also excluded from the entire sample as they were recently formed after splitting form other districts). Columns 2-10 use the preferred sample and stepwise inclusion of control variables. Robust standard errors clustered at district level in all specifications are reported in parentheses. *p<0.10, **p<0.05, ***p<0.01.*

Two-stage least squares (2SLS) results are reported in Columns 2–11, with stepwise addition of control variables. In Column 3 we add the share of votes in the district for the winning President. Column 4 adds a dummy variable for whether a Cabinet Minister is from that district. Columns 5 and 6 add measures of education in a districts. Columns 7 and 8 add health outcome variables while Columns 9 and 10 add measures of agricultural security and production. All specifications except that in Column 11 exclude the districts with the biggest cities (Blantyre and the capital Lilongwe) since, as political and administrative centers, these may behave differently.

The results in table (4.5.1) shows that ethnic affinity performs strongly as an instrument, with first stage regression statistically significant at 1% level in all specifications. When we instrument for aid using ethnic affinity, the estimate of the affect of aid on economic growth increases compared to the OLS estimate[57] of 0.0637 (about 4 times as large) and is statistically significant at 1% level across all specifications in columns 2–11.

As expected, we find that the coefficient of initial light density is negative and statistically

[57]This is discussed in detail later.

significant in all specifications, capturing a conditional convergence across districts. Public spending (that excludes aid) is found to be insignificant, which is reassuring if one is concerned that an effect on growth may operate through the President's influence on other non-development district spending. The log of gross primary enrollment is weakly significant at 10% level in the specification with all controls. Maize yield is statistically significant at 5% level, which is expected since maize is one of the key trading commodities for smallholder farmers in rural districts which generates cash incomes and hence exerts stimulus on the rural economy. Strong maize harvests have also been found to lead to lower inflation, DfID Report (2010). Column 11 has results for specification using sample that includes the cities of Blantyre and Lilongwe and as can be seen, the inclusion of these cities does not qualitatively alter our results.

Across all estimated specifications, the results indicate F-statistics of excluded instruments that range between 10.86 and 12.25 and Anderson-Rubin p-values below 0.05 accentuate the relevance of ethnic affinity as an instrument. The results indicate a robust positive effect of the log of aid on the change in light density. In the specification with all controls in column 10, we find that a 10% increase in aid causes light density to increase by 2.22% per year. Further, a standard deviation of 1.1076 for the log of aid implies that the effect of a one standard deviation increase in aid is to increase light density 25%.

Table (4.5.2) presents estimation results when the instrumental variable used to identify causal effects of aid is political switching. Following the same structure as table (4.5.1), column 1 reports baseline OLS specification results while columns 2–11 involve stepwise inclusion of the controls developing up to the preferred specification in column 10. Column 11 presents results of the preferred specification when Lilongwe and Blantyre are included in the sample.

F-statistics for instrument exclusion range from 9.069 to 10.84 in the various specifications and the Anderson-Rubin p-value below 0.05 underline the strength of the instrument used in the study.[58] The results suggest a positive and statistically significant effect of aid on economic growth across all specifications. The preferred estimation in column 10 suggests that a 10% increase in aid causes an increase in growth of light density of 1.17% per year.

[58]While in some specifications including the regression with all controls have F-statistics for instrument exclusion slightly below 10, this is of minimal concern.

Table 4.5.2: Regression results for estimation with political switching instrument

	1	2	3	4	5	6	7	8	9	10	11
	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Aid (log)	0.0637*	0.2003***	0.1378***	0.1321**	0.1284**	0.1263**	0.1260**	0.1226**	0.1211**	0.1173*	0.1357**
	(0.0338)	(0.0601)	(0.0507)	(0.0537)	(0.0556)	(0.0493)	(0.0494)	(0.0531)	(0.0541)	(0.0602)	(0.0633)
Initial light density (log)	-0.9674***	-0.9590***	-1.0932***	-1.0937***	-1.1083***	-1.1082***	-1.1085***	-1.1120***	-1.1114***	-1.0962***	-1.0113***
	(0.0739)	(0.0713)	(0.0683)	(0.0679)	(0.0679)	(0.0676)	(0.0678)	(0.0656)	(0.0660)	(0.0576)	(0.0655)
Public expenditures (log)	-0.1151*	-0.0035	0.0553	0.0587	0.0570	0.0574	0.0577	0.0614	0.0597	-0.0147	-0.0183
	(0.0615)	(0.0493)	(0.0431)	(0.0419)	(0.0406)	(0.0413)	(0.0411)	(0.0398)	(0.0394)	(0.0556)	(0.0575)
Population density (log)	2.0102*	1.9151***	2.2004***	2.2284***	1.7786***	1.7967***	1.8341***	2.2170**	2.2348**	2.1258**	1.3301**
	(1.0225)	(0.6601)	(0.4741)	(0.4892)	(0.4960)	(0.5407)	(0.5486)	(0.8916)	(0.8985)	(0.8288)	(0.8066)
Rainfall (log)	-0.0332	-0.1039	-0.0126	-0.0172	-0.0199	-0.0205	-0.0206	-0.0213	-0.0222	0.0290	0.0216
	(0.1052)	(0.1180)	(0.1127)	(0.1130)	(0.1122)	(0.1127)	(0.1127)	(0.1117)	(0.1114)	(0.1104)	(0.0952)
Poverty rate	0.0859	0.1713	0.1941	0.2029	0.1616	0.1602	0.1615	0.1665	0.1649	0.2074	0.1336
	(0.2079)	(0.2528)	(0.2143)	(0.2098)	(0.2157)	(0.2079)	(0.2057)	(0.2103)	(0.2090)	(0.1900)	(0.2025)
District vote share	0.0000**		0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000**
	(0.0000)		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Minister	0.0602			0.0331	0.0297	0.0311	0.0319	0.0341	0.0339	0.0474	0.0461
	(0.1049)			(0.0378)	(0.0374)	(0.0351)	(0.0355)	(0.0365)	(0.0364)	(0.0295)	(0.0359)
Gross primary enrolment (log)	0.8586**				0.5003	0.5125	0.5152	0.5227	0.5229	0.5561*	0.6705**
	(0.3119)				(0.4098)	(0.3304)	(0.3378)	(0.3365)	(0.3347)	(0.2948)	(0.3262)
Number of classroom buildings (log)	0.1084					-0.0443	-0.0444	0.0051	0.0147	0.3008	-0.1292
	(0.5553)					(0.4318)	(0.4318)	(0.4583)	(0.4620)	(0.4618)	(0.4222)
Life expectancy	0.0228						-0.0024	-0.0003	-0.0008	0.0022	0.0280
	(0.0182)						(0.0116)	(0.0121)	(0.0118)	(0.0134)	(0.0262)
Infant mortality (log)	0.6716							0.5994	0.6377	0.7465	-0.4163
	(0.9970)							(1.0362)	(1.0726)	(0.9389)	(1.0486)
Food security rate	-0.0884								0.0308	0.0342	-0.0453
	(0.0844)								(0.0680)	(0.0662)	(0.0754)
Maize production (log)	0.3848**									0.2685**	0.3015**
	(0.1441)									(0.1093)	(0.1246)
First stage effect											
Political switching		1.0616***	1.0275***	1.0065***	1.0057***	1.1443***	1.1424***	1.0957***	1.0933***	1.0914***	1.0914***
		(0.1432)	(0.1471)	(0.1542)	(0.1556)	(0.1837)	(0.1849)	(0.1952)	(0.1977)	(0.1952)	(0.1952)
Observations	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*246*
Number of id	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*26*
District-Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
Including cities	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*Y*
AR F-Test (p-value)		*0.00503*	*0.0230*	*0.0399*	*0.0320*	*0.0369*	*0.0383*	*0.0189*	*0.0177*	*0.01992*	*0.0323*
KP Wald F-stat		*10.13*	*9.530*	*9.166*	*9.069*	*10.13*	*9.933*	*9.150*	*9.635*	*9.741*	*10.84*

*Notes: The table presents results from regression of change in the log of recorded nighttime light density in each district for the period 1999 to 2013. Each observation is a district-year statistic and most explanatory variables have been transformed into natural logs. The instrumental variable, political switching, is measured as the proportion of Members of Parliament (MPs) in a district that defect from the party with which they won their Parliamentary seat to join the ruling President's party. Columns 1-10 do not include the two cities of Blantyre and Lilongwe while column 11 includes the two cities (two districts, namely Neno and Likoma, are also excluded from the entire sample as they were recently formed after splitting form other districts). Columns 2-10 use the preferred sample and stepwise inclusion of control variables. Robust standard errors clustered at district in all specifications are reported in parentheses. *p<0.10, **p<0.05, ***p<0.01.*

A standard deviation increase in aid causes an increase in the log of light density by 19%.

The results for estimation with political switching also shows that initial light density is statistically significant suggesting conditional convergence across districts. Public spending is not significant in all specifications while the log of gross primary enrollment is weakly significant at 10% level. The log of maize production is significant at 5%. Consistent with the literature on urbanisation and development (see Desmet and Henderson (2015)), the log of population is also found to be statistically significant implying districts with greater population density grow faster.

The preferred specification is one that uses both instruments jointly. We thus assess estimation using the two instruments jointly in the final baseline specification. The results of this over-identified estimation are reported in table 4.5.3, which takes the same structure as tables (4.5.1) and (4.5.2). The two stage least squares results reported in columns 2–11 indicate a statistically significant and positive effect of aid on growth, concurring with the results from the just-identified specifications. In particular, in the preferred model reported in column 10, a coefficient for aid of 0.1444 significant at 1% level suggests that

a 10% increase in aid causes light density to increase by 1.44% and a standard deviation increase in aid leads to a 16% increase in light density.

Table 4.5.3: Results with both instrument

	1	2	3	4	5	6	7	8	9	10	11
	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Aid (log)	0.0637*	0.2155***	0.1765***	0.1707***	0.1722***	0.1654***	0.1653***	0.1566***	0.1568***	0.1440***	0.1711***
	(0.0338)	(0.0658)	(0.0468)	(0.0506)	(0.0496)	(0.0456)	(0.0455)	(0.0508)	(0.0515)	(0.0555)	(0.0618)
Initial light density (log)	-0.9674***	-0.9639***	-1.1012***	-1.1012***	-1.1164***	-1.1159***	-1.1160***	-1.1165***	-1.1163***	-1.1000***	-1.0161***
	(0.0739)	(0.0744)	(0.0706)	(0.0702)	(0.0692)	(0.0686)	(0.0688)	(0.0666)	(0.0670)	(0.0586)	(0.0660)
Public expenditures (log)	-0.1151*	0.0004	0.0631	0.0653	0.0645	0.0649	0.0650	0.0656	0.0645	-0.0101	-0.0120
	(0.0615)	(0.0508)	(0.0464)	(0.0452)	(0.0439)	(0.0442)	(0.0441)	(0.0417)	(0.0417)	(0.0565)	(0.0587)
Population density (log)	2.0102*	1.8240***	1.9703***	2.0008***	1.5307***	1.5835***	1.5978***	1.8373**	1.8364**	1.8294**	1.533**
	(1.0225)	(0.6594)	(0.4374)	(0.4539)	(0.4408)	(0.5065)	(0.4948)	(0.8407)	(0.8465)	(0.7882)	-0.7625
Rainfall (log)	-0.0332	-0.0999	-0.0055	-0.0092	-0.0108	-0.0125	-0.0125	-0.0143	-0.0148	0.0339	0.0303
	(0.1052)	(0.1198)	(0.1133)	(0.1131)	(0.1127)	(0.1134)	(0.1134)	(0.1124)	(0.1121)	(0.1105)	(0.0967)
Poverty rate	0.0859	0.1832	0.2224	0.2276	0.1906	0.1861	0.1866	0.1848	0.1842	0.2212	0.1395
	(0.2079)	(0.2589)	(0.2233)	(0.2197)	(0.2257)	(0.2169)	(0.2151)	(0.2160)	(0.2151)	(0.1954)	(0.2099)
District vote share	0.0000**		0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000**
	(0.0000)		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Minister	0.0602			0.0242	0.0197	0.0233	0.0236	0.0262	0.0257	0.0412	0.0375
	(0.1049)			(0.0371)	(0.0366)	(0.0348)	(0.0351)	(0.0367)	(0.0366)	(0.0292)	(0.0375)
Gross primary enrolment (log)	0.8586**				0.4887	0.5169	0.5179	0.5213	0.5214	0.5546*	0.6601**
	(0.3119)				(0.4166)	(0.3348)	(0.3429)	(0.3433)	(0.3420)	(0.2997)	(0.3348)
Number of classroom buildings (log)	0.1084					-0.1000	-0.1000	-0.0646	-0.0600	0.2411	-0.1905
	(0.5553)					(0.4236)	(0.4237)	(0.4462)	(0.4496)	(0.4479)	(0.4233)
Life expectancy	0.0228						-0.0009	-0.0001	-0.0004	0.0024	0.0282
	(0.0182)						(0.0115)	(0.0121)	(0.0117)	(0.0131)	(0.0259)
Infant mortality (log)	0.6716							0.3100	0.3278	0.5134	-0.7063
	(0.9970)							(1.0289)	(1.0613)	(0.9454)	(1.0927)
Food security rate	-0.0884								0.0230	0.0284	-0.0564
	(0.0844)								(0.0668)	(0.0642)	(0.0773)
Maize production (log)	0.3848**									0.2649**	0.2977**
	(0.1441)									(0.1081)	(0.1234)
First stage effect											
Ethnic affinity		0.7160***	0.7428***	0.7244***	0.7349***	0.7831***	0.7834***	0.6284***	0.6396***	0.6249***	0.6200**
		(0.2221)	(0.2151)	(0.2154)	(0.2182)	(0.2353)	(0.2341)	(0.1981)	(0.1918)	(0.1993)	(0.2352)
Political switching		0.8480***	0.8024***	0.7985***	0.7931***	0.9247***	0.9247***	0.9288***	0.9194***	0.9221***	0.8780***
		(0.1901)	(0.1949)	(0.1968)	(0.1996)	(0.2104)	(0.2110)	(0.2223)	(0.2222)	(0.2258)	(0.2192)
Observations	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*246*
Number of id	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*26*
District-Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
Including cities	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*Y*
AR F-Test (p-value)		*0.0236*	*0.0139*	*0.0253*	*0.0172*	*0.0154*	*0.0152*	*0.0199*	*0.0180*	*0.0310*	*0.0170*
KP Wald F-stat		*14.49*	*13.61*	*13.83*	*13.91*	*14.04*	*13.90*	*12.62*	*12.84*	*13.43*	*14.20*
Hansen J (p-value)	.	*0.549*	*0.118*	*0.133*	*0.137*	*0.17*	*0.165*	*0.162*	*0.12*	*0.149*	*0.142*

*Notes: The table presents results from regression of change in the log of recorded nighttime light density in each district for the period 1999 to 2013. Each observation is a district-year statistic and most explanatory variables have been transformed into natural logs. Two instrumental variables are used, political switching and ethnic affinity as defined in earlier tables. Columns 1-10 do not include the two cities of Blantyre and Lilongwe while column 11 includes the two cities (other districts, namely Neno and Likoma are also excluded from the entire sample as they were recently formed after splitting form other districts). Columns 2-10 use the preferred sample and stepwise inclusion of control variables. Robust standard errors clustered at district in all specifications are reported in parentheses. *p<0.10, **p<0.05, ***p<0.01.*

F-statistics for instrument exclusion range from 12.62 to 14.49 while Anderson-Rubin p-values are all below 0.05, attest to the strength of the identification strategy in our preferred specification. Further in this specification we also test whether excluded instruments are jointly valid i.e. uncorrelated with the error term and correctly excluded from the estimated equation, using the Hansen J-statistic. As can be seen in the table, the p-value of the Hansen J-statistic is between 0.12 and 0.55, implying that we fail to reject over-identifying restrictions in all the specifications. Failure to reject the null hypothesis provides support that the instruments satisfy the required orthogonality conditions. For further reassurance about the results in our preferred specification, we also estimate using GMM methodology. The results of this estimation are reported in the appendix table (4.B.4) and are similar to the ones we find using two stage least squares methodology.

Concerns about the test for joint exogeneity of the instruments used may arise if the instruments used are all affected by some bias of the same sign and magnitude implying

that any possible failure of the exclusion restriction of any instrument would mean that there is a potential direct effect of that instrument on a districts light density. For both instruments, the study conducts a number of robustness checks which are reported in subsequent sections and will show that this is very unlikely to be the case.

4.5.1 Discussion of the main results

The results of estimation using the preferred specification show that the estimated effect of aid on light density is over twice as large as the OLS coefficient. Similarly, the coefficient for political affinity is close to 3 times that of the OLS while for ethnic affinity it is about 4 times as large. A plausible explanation for this disparity in the coefficients is that it may be caused by the classic measurement error. Other studies (see Dreher and Lohmann (2015)) also report similar increase in the estimated effect between OLS and 2SLS results. Most of the data on aid in a district was collected during the Malawi Geocoding project in 2008 on ongoing projects, some planned/future projects and completed projects (historical data) from 1996. With the state of record keeping in Malawi, as in most developing countries, it is very unlikely that these records, particularly for the historical or completed projects, were accurate. Thus it is highly likely that aid may be measured with error. With the classical measurement error, there is attenuation bias of the estimated OLS effect. The use of instruments should help overcome the concerns.

Another possible concern that may explain the disparity between the OLS and IV results is due to omitted variables. In all the specifications estimated in this study, district as well as year specific fixed effects are controlled for. Year fixed effects account for secular variation in both aid and light density that affect all districts similarly. These may include improvement in satellites and their settings or reduction in aid due to withdrawal of foreign assistance. District fixed effects account for time invariant variation in light density across districts. Nevertheless, it is possible that other time varying factors that may affect the effect of aid on light density are still omitted and could confound the effect of aid on growth, making the IV estimates larger than the OLS coefficient. Robustness checks reported in the next section add various variables to the baseline specification in order to test if there is any confounding effect on the baseline results. As will be reported we find that even after adding such variables, the coefficient for aid remains statistically

significant and similar in magnitude to the baseline results.

In summary, the disparity between the IV and OLS estimates may just be as a result of the classical measurement error. Results to be presented in the next segment will reveal that the first stage estimates remain very strong and second stage coefficients also remain robust and not significantly different from the baseline results with little worry of confounding effects.

As reported, the estimated effect of aid using our preferred specification shows that a 10% increase in aid causes light density to increase by 1.44% per year. Compared to previous findings in the literature, our estimate of the effect of aid is somewhat lower than the result in Galiani et al. (forthcoming), however this discrepancy may be explained by our focus on one of the poorest of low income countries. A standard deviation increase in aid leads to an increase in light density by 16%. This is over a one standard deviation of the district level aid flows. Our results are also similar to the findings of Dreher and Lohmann (2015), when they disaggregate their results and estimate according to continents and income status. Results reported (in table 6 of their paper) for Sub-Saharan Africa (SSA) and least developed countries (LDC) also find a statistically significant and positive effect of aid on growth at the subnational level. The effect of aid on growth is, in absolute terms, qualitatively important for short run growth.

Noteworthy to mention a possible problem with dynamic panel data models with fixed effects, particularly in the context of small number of time series observations per panel unit (T) and large number of explanatory variables. This is popularly known as the *Nickell bias* (Nickell (1981)). As Nickell shows, the bias arises because the demeaning process, which subtracts the individual mean value of the dependent and each independent variable from the respective variables, creates a correlation between regressor and error term. As in most aid-growth studies, we do not address this potential bias (usually done through first differencing); however as Nickell (1981) demonstrates, the size of the bias diminishes as T increases;[59] our study period covers 15 years with about 11 observations on average, which is reasonably large enough.

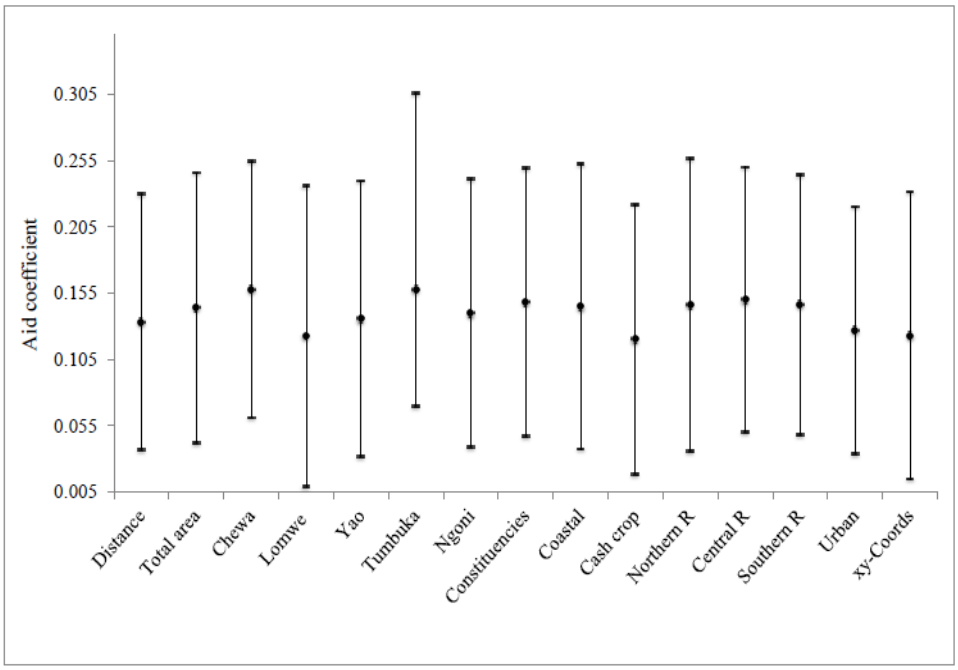
[59]Nickell (1981) demonstrates that the size of the inconsistency, as the number of explanatory variables increases, is of order $1/T$ which may be quite sizable in a "small T" context.

4.6 Robustness Checks

The study set out to test the causal effects of aid on economic activities at district level in Malawi, with light density used a proxy for economic activity. The findings, using instrumental variable approach, reveal that aid has a statistically significant positive effect on light density. As mentioned previously, potential concerns may arise if there are some omitted variables that may be correlated with both the amount of aid a district receives and also light density and thus confound the effect of aid. In order to check the robustness of the findings, we conduct a number of estimations using the preferred specification and sample, and adding some more variables that may affect both the allocation of aid or indeed affect light density in a district to examine if they alter the findings.

Tables 4.B.5 and 4.B.6 present results of these checks (to assist with the discussion, figure 4.6.1 gives a visual presentation of the results from the robustness checks). Note that a number of the variables used in the robustness checks are time-invariant, hence to enable fixed effects regression we interact these variables with time effects (year dummy).

Figure 4.6.1: Results from robustness checks



A source of concern may be proximity to Malawi's capital (Lilongwe), where most international donors have offices. Districts close to Lilongwe would receive more aid because they have lower transaction costs of delivering aid and donors could have greater exposure

to these areas. Further, such districts may benefit from spillover of urbanization from the capital city and hence have higher light density. Column 1 of the table 4.B.5 controls for the log of distance from each district to the capital city. Similarly, potential concerns may be that the effect of aid is confounded by the size of a district. Large districts with a vast expanse of land, such as Mzimba district, have communities sporadically located meaning increasing the cost of delivering aid and so may receive more aid. Additionally, larger district size may allow for higher population growth which can lead to more aid and also affect light density. Column 2 shows results for specification with total land area for each district.

To test whether ethnicity may still play a role in growth other than through favoritism in allocation of aid, columns 3–7 look to account for the possible economic differences between ethnicities. To do this, we include a dummy variable for equal to 1 if a district population majority is of that ethnicity.[60] Additionally, the political switching instrument is measured by the number of MPs that switch to the president's political party. Since there is heterogeneity across districts on the number of constituencies, one may suspect that districts with more constituencies (and hence more MPs to switch) may receive more aid. Column 8 has results for inclusion of number of constituencies. As table (4.B.5 shows, adding these variables does not alter the baseline results significantly.

Lake Malawi is the center of the country's tourism industry. As such districts along its coast may benefit from preferential tourism-specific investments and may have higher light density than other districts. Table (4.B.6) column 9 includes a dummy for whether a district borders Lake Malawi. Column 10 includes a dummy for districts that grow one of the major cash crops in Malawi namely tobacco, tea, cotton and sugar. Since the cash crops are Malawi's main source of exports, cash crop growing districts may receive preferential agriculture aid allocation as a way of boosting production for the economy. The results suggest that neither being coastal nor growing a cash crop significantly changes the results.

Malawi is divided into 3 administrative regions; Northern, Central and Southern region. We therefore include a dummy variable for each region, taking the value 1 for districts

[60]Includes 5 dummy variables, one each for Chewa, Lomwe, Yao, Tumbuka and Ngoni, the major ethnic groups in Malaw that make up about 85% of Malawi's population.

in a particular region to capture any shocks that may go beyond the district level onto a more aggregate level. The possibility of regional shocks is exacerbated by the nature of ethnic locations across Malawi. As figure 4.4.1 shows, ethnic boundaries go beyond districts with a single race or combination of few races occupying an entire region. As a result, shocks that may arise due to ethnicity factors may go beyond district boundaries to regional level. The results in columns 11-13 show that inclusion of regional dummies does not significantly alter the baseline results.

Similarly, further administrative differences between districts since regulations differ with regards to collection and use of locally generated revenues across different type of councils (city and town councils vs. district councils).[61] Column 14 introduces a dummy variable that takes the value 1 if a district has a town (or municipal) council rather than just a district council. City and town councils are allowed to collect and use more domestic revenues, for example through city rates or town council levies. District councils do not collect such revenues. As such, one can expect town councils to have higher light density than district councils. Moreover, districts that have townships have a higher proportion of urban households within the townships, and hence such districts may receive more aid than other districts since it is more difficult to deliver aid in rural areas. Again, we observe that controlling for this has no significant effect on the role of aid.

Another possible source of bias may be if there is some heterogeneity across districts due to features that may differ on a minor geographical scale, for example, if agricultural productivity varies beyond some particular latitude or longitude due to topological variation. In column 15 are results for estimation with inclusion of controls for latitude and longitude (we only show the results for the 4th polynomial) and the results also show no significant difference from the baseline results.

The final robustness check conducted pertains to the dependent variable used. Despite gaining prominence among economists in empirical growth studies use of luminosity as a measure of output growth or economic activity has not gone without facing some concerns. Chen and Nordhaus (2011) , conducting study on African countries and cautioned that the

[61]Currently, Malawi has 4 cities though the major ones are Lilongwe and Blantyre (the other two are Zomba, the old capital of Malawi and Mzuzu city, the in the Northern region). These two 'minor' cities are also just classified as towns in the study. There are also 2 municipal councils (Kasungu and Luchenza) and 8 townships namely Dedza, Karonga, Kasungu, Luchenza (inThyolo district) Mangochi, Balaka, salima and Zomba town.

relationship between luminosity and output may be uncertain outside of highly populated areas, where the luminosity data is dominated by noise. Cogneau and Dupraz (2014) in their critique of Michalopoulos and Papaioannou (2013) argue that when population effects on light density are not properly and carefully accounted for, the estimation results may be misleading. Cogneau and Dupraz (2014) further argue that light per capita (calculated as log light intensity minus log population) is a better predictor of GDP per capita than light density.

Other than including population density in all the specifications, estimation with light per capita as the dependent variable is conducted. The results of this examination are shown in table (4.B.7) in the appendix. The first column of table reports fixed effects OLS estimation results, while columns 2–4 report results for the IV estimation using our preferred sample. In column 5 are results from the preferred specification but with a sample that includes Lilongwe and Blantyre. As shown, our results still find a statistically significant and positive effect of aid on the change in light density.

4.7 Extensions

We have detailed information on each aid project in addition to the geographical detail including the type of project and the nature of the funding (whether a loan or a grant; whether multilateral or bilateral donor). Further, one of the advantages of our identification strategy is that it provides a way of isolating the variation in aid disbursement to different districts over time. We can thus look to understand impact of aid on growth over time.

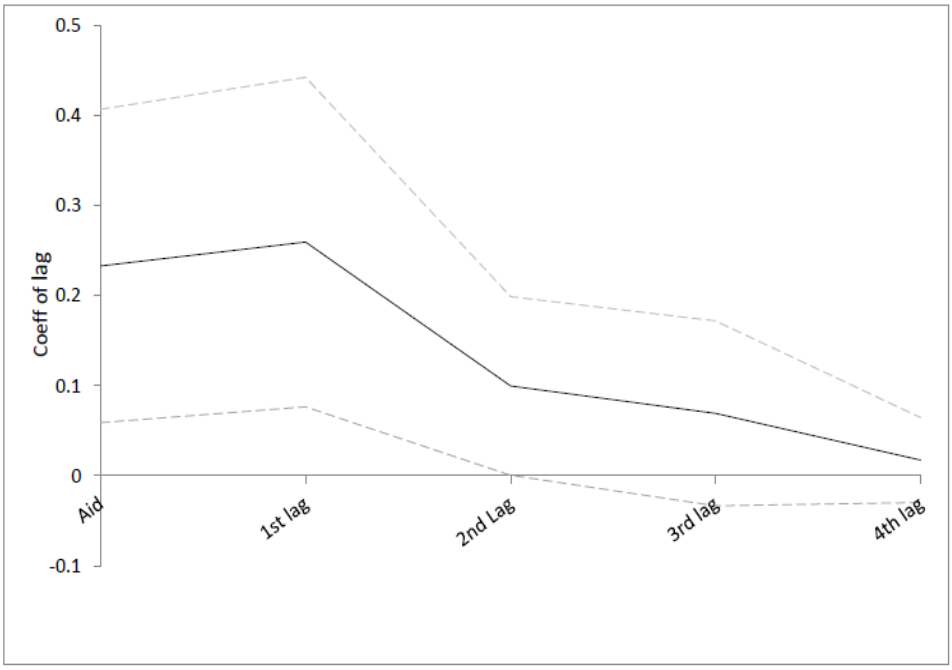
4.7.1 Time lags

In the first extension, the study considers the possibility that the levels of light density in a district at a given time may be influenced by aid received in previous periods. It is plausible some time lags from the time aid is received to the time that its effects can be captured in changes in light density for example through investment (e.g. construction of houses or plants) or private consumption (e.g. electronic devices). Further, it is natural to expect that investments in such sectors as health and education should affect economic

growth over the long run i.e. beneficiaries may not immediately be engaged in economic activities so their contribution to growth/light density may best be captured in later periods.

In table (4.B.9), we add lags of 1 to 4 years separately at first to the preferred specification from Table 4.5.3. The results suggest a hump-shaped response of growth to an increase in aid flows, with a peak effect at one year since the aid was disbursed. Figure (4.7.1) provides a visual presentation of the results from regression with lags, with a 95% interval enclosing. The full specification with five lags, in Column 7, shows that the impact of aid is to increase contemporaneous growth, but that the impact of aid lagged one year is greater.

Figure 4.7.1: Results for estimation with lagged aid



A standard deviation increase in the log of current aid causes an increase in change in light density by 25% while a standard deviation increase in the first lag of aid increases light density by 30%. Aid allocated two years previously is statistically significant but quantitatively less strong. At 3-4 years lagged, aid disbursements no longer have an impact on growth.

4.7.2 Project type

The next extension utilises information available pertaining distribution of aid across different implementing sectors within districts. We therefore examine the effects of aid allocated to targeted outcomes for the three major sectors of health, education and agriculture.[62] These sectors have been chosen as they have been the most aided sectors in Malawi, and collectively received about 56% of all total aid disbursed during the study period. The results of estimation of this specification are presented in table (4.7.1).

Table 4.7.1: Regression results for estimation using aid to the three sectors of Agriculture, Education and Health

	Agriculture 2SLS	Education 2SLS	Health 2SLS
Sector aid	0.2831*	0.1204**	0.0220
	(0.1519)	(0.0591)	(0.0619)
Initial light density	-1.1411***	-1.2751***	-1.2852***
	(0.0857)	(0.0935)	(0.0642)
First stage effect			
Ethnic affinity	0.9539***	0.3947*	0.6024
	(0.3278)	(0.2002)	(0.4069)
Political switching	0.4511**	1.1569***	1.0957**
	(0.1998)	(0.2430)	(0.4851)
Observations	*167*	*173*	*166*
Number of id	*24*	*24*	*24*
District-Year FE	*Y*	*Y*	*Y*
Including cities	*Y*	*Y*	*Y*
AR F-Test (p-value)	*0.0088*	*0.00491*	*0.047*
KP Wald F-stat	*10.85*	*10.47*	*8.342*
Hansen J (p-value)	*0.848*	*0.665*	*0.181*

*Notes: The table presents results from regression of change in the log of recorded nighttime light density in each district for the period 1999 to 2013, using the preferred specification, for aid disbursed to the Agriculture, Education and Health sectors in each district. Full table presented in the appendix (table 4.B.10). *p<0.10, **p<0.05, ***p<0.01.*

The first results column shows estimation with aid to agriculture sector; the second shows estimation with aid to education sector and the last shows estimation with aid to the health sector. As the table shows, our instruments perform relatively well for each of the sectors, apart from there is no connection between ethnic affinity and health aid.

The largest coefficient is on aid to agriculture which makes sense given the importance

[62] In later iterations, I intend to include in the analysis economic governance as well as water and sanitation sectors as they also receive significant amounts.

of agriculture to the Malawian economy (a 10% increase in agriculture aid causes an increase in economic growth by 2.8% per year). However, the statistical significance for aid to agriculture sector is relatively weak. The most statistically significant impact on growth is from aid for education projects. Much of the aid to the education sector finances investment in education infrastructure (such construction of classrooms), which may help explain the stronger effect on the growth of light density.

The results suggest no apparent connection between aid for health projects and growth in the short run. This result for health aid may be because it takes a longer time for improvements in needs that aid to the health sector mainly target, such as like infant mortality, disease prevalence and prevention, to be reflected in economic growth. To illustrate this point, we take lags of health aid and examine their effects on change in light density.

Figure 4.7.2: Results for estimation with lags of health aid

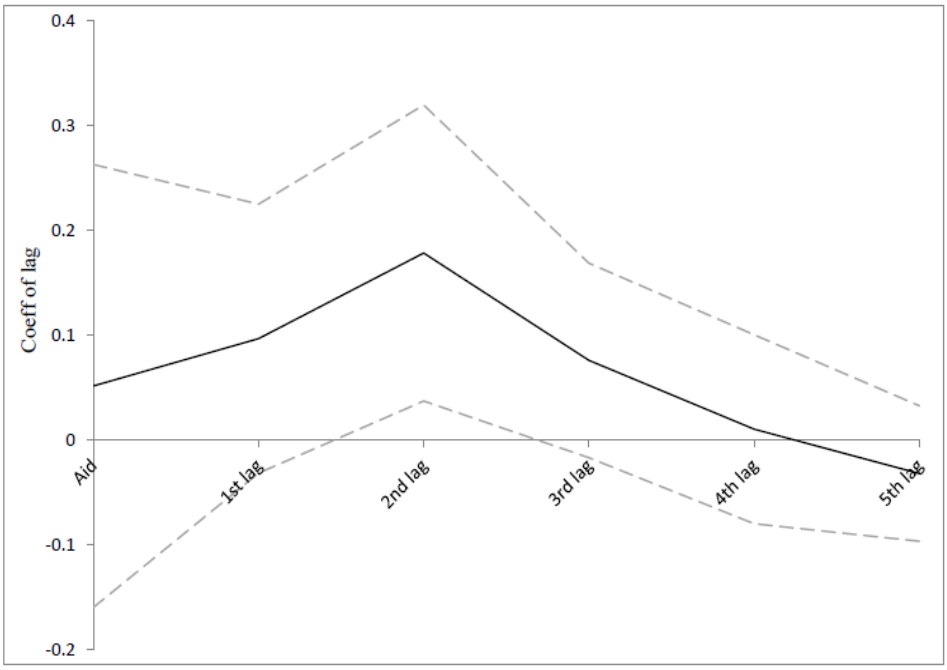


Figure (4.7.2) provides a visual illustration of the results. The effect of health aid peaks with the second lag. The results reveal a weakly positive effect of health aid on growth, being statistically significant at 10% level. The largest coefficient is for the second lag, which is also strongly significant at 5% level. The third lag of health aid is weakly significant (at 10% level) while the fourth and fifth lags are found to have no significant effect on growth. We saw in the first extension (section 4.7.1) a hump-shaped effect of total aid on light density over time, peaking at the first lag; figure (4.7.2) similarly illustrates

a hump-shaped effect for health aid over time, but it takes up to the second lag to realise the largest effect.

4.7.3 Funding type

A further analysis examines the effect of different types of aid on light density in a district. The results of this estimation are reported in table 4.7.2. The regressions use the preferred sample and specification with both instruments to test the causal effects of grants, loans, bilateral aid and multilateral aid on light density. The table reports specification with bilateral aid in the first column, multilateral aid in the second column, the third column has results for grants and the last column reports results for loans. The instruments work well in each of these types of aid except for loans, which has a weaker connection to aid flows. A possible explanation for this may be that loans attract more accountability and oversight as they require Parliamentary approval (for the government to incur a loan), a process that may include revealing information on not only the source of the funds but also the intended projects and their beneficiaries. Further, often donors who make loans place conditions and will likely monitor the internal allocation and performance of the project much more closely than a grant.

Table 4.7.2: Regression results for estimation using types of aid

	Bilateral aid 2SLS	Multilateral aid 2SLS	Grants 2SLS	Loans 2SLS
Aid	0.3246**	0.2580**	0.3622**	0.1431*
	(0.1318)	(0.1013)	(0.1524)	(0.0629)
Initial light density	-1.2339***	-1.0763***	-1.2935***	-1.0135***
	(0.0800)	(0.1147)	(0.0913)	(0.0976)
First stage effect				
Ethnic affinity	0.9795**	0.4453*	0.6327**	0.1949
	(0.4198)	(0.2426)	(0.2936)	(0.2400)
Political switching	0.471**	0.9315***	0.7833**	0.4595*
	(0.2918)	(0.2288)	(0.3085)	(0.2000)
Observations	*189*	*198*	*204*	*191*
Number of id	*24*	*24*	*24*	*24*
District-Year FE	*Y*	*Y*	*Y*	*Y*
Including cities	*Y*	*Y*	*Y*	*Y*
AR F-Test (p-value)	*0.0245*	*0.00232*	*0.0246*	*0.0828*
KP Wald F-stat	*9.45*	*9.763*	*10.557*	*7.735*
Hansen J (p-value)	*0.977*	*0.399*	*0.529*	*0.219*

*Notes: Notes: The table presents results from regression of change in the log of recorded nighttime light density in each district for the period 1999 to 2013, using the preferred specification, for aid disaggregated into different types funding namely bilateral, multilateral, multilateral, loans and grants. Full table presented in the appendix (table 4.B.11).. *p<0.10, **p<0.05, ***p<0.01.*

As shown in table (4.7.2), coefficients for grants, bilateral and multilateral aid are strongly significant (at 5% level) while the coefficient for loans is weakly significant, at 10% level. Grants have the biggest coefficient (0.218), implying that a 10% increase in grants causes

an increase in light density of 3.6% annually. It is hence little surprise that Malawi's key aid policy strategy emphasises the Malawi government's preference for official development assistance take the form of grants: *"In terms of official development assistance, the Government's policy is that as much as possible development support should be in form of grants"* (Malawi Government (2014), pp 38). Bilateral aid is shown to have a larger short-run impact on growth than multilateral aid.

4.8 Conclusion

This chapter conducts an examination of the effects of foreign aid transfers on economic growth, complementing the existing body of literature by evaluating aid effectiveness at a disaggregated level. Much of the empirical literature on aid has focused on country-level growth effects, leaving an important gap in evidence at the regional level. By bringing the macroeconomic analysis of the effects of aid to the sub-national level, we contribute to the aid effectiveness literature by helping fill this gap. Our regressions used geo-coded data of 623 projects across Malawi's 28 administrative districts for the period 1999-2013.

Using two novel instruments that exploit Presidential powers to influence aid allocation across districts, separately at first and then together in the preferred specification, we show evidence of a robust and qualitatively significant positive effect of aid on contemporaneous growth at the district level. Malawi is among the poorest of the LICs, but the apparent success of aid in causing growth in this country, as shown through our results, suggests that some of the pessimism regarding aid effectiveness that has emanated out of the mixed empirical evidence in recent years may have been misplaced. In focusing the disbursement of aid within one country, we have developed a new way of isolating the causal relationship between the flow of aid and the rate of growth.

Additionally, we go beyond the baseline analysis and disaggregate aid flows into different categories including types (loan or grant) or implementing sectors (agriculture, health and education) as well as type of funding organisation (bilateral or multilateral). Our results reveal that the identification strategy performs relatively well for all the categories except for aid to the health sector as well as aid in the form of loans. We find statistically significant and positive effect on growth for bilateral and multilateral aid as well as grants.

Loans are found to be weakly connected to changes in economic growth. The study also finds significant effect of aid to the agriculture and education sectors on economic growth, while it takes longer for the effects of health aid to be reflected in changes in economic growth. Our results have implication on Malawi government policy with regards to receipt of aid and its use; the governments policy on aid should be aimed at negotiating for more grants.

Furthermore, our identification strategy provides a way of isolating the variation in aid disbursement across districts over time, which allows us to analyse the effects of aid on growth over time. In this regard, we estimate the effects of aid received in previous periods on current growth and the results reveal a hump-shaped response up to two years after the initial disbursement.

Our results build on recent findings of Galiani et al. (forthcoming) who find a positive, statistically significant and sizable effect of aid on growth. The magnitude of the estimated aid effect (using our preferred specification) that we find is smaller that they report, but this may be explained by our focus on one of the world's poorest countries. The results are also similar to those reported by Dreher and Lohmann (2015) when they classify their sample according to continents and country income-classification. For SSA and LDCs (which both suit Malawi's classification), they show a significant positive effect of aid.

The identification strategy we employ is particular to the political and institutional environment in Malawi. Broadly there is already significant evidence on the role of ethnicity, particularly in African political and development studies, most commonly via a leader's birthplace (see Hodler and Raschky (2014), Francois et al. (2015)). The instrument based on political defections has not been tried in other countries, as such there is room for more research that can analyse how political incentives that lead to defections may affect the growth process.

Appendix

4.A Figures

Figure 4.A.1: Skewness of the Aid variable

(a) Distributed Aid (b) Log of Aid

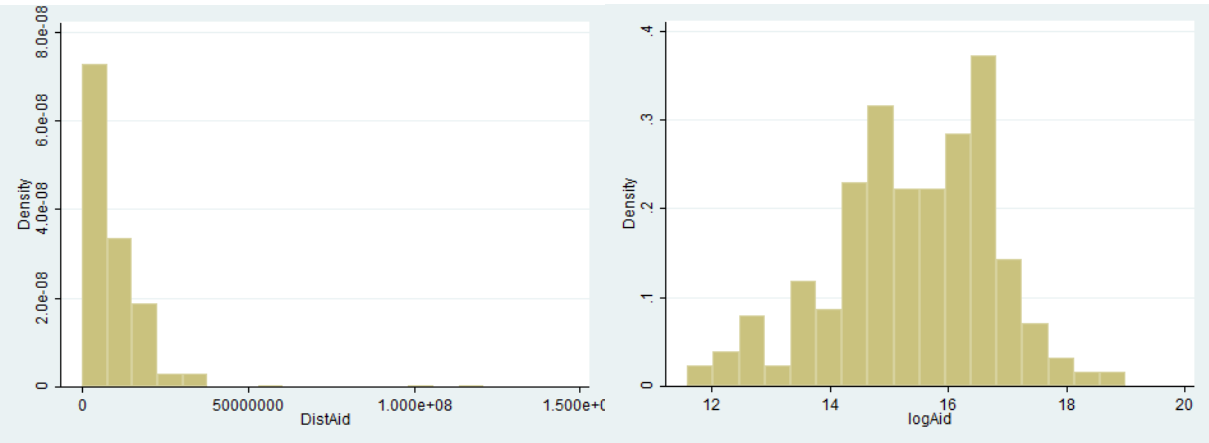


Figure 4.A.2: Skewness of the Light intensity variable

(a) Sum of pixels (b) Log of pixels sum

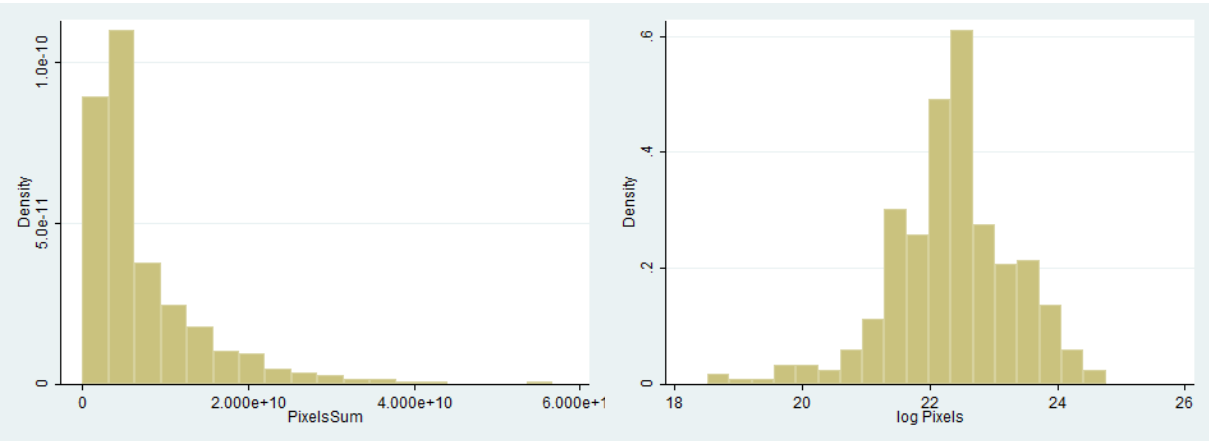
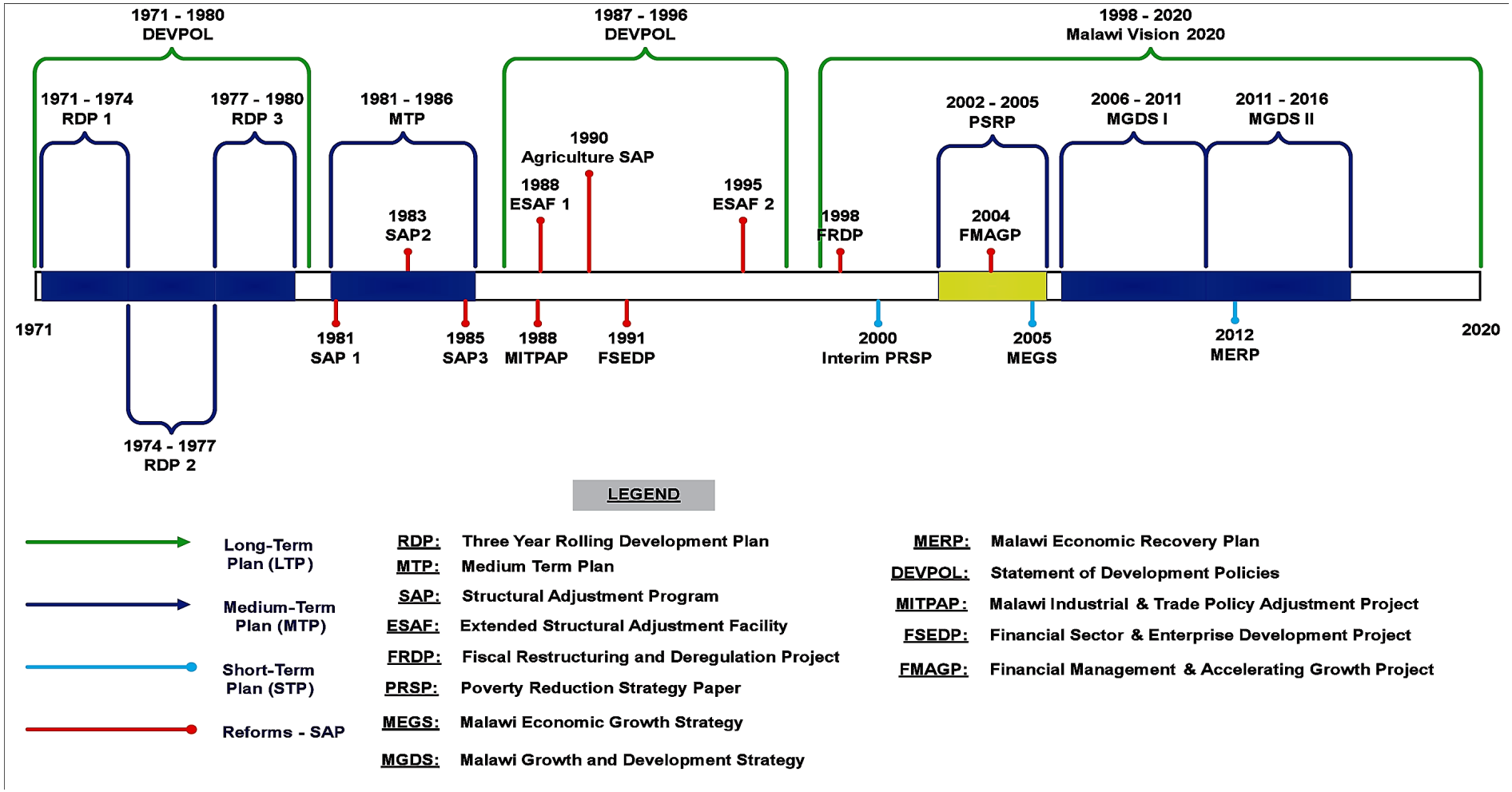


Figure 4.A.3: Malawi development policies and reforms (1970-2020)



Notes: Figure from Chirwa and Odhiambo (2016).

Figure 4.A.4: Zoomed in image of Lilongwe (2013)

Figure 4.A.5: Lagged agriculture aid

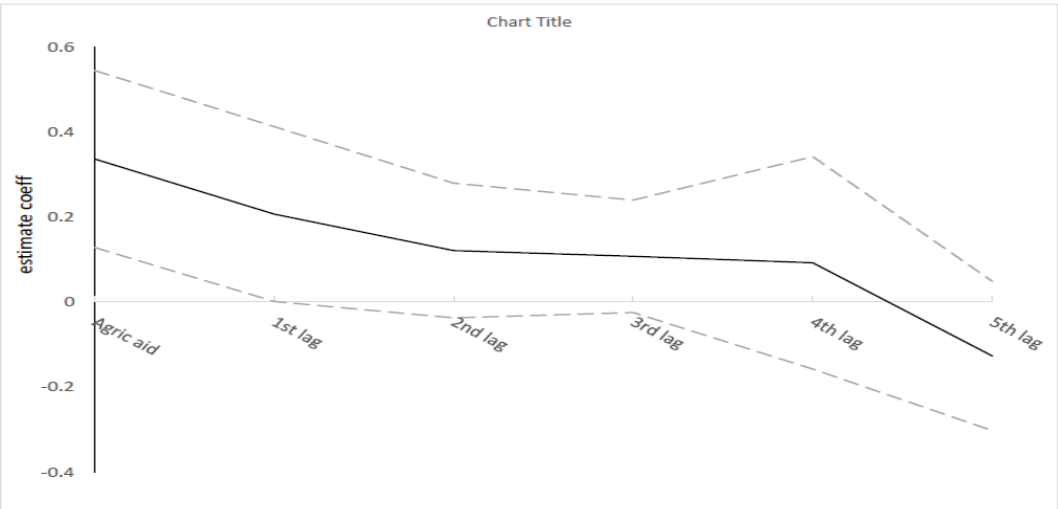
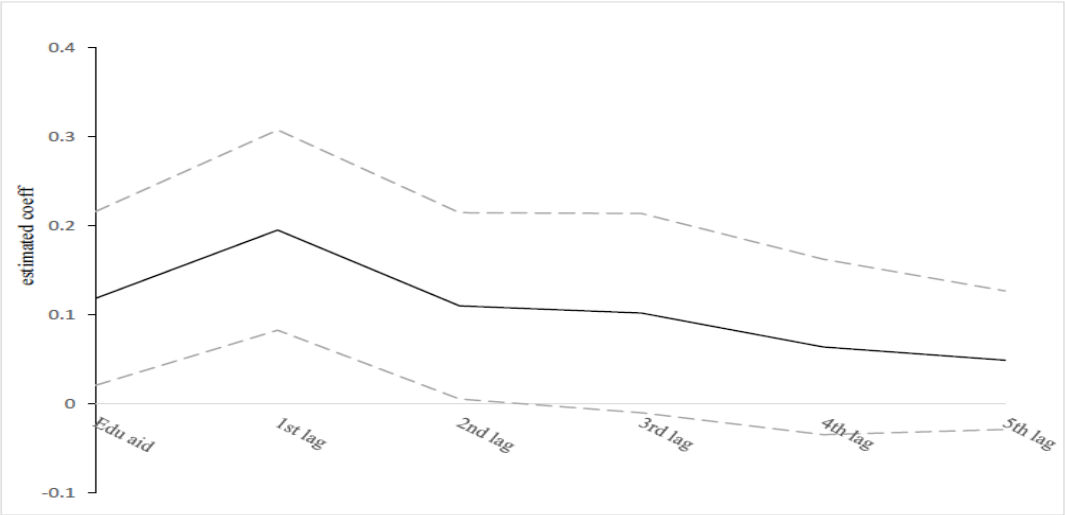


Figure 4.A.6: Lagged education aid



4.B Tables

Table 4.B.1: List of Malawi districts used in the study

Region	Districts (Full sample)	Districts (Prefered sample)
Northern	Chitipa	Chitipa
	Karonga	Karonga
	Likoma	
	Mzimba	Mzimba
	Nkhatabay	Nkhatabay
	Rumphi	Rumphi
Central	Dedza	Dedza
	Dowa	Dowa
	Kasungu	Kasungu
	Lilongwe	
	Mchinji	Mchinji
	Nkhotakota	Nkhotakota
	Ntcheu	Ntcheu
	Ntchisi	Ntchisi
	Salima	Salima
Southern	Balaka	Balaka
	Blantyre	
	Chikwawa	Chikwawa
	Chiladzulu	Chiladzulu
	Machinga	Machinga
	Mangochi	Mangochi
	Mulanje	Mulanje
	Mwanza	Mwanza
	Neno	
	Nsanje	Nsanje
	Phalombe	Phalombe
	Thyolo	Thyolo
	Zomba	Zomba

Notes: The table lists Malawi's administrative districts. In the full sample column, are all the 28 districts while in the preferred sample column has the 24 districts that are used in the main/preferred specification.

Table 4.B.2: Data descriptions and sources

Variable	Description	Source	Years
Light density	Average nighttime light intensity per district	National Geographical Data Centre (http://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html)	1999 - 2013
Distributed aid	Amount of aid distributed to each district, measured in million US dollars.	Malawi Ministry of Finance's Aid Management Platform (AMP) and AidData (http://www.aiddata.org)	2000 - 2013
Political Affinity	The proportion of Members of Parliament in a district who defected from their political party to join the ruling party.	Malawi Electoral Commission (MEC) Reports and Hansards from the Malawi Parliament Library	1999, 2004, 2009
Ethnic Affinity	The proportion of a district's population that belong to the same ethnicity as the ruling President	National Statistical Office (NSO) population census reports (http://www.nsomalawi.mw)	1999 and 2008
Population density	Estimate of a district's population density (number of people per square kilometre).	National Statistical Office (NSO) population census reports (http://www.nsomalawi.mw)	2000 and 2008
Public expenditures	Estimate of all available financing at district level including central government transfers, but excludes foreign aid.	National Local Government Finance Commission (NLGFC) annual reports	2004 - 2013
Poverty rate	Percentage of population per district whose incomes are below the international poverty line ($1.25/day)	NSO's Integrated Household Surveys (IHS); Demographic and Health Surveys and Living standards Management Surveys	2000, 2004, 2010
Rainfall	Estimated amounts of rainfall received in each district.	Meteorological reports from Weather stations across Malawi	1999 - 2013
Minister	Dummy variable that which takes the value 1 if a district is home to a current Cabinet member, or 0 otherwise	Various reports from the Office of the President and Cabinet (OPC); Parliamentary Hansards	1999 - 2013
Constituencies	Total number of constituencies in district	Parliamentary Hansards	1999 - 2013
Distance from Lilongwe	This is an estimated distance from each particular district to the capital city (Lilongwe)	Google maps (https://www.google.co.uk/maps	
Total land area	Estimated total land area in each district	Google maps (https://www.google.co.uk/maps)	
District vote share	The share of votes that a winning president received from each district in a general election	Malawi Electoral Commission (MEC) Reports	1999, 2004, 2009
Gross primary enrolment	Number of student enrolled in primary school relative to the population of school going children in a district	Ministry of Education, Science and Technology reports from the Education Management Information System (EMIS)	1999 - 2013
Number of classroom buildings	Total number of building used as classrooms in a district	Ministry of Education, Science and Technology reports from the Education Management Information System (EMIS)	2000 - 2013
Life expectancy	Estimated average life expectancy of the population in a district	NSO's Integrated Household Surveys (IHS); Demographic and Health Surveys and Living standards Management Surveys	2000, 2004, 2010
Infant mortality	Estimated number of deaths of infants (under 1 year) per 1000 live births in a district	NSO's Integrated Household Surveys (IHS); Demographic and Health Surveys and Living standards Management Surveys	2000, 2004, 2011
Food insecurity rate	Proportion of the population in a district who are reported to have inadequate food to sustain them throughout the year	NSO's Integrated Household Surveys (IHS); Demographic and Health Surveys and Living standards Management Surveys	2000, 2004, 2012
Maize production	Estimated yield of Malawi's staple food (Maize) per district	Ministry of Agriculture and Food Security's Annual Crop Yield reports.	1999 - 2013

Table 4.B.3: District level descriptive statistics

				Percentiles		
	Obs	Mean	Std. Dev.	25th	50th	75th
Change in light density	310	0.0760	0.4759	-0.1838	0.0363	0.3219
Initial light density	335	14.3295	0.8946	13.1657	14.4312	14.9007
Distributed aid	252	15.6832	1.1076	15.0614	15.7485	16.4323
Political switching	360	0.3482	0.4443	0	0	0.8600
Ethnic affinity	360	0.2666	0.3073	0.0100	0.0900	0.6100
Public expenditures	336	14.0118	0.9927	13.1954	14.0870	14.8704
Population density	360	4.7839	0.6475	4.3432	4.8315	5.1841
Poverty rate	360	57.7719	13.201	47.7	57.3	67.2
Rainfall	336	6.8324	0.2999	6.6380	6.8243	7.0475
Winning president's vote share	360	54.7473	28.2016	27.3388	54.4093	81.8651
Minister	360	0.5361	0.4994	0	1	1
Total land area	336	8.0176	0.5768	7.6608	8.1184	8.3602
Gross primary enrollment	335	11.5109	0.6026	11.1838	11.4755	11.8864
Number of classroom buildings	335	6.8623	0.3951	6.6080	6.8211	7.0825
Life expectancy	360	47.6679	4.3921	44.33	46.89	50
Infant mortality rate	336	4.4389	0.3269	4.2529	4.4015	4.5508
Food security rate	360	48.2192	17.073	36.05	46.7	61.7
Maize production	336	11.1357	0.6804	10.7866	11.1856	11.5834

Notes: The table shows summary statistics of the main variables used in the analysis. Variables are means over 24 districts, excluding the major cities of Lilongwe and Blantyre as well as recently formed district of Neno and Likoma.

Table 4.B.4: Results with both instrument (GMM estimation)

	1	2	3	4	5	6	7	8	9	10	11
	OLS	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM
Aid (log)	0.0637*	0.1999***	0.1710***	0.1609***	0.1691***	0.1595***	0.1598***	0.1483***	0.1494***	0.1508***	0.1754***
	(0.0338)	(0.0605)	(0.0466)	(0.0502)	(0.0496)	(0.0455)	(0.0454)	(0.0505)	(0.0513)	(0.0553)	(0.0618)
Initial light density (log)	-0.9674***	-0.9486***	-1.0825***	-1.0821***	-1.1000***	-1.0977***	-1.0977***	-1.0914***	-1.0945***	-1.0786***	-1.0151***
	(0.0739)	(0.0698)	(0.0696)	(0.0690)	(0.0685)	(0.0678)	(0.0680)	(0.0649)	(0.0658)	(0.0567)	(0.0660)
Public expenditures (log)	-0.1151*	-0.0029	0.0709	0.0730	0.0787*	0.0788*	0.0786*	0.0766*	0.0746*	-0.0107	-0.0229
	(0.0615)	(0.0505)	(0.0462)	(0.0449)	(0.0431)	(0.0434)	(0.0434)	(0.0411)	(0.0413)	(0.0564)	(0.0584)
Population density (log)	2.0102*	1.8837***	1.9098***	1.9646***	1.4965***	1.5373***	1.5022***	1.7926**	1.7818**	1.6321**	1.1901**
	(1.0225)	(0.6518)	(0.4357)	(0.4533)	(0.4403)	(0.5058)	(0.4916)	(0.8403)	(0.8459)	(0.7763)	(0.6014)
Rainfall (log)	-0.0332	-0.1069	0.0409	0.0324	0.0189	0.0229	0.0230	0.0239	0.0232	0.0880	0.0676
	(0.1052)	(0.1193)	(0.1094)	(0.1097)	(0.1113)	(0.1115)	(0.1114)	(0.1100)	(0.1100)	(0.1040)	(0.0946)
Poverty rate	0.0859	0.1620	0.2701	0.2654	0.2630	0.2403	0.2376	0.2502	0.2493	0.2648	0.1744
	(0.2079)	(0.2565)	(0.2212)	(0.2183)	(0.2216)	(0.2146)	(0.2130)	(0.2124)	(0.2118)	(0.1930)	(0.2090)
District vote share	0.0000**		0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000**
	(0.0000)		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Minister	0.0602			0.0305	0.0244	0.0300	0.0295	0.0356	0.0352	0.0441	0.0432
	(0.1049)			(0.0369)	(0.0365)	(0.0345)	(0.0350)	(0.0363)	(0.0362)	(0.0291)	(0.0374)
Gross primary enrollment (log)	0.8586**				0.3818	0.4538	0.4575	0.4987	0.5078	0.5679*	0.7187**
	(0.3119)				(0.4117)	(0.3328)	(0.3411)	(0.3430)	(0.3419)	(0.2996)	(0.3333)
Number of classroom buildings (log)	0.1084					-0.1353	-0.1289	-0.0720	-0.0632	0.1589	-0.1796
	(0.5553)					(0.4231)	(0.4234)	(0.4462)	(0.4496)	(0.4443)	(0.4232)
Life expectancy	0.0228						0.0020	0.0035	0.0019	0.0044	0.0222
	(0.0182)						(0.0114)	(0.0119)	(0.0116)	(0.0130)	(0.0257)
Infant mortality (log)	0.6716							0.4575	0.4693	0.4447	-0.9315
	(0.9970)							(1.0251)	(1.0582)	(0.9442)	(1.0859)
Food security rate	-0.0884								0.0577	0.0336	-0.0267
	(0.0844)								(0.0637)	(0.0641)	(0.0756)
Maize production (log)	0.3848**									0.2880***	0.3117**
	(0.1441)									(0.1069)	(0.1231)
First stage effect											
Ethnic affinity		0.7160***	0.7428***	0.7244***	0.7349***	0.7831***	0.7834***	0.6284***	0.6396***	0.6249***	0.6200**
		(0.2221)	(0.2151)	(0.2154)	(0.2182)	(0.2353)	(0.2341)	(0.1981)	(0.1918)	(0.1993)	(0.2352)
Political switching		0.8480***	0.8024***	0.7985***	0.7931***	0.9247***	0.9247***	0.9288***	0.9194***	0.9221***	0.8780***
		(0.1901)	(0.1949)	(0.1968)	(0.1996)	(0.2104)	(0.2110)	(0.2223)	(0.2222)	(0.2258)	(0.2192)
Observations	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*226*	*246*
Number of id	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*24*	*26*
District-Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
Including cities	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*Y*
AR F-Test (p-value)	.	*0.0236*	*0.0139*	*0.0253*	*0.0172*	*0.0154*	*0.0152*	*0.0199*	*0.0180*	*0.0310*	*0.0170*
KP Wald F-stat	.	*14.49*	*13.61*	*13.83*	*13.91*	*14.04*	*13.90*	*12.62*	*12.84*	*13.43*	*14.20*
Hansen J (p-value)	.	*0.549*	*0.118*	*0.133*	*0.137*	*0.17*	*0.165*	*0.162*	*0.12*	*0.149*	*0.142*

*Notes: The table presents results from GMM regression of change in the log of recorded nighttime light density in each district for the period 1999 to 2013. Each observation is a district-year statistic and most explanatory variables have been transformed into natural logs. Two instrumental variables are used, political switching and ethnic affinity are as defined in earlier tables. Columns 1-10 do not include the two cities of Blantyre and Lilongwe while column 11 includes the two cities (other districts, namely Neno and Likoma are also excluded from the entire sample as they were recently formed after splitting form other districts). Columns 2-10 use the preferred sample and stepwise inclusion of control variables. Robust standard errors clustered at district in all specifications are reported in parentheses. *p<0.10, **p<0.05, ***p<0.01.*

Table 4.B.5: Robustness checks 1/2

	1	2	3	4	5	6	7	8
	Distance from LL	Land area	Chewa	Lomwe	Yao	Tumbuka	Number of constituencies	xy-coords (4th poly)
Aid (log)	0.284***	0.286***	0.287***	0.287***	0.288***	0.289***	0.291***	0.288***
	(0.0118)	(0.0115)	(0.0101)	(0.0129)	(0.0127)	(0.0121)	(0.0100)	(0.0117)
Public expenditure (log)	0.117**	0.116**	0.111**	0.123**	0.119**	0.119**	0.115**	0.123**
	(0.0661)	(0.0679)	(0.0744)	(0.0775)	(0.0739)	(0.0733)	(0.0702)	(0.0689)
Population density (log)	0.612***	0.624***	0.633***	0.634***	0.633***	0.628***	0.631***	0.634***
	(0.1349)	(0.1569)	(0.1389)	(0.1387)	(0.1384)	(0.1375)	(0.1370)	(0.1399)
Poverty rate	-0.0364	-0.0356	-0.0363	-0.0356	-0.0357	-0.0371	-0.0359	-0.0356
	(0.1695)	(0.1661)	(0.1657)	(0.1659)	(0.1646)	(0.1671)	(0.1651)	(0.1659)
Rainfall (log)	0.0238	0.0229	0.0231	0.0229	0.0236	0.0251	0.0235	0.0229
	(0.1461)	(0.1456)	(0.1433)	(0.1560)	(0.1425)	(0.1422)	(0.1419)	(0.1560)
Minister (Dummy)	0.121	0.124	-0.121	-0.158	-0.121	-0.125	-0.122	-0.158
	(0.0938)	(0.0917)	(0.0931)	(0.0924)	(0.0928)	(0.0928)	(0.0934)	(0.0924)
District vote share	0.0579	0.0588	0.0562	0.0565	0.0578	0.0545	0.0547	0.0565
	(0.1680)	(0.1640)	(0.1650)	(0.1657)	(0.1638)	(0.1590)	(0.1598)	(0.1657)
Gross primary enrollment (log)	0.136**	0.145*	0.158**	0.145*	0.128*	0.143*	0.148*	0.145*
	(0.0612)	(0.0756)	(0.0772)	(0.0756)	(0.0753)	(0.0761)	(0.0771)	(0.0756)
Number of classrooms (log)	0.429	0.441	0.419	0.446	0.394	0.424	0.408	0.446
	(0.3979)	(0.3495)	(0.3980)	(0.3950)	(0.3984)	(0.3956)	(0.3909)	(0.3950)
Life expectance	0.574	0.585	0.503	0.585	0.513	0.524	0.559	0.585
	(0.7615)	(0.7250)	(0.7160)	(0.7250)	(0.7130)	(0.7190)	(0.6770)	(0.7250)
Infant mortality (log)	-0.287***	-0.302***	-0.322***	-0.302***	-0.286***	-0.302***	-0.287***	-0.302***
	(0.0668)	(0.0651)	(0.0671)	(0.0651)	(0.0607)	(0.0654)	(0.0629)	(0.0651)
Maize production (log)	0.283**	0.279**	0.278**	0.272**	0.274***	0.424***	0.419***	0.272**
	(0.1212)	(0.1230)	(0.1416)	(0.1229)	(0.1284)	(0.0956)	(0.0980)	(0.1229)
Food insecurity	-0.165*	-0.163*	-0.165*	-0.163*	-0.169*	-0.164*	-0.149**	-0.163*
	(0.0896)	(0.0928)	(0.0921)	(0.0928)	(0.0928)	(0.0934)	(0.0693)	(0.0928)
First stage effect:								
Political Affinity	0.4571***	0.4533***	0.4317***	0..4423***	0.4720***	0.4588***	0.4550***	0..4423***
	(0.1484)	(0.1441)	(0.1458)	(0.1348)	(0.1433)	(0.1446)	(0.1454)	(0.1348)
Ethnic affinity	0.6486***	0.6566***	0.6363***	0.6811***	0.6779***	0.6540***	0.6563***	0.6811***
	(0.3415)	(0.1399)	(0.1376)	(0.1308)	(0.1394)	(0.1387)	(0.1396)	(0.1308)
Observations	*251*	*251*	*251*	*251*	*251*	*251*	*251*	*251*
R-squared	*37.259*	*0.4506*	*37.247*	*38.348*	*30.02*	*33.079*	*37.247*	*38.348*
District FE	*N*	*N*	*N*	*Y*	*Y*	*Y*	*Y*	*Y*
Year FE	*N*	*N*	*N*	*Y*	*Y*	*Y*	*Y*	*Y*
Including cities	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*
AR F-test (p-value)	*0.0070*		*0.0087*	*0.0050*	*0.0000*	*0.0001*	*0.0090*	*0.0050*
KP Wald F-Stat	*24.09*		*42.38*	*30.96*	*59.36*	*50.94*	*42.36*	*30.96*
Hansen J (p-value)	*0.569*		*0.623*		*0.915*	*0.996*	*0.636*	

*Notes: The table presents results from regression of log of recorded nighttime light density (i.e. light intensity per square kilometer) in each district for the period 1999 to 2013. Each observation is a district-year statistic and all explanatory variables except the Minister dummy have been transformed into natural logs. All specifications include year and district specific fixed effects. Two instrumental variables are used, political affinity and ethnic affinity as defined in earlier tables. All Columns do not include the two cities of Blantyre and Lilongwe as well as Neno and Likoma. The first column controls for distance from Lilongwe, the second controls for total land area for each district. Columns 3-6 include a dummy variable that takes the value 1 if the majority of the people in that district belong to either of the main ethnic groups in Malawi (Chewa, Lomwe, Yao and Tumbuka) and 0 otherwise, while column 7 includes the log of number of constituencies in a district. In column 8 is specification that includes x-y coordinates of each district up to the 4th polynomial. Robust standard errors clustered at district in all specifications are reported in parentheses. *p<0.10, **p<0.05, ***p<0.01*

Table 4.B.6: Robustness checks 2/2

	9	10	11	12	13	14
	Coastal	Cash crop	Urban / Town	Northern	Central	Southern
Aid	0.289***	0.290***	0.291***	0.289***	0.289***	0.288***
	(0.0111)	(0.0107)	(0.0100)	(0.0115)	(0.0117)	(0.0118)
Public expenditure	0.119**	0.119**	0.115**	0.114**	0.123**	0.145**
	(0.0701)	(0.0723)	(0.0702)	(0.0604)	(0.0689)	(0.0730)
Population density	0.633***	0.628***	0.631***	0.628***	0.634***	0.451**
	(0.1400)	(0.1394)	(0.1370)	(0.1390)	(0.1399)	(0.2130)
Poverty rate	-0.0357	-0.0371	-0.0359	-0.0368	-0.0356	-0.0774
	(0.1646)	(0.1671)	(0.1651)	(0.1620)	(0.1659)	(0.1840)
Rainfall	0.0236	0.0251	0.0235	0.0236	0.0229	0.0246
	(0.1425)	(0.1422)	(0.1419)	(0.1455)	(0.1560)	(0.1120)
Minister (Dummy)	-0.121	-0.125	-0.122	-0.123	-0.158	0.199
	(0.0928)	(0.0928)	(0.0934)	(0.0921)	(0.0924)	(0.0812)
Vote share	0.0578	0.0545	0.0547	0.0548	0.0565	0.0232
	(0.1638)	(0.1590)	(0.1598)	(0.1584)	(0.1657)	(0.2760)
Gross primary enrollment	0.128*	0.143*	0.148*	0.130*	0.145*	0.184*
	(0.0753)	(0.0761)	(0.0771)	(0.0756)	(0.0756)	(0.0805)
Number of classrooms	0.394	0.424	0.408	0.398	0.446	0.483
	(0.3984)	(0.3956)	(0.3909)	(0.4000)	(0.3950)	(0.3130)
Life expectance	0.513	0.524	0.559	0.584	0.585	0.537
	(0.7130)	(0.7190)	(0.6770)	(0.6593)	(0.7250)	(0.6520)
Infant mortality	-0.286***	-0.302***	-0.287***	-0.299*	-0.302***	-0.289***
	(0.0607)	(0.0654)	(0.0629)	(0.1550)	(0.0651)	(0.0770)
Maize production	0.274***	0.424***	0.419***	0.408***	0.272**	0.286*
	(0.1284)	(0.0956)	(0.0980)	(0.0909)	(0.1229)	(0.1610)
Food insecurity	-0.169*	-0.164*	-0.149**	-0.154**	-0.163*	-0.141**
	(0.0928)	(0.0934)	(0.0693)	(0.0684)	(0.0928)	(0.0716)
First stage effect:						
Political Affinity	0.4720***	0.4588***	0.4550***	0.4497***	0..4423***	0.377**
	(0.1433)	(0.1446)	(0.1454)	(0.1426)	(0.1348)	(0.1780)
Ethnic affinity	0.6779***	0.6540***	0.6563***	0.6116***	0.6811***	0.511***
	(0.1394)	(0.1387)	(0.1396)	(0.1386)	(0.1308)	(0.1420)
Observations	*251*	*251*	*251*	*251*	*251*	*251*
R-squared	*30.02*	*33.079*	*37.247*	*37.247*	*38.348*	*35.815*
District FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
Including cities	*N*	*N*	*N*	*N*	*N*	*N*
AR F-test (p-value)	*0.0000*	*0.0001*	*0.0090*	*0.0083*	*0.0050*	*0.0015*
KP Wald F-Stat	*59.36*	*50.94*	*42.36*	*40.92*	*30.96*	*39.6*
Hansen J (p-value)	*0.915*	*0.996*	*0.636*	*0.636*	*0.516*	*0.607*

*Notes: The table presents results from regression of log of recorded nighttime light density (i.e. light intensity per square kilometre) in each district for the period 1999 to 2013. Each observation is a district-year statistic and all explanatory variables except the Minister dummy have been transformed into natural logs. All specifications include year and district specific fixed effects. Two instrumental variables are used, political affinity and ethnic affinity as defined in earlier tables. All Columns do not include the two cities of Blantyre and Lilongwe as well as Neno and Likoma. Column 9 includes a dummy variable that takes the value 1 if the district lies along the coast of Lake Malawi and 0 otherwise; column 10 includes a dummy variable that takes the value 1 if the district produces one of Malawi's any of the main cash crops in Malawiand 0 otherwise; column 11 is a dummy that takes the value 1 if the district is classified as a town council rather than a district council, and 0 otherwise and lastly in columns 12-14 include a dummy variable taking the value 1 if the district is in either of the three regions of Malawi (the Southern region or Central region or Northern region) and 0 otherwise. Robust standard errors clustered at district in all specifications are reported in parentheses. *p<0.10, **p<0.05, ***p<0.01.*

Table 4.B.7: Results for specification with light per capita as dependent variable

	1 2SLS	2 2SLS	3 2SLS	4 2SLS	5 2SLS
Aid (log)	0.0638*	0.2218***	0.1180*	0.1444***	0.2370***
	(0.0340)	(0.0758)	(0.0603)	(0.0556)	(0.0549)
Initial light density (log)	-0.9663***	-1.1101***	-1.0953***	-1.0991***	-0.9985***
	(0.0741)	(0.0637)	(0.0577)	(0.0587)	(0.0646)
Public expenditures (log)	-0.1143*	0.0040	-0.0139	-0.0093	0.0357
	(0.0617)	(0.0634)	(0.0557)	(0.0566)	(0.0537)
Population (log)	1.9842*	0.9408	2.0934**	1.8000**	1.3808**
	(1.0277)	(1.0024)	(0.8372)	(0.7954)	(0.8087)
Rainfall (log)	-0.0328	0.0487	0.0296	0.0345	0.0814
	(0.1054)	(0.1130)	(0.1106)	(0.1107)	(0.1008)
Poverty rate	0.0862	0.2618	0.2079	0.2216	0.2594
	(0.2079)	(0.2195)	(0.1901)	(0.1954)	(0.2093)
District vote share	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Minister (dummy)	0.0172	0.0226	0.0470	0.0408	0.0234
	(0.0324)	(0.0340)	(0.0295)	(0.0292)	(0.0320)
Gross primary enrollment rate	0.8605**	0.5518*	0.5578*	0.5562*	0.1913*
	(0.3122)	(0.3210)	(0.2951)	(0.3000)	(0.0951)
Number of classroom buildings (log)	0.1109	0.0702	0.3025	0.2434	-0.2127
	(0.5563)	(0.4755)	(0.4623)	(0.4484)	(0.2700)
Life expectancy	0.0230	0.0032	0.0024	0.0026	0.0184
	(0.0184)	(0.0129)	(0.0135)	(0.0133)	(0.0159)
Infant mortality (log)	0.6616	-0.1751	0.7317	0.5008	-0.9297
	(1.0031)	(1.1282)	(0.9474)	(0.9525)	(0.8868)
Food security rate	-0.0896	0.0103	0.0330	0.0272	0.0423
	(0.0845)	(0.0701)	(0.0662)	(0.0643)	(0.0719)
Maize production (log)	0.3852**	0.2548**	0.2687**	0.2652**	0.2684**
	(0.1442)	(0.1069)	(0.1093)	(0.1081)	(0.1081)
First stage effect					
Ethnic affinity		1.1453***		0.6249***	0.7325***
		(0.1900)		(0.1993)	(0.2147)
Political switching			1.0914***	0.9221***	0.7338***
			(0.1952)	(0.2258)	(0.2037)
Observations	*226*	*226*	*226*	*226*	*248*
Number of id	*24*	*24*	*24*	*24*	*26*
District-Year FE	*Y*	*Y*	*Y*	*Y*	*Y*
Including cities	*N*	*N*	*N*	*N*	*Y*
AR F-Test (p-value)	–	*0.0122*	*0.0177*	*0.0316*	*0.000928*
KP Wald F-stat	–	*11.32*	*9.741*	*13.43*	*13.50*
Hansen J (p-value)	–	–	–	*0.155*	*0.160*

*Notes: The table presents results from 2SLS regression of log of recorded nighttime light per capita (i.e. log light intensity minus log population) in each district for the period 1999 to 2013. Each observation is a district-year and most explanatory variables have been transformed into natural logs. All specifications include year and district specific fixed effects. Column 1 reports OLS estimation results while columns 2 - 4 show results from the preferred sample. Column 5 has results for estimation for sample that includes the two cities of Lilongwe and Blantyre. Column 2 reports results for estimation with only political affinity instrument; column 3 reports results for ethnic affinity instrument and columns 4 and 5 show over-identified estimations. Robust standard errors clustered at district in all specifications are reported in parentheses. *p<0.10, **p<0.05, ***p<0.01.*

Table 4.B.8: VIF test results

	VIF	1/VIF
Distrubuted aid	1.28	0.781541
Public expenditures	1.78	0.5612
Population density	3.37	0.296505
Poverty rate	1.7	0.589584
Rainfall	1.23	0.815824
Minister Dummy	2.09	0.478554
District vote share	1.59	0.630673
Gross primary enrolment	5.5	0.181905
Number of classrooms	7.82	0.127914
Infant Mortality	2.2	0.453784
Life expectancy	1.71	0.584214
Maize production	1.82	0.550217
Food production	1.54	0.648032

Notes: The table presents a test for the magnitude of multicollinearity in the preferred specification.

Table 4.B.9: Lags

	1	2	3	4	5	6	7
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Aid (log)	0.1388*	0.2604***	0.2491***	0.1368	0.1351	0.1334	0.2329***
	(0.0764)	(0.0682)	(0.0639)	(0.1005)	(0.0881)	(0.0854)	(.0888)
Initial light (log)	-1.1245***	-1.1883***	-1.2800***	-1.3378***	-1.2516***	-1.3183***	-1.3771***
	(0.0752)	(0.0779)	(0.0748)	(0.0729)	(0.0667)	(0.0620)	(0.0787)
Public expenditures (log)	-0.0996	-0.1356*	-0.1043	-0.2675***	-0.0991	-0.0621	-0.0654
	(0.0733)	(0.0763)	(0.0703)	(0.0809)	(0.0956)	(0.1126)	(0.1663)
Population (log)	4.3948***	4.3584***	4.2157***	4.2402***	4.2442***	3.9551***	3.2762***
	(1.0663)	(1.0808)	(1.2225)	(1.2012)	(1.2056)	(1.2169)	(1.1168)
Rainfall (log)	-0.1749***	-0.1886	-0.2746***	-0.2135	-0.1941*	-0.2106*	0.2408
	(0.0637)	(0.1155)	(0.1009)	(0.2334)	(0.1010)	(0.1184)	(0.1910)
Poverty rate	0.0383	-0.2155	-0.7782*	0.2612	-0.0896	-0.5211	-0.2891
	(0.2818)	(0.3834)	(0.4227)	(0.3128)	(0.3902)	(0.4462)	(0.5316)
District vote share	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Minister (dummy)	0.1195	0.1185	0.0580	0.0719	0.0950	0.0815	0.0837
	(0.1096)	(0.1102)	(0.1036)	(0.1095)	(0.1046)	(0.1042)	(0.1065)
Gross primary enrollment (log)	0.6930**	0.2318	0.2242	-0.0435	0.0122	-0.0873	-0.3415
	(0.2749)	(0.2888)	(0.2415)	(0.2581)	(0.2402)	(0.2416)	(0.3091)
No. classrooms (log)	0.0911	0.1906	0.2097	0.3569	0.2778	0.3202	1.1411*
	(0.4067)	(0.6228)	(0.5040)	(0.5173)	(0.4401)	(0.5087)	(0.5898)
Life expectancy	0.0044	-0.0117	-0.0202	-0.0061	-0.0069	-0.0181	-0.0362**
	(0.0078)	(0.0141)	(0.0126)	(0.0147)	(0.0148)	(0.0152)	(0.0145)
Infant mortality (log)	-3.5945***	-2.8304*	-4.8452***	-6.8467***	-5.5946***	-7.2350***	-10.5581***
	(1.3331)	(1.5283)	(1.4585)	(1.6705)	(1.7003)	(2.1513)	(3.1688)
Food insecurity	-0.1105	-0.0417	0.0241	0.1431	-0.0439	-0.0597	-0.4471*
	(0.1116)	(0.1676)	(0.1713)	(0.1832)	(0.2111)	(0.2209)	(0.2425)
Maize production (log)	0.3585***	0.3526**	0.4632***	0.2975	0.3101**	0.3703**	0.2321
	(0.1298)	(0.1438)	(0.1741)	(0.1973)	(0.1327)	(0.1825)	(0.1922)
2nd Lag	0.0798**				0.1903***	0.1832**	0.2595***
	(0.0367)				(0.0690)	(0.0855)	(0.0934)
3rd Lag		0.0246			0.0418*	0.0457	0.0996**
		(0.0233)			(0.0228)	(0.0471)	(0.0506)
4th Lag			0.0154			0.0057	0.0692
			(0.0229)			(0.0259)	(0.0524)
5th Lag				0.0269			0.0173
				(0.0320)			(0.0241)
First stage effect							
Ethnic affinity	0.5720***	0.4089**	0.5665***	0.7046***	0.3915**	0.4047*	0.4921**
	(0.2002)	(0.1811)	(0.1970)	(0.2215)	(0.1833)	(0.2146)	(0.2220)
Political switching	0.7025***	0.7802***	0.7225***	0.6497**	0.7665***	0.7031***	0.7155***
	(0.1535)	(0.1425)	(0.1589)	(0.2399)	(0.1480)	(0.1688)	(0.1875)
Observations	*187*	*166*	*148*	*128*	*159*	*136*	*112*
Number of id	*24*	*24*	*24*	*24*	*24*	*24*	*24*
District-Year FE	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*
Including cities	*N*	*N*	*N*	*N*	*N*	*N*	*N*
AR F-Test (p-value)	*0.220*	*0.000824*	*0.00237*	*0.00936*	*0.0557*	*0.0102*	*0.0383*
KP Wald F-stat	*12.67*	*11.43*	*10.20*	*11.37*	*11.37*	*8.489*	*9.823*
Hansen J (p-value)	*0.428*	*0.311*	*0.329*	*0.171*	*0.645*	*0.435*	*0.216*

*Notes: The table presents results from regression of change in the log of recorded nighttime light density in each district for the period 1999 to 2013. Each observation is a district-year statistic and most explanatory variables have been transformed into natural logs. All regressions use the preferred specification with the two instrumental variables are, political affinity and ethnic affinity as defined in earlier tables. In all the regressions, district-year fixed effects are included and do not include the two cities of Blantyre and Lilongwe (neither are the two districts of Neno and Likoma). Columns 1-4 includes each of the lags (2nd - 5th lag) separately while columns 5-7 involves stepwise inclusion of the lags. Robust standard errors clustered at district in all specifications are reported in parentheses. *p<0.10, **p<0.05, ***p<0.01.*

Table 4.B.10: Regression results for estimation using aid to the three sectors of Agriculture, Education and Health

	Agriculture 2SLS	Education 2SLS	Health 2SLS
Sector aid (log)	0.2831*	0.1204**	0.0220
	(0.1519)	(0.0591)	(0.0619)
Initial light density (log)	-1.1411***	-1.2751***	-1.2852***
	(0.0857)	(0.0935)	(0.0642)
Public expenditures (log)	0.2619*	0.0463	0.1658**
	(0.1339)	(0.0945)	(0.0783)
Population density (log)	1.8452***	1.6159**	4.0308**
	(0.4737)	(0.5933)	(1.7555)
Rainfall (log)	-0.2261	-0.1276	0.3033**
	(0.1460)	(0.0929)	(0.1453)
Poverty rate	-0.2103	0.0359	-0.2746
	(0.3582)	(0.1640)	(0.2449)
District vote share	0.0000**	0.0000***	0.0000*
	(0.0000)	(0.0000)	(0.0000)
Minister (dummy)	0.0071	-0.0177	0.0301
	(0.0517)	(0.0485)	(0.0430)
Gross primary enrollment (log)	0.6965*	0.9011***	0.2126
	(0.3889)	(0.3135)	(0.3524)
No. classrooms (log)	1.7477**	0.9352**	0.5071
	(0.8231)	(0.4555)	(0.5930)
Life expectancy	0.0175	0.0041	0.053*
	(0.0210)	(0.0080)	(0.0143)
Infant mortality (log)	0.4381	0.6970	0.7657**
	(2.4299)	(1.6386)	(0.3780)
Food insecurity rate	-0.2801	-0.0150	-0.0582
	(0.2268)	(0.1167)	(0.1757)
Maize production (log)	0.1988**	0.1701*	0.2583**
	(0.0974)	(0.0956)	(0.1276)
First stage effect			
Ethnic affinity	0.9539***	0.3947*	0.6024
	(0.3278)	(0.2002)	(0.4069)
Political switching	0.4511**	1.1569***	1.0957**
	(0.1998)	(0.2430)	(0.4851)
Observations	*167*	*173*	*166*
Number of id	*24*	*24*	*24*
District-Year FE	*Y*	*Y*	*Y*
Including cities	*Y*	*Y*	*Y*
AR F-Test (p-value)	*0.0088*	*0.00491*	*0.047*
KP Wald F-stat	*10.85*	*10.47*	*8.342*
Hansen J (p-value)	*0.848*	*0.665*	*0.181*

*Notes: The table presents results from regression of change in the log of recorded nighttime light density in each district for the period 1999 to 2013. Each observation is a district-year statistic and most explanatory variables have been transformed into natural logs. All regressions use the preferred specification with the two instrumental variables are, political affinity and ethnic affinity as defined in earlier tables. In all the regressions, district-year fixed effects are included and do not include the two cities of Blantyre and Lilongwe (neither are the two districts of Neno and Likoma). The first column presents results from estimation using aid to the agriculture sector, the second column has results for aid to the education sector and the final column has results for estimation using health sector aid. *p<0.10, **p<0.05, ***p<0.01.*

Table 4.B.11: Regression results for estimation using types of aid

	Bilateral aid 2SLS	Multilateral aid 2SLS	Grants 2SLS	Loans 2SLS
Aid (log)	0.3246**	0.2580**	0.3622**	0.1431*
	(0.1318)	(0.1013)	(0.1524)	(0.0629)
Initial light density (log)	-1.2339***	-1.0763***	-1.2935***	-1.0135***
	(0.0800)	(0.1147)	(0.0913)	(0.0976)
Public expenditures (log)	-0.0236	0.1464**	-0.1400*	0.0161
	(0.0777)	(0.0631)	(0.0835)	(0.0546)
Population density (log)	1.1089***	2.3608***	1.7468***	1.0050**
	(0.7274)	(0.8105)	(0.7559)	(0.6111)
Rainfall (log)	0.0888	-0.0698	-0.0405	-0.0500
	(0.1904)	(0.1538)	(0.1334)	(0.0897)
Poverty rate	-0.1272	-0.0400	-0.0476	-0.2370
	(0.2260)	(0.2392)	(0.2366)	(0.2230)
District vote share	0.0000	0.0000*	0.0000	0.0000*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Minister (dummy)	0.0267	0.1356**	0.0213	0.0614
	(0.1040)	(0.0611)	(0.0640)	(0.0436)
Gross primary enrollment (log)	0.1373	0.6430**	0.3343	0.8095**
	(0.3860)	(0.2809)	(0.4009)	(0.3319)
No. classrooms (log)	1.4181**	0.7747*	1.4453**	0.7118*
	(0.6861)	(0.4447)	(0.5679)	(0.4652)
Life expectancy	-0.0149	0.0384**	-0.0116	0.0170
	(0.0219)	(0.0195)	(0.0165)	(0.0141)
Infant mortality (log)	0.0951	0.2064	-2.1928	0.0023
	(1.4345)	(1.6178)	(1.9474)	(1.4748)
Food insecurity	-0.3089	-0.3481**	-0.0853	-0.1421
	(0.2056)	(0.1371)	(0.1599)	(0.1080)
Maize production (log)	0.1863**	0.3259**	0.3061**	0.1927**
	(0.0917)	(0.1076)	(0.1193)	(0.0740)
First stage effect				
Ethnic affinity	0.9795**	0.4453*	0.6327**	0.1949
	(0.4198)	(0.2426)	(0.2936)	(0.2400)
Political switching	0.471**	0.9315***	0.7833**	0.4595*
	(0.2918)	(0.2288)	(0.3085)	(0.2000)
Observations	*189*	*198*	*204*	*191*
Number of id	*24*	*24*	*24*	*24*
District-Year FE	*Y*	*Y*	*Y*	*Y*
Including cities	*Y*	*Y*	*Y*	*Y*
AR F-Test (p-value)	*0.0245*	*0.00232*	*0.0246*	*0.0828*
KP Wald F-stat	*9.45*	*9.763*	*10.557*	*7.735*
Hansen J (p-value)	*0.977*	*0.399*	*0.529*	*0.219*

*Notes: The table presents results from regression of change in the log of recorded nighttime light density in each district for the period 1999 to 2013. Each observation is a district-year statistic and most explanatory variables have been transformed into natural logs. All regressions use the preferred specification with the two instrumental variables are, political affinity and ethnic affinity as defined in earlier tables. In all the regressions, district-year fixed effects are included and do not include the two cities of Blantyre and Lilongwe (neither are the two districts of Neno and Likoma). The first column presents results from estimation using bilateral aid, second column has results for multilateral aid, the third column presents results for regressions using aid disbursed in the form of grants and the final column has results for estimation for aid in the form of loans. *p<0.10, **p<0.05, ***p<0.01.*

Chapter 5

Foreign Aid and Government Spending in an Endogenous Growth Model with Subsistence Consumption

Abstract

This chapter analyses theoretically the effects of foreign aid on growth and economic welfare in a small developing country setting. We use Stone-Geary preferences to capture the subsistence constraints of the agents and consider the impact of two components of aid, namely productive aid and pure aid. The analysis is based on a model in which private capital accumulation drives growth and public capital enhances productivity of private capital. The main results can be summarised as follows: (i) productive aid has higher long run growth and welfare effects than pure aid (ii) the rate of convergence depends crucially on how close the initial conditions are to the subsistence level (iii) while growth effects are maximised when all the aid is allocated to productive aid, we find that optimal welfare is reached when some proportion of aid is also allocated to pure aid.

5.1 Introduction

The ability to accumulate reproducible inputs (both physical and human capital) through internal saving remains one of the fundamental sources of long run growth (in addition to increase in total factor productivity). In most growth models, the assumption is that agents may not only be willing to make the choice between consumption in the present period or consumption in future periods, but also that they have the ability to make

this choice (ability to save in the current period). What such models abstract from is the concept that there exists a minimum level of consumption that is necessary for the sole purpose of sustaining life (Sharif (1986)) - this minimum level of consumption is often referred to in development studies as subsistence consumption[1]. When per capita incomes are around or indeed below this level, then agents will be limited in their ability to make the intertemporal choice. Increase in per capita incomes may help raise current consumption to/above the subsistence level, beyond which agents are able to save.

The requirement of subsistence may be trivial for developed economies since this level of income may in fact be a less significant proportion of their per capita incomes. When one considers developing economies however, the notion can assume a rather important role since agents' incomes may actually be less than the required levels to sustain a reasonable standard of living. Thus subsistence consumption requirement may restrict the ability of agents to substitute consumption intertemporally, as such it affects the capacity for agents to save when incomes are low (Steger (2000)). The key implication of subsistence consumption is that when incomes are low enough, agents who may be willing to save are limited in their ability to do so because of the requirement to consume in the current period just to sustain their lives.[2] It is therefore important to analyse whether inclusion of subsistence in growth models has significant implications for the process of growth.

In the development literature, subsistence consumption is also critical as it is related to one of the two self-reinforcing canonical mechanisms that lead to poverty traps, namely low levels of savings (the other mechanism is low capital productivity). It is not so hard to imagine how subsistence consumption can generate poverty traps: if income is very close to the subsistence threshold as is often the case in very low levels of development, then savings will be perpetually low resulting in low investment and hence countries in such a situation will converge to an equilibrium with low capital and low income per capita (Kraay and Raddatz (2007)).

[1]Early development theorists emphasized minimum nutrition needs for workers (Leibenstein (1957) and Rodgers (1975)) while others took a humanitarian approach, emphasizing the social aspects of life including physical health and social decency (Streeten et al. (1981) and Quibria (1982)). From the early 1980s, development studies took the basic needs approach which argues for a concrete specification of minimum basic 'material and non-material needs' to sustain a basic standard of living (Streeten (1979) and Streeten et al. (1981))

[2]An alternative interpretation to "willingness to save" is to think of it as a situation where with very low incomes, not saving becomes the utility-maximising choice for agents (Temple et al. (2014)).

Steger (2000) takes into account the concept of subsistence consumption and analyses its impact within the framework of an AK growth model. The concept of subsistence is incorporated by adopting Stone-Geary Preferences (SGP)[3]; the motivation for using SGP in the model is that it has the desired characteristic that intertemporal elasticity of substitution is low at low levels of consumption leading to a 'subsistence constraint' which implies that low investment can co-exist with high returns to investment (Temple et al. (2014)). In terms of our analysis, a model with SGP can be ideal for the analysis of the potential effects of foreign aid on investment and growth because they are likely to be substantially large in environments where the average consumption is close to subsistence than where it is not.

Our analysis will use a model similar to the one developed in Steger (2000) and augment it with foreign aid flows in an effort to analyse the effects of foreign aid when the requirement of subsistence consumption is accounted for. Such an analysis is very important when one considers that one of the main motivations for providing debt relief and scaling up of development assistance to low income countries, especially within the framework of the Millennium Development Goals (MDGs), is the acknowledgment that these least developed countries may be stuck in poverty traps and are so impoverished that they are unable to meet even the most basic levels of subsistence to sustain a reasonable level of livelihood. Thus, recognizing that subsistence is woven within the motivation for provision of aid, it seems appropriate that a comprehensive analysis of aid-growth nexus should also take into account any implications that subsistence requirement may in fact affect the relationship between aid and growth.

5.1.1 A Brief Note on Subsistence

For a more comprehensive survey of the concept of subsistence, Sharif (1986) analyses its relevance in both theoretical and empirical contexts, in policy formulation as well as discussing in detail its measurement. Subsistence is defined as an absolute minimum of standard for not only physical needs but also mental survival and productive efficiency. Thus contrary to most conventional treatment of subsistence that only concentrates on

[3]Stone-Geary preferences are a generalisation of the Cobb-Douglas preferences and are a form of non-homothetic preferences often used in models that require a certain minimal level of some good (or basket of goods) to be consumed, irrespective of the price of the good/basket or the consumer's income.

physical needs, the concept also captures mental efficiency for productive living in society.

Sharif (1986) makes a distinction between two forms of subsistence: the first one is subsistence as a mode of production, which involves low-productivity small-scale production (mainly agricultural production) geared towards domestic consumption to attain a certain minimum level of living. The second form sees subsistence as a mode of consumption; it involves the provision for consumption of necessary goods and services to satisfy the most basic needs of life, both physical and mental. In modern development literature, the most commonly used measure for subsistence as mode of consumption is the concept of international poverty line which identifies the proportion of population in a country that are considered to be poor. A United Nations (UN) joint statement made in 1998 (and signed by the heads of all UN agencies) defined poverty as "**a denial of choice**s and opportunities and a violation of human dignity; it means a lack of basic capacity to participate effectively in society and its development..."

Further, a United Nations (UN) declaration made at the World Summit on Social Development, held in Copenhagen in 1995, identified two levels of poverty; the first is absolute poverty defined as "a condition characterised by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information, determined not only by income but also on access to services." The second level of poverty is termed overall poverty and refers to "lack of income and productive resources to ensure sustainable livelihoods; often characterised by hunger and malnutrition, ill health, limited or lack of access to education and other basic services, increased morbidity and mortality from illness, homelessness and inadequate housing, unsafe environments, social discrimination and exclusion. It is also characterised by a lack of participation in decision-making and in civil, social and cultural life," Gordon (2005).

The World Bank's international poverty lines are commonly used in the literature to compare poverty levels across countries. The World Bank classification uses two thresholds; the lower poverty line ($275) often associated with absolute poverty and the upper poverty line ($370)[4] often used to measure overall poverty levels (in constant 1985 PPP prices).

The importance of the concept of subsistence to growth theory cannot be overemphasized;

[4]Poverty lines refer to incomes per person per year.

most economic growth theories are built on the premise that growth emanates from the ability of an economy to accumulate reproducible factors of production, one of the most critical being internal savings. A subsistence requirement constitutes a barrier for agents' ability to save, thus crucially influencing the process of private capital accumulation and thereby of economic growth. In order to illustrate the practical importance of a subsistence requirement and the ability to accumulate savings, Table 5.1.1[5] shows the ratio of per capita incomes for different groups of countries (classified in terms of incomes) and the World Bank's international poverty lines. Column C has ratio of per capita incomes and the lower poverty line while column D has the ratio of per capita incomes and the upper poverty line.

Table 5.1.1: Ratio of per capita incomes and World Bank poverty lines

Income Group	**Per capita GNI (in 2005 prices)**	**Per capita GNI/Lower PL**	**Per capita GNI/Higher PL**
A	**B**	**C**	**D**
Low income	297.49	1.08	0.80
Sub-Saharan Africa (all income levels)	352.18	1.28	0.95
Heavily indebted poor countries (HIPC)	418.25	1.52	1.13
Least developed countries: UN classification	409.89	1.49	1.11
Lower middle income	853.43	3.10	2.31
Upper middle income	2,808.00	10.21	7.59
High income: OECD	35,176.88	127.92	95.07

Notes: All statistics from World Development Indicators (WDI), in constant 2005 prices. Country grouping according to the World Bank (list of the countries under each country group presented in appendix 5.C). The last two columns present the ratios of per capita incomes and the lower and upper poverty lines respectively (Lower PL=$275; Upper PL=$370).

As can be seen in column C of the table, for low-income countries such as countries within the Sub Saharan region, highly indebted poor countries (HIPC) and least developed countries (LDCs)[6] per capita incomes only marginally exceed the threshold for absolute poverty (lower poverty line). Column D further indicates that Sub Saharan countries and low income countries in general have per capita incomes that fall short of the upper poverty line, implying agents may actually have less incomes than required to enable them attain a reasonably sustainable living. In such situations, the concept of subsistence consumption requires a critical consideration when analysing growth.

For countries in the other income groups, subsistence considerations do not seem to be of major importance; upper middle income countries have per capita incomes that are 7.6 times the upper poverty line, where lower middle income countries 2.3 times the upper poverty line. Subsistence requirements may therefore not be as important for high income countries as they are for low income countries. As the distance between per capita incomes (and hence actual consumption) and the poverty lines get larger, subsistence needs become

[5]The table is a modified version of the one found in Steger (2000).

[6]Suffice to say, most of the countries categorised as either HIPCs or LDCs are from the Sub Saharan region.

less pressing and so agents are able to save higher proportion of their incomes which subsequently further increases the gap between per capita incomes and the subsistence thresholds.

It is worth noting that the table 5.1.1 only gives average per capita GNI, and as such it has not taken into account income distribution among the population. Suffice to say, empirical evidence suggests high income inequality for low income countries compared to high income countries, as such we interpret the table to imply that a good proportion of total population in low income countries have per capita incomes close to or below the poverty line.

Outline of the chapter

The chapter has the following structure: section 5.2 discusses the contribution of our study to the existing literature; section 5.3 reviews in detail the endogenous growth model developed by Steger (2000) which incorporates subsistence consumption within an A-K growth model and replicates its associated simulation results. The main contribution of the chapter is presented in section **??** which describes a dynamic small open economy model with subsistence consumption in which output is produced using two factor inputs namely private capital and public capital. The section presents the transitional dynamics generated by foreign aid transfers and also gives some simulation results. Section **??** discusses the optimal allocation of aid between pure aid and productive aid that maximises the private agent's welfare and finally, section 5.5 wraps up the chapter by presenting concluding remarks.

5.2 Related Literature and Contribution

Theoretical literature on the macroeconomic effects of aid employ varying approaches to incorporating foreign aid transfers in models of growth. In this section we briefly introduce some of these approaches and then later define our contribution to this literature.

In this analysis, we characterise two different mechanisms that stand out in the theoretical treatment of foreign aid in the existing literature: the first looks at how foreign aid affects production of output while the second analyses whether aid provides direct utility to

households/agents. In describing the two approaches, we will also define the different types of aid commonly used in the literature.

Production function: Theoretical models of aid differ in how they incorporate foreign transfers to affect private production. In this regard, there are two distinct approaches used; the first approach allows foreign aid to directly impinge on the production process by making aid variables (e.g aid funded government expenditures, see Fisher and Turnovsky (1998)) or variables accumulated using aid (e.g. stocks of public investment goods accumulated using aid, see Turnovsky (2009)) as a factor input in the household's production function and are modeled to raise the productive capacity of private capital[7]. In terms of types of aid, this is what is often referred to as *productive aid*[8]. The second approach does not include foreign aid as a factor input, rather aid is transfered directly to the private sector in lumpsum form and constitutes the household's extra source of lifetime resources which the agent can then use either for consumption or indeed to enhance accumulation of private capital used in production of output, without affecting productive capacity of private capital (see Temple et al. (2014), Kraay and Raddatz (2007)). This form of aid transfered to the private sector in lumpsum is referred to as *pure aid*.

Utility function: In terms of utility function, the distinction is made between studies that feature aid financed parameters explicitly as components in the specification of the utility function and those that do not. For models that explicitly include aid in the utility function, this is most commonly incorporated through real government expenditure on consumption goods (see Turnovsky and Fisher (1995). In models that do not explicitly incorporate aid in the specification of the utility function, the effect of aid on the agent's utility is indirectly derived via the increase in consumption arising from increase in lifetime incomes when aid is disbursed as pure aid.

Much of early theoretical analysis of the macroeconomic effects of foreign aid was done within the neoclassical growth framework, beginning from Harrod-Domar models from the early 1950s to early 1980s and the Solow growth model, together with its subsequent

[7]Other studies such as Annen and Kosempel (2009) analyse aid in the form of technical assistance which improves the total factor productivity associated with private capital

[8]Note that for some studies, productive aid refers to the actual expenditure, particularly on infrastructure such as roads, education, bridges etc, which they argue is private productivity enhancing. Alternatively, other studies suggest that other than the expenditures on infrastructure, it is the accumulated 'public capital' stocks that matter for private productivity

extensions and refinements, from the late 1980s[9]. The Solow framework in particular was used to analyse low rates of domestic saving and capital accumulation as well as low or negative rates of growth of capital productivity characteristic of poor countries, mainly resulting from poor infrastructure[10]. Using an extended Solow model, Sachs et al. (2004) include critical thresholds that must be reached that would lead to a "step" increase in underlying productivity of capital. Foreign aid can thus give the initiation of a temporary *big push* through targeted investments and help developing countries reach these critical thresholds.

In recent years, going along with growth accounting in general, analysis of potential long-term effects of aid has been conducted within the context of endogenous growth models. Obstfeld (1999) applied numerical simulations to a version of the Ramsey growth framework to assess the effects of aid, finding that aid given in the form of lump-sum transfers has no effect on the steady-state growth and will only accelerate output growth if given to economies that are already undergoing transition dynamics[11]. These studies analyse foreign aid in the traditional "pure aid" form; as described earlier, aid in this form does not feature explicitly as a factor input in production and hence does not alter the productive capacity of capital.

Another strand of literature using endogenous growth framework adopts productive aid form and assumes that aid is used to finance public capital accumulation that enhances productivity of and hence stimulates accumulation of private capital. Examples of studies in this strand include Chatterjee and Turnovsky (2005) who adopt a constant elasticity of substitution (CES) production function and found that when aid is tied to construction of public infrastructure, it can stimulate steady state growth. Similar results are drawn from Kalaitzidakis and Kalyvitis (2008) who find that foreign transfers can boost the recipient's growth rate if it is used to co-finance accumulation of public capital.

[9]Although the neoclassical growth model was central to growth accounting debates in the 1960s and 1970s, the Solow growth model is largely inconspicuous in the mainstream development literature until the late 1980s (Snowdon (2009)). This is evidenced, for example, by the lack of discussion of the Solow model in the classic and widely used collections of readings on development such as Livingstone (1971) and Agarwala and Singh (1971) (first published in 1958).

[10]Other mechanisms that have been put forward in the literature that give rise to poverty traps include high rates of corruption, political instability, heavy disease burdens, relative physical isolation (Sachs et al. (2004) and inefficient operation of shallow financial markets (Azariadis and Drazen (1990).

[11]In an earlier study, Boone (1996) considered a Ramsey-type growth model with internal transfers and endogenous tax rates, without analysing its transitional dynamics

As Temple et al. (2014) suggest, the major drawback with the approach employed in these studies stems from the observation that transitional dynamics of Ramsey-type models with isoelastic preferences often seem unrealistic when compared with observed growth experiences[12].The introduction of SGP as done by Steger (2000) has the ability to generate more realistic growth paths, since the intertemporal elasticity of substitution is low when consumption is low, and as a result a model with SGP is highly tractable and provides the most direct mechanism to maximizing investment and welfare effects of foreign transfers. Under these preferences investment may be deferred, hence such models are sometimes referred to as *slow convergence models* (see Christiano et al. (1989)).

Some recent studies have undertaken to analyse the growth and welfare effects of foreign transfers in models with SGP. Kraay and Raddatz (2007) conduct such an analysis using optimizing agents in a Ramsey model framework to show that subsistence considerations do not necessarily generate poverty traps, simply because unless the economy starts right at the subsistence level, they find that the low equilibrium is unstable and hence cannot constitute a trap. However, they do find that when an economy starts very close to the unstable equilibrium, it can exhibit consumption close to subsistence, low saving rates and low growth for a substantially long period of time.

The analysis in this chapter takes the approach by Chatterjee et al. (2001) and Turnovsky (2009) which explores the role of public capital accumulation and its impact on growth and merges with the approach adopted by Steger (2000) and Temple et al. (2014) by introducing SGP in the framework of a Ramsey model. In so doing we contribute to the discussion on the role of foreign aid by bringing together two fundamentally significant issues for developing countries into one framework:

a) *Subsistence constraints*: Much of the literature on aid effectiveness has regarded credit constraints as the key impediment to capital accumulation and hence the central barrier to growth for developing countries as well as the key motivation for disbursement of aid. While acknowledging the impact of credit constraints on slow capital accumulation observed in developing countries (Dodlova et al. (2015)), empirical evidence suggest that it is in fact subsistence constraints that impose more significant barrier

[12]Sharp decline in returns to capital in the early stages of transition and very high productivity growth, both of which are not observed in the data, a problem well illustrated by King and Rebelo (1993)

to capital accumulation than credit constraints (Kraay and Raddatz (2007)). When incomes are close to subsistence, two forces slow down capital accumulation: i) agents are simply unable to save; their incomes are used for consumption hence low aggregate savings available for investment capital and ii) government is unable to raise adequate tax revenues to provide requisite goods and services (including infrastructure) necessary to raise private capital productivity which works as a disincentive to capital accumulation and investment. Incorporating subsistence constraints in theoretical growth framework provides an important mechanism for analysing effects of aid and has the ability to generate larger growth effects of foreign transfers.

b) *Public capital (and how it is financed)*: Since the empirical study by Aschauer (1989), public capital has increasingly been shown to play such a significant role in production and hence on growth, particularly in low income countries where the government/public sector is often the largest sector of the economy. While there is some considerable literature on the topic, Fisher and Turnovsky (1998) assert that the extent to which public capital affects growth may depend on the financing mechanism for its accumulation. Foreign aid constitutes one of the critical sources of financing for public capital accumulation.

The few studies in the existing literature that analyse a framework of aid and subsistence constraints or public capital have analysed them separately. On the one hand, studies such as Kraay and Raddatz (2007) and Temple et al. (2014) incorporate subsistence constraints within Ramsey framework and conduct theoretical analysisof the macroeconomic effects of aid on growth. The critical feature from incorporating subsistence constraints through SGP is a variable intertemporal elasticity of substitution, which is increasing with consumption at lower levels of income. This implies that households, who are unable to save when incomes are close to subsistence, become more willing and able to save as incomes (and hence consumption) exceed the subsistence level, leading to rapid increase in aggregate savings and faster capital accumulation. These studies therefore find evidence that aid transfers, which are a source of incomes for households, accelerate the transition to their balanced-growth equilibrium by enhancing capital accumulation. This is further corroborated by empirical evidence from Sachs (2001) and Sachs et al. (2004) who claim that if foreign aid is sufficient enough and given for a long enough period, then the capital

stock would rise to lift households above subsistence and set it towards its self-sustaining balanced-growth equilibrium.

On the other hand, research such as Chatterjee and Turnovsky (2005) and Fisher and Turnovsky (1998) provide a theoretical framework to illustrate the role of foreign aid transfers on growth through public capital accumulation in a the context of a Ramsey growth model. The role for public capital in such models is to enhance productivity of private capital. The key result from these studies is that when aid is used for productive purposes, for example when it is 'tied' to public investment, it has potential growth effects by raising the productivity of private capital. By influencing the transitional growth rates, aid flows are found to have long run effects on the levels of key variables such as the capital stocks, output, and welfare (Chatterjee and Turnovsky (2005)).

The main contrast between our study and the model used in Chatterjee and Turnovsky (2005) pertains to agent's preferences; in their model agents have isoelastic preferences where the intertemporal elasticity of substitution between consumption and savings is determined only by the agent's time preference which is constant (as such it does not vary with changes to per capita incomes and consumption). In our analysis, we use Stone-Geary preferences (SGP). As such, the intertemporal elasticity of substitution between consumption and savings is determined not only by the constant preferences, but also the proportional difference between current consumption levels and the subsistence level. Hence, the IES is increasing in consumption; this is consistent with empirical evidence from low income countries and, as argued by Temple et al. (2014), the effects of foreign transfers on private investment and output growth are found to be substantial when SGP are used.

Our analysis brings together the two important concepts (subsistence constraints and public capital) into one theoretical framework, which allows for a more comprehensive understanding of the potential effects of aid in a more complete structure. The existing literature has analysed the effects of aid in the context of subsistence and public capital accumulation independently. This provides useful insight into the mechanisms through which aid may affect growth in least developed countries. We argue that it is only when they are considered simultaneously in one framework that a true picture of how aid affects the growth of output can be realised. This is primarily because in reality, many developing

countries not only face subsistence constraints but at the same time rely heavily on public capital in production. By bringing the two concepts together within one structural model, we bring the analysis into a comprehensive framework that captures a closer reflection to experiences in developing countries and hence offer a broader perspective into the dynamic effects of foreign aid on the growth of output in these countries.

Using our framework leads to some new insights on the potential effects of aid on economic growth as well as policy choices for government that maximise aid's impact. The first key contribution of our analysis to the literature on foreign aid effectiveness is to estimate the effects of aid in a comprehensive framework with both subsistence constraints and productivity enhancing public capital. The implication of this is that, when incomes (and consumption) are close to subsistence, the effect on aggregate savings of aid financed productivity enhancing public capital are amplified by the increasing ability and willingness to save as incomes increase. As a result, unlike the results from the existing literature, foreign aid does not only accelerate the transition within the optimal growth path, it actually shifts the economy on to a higher level balanced-growth equilibrium.

The second contribution of the analysis is to examine the conduct of government policies, again when subsistence constraints are considered. If current levels of income and consumption are close to subsistence, then government may prioritise short term gains from foreign aid over longer term effects. Our framework enables an analysis of the trade-off since the government can allocate aid between pure aid, which has immediate impact on household incomes and consumption (and immediate welfare gains), and productive aid for investment in public capital goods whose impact is gradual and longer term.

5.3 A Growth Model with Subsistence Consumption: Recap of Steger's Model

In this section we discuss the implications of the requirement of subsistence in the context of growth theory. The requirement of subsistence consumption for intertemporal consumption decisions is formalised using an intertemporal Stone-Geary utility function, where the subsistence level of consumption is interpreted as the minimum consumption necessary to sustain life, and any consumption exceeding the subsistence level creates

well-being.

The model developed by Steger (2000) is our starting point. In this study the author analyses the implication of the requirement of subsistence on agent's intertemporal choice between consumption and savings. To illustrate this, an endogenous growth framework with SGP is employed in which production of output is done using only private capital. Agents in this model cannot borrow and are not engaged in international trade, so that capital for production is accumulated from domestic savings only.

The last point is where we will depart from Steger's framework, in section 5.4. The assumption that the only source of financing for investment is through domestic savings does not reflect well on the experiences of most developing countries who, as shown in Table 1 above, have such low levels of per capita incomes that they cannot accumulate adequate savings. In reality, external transfers, often in the form of aid, are a critical source for investment financing in developing countries. Furthermore, it is widely accepted in the literature (see Sachs (2001), Sachs et al. (2004)) that low levels of capital in poor countries may be associated with low marginal productivities of capital often due to poor quality infrastructure (including roads, electricity and communications) implying weak incentives to invest. With this in mind, we allow for the economy in our model to receive foreign aid transfers which can then be used either as transfers to the private sector to complement household incomes or used by the government sector for investment into public infrastructure that enhances the productivity of private capital.

5.3.1 Steger (2000) Model

The linear growth model developed by Steger (2000) is based on a single sector, closed economy framework to explain economic growth with subsistence consumption. The model considers an economy populated by an infinitely lived representative producer-consumer household which enjoys consumption of a privately produced good. Gross output (in per capita terms), denoted $y(t)$ of the good is a linear function of capital given by:

$$y(t) = Ak(t) \tag{5.3.1}$$

where all variables are expressed in per capita terms and t is a time index. $k(t)$ denotes stock of capital (both human and physical) and A is a constant technology parameter.

The linear growth mode is interpreted as a basic version of endogenous growth models and can be obtained from a Uzawa-Lucas economy that follows a balanced-growth path, with no externalities and is characterised by identical technologies in the production of physical and human capital by aggregating both types of capital (Rebelo (1992) and Lucas (1988)).

Consumption of the good, denoted $c(t)$ (exceeding the subsistence level denoted $\bar{c}$), creates well-being; the instantaneous utility function defined in the range $c(t) > \bar{c}$ and is expressed as:

$$u(c(t)) = \int_0^\infty \frac{[c(t) - \bar{c}]^{(1-\theta)}}{1-\theta} e^{-(\rho-n)t} dt \quad ; \quad \theta > 0 \quad ; \quad \theta \neq 1 \tag{5.3.2}$$

where $c(t)$ denotes consumption, $\bar{c} \geq 0$ represents the subsistence level of consumption. θ is a constant preference coefficient and is a measure of the relative risk aversion implicit in the utility function, it is also the inverse of the instantaneous elasticity of intertemporal substitution (IES). ρ is the individual time preference rate, and n is the constant rate of population growth. The instantaneous utility function is assumed to be strictly concave in private consumption, twice continuously differentiable and assumes that consumption is additively separable and that the value of the utility function converges to a finite value, requiring that $\rho > n$. The instantaneous Stone-Geary utility function implies a variable intertemporal elasticity of substitution[13] (time index (t) omitted):

$$\sigma(c)^{-1} = \frac{u'(c)}{u''(c)c} = \frac{c - \bar{c}}{\theta c} \tag{5.3.3}$$

The IES is zero when consumption exactly equals the subsistence level of consumption and is increasing with the level of consumption; it asymptotically converges to θ^{-1} as consumption grows without bound. Note that this formulation is merely a transformation of the regular Constant Elasticity of Substitution (CES), which can be obtained when $\bar{c} = 0$. The representative household is assumed to maximise its dynastic lifetime utility, subject to a number of constraints, hence the household's problem is expressed as:

$$\max_{U[c(t)]} \int_0^\infty \frac{[c(t) - \bar{c}]^{(1-\theta)}}{1-\theta} e^{-(\rho-n)t} dt$$

subject to:

$$\dot{k}(t) = (A - \delta - n)k(t) - c(t) \quad ; \quad k(0) \; is \; given \quad ; \quad k(t) > 0$$

[13]The IES is the inverse of elasticity of marginal utility w.r.t consumption: $\sigma(c) = \frac{u''(c)c}{u'(c)} = \frac{\theta c}{c - \bar{c}}$

$$\bar{c} \leq c(t) \leq Ak(t)^{14} \tag{5.3.4}$$

where most variables as already defined; $\dot{k}(t)$ is the derivative with respect to time denoting accumulation of private capital over time and δ is the rate of depreciation of already existing capital. Each household is endowed with some positive initial capital, $k(0)$.

The general equilibrium in this economy can be found by combining the assumptions made above along with optimality conditions of the representative household's dynamic problem: to choose time path for private consumption, $c(t)$ the control variable, and private capital, $k(t)$ which is the state variable, to maximise the expected lifetime utility expressed in equation 5.3.2, subject to the sequences given by equation 5.3.1 and resource constraints expressed by equation 5.3.4.

Thepresent-value Hamiltonian for the above stated dynamic problem is set as

$$\mathcal{H} \equiv \frac{[c(t) - \bar{c}]^{(1-\theta)}}{1-\theta} e^{-(\rho-n)t} + \lambda(t)\{(A - \delta - n)k(t) - c(t)\} \tag{5.3.5}$$

where the co-state variable $\lambda(t)$ is the shadow value of wealth. Deriving necessary optimality conditions to the problem gives[15]

$$\frac{\partial \mathcal{H}}{\partial c(t)} = [c(t) - \bar{c}]^{-\theta} e^{-(\rho-n)t} - \lambda(t) = 0$$

$$\Rightarrow [c(t) - \bar{c}]^{-\theta} e^{-(\rho-n)t} = \lambda(t)$$

$$\frac{\partial \mathcal{H}}{\partial k(t)} = \lambda(t)(A - \delta - n) = -\dot{\lambda}(t)$$

Using the resource constraint and the optimality conditions derived, we can show that the canonical system that governs the dynamics of the economy consists of two linear differential equations in $c(t)$ and $k(t)$ expressed as:

$$\dot{c} = [c(t) - \bar{c}]\theta^{-1}(A - \delta - \rho) \tag{5.3.6}$$

$$\dot{k} = (A - \delta - n)k(t) - c(t) \tag{5.3.7}$$

Additionally, the following parameter conditions must also hold:

$$\rho > n$$

$$A - \delta - n > 0$$

$$\lim_{t\to\infty} [\lambda(t) e^{-(\rho-n)t} k(t)] = 0$$

$$\lim_{t\to\infty} [\lambda(t) e^{-(A-\delta-n)t} k(t)] = 0$$

The first of the four conditions ensures finiteness of the discounted sum of expected future

[15]Step-by-step mathematical solution to the model is presented in the appendix 5.A

utility while the second condition can be interpreted to ensure a positive interest rate.The last two conditions are transversality conditions to ensure that the agent's intertemporal budget constraint is met. The system differential equations 5.3.6 and 5.3.7 can be solved analytically and yield the following solutions:

$$c(t) = \bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}(A-\delta-\rho)t} \tag{5.3.8}$$

$$k(t) = \bar{k} + [k(0) - \bar{k}]e^{\theta^{-1}(A-\delta-\rho)t} \tag{5.3.9}$$

where

$$c(0) = (\zeta - \xi)k(0) + \frac{\xi\bar{c}}{\zeta}\ ; \qquad \zeta = (A - \delta_k - n) \ \text{ and } \ \xi = \theta^{-1}(A - \delta_k - \rho) \tag{5.3.10}$$

and $\bar{k}$ is the per capita stock of subsistence capital – it represents the minimal economic surplus available only to be used to trade for basic goods to maintain the agent's existence and provides little to no surplus for other investments; its value is defined as

$$\bar{k} = \frac{\bar{c}}{A - \delta - n}$$

Dynamic Equilibria

The implication of solutions 5.3.8 and 5.3.9 is that the model exhibits multiple equilibria – in particular there are principally three possible steady states: two steady states with zero growth with both consumption and capital constant and the third is the asymptotic balanced-growth equilibrium in which consumption and capital both grow at constant rates.

i) *Subsistence equilibrium*

The subsistence steady state occurs when $c^* = \bar{c}$ i.e. consumption exactly equals the level of subsistence consumption (and per capita capital, $k(t)$, also equal to the subsistence level of capial, $\bar{k}$).[16] This steady state is a 'low-level-development' equilibrium which occurs when the net marginal product of capital is lower than the time preference i.e. $A - \delta - \rho < 0$. Intuitively, at this steady state, individuals are simply unable to substitute consumption intertemporally, as such they do not have the ability to save or invest. Hence net savings per capita equal to zero and the output produced per period suffices just to cover subsistence consumption and cover for depreciation of existing capital and population growth. The subsistence level ($\bar{k}$) is therefore the long run solution to the dynamic problem expressed by equation 5.3.4.

[16]Variables with $*$ represent steady state values e.g. c^* represents the steady state level of consumption

When the economy is at the subsistence equilibrium both consumption and capital stock (per capita) are equal to their subsistence level and the net marginal product of capital is relatively lower than the time preference. Intuitively, at the subsistence level of income individuals do not have the ability to save and the economy will fail to grow since households are too poor to invest. Often this equilibrium is taken by some authors such as Sachs et al. (2004) as a poverty trap, justifying the need for external resources to help such economies escape this low-investment trap to a level where households can have enough incomes to save and invest (thus the basis behind the 'Big Push' approach to foreign aid).

ii) *Knife-edge equilibrium*

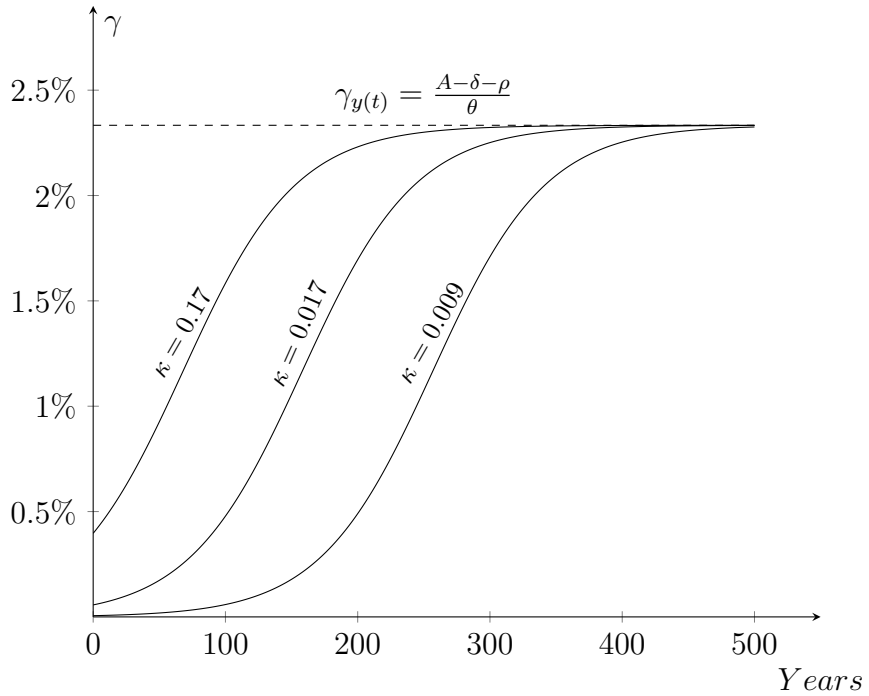
This steady state occurs when the net marginal product of capital equals the time preference rate, i.e. $A-\delta-\rho=0$. In this steady state initial consumption and initial capital are both slightly above their subsistence levels. At the same time, the net marginal product evaluated at the initial period is slightly greater than the time preference, hence agents are able and willing to substitute their consumption intertemporally. As the economy grows, marginal product of capital declines to the extent that it may converge to a constant asymptotic equilibrium level that is too low to guarantee unbounded growth. Eventually, the net marginal product equals the time preference rate and the economy converges to a steady-state with zero growth for both capital and consumption. In this case, the initial endowment ($k(0)$) is the long run solution to the dynamic problem.

iii) *Unbounded-growth equilibrium*

The asymptotic balanced-growth equilibrium occurs when the growth condition is valid asymptotically, that is when the net marginal product of capital is greater than the time preference $A-\delta-\rho>0$. In this case the economy is characterised by unbounded growth and the growth rates of both consumption and capital will converge to their common asymptotic balanced-growth-equilibrium value. Figure 5.3.1[17] below shows the time paths for the growth rate of output, $\gamma_{y(t)}$, (which also equals the growth rate of capital, $\gamma_{k(t)}$) as it monotonically transitions and converges towards its asymptotic balanced-growth-equilibrium value, for different initial abilities to save, $\kappa=\frac{k(0)-\bar{(}k)}{k(0)}$.

[17]As we have analytical solutions to the model, we draw figures in Latex using Tikz package. The parameter values used in drawing the figures 5.3.1 - 5.3.5, are presented in table 5.C.1 of appendix 5.C and are similar to those used in the original Steger (2000).

Figure 5.3.1: Time path for the growth rate of output (and capital)



The dynamics of consumption from the above solutions can be used to obtain the growth rate for consumption in balanced-growth equilibrium, $\gamma_{c(t)}$; to achieve this we differentiate $c(t)$ given by equation 5.3.8 with respect to time to obtain

$$\dot{c}(t) = [c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)e^{\theta^{-1}(A-\delta-\rho)t}$$

and then subsequently divide the above result with the original relation for c(t) i.e. we find $\lim_{t\to\infty} \frac{\dot{c}}{c(t)}$:[18]

$$\gamma_{c(t)} = \lim_{t\to\infty} \frac{\dot{c}(t)}{c} = \frac{[c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)e^{\theta^{-1}(A-\delta-\rho)t}}{\bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}(A-\delta-\rho)t}}$$

$$\Rightarrow \lim_{t\to\infty} \left(\frac{[c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)}{\left[\frac{\bar{c}}{e^{\theta^{-1}(A-\delta-\rho)t}}\right] + [c(0) - \bar{c}]} \right)$$

which simplifies to

$$\lim_{t\to\infty} \frac{\dot{c}(t)}{c(t)} = \left(\frac{[c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)}{[c(0) - \bar{c}]} \right) = \theta^{-1}(A - \delta - \rho)$$

Similarly, to obtain the growth rate for capital in the balanced-growth equilibrium, we do the same process by differentiating equation 5.3.9 with respect to time and dividing by $k(t)$ to obtain

$$\gamma_{k(t)} = \lim_{t\to\infty} \frac{\dot{k}}{k} = \frac{[k(0) - \bar{k}]\theta^{-1}(A - \delta - \rho)e^{\theta^{-1}(A-\delta-\rho)t}}{\bar{k} + [k(0) - \bar{k}]e^{\theta^{-1}(A-\delta-\rho)t}}$$

[18]For detailed solution, see appendix (5.A).

Using the same method as above, we obtain the common asymptotic balanced-growth equilibrium value for consumption and capital:

$$\gamma_{c(t)} = \lim_{t\to\infty} \frac{\dot{c}}{c} = \lim_{t\to\infty} \frac{\dot{k}}{k} = \gamma_{k(t)} = \theta^{-1}(A - \delta - \rho) \tag{5.3.11}$$

The time path illustrated in figure 5.3.1 assumes a case of a small developing economy without any aid inflows; the proportional difference between the initial stock of capital and the subsistence level of capital (κ) is only marginal (assumed to be $\kappa = 0.009$) implying that agents are extremely limited in their ability to raise capital for domestic investment internally (through savings). When the proportional difference between capital and its subsistence level approaches zero (i.e. capital is significantly close to the subsistence level), it takes a longer time for the economy to transition along the optimal growth path to the constant-rate asymptotic balanced-growth equilibrium. In the above example, figure 5.3.1 indicates that it takes up to 250[19] years to eliminate half the distance to the balanced-growth equilibrium level of output growth. As κ increases (for instance to 0.017 and 0.17 in figure 5.3.1), the time it takes to reach the asymptotic equilibrium shortens.

5.3.2 Transitional Dynamics

The linear differential equations expressed by equations 5.3.6 and 5.3.7 allows for the explicit solution of the stable arm of the saddle path which leads to the steady state. We derive the policy function as

$$c'k(t) = \frac{\dot{c}}{\dot{k}} = \frac{[c(t) - \bar{c}]\theta^{-1}(A - \delta - \rho)}{(A - \delta - n)k(t) - c(t)} = \frac{c'k(t)\theta^{-1}(A - \delta - \rho)}{(A - \delta - n) - c'k(t)}$$

simplifying the above gives (refer to model solution in appendix 5.A)

$$\Rightarrow c(t) = z[k(t) - \bar{k}] + \bar{c} \tag{5.3.12}$$

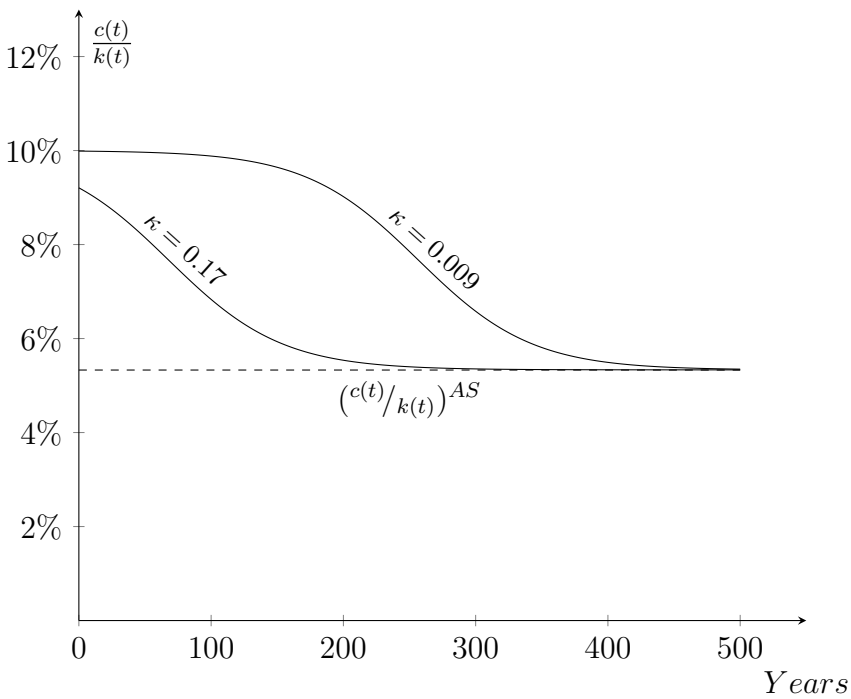
where z=$[A - \delta - n] - \theta^{-1}[A - \delta - \rho] > 0$ is a constant. The policy function expressed by the equation (5.3.12) expresses the relationship between the optimal value value of the control variable ($c(t)$) and the optimal state variable ($k(t)$), given the initial condition for capital, such that all the optimality conditions, including the transversality condition, are satisfied (Barro and Sala-I-Martin (2004), Steger (2000)).

Take off can only be achieved when the net marginal product of capital exceeds the time preference rate and consumption exceeds the subsistence level i.e. whenever individuals

[19] Admittedly, under this parameterisation the time period (500 years) is long, however the period could easily be reduced by altering the parameters without significantly affecting the properties of the solutions.

are willing to save and have the ability to save and invest, the economy will take off. With time, both per capita consumption and capital stock then will grow and reach their asymptotic balance-growth equilibrium. As per capita output slowly grows over time, consumption exceeds subsistence and the ability to save increases allowing the economy to take off. During the transition to the asymptotic balanced-growth, the net marginal product of capital rises giving incentive for agents to save and invest more, leading to a gradual increase in capital compared to the increase in consumption, and as such the consumption-capital ratio ($c/k - ratio$) declines monotonically. This is shown in figure 5.3.2 ($({}^{c(t)}/_{k(t)})^{AS}$ in the figure refers to the asymptotic level of the $c/k - ratio$).

Figure 5.3.2: Time path for the consumption/capital ratio



As output continues to grow, the proportional difference between consumption and its subsistence level increases further, as does the intertemporal elasticity of substitution. The IES represents the willingness and ability to substitute consumption over time therefore as it rises so will savings and hence capital.

As capital continues to grow, its net marginal product will begin to fall which will begin to reduce the agent's incentives to save; consumption will begin to grow faster than capital as agents save less and consume more. Reduction in the marginal product of capital further implies decline in output growth as the economy approaches the asymptotic

steady state level. Once the economy reaches its balanced-growth equilibrium, capital and consumption grow and the same constant rate, as will output. With consumption and capital growing at the same rate, the c/k-ratio also monotonically converges to its asymptotic balanced-growth equilibrium rate. In figure 5.3.2, the line marked $\kappa = 0.009$ shows the benchmark case when the ability to save is close to zero ($\kappa = 0.009$) while the line marked $\kappa = 0.17$ presents the transitional path when the initial ability to save increases to 0.17.

Whenever the economy moves on to the transitional path to the self-sustained balanced-growth steady state, the net saving rate, defined as the relationship between net investment and net output, increases along with per capita income and approaches its asymptotic balanced-growth equilibrium. Using the policy function given above (equation 5.12), the net saving rate can be derived and expressed as

$$s_y(t) = \left[\frac{A - \delta - \rho}{\theta(A - \delta - n)}\right]\left[\frac{k(t) - \bar{k}}{k(t)}\right] \tag{5.3.13}$$

As demonstrated by Steger (2000), a value of net savings equal to zero implies a constant stock of capital, i.e. gross investment only suffices to cover the depreciation of existing stock of capital, $\delta_k k(t)$, and to enable expansion of capital that covers for rate of growth of population, $nk(t)$. So long as initial capital stock exceeds the subsistence level ($k(0) > \bar{k}$), then equation 5.3.13 implies that the saving rate will be positive whenever $A - \delta - \rho > 0$ and negative whenever $A - \delta - \rho < 0$.

Domestic savings and investment have traditionally been assigned a key role in economic growth and development. Often, the saving rate is considered to be determined by the ability and the willingness to save (e.g. Hussein and Thirlwall (1999)). Equation 5.3.13 above can directly be applied to these concepts; the ability to save, also known as economic or investible surplus, is defined as the proportional difference between the current and subsistence level of income, and within this framework it is represented by the term $\left[\frac{k(t)-\bar{k}}{k(t)}\right]$ in equation 5.3.13 of the saving rate. When per capita private capital nears the subsistence level, the ability to save approaches zero and hence the entire saving rate will also converge towards zero. On the other hand, as $k(t)$ approaches infinity, the ability to save converges to 1. The willingness to save is determined by preferences and technology parameters, and in this framework it is represented by the term $\left[\frac{A-\delta-\rho}{\theta(A-\delta-n)}\right]$.

Figure 5.3.3: Time path for the saving rate

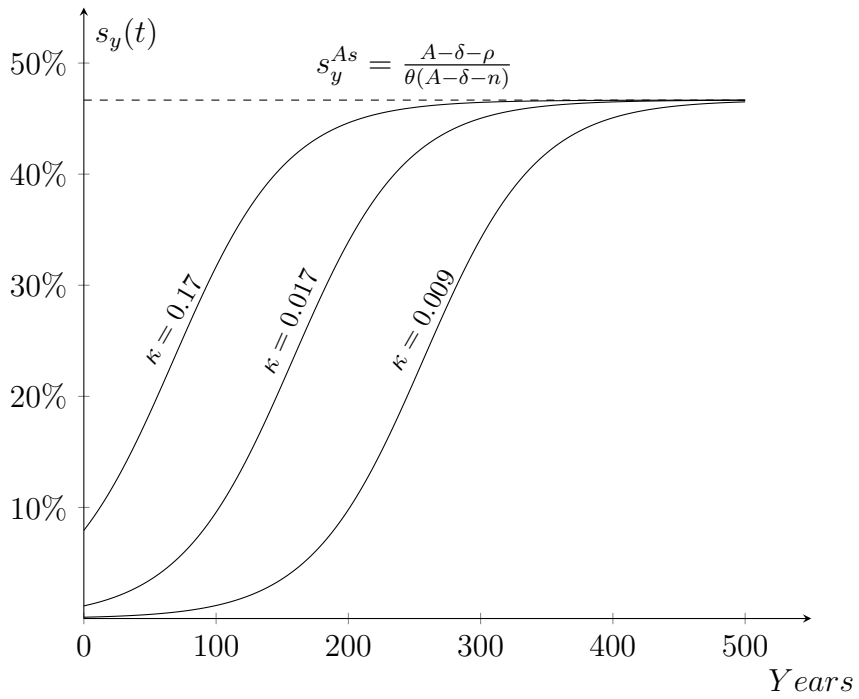


Figure 5.3.3 above illustrates the time path for the saving rate (simulations use the same parameter values as before) and beginning with the benchmark when the ability to save is assumed to be $\kappa = 0.009$. The growth rates of per capita consumption and capital will both converge to their common asymptotic balanced-growth equilibrium at a certain time and the $c(t)/k(t) - ratio$ monotonically converges to a constant. Along the transitional path the saving rate is increased as per capita incomes and approaches its constant asymptotic balanced-growth equilibrium rate given as:

$$\lim_{t\to\infty} s_y(t) \to \left[\frac{A-\delta-\rho}{\theta(A-\delta-n)}\right] \tag{5.3.14}$$

The lines marked $\kappa = 0.017$ and $\kappa = 0.17$ show transitional paths of the saving rate when for alternative (higher) levels of initial ability to save. s_y^{As} is the asymptotic steady state saving rate.

5.3.3 Foreign aid in Steger's model: An extension

In this part we present an extension to the growth model with subsistence, by introducing foreign aid within the model framework. Note that unlike the model that we propose in section (5.4), in which foreign aid is allocated by the recipient government to either finance public investment or towards lumpsum transfers to households, here we do not

have a government sector and all the aid goes directly into the agent's budget constraint. This approach has been widely used in the literature including studies suh as Kraay and Raddatz (2007) and Temple et al. (2014).

In this approach, foreign aid is incorporated into the theoretical framework of growth by modifying the economy's resource constraints so that domestic investment is financed not only by domestic output but also the external resources. With this modification the capital accumulation equation expressed by (5.3.4) which describes the evolution of capital in the economy now incorporates an exogenously determined and forecastable variable, denoted $a(t)$, for net per capita aid so that it now takes the form[20]:

$$\dot{k} = (A - \delta - n)k(t) + a(t) - c(t) \tag{5.3.15}$$

where all the variables are as already defined. Equation (5.3.15) captures the ability for low income countries to raise investment from internal savings $((A - \delta - n)k(t) - c(t))$ as well as from external resources, $a(t)$, received from foreign development partners. As is standard in the literature, to assess the importance of aid for a low-income country, it is useful to examine aid as a proportion of its GDP[21]; so that net flows $(a(t))$ can be expressed as

$$a(t) = \mu y(t); \qquad 0 < \mu > 1$$

where $a(t)$, is as defined above and μ is the proportion of aid relative to the recipient country's output. Using this assumption, we can replace $(a(t))$ in the budget constraint ((5.3.15) and re-write it as

$$\dot{k} = (A(1 + \mu) - \delta - n)k(t) + a(t) - c(t) \tag{5.3.16}$$

Following the same process as in section (5.3) above, the representative household will maximise its lifetime utility as given by equation (5.3.2) subject to resource constraints given by equation (5.3.16), and taking $k(0)$ as given. The preceding dynamic problem would hence be solved following a similar procedure as before. The optimal paths for consumption and capital will now include foreign aid and be expressed as:

$$c(t) = \bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}(A(1+\mu)-\delta-\rho)t} \tag{5.3.17}$$

$$k(t) = \bar{k} + [k(0) - \bar{k}]e^{\theta^{-1}(A(1+\mu)-\delta-\rho)t} \tag{5.3.18}$$

[20]In the context of the model that we develop in the next section, the approach being discussed here is similar to the case where the recipient government allocates all the aid towards transfers to the private sector.

[21]See Neanidis and Varvarigos (2005) and Qian (2014)

where

$$c(0) = k(0)[(A(1+\mu) - \delta - n) - (\theta^{-1}(A(1+\mu) - \delta - \rho)]$$

$$\bar{k} = \frac{\bar{c}}{(A(1+\mu) - \delta - n)k(t)}$$

In the case of no foreign aid receipts (i.e. $a(t) = 0$), the model operates similarly to the linear growth model with subsistence consumption reviewed in the previous section, with the economy caught in the low-income and low-capital-productivity subsistence equilibrium; both consumption and capital are close their subsistence levels and the net marginal product of capital is lower than the time preference. It will take a very long time for such an economy to escape the poverty trap and transition to its unbounded constant growth rate steady state. In the case that the country receives some foreign aid, it represents an extra source of resources that can be used for financing for investment other than domestic saving. It becomes an increase in the lifetime resources of households and hence it increases the ability to save and invest. As we have seen, when the ability to save increases the economy's saving rate increases leading to increase in the capital stock helping the economy take off from the subsistence equilibrium.

As we found in section (5.3), to obtain the growth rate of both consumption and capital in the balance-growth equilibrium, we divide the time differential with the optimal level of consumption/capital:

$$\frac{\dot{c}}{c} = \frac{[c(0) - \bar{c}]\theta^{-1}(A(1+\mu) - \delta - \rho)e^{\theta^{-1}(A(1+\mu)-\delta-\rho)t}}{\bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}(A(1+\mu)-\delta-\rho)t}}$$

$$\frac{\dot{k}}{k} = \frac{[k(0) - \bar{k}]\theta^{-1}(A(1+\mu) - \delta - \rho)e^{\theta^{-1}(A(1+\mu)-\delta-\rho)t}}{\bar{k} + [k(0) - \bar{k}]e^{\theta^{-1}(A(1+\mu)-\delta-\rho)t}}$$

Additionally, as the economy moves along the balanced-growth path to the high income steady state, foreign aid becomes less significant to the economy as it becomes able to rely solely on domestic savings to adequately finance the economy's investment demands. This implies that in the long run, the proportion of aid to national output will decline towards 0 i.e $\mu \to 0$ so that

$$\frac{\dot{c}}{c} = \frac{[c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)e^{\theta^{-1}(A-\delta-\rho)t}}{\bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}(A(1+\mu)-\delta-\rho)t}}$$

$$\frac{\dot{k}}{k} = \frac{[k(0) - \bar{k}]\theta^{-1}(A - \delta - \rho)e^{\theta^{-1}(A-\delta-\rho)t}}{\bar{k} + [k(0) - \bar{k}]e^{\theta^{-1}(A(1+\mu)-\delta-\rho)t}}$$

and hence the growth rate of consumption and capital (as well as output) in the balanced-growth equilibrium will be the same as in Steger (2000) case without foreign aid, expressed

by equation (5.3.11), i.e.

$$\gamma_c = \gamma_k = \lim_{t\to\infty} \frac{\dot{c}}{c} = \lim_{t\to\infty} \frac{\dot{k}}{k} = \theta^{-1}(A - \delta - \rho)$$

Effect of aid on capital (and output) growth

Figure 5.3.4: Growth rate of capital (and output)

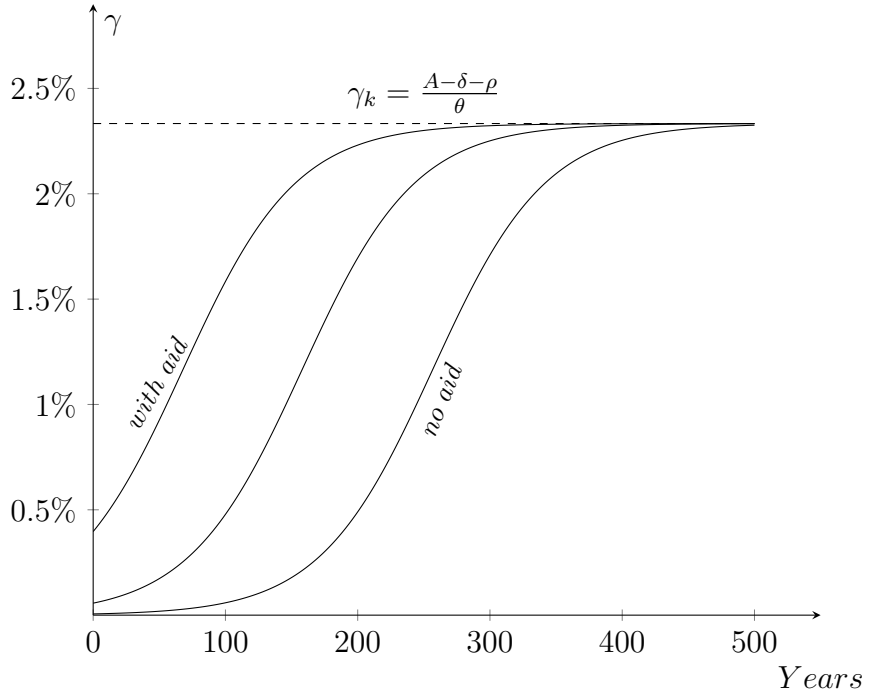


Figure 5.3.4 presents simulation results to analyse the aid-growth nexus and show how a stable inflow of aid affects the rate of growth of both output and capital, in the framework of Steger's model. The coefficient values used here are presented in table 5.C.1 of appendix 5.C and are the same as those employed earlier. The economy is assumed to start at the point where the economy has not received any foreign aid and the ability to save and invest are close to zero. An in flow of foreign aid is then assumed to raise the ability to invest from $\left[\frac{k(0)-\bar{k}}{k(t)}\right] = 0.009$ to $\left[\frac{k(0)-\bar{k}}{k(t)}\right] = 0.17$. As displayed in the figure, the transitional path for the growth rate of output for the economy before receiving aid is shown by the line marked *no aid*, and as in the case for savings, it takes about 500 years for the economy to transition from the subsistence equilibrium to the asymptotic balanced-growth steady state level. An inflow of foreign aid increases the agent's ability to save and as displayed in the figure, the effect of this aid inflow is to raise the growth rate of output and a shift upwards of the transitional path for the growth rate of output, displayed by the line marked *with aid*. Thus an increase in aid shortens the time required for the economy to transition from the initial equilibrium to its balanced growth steady state; in

the above case it now takes about 100 years to eliminate half the distance between the initial (subsistence) equilibrium to the balanced-growth equilibrium level, unlike in the case without aid which took about twice the time.

Aid presents an increase in the lifetime resources available to the representative agent; it enables higher levels of consumption and, for economies that are below their growth path, aid transfers can spur growth only to the extent that they hasten convergence to the economies' balanced-growth steady state. As we have shown in this section, in this formulation of the Ramsey model, transfers will not change the height of the balanced growth path of per capita output since exogenous aid does not alter the agent's preferences (the terms of the intertemporal trade-offs between consumption today or capital stock tomorrow) or the technology/rules of production which determine the asymptotic balanced-growth rate of change.

Effect of aid on the saving rate

The effect of an aid inflow on the agent's saving rate is similar to the effect on the growth rate of output. Since the aid is assumed in this formulation to enter directly into the agent's budget constraint, it has a direct effect of increasing the resources available to the agent to either enhance his consumption levels or indeed to save. This direct effect on income increases the ability to save and hence the saving rate during the transition to the balanced-growth equilibrium.

Furthermore, just is the case with the impact on the growth rate of output, an injection of foreign aid shortens the time it takes for the saving rate to transition to the asymptotic balanced-growth equilibrium level, as shown in figure 5 below which presents the time path for the saving rate. Notably, the injection of aid in this model does not affect the long run saving rate itself, this is related to the long-standing observation that foreign aid transfers are unlikely to alter the economy's aggregate investment rate (see Deaton (2013) and Temple et al. (2015), while Temple and van de Sijpe (2015) present evidence that suggest foreign aid mainly translates into higher household consumption rather than investment).

In the above figure, the line *no aid* represents the time path for the saving rate in the case that the economy does not receive any foreign aid transfers.As illustrated earlier in

Figure 5.3.5: Time path for the saving rate

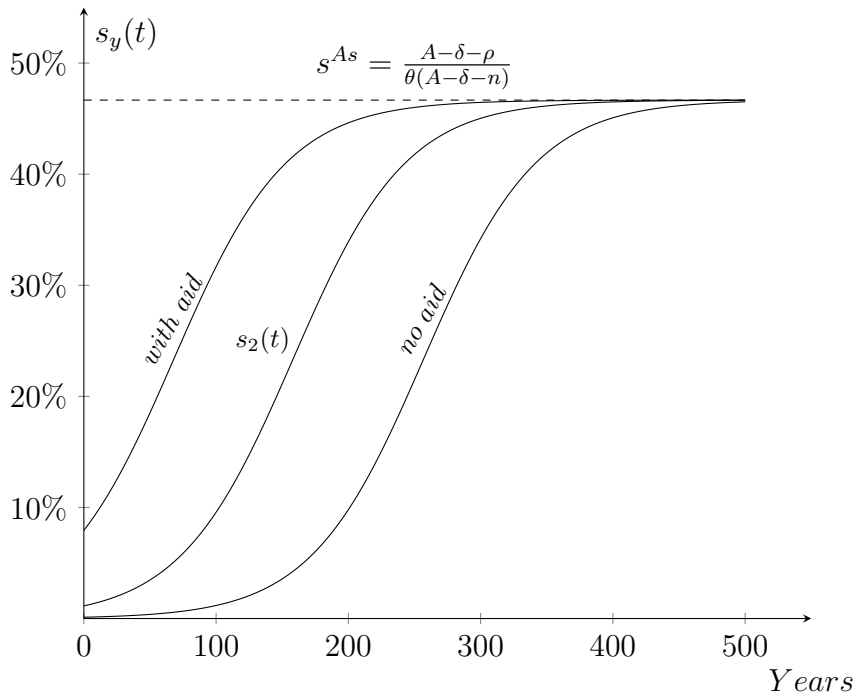


figure (5.3.3) it takes about 250 years to eliminate half of the distance between the initial (subsistence) equilibrium to the balanced-growth equilibrium level.

An inflow of aid raises the aggregate resources in the economy and hence increases the per capita lifetime resources for the agent. With this aid inflow, the economy's ability to save jumps from 0.009 to 0.17 and resultant from that, private savings increase rapidly. In the above figure, the time path for the saving rate after infusion of foreign aid transfers is illustrated by *with aid* while s^{As} is the asymptotic saving rate. Foreign transfers push the ability to save upwards so that the economy starts off with already higher saving rate and it goes on to rise rapidly as the economy transitions towards the asymptotic balance-growth equilibrium.

Again, as with the growth rate of capital, the asymptotic balanced-growth equilibrium saving rate is determined by constant factors that are unaffected by the aid inflows (preferences, production technology and depreciation rate and population growth rate); as a result, the saving rate will converge to the same asymptotic rate as the initial case when there are aid flows. The effect of aid is therefore to accelerate transition of the saving rate from the subsistence equilibrium to its asymptotic steady state rate.

The growth model developed in Steger (2000) and reviewed in this section shows that

the requirement of subsistence affects the process of growth by restricting the ability to save. Furthermore, with variable intertemporal elasticity of substitution, a model that takes into account subsistence constraints has saving rate that increases with per capita incomes and causes the growth rate of incomes to increase.

Steger (2000) benchmark framework makes the assumption of a small closed economy[22] in which domestic investment is solely financed from internal savings. This assumption is not particularly appropriate for LDCs, who are most affected by subsistence constraints – low income countries often have per capita incomes so close to or even below subsistence levels such that they have very limited ability to raise adequate savings for domestic investment. As a result, foreign resources (in particular aid in the form of grants and loans) constitute a fundamentally significant source of additional resources to such economies which can then be used for consumption and accumulation of private capital for domestic investment.

The extension to Steger (2000) model discussed in subsection (5.3.3) recognises the role that foreign aid plays in LDCs so they analyse the impact of foreign aid on the growth of output when subsistence constraints are considered. The main drawback of this approach in analysing the impact of aid is that it often assumes that all the aid received is used in the accumulation of the private agent's capital. As noted earlier, the experience in developing countries is that this type of aid (in the form of transfers to the agent's budget constraint) does not affect the economy's aggregate investment rate and quite often much of the aid is used to increase consumption rather than investment.

It is with this background that in the next section we propose a model which takes into account subsistence constraints and foreign aid. Unlike the approach discussed so far, we will introduce a government sector which makes decisions about the allocation; this is consistent with experience from developing countries where most of the aid provided through the government.

[22]Other than the assumption of no borrowing (which includes no borrowing from the international financial market), it is also standard in the literature to assume that agents are not engaged trade.

5.4 Government Spending and Public Capital Accumulation

We have so far established two key concepts which we will build on in this section: firstly, subsistence constraints provide an important mechanism for analysing growth determinants and secondly that foreign aid constitutes an important source of financing in developing countries. Key to the model developed in this section is the introduction of a government sector which receives the foreign transfers from development partners/donors. This is in line with experience from developing countries where the government/public sector has a significant influence on private production through provision of essential capital goods and services that augment private capital and increases its marginal product. The analysis in chapter 4 gives empirical evidence from Malawi on the relationship between aid and growth which suggests that government allocation of foreign aid affects the rate of growth of output.

In the model developed in this section, when the government receives foreign resources it makes a decision on its allocation towards two uses. Firstly, the government can allocate aid towards lump sum transfers to the private sector which the representative agent can use to complement his consumption or private capital accumulation. Secondly, it can use the aid to complement the often minimal domestic tax revenues that the government levies on private output, to finance accumulation of public capital.

Taking into account these considerations together, we analyse the critical role that foreign aid plays in complementing domestic resources available to finance public capital goods that are then made freely and equally available to the private sector. Examples of public capital goods include transport infrastructure (such as roads, railways, bridges etc), public education, public hospitals, and it also includes critical components such as water and sewer systems, public electric and gas utilities, as telecommunications which are often not readily provided by the private sector in developing countries. These capital stocks raise the marginal physical product of and thus stimulate long run accumulation of private capital. At the same time, we also incorporate the likely possibility that some of the received aid may not be used for productive purposes (i.e. it may be used for purposes other than public capital accumulation), and as such it may not have direct effect on

capital productivity and production.

Our interest is to find out if a comprehensive framework that captures foreign aid in the context of the constraints on households posed by subsistence requirements as well as the important role that the public sector plays in developing countries will help to yield more powerful insights for our interpretation on the aid-growth nexus and provide better recommendations for policies on foreign aid.

5.4.1 Analytical Framework

We can now turn to a more formal description of our model, laying out its components in turn and then deriving the results concerning the impact of foreign aid on the growth of output.

Private sector

Consider a small open[23] economy populated by identical infinitely lived individuals so that aggregate private quantities are multiples of individual quantities. We consider a representative producer-consumer agent who produces a single traded commodity. Our first departure from the Steger's model is that gross output (per capita), $y(t)$, of the commodity in our model is produced using two forms of capital (private and public capital), employing a Constant Elasticity of Substitution (CES) production function expressed as:

$$y(t) = [\alpha(Ak(t))^{\upsilon} + (1-\alpha)(A_g k_g(t))^{\upsilon}]^{1/\upsilon} \tag{5.4.1}$$

where per capita variables in small letters imply division by labour input i.e. $y(t) = {}^{Y(t)}/_{L}$; $k(t) = {}^{K(t)}/_{L}$; and $k_g(t) = {}^{K_g(t)}/_{L}$ and the variables in capitals are economy aggregate values. At the beginning of each period each agent is endowed with an initial stock of private capital $k(0) > 0$ and an initial stock of per capita public capital $k_g(0) > 0$. $0 < \alpha < 1$ and $\upsilon < 1$. $k(t)$ denotes the representative agent's stock of private capital, $k_g(t)$ denotes the stock of public capital, A is a constant technology (total productivity) parameter associated with private capital while A_g is the total productivity parameter associated with public capital;[24] α is a share parameter for the production inputs.

[23]In this framework, open economy merely implies that the economy does receive external transfers in the form of aid, otherwise as already alluded to, we assume that agents are not involved in trade and have no access to international capital markets

[24]Without loss of generality, we set $A_g = 1$. This is done merely for simplicity in solving the model and should have no significant effect on the results.

Following Chatterjee and Turnovsky (2005) and Turnovsky (1996), the production function is assumed to exhibit positive net marginal productivity in all factor inputs i.e. $f_k > 0$ and $f_g > 0$ (to conserve on notation, f_k and f_g denote the derivative of the production function with respect to private capital and public capital respectively). The model does not include labour in the production function, hence private capital should be taken broadly to include human as well as physical capital (see King and Rebelo (1993)). Additionally, we also make the standard assumption of diminishing marginal physical product of private captal, that is $f_{kk} < 0$ (f_{kk} denotes the second derivative of the production function with respect to private capital) and for all values of υ, there are constant returns to scale in both factors of production together.

As observed in Barro (1991*b*), the assumption here is that public capital ($k_g(t)$) is measurable, for instance by the per capita quantity of government productive investment, though not only limited to government purchases; the important issue conceptually is that the government does not engage in production by itself, rather it purchases some flows of services/output from the private sector and makes these available freely and equally to households and that they correspond to some required input that matters for private production of output as expressed in the production function (5.4.1).

The agent consumes the good which yields utility over the infinite horizon; thus the representative agent chooses the paths for consumption, $c(t)$ and stock of private capital $k(t)$ to maximise his dynastic Stone-Geary lifetime utility function represented as:

$$\max_{\{c(t)\}} \int_0^\infty \frac{[c(t) - \bar{c}]^{(1-\theta)}}{1-\theta} e^{-(\rho-n)t} dt$$

subject to:

$$\dot{k} = (1-\tau)y(t) + T(t) - (\delta + n)k(t) - c(t) \tag{5.4.2}$$

$$k(t) > 0$$

where as before, $k(t)$ denotes stock of private capital (both human and physical); $c(t)$ denotes consumption and the subsistence level of consumption is denoted by $\bar{c}$. The representative agent also receives some lump-sum income transfers from the government, and are denoted in the model by $T(t)$ while θ is a constant preference coefficient, ρ the individual time preference rate, δ_k represents depreciation of private capital and n the constant rate of population growth. Additionally, the agent is endowed with some initial level of private capital, $k(0) > 0$ as well as an initial stock of public capital, $k_g(0) > 0$.

A second distinction from the framework employed in Steger (2000) is the introduction of a Government sector that imposes a flat-rate marginal income tax rate on private output/income, denoted by $\tau \in [0, 1]$ – the private sector takes this tax rate as given.

A critical feature of the model pertains to the inclusion of public capital, $k_g(t)$ in the production technology. Public capital is accumulated by the government sector and is co-financed from domestic resources (income taxes) and foreign resources (aid). In this analysis, the public capital good is assumed to be non-rival and non-excludable capital good available freely and equally to each individual agent, independent of the size of the economy. Further, public capital is also assumed not to be subject to congestion effects, i.e. the model abstracts from externalities associated with public capital.

Government sector: Foreign aid and public capital accumulation

With the purpose of introducing foreign aid, we bring in a government sector into the model. We assume that at each instant a foreign donor (this may be a single country, a group of countries or an international organisation) disburses transfer of resources in the form of aid (either grants or loans) to the small economy of the amount $a(t)$, measured in units of domestic output.

Following Chatterjee and Turnovsky (2005), we assume that only a fraction, $\varphi \in [0, 1]$, of the aid received is invested in the production of public capital, representing "productive transfers" while the remaining fraction, $(1 - \varphi)$, is allocated to the private sector in the form of lump-sum transfers ($T(t)$).[25] Thus for instance, $\varphi = 1$ refers to a case where all the aid is tied to some productive expenditures and is used in producing public capital. On the other hand, $\varphi = 0$ implies that none of the aid received has been used for any productive purpose but has instead been totally transferred to the private sector i.e. non-productive transfers or pure aid.

Empirical research by Aschauer (1988, 1989), which provided evidence to suggest that public capital has a critical impact on the productivity of private capital, stimulated much of the recent interest on the effects of public capital. The role of public investment in

[25]In our model, the allocation decision of aid into productive expenditure and lump-sum transfers is assumed to be made by the government. In some studies, the allocation is assumed to have been pre-determined by the donor. Either way, what matters in terms of the model is that for the agent this decision is exogenously made.

private capital formation has since become a crucial public policy matter. There is growing consensus in recent literature that in general support the notion of productivity enhancing impact of public capital (Fisher and Turnovsky (1998), Chatterjee and Turnovsky (2004, 2005).

Theoretical studies that analyse the role of public expenditures distinguish between two main kinds; the first is often referred to as unproductive government consumption expenditures, which in many cases provide direct utility to private agents/households but have no direct effect on the formation of private capital. Examples of such expenditures include expenditures on national parks and social programmes. The other is productive government expenditure which is used in the accumulation of public capital that enhances the productive capacity of private firms/agents and is introduced as an argument in the production function to reflect, among many reasons, a positive externality in production. The most common examples of such productive expenditure is expenditure on infrastructure such as roads and ports, information and communication infrastructure etc.

A further analytical distinction in the literature regarding productivity of public expenditure identifies two formulations: most existing studies treat the current flow of government infrastructure expenditures as the source of contribution to productive capacity, for example Aschauer and Greenwood (1985), Barro (1988), Aschauer (1988) and Devarajan et al. (1996) use productive government flows in a neoclassical Ramsey framework while Turnovsky (1996) and Barro (1991*b*) do so in a simple AK endogenous growth model.

Arising from the key criticism of the first formulation, an alternative formulation argues that rather than the flow of expenditure on roads and communication systems, it is the accumulated stocks of public capital that are relevant for productive capacity. A growing section of the literature on productive government expenditures is adopting this formulation, for instance Chatterjee and Turnovsky (2004, 2005) Chatterjee et al. (2001) and Turnovsky (2009) who extend Rebelo (1992) AK model to include stocks of public capital in the production function. The analysis in this study will follow this later formulation[26].

An important issue, particularly for resource constrained low-income developing countries pertains to how new investment on public capital (and maintenance of existing capital)

[26]Barro (1991*b*) suggest that the distinction between the two formulations is not substantive because output can be used for consumption or to augment public or private capital.

is financed. In these economies, a key source of financing for public capital expenditures is foreign transfers, especially official development assistance in the form of loans and grants. As noted in Chatterjee and Turnovsky (2005), in the post-World War II era, capital transfers from the developed to the developing world have increasingly taken the form of ODA, with up to three-quarters of ODA being fully or partially tied to investment in infrastructure and other public capital goods. In this analysis, we bring together the issue of subsistence consumption and analyse the potential effects of aid in economies where subsistence requirements are significant, in an intertemporal model of a small open economy characterised by endogenous growth.

Beginning with a given initial stock of public capital $k_g(0) > 0$, the accumulation of public capital is expressed as:

$$\dot{k_g}(t) = G(t) - (\delta_g + n)k_g(t) \tag{5.4.3}$$

where $\dot{k_g}(t)$ is the time derivative of public capital, G(t) is the accumulated stock of public capital goods, δ_g is the depreciation rate for public capital and n is population growth. We assume that all revenues from income taxes are used exclusively for the production of public goods which is co-financed by the fraction of aid that is used for productive purposes and that the only source of financing for lump-sum transfers to the private sector comes from foreign aid.

With these assumptions, the government's budget constraints are expressed as

$$G(t) = \tau y(t) + \varphi a(t)$$

$$T(t) = (1 - \varphi)a(t)$$

where τ is non-distotionary constant income tax rate[27] and φ is the proportion of aid that is used productively financing public investment for public capital accumulation; $T(t)$ represents lump sum transfers from the Government to the private sector, fully financed from the fraction $(1 - \varphi)$ of total aid that is not used for public capital accumulation. Note that lump sum transfers are entirely financed by aid simply because our focus is solely on the composition and potential effects of foreign aid receipts.

[27]It is noteworthy to mention that other studies, such as Neanidis and Varvarigos (2009), use an alternative assumption from that of a constant tax rate used in this analysis; rather they assume a proportionate tax rate also exogenously set by the government. Using either of the two (constant tax rate or proportional tax rate) has no significant effect on the underlying structure of the model and does not alter or improve the results and message from our analysis.

Finally, the assumptions on government expenditures imply that the government sets its taxes and operations to continuously maintain a balanced budget:[28]

$$\tau y(t) + a(t) = T(t) + G(t)$$

The focus of our analysis is to examine the effects of foreign aid along an equilibrium path with sustainable long-run growth, as such we do not make any effort in analyzing the government's decision problem in choosing the tax rate, τ [29] ; we only assume that the government is resource constrained and makes such a decision to run a balanced budget, after receiving aid inflows.

As done earlier, to assess its importance the total aid disbursement is tied to the scale of the recipient economy, such that:

$$a(t) = \mu y(t)$$

so that we can re-write the government investment budget constraint as

$$\begin{aligned} G(t) &= \tau y(t) + \varphi\mu y(t) = (\tau + \psi)y(t); \\ T(t) &= (1 - \varphi)\mu y(t) = (\mu - \psi)y(t) \end{aligned} \tag{5.4.4}$$

where $\psi = \varphi\mu$

While the assumption that total aid be tied to the scale of the economy would technically imply that taxes on output also affect transfers, in our analysis that is not the case and we assume that all the lump sum transfers are financed through foreign aid receipts and are hence unaffected by taxes. Also, note that the idea for inclusion of public capital as a separate input in the production function is that the two inputs are not close substitutes.

The assumptions made pertaining to the allocation of aid allow the model to capture the different ways in which recipient governments could use foreign aid once it is received. Lump-sum transfers to the private sector are a form of 'traditional untied or pure aid' while the production component used in accumulation of public capital take the form of 'tied project' aid. Lump-sum transfers augment the private sectors' disposable incomes to consume (or save); in the context of our analysis direct lump-sum transfers can thus

[28]The assumption of balanced budget in which only non-distotionary income taxes and non-costly development assistance (i.e. No repayments are considered in the model) are the sources of government expenditure is restrictive, but it makes for simple analysis.

[29]An analysis of the government's decision on both G and τ would make a useful extension to this analysis; for an attempt at this see Davoodi and Zou (1998), Lin and Liu (2007) and Zhang and Zou (1996).

be used to improve consumption levels for economies with per capita incomes below subsistence and hence reduce limitations on the economy's ability to save imposed by the subsistence constraints. On the other hand, productive 'tied aid' is used in production of public capital freely available to the private sector and affects the private sector in two ways: firstly, as already seen, productive aid can lead to lower income tax rates[30]. increasing the agent's disposable incomes (and thus increasing incentives to save) as found in Neanidis and Varvarigos (2009) and secondly, by construction of the model, productive expenditure leads to public capital accumulation which enhances the productivity of private capital, just as found in Chatterjee and Turnovsky (2005). Higher returns from private capital increase incentives towards private investment and thus increases the agent's willingness to save and invest, raising aggregate investment and output growth.

In order for the level of public capital available to individual agents to remain constant over time given the agent's private capital, $k(t)$, and to ensure balanced endogenous growth, the government must set $k_g(t)$ to grow at the same rate as $k(t)$ so that $\dot{k}(t)/k(t) = \dot{k_g}(t)/k_g(t)$.[31]

Combining equations (5.4.3) and (5.4.4), we can re-write the accumulation of public capital as

$$\dot{k_g}(t) = (\tau + \psi)y(t) - (\delta_g + n)k_g(t) \tag{5.4.5}$$

Now we introduce some assumptions pertaining to the fiscal response by the government. In particular, following Barro (1991*b*), we assume that at each instant the government adjusts its fiscal policy so as to maintain a constant rate of investment in productive public ventures, i.e. infrastructure, and hence over time keep public capital as a fraction, say $\bar{g}$, of output, y, so that

$$\dot{k_g}(t) = \bar{g}y(t) \tag{5.4.6}$$

where $\bar{g}$ is a public policy parameter chosen by the government. The above assumptions on government's fiscal response (an exogenously set constant rate of government expenditure on public investment and allocating a fixed fraction of gross output to public investment) are necessary to sustain an equilibrium of on-going endogenous growth (Barro (1991*b*)) and it is also consistent with the experience of developing countries (see Chatterjee et al. (2001) and Neanidis and Varvarigos (2009)).

[30] A rise in aid receipts, when used to co-finance public capital investment, can allow the government to reduce the tax rate on the private sector's income

[31] See Chatterjee et al. (2001); Fisher and Turnovsky (1998) and Barro (1991*b*)

5.4.2 Dynamic General Equilibria

The general equilibria in this economy can be obtained by combining the assumptions made in the previous section along with optimality conditions of the representative agent's dynamic problem: to choose sequences of private consumption,$c(t)$, and private capital, $k(t)$, to maximise the expected lifetime utility expressed in equation (5.3.2), subject to the constraints expressed by equation (5.4.2).

When maximizing his utility, the representative agent takes government's decisions on taxes and expenditures as well as the stock of public capital, $k_g(t)$, as exogenous to his private decisions. The agent does not internalize the effect of his private investment decisions on public investment and the evolution of public capital, i.e. we assume that the agent's decision regarding consumption and savings (private capital accumulation) do not affect the government's decision with regards to expenditures on public investments and the accumulation of public capital. As such the dynamics of the economy and the steady-state equilibrium in this case will be independent of the evolution of public capital, what will be important to the agent is that he will have some level of public capital stock in each period that is freely available for use in his production.

To solve the model, we first utilise the earlier assumption on public capital, expressed by equation (5.4.6), which we combine with the public accumulation function (equation 5.4.5) to yield[32]

$$\bar{g}y(t) = (\tau + \psi)y(t) - (\delta_g + n)k_g(t)$$

This can be re-written as

$$(\tau + \psi - \bar{g})y(t) = (\delta_g + n)k_g(t)$$

$$k_g(t) = \left(\frac{\tau + \psi - \bar{g}}{\delta_g + n}\right) y(t)$$

$$k_g = \left[\frac{\tau + \psi - \bar{g}}{\delta_g + n}\right] \left[\{\alpha(Ak(t))^{\upsilon} + (1-\alpha)(k_g(t))^{\upsilon}\}^{1/\upsilon}\right]$$

which can be simplified to obtain

$$k_g = \left[\frac{\alpha^{1/\upsilon}(\tau + \psi - \bar{g})}{(\delta_g + n) - ((\tau + \psi - \bar{g})(1-\alpha))^{1/\upsilon}}\right] Ak(t) = \Omega Ak(t)$$

[32] An additional restriction from this expression is that $\tau + \varphi \geq \bar{g}$ which is interpreted to ensure positive tax rates, as in Neanidis and Varvarigos (2009).

where

$$\Omega = \left[\frac{\alpha^{1/\upsilon}(\tau + \psi - \bar{g})}{(\delta_g + n) - ((\tau + \psi - \bar{g})(1 - \alpha))^{1/\upsilon}}\right]$$

Note from this expression that ${}^{\partial\Omega}/_{\partial\mu} > 0$ and ${}^{\partial\Omega}/_{\partial\varphi} > 0$. Substitute the above equation for $k_g(t)$ into the production function (5.4.1) to get

$$y(t) = \{\alpha(Ak(t))^{\upsilon} + (1 - \alpha)(\Omega Ak(t))^{\upsilon}\}^{1/\upsilon}$$

$$y(t) = (\alpha + (1 - \alpha)\Omega^{\upsilon})^{1/\upsilon} Ak(t)$$

or

$$y(t) = \phi Ak(t) \tag{5.4.7}$$

where $\phi = (\alpha + (1 - \alpha)\Omega^{\upsilon})^{1/\upsilon}$

As long as the government sets fiscal policy such that public capital to grow at the same rate as output, the economy will converge to a constant asymptotic growth rate and the dynamics of the model will be similar to the Ak model analysed in the previous section (Barro (1991*b*)). The production function in equation (5.B.3) implies that the net marginal product of private capital is now $f_k = \phi A > 0$.

We have thus transformed the production function in such manner that at each instant and for a given public capital ratio, $\bar{g}$, gross per capita output, $y(t)$, is proportional to private capital, $k(t)$. An inflow of aid, say a, enables the government to pursue an expansionary fiscal policy leading to an increase public capital accumulation (for any $\varphi > 0$), leading to an increase in Ω to Ω_a and hence an increase in ϕ to ϕ_a; the result will be an upward shift of the marginal product of private capital from $f_k = \phi A$ to $f_k = \phi_a A$[33]. A similar effect results from allocating more aid towards public capital accumulation, for any given level of aid. Increasing φ raises Ω and hence higher ϕ and the associated marginal product of private capital.

Substituting equation 5.B.3 to update the resource constraints expressed by equation 5.4.5, which can now be expressed as:

$$\dot{k}(t) = (1 - \tau)\phi Ak(t) + T(t) - (\delta_k + n)k(t) - c(t) \tag{5.4.8}$$

$$\bar{c} \leq c(t) \leq (1 - \tau)\phi Ak(t)$$

The representative agent will therefore seek to maximise his lifetime utility, expressed by equation 5.3.2, subject to the resource constraints expressed by equation 5.4.8. Thepresent-

[33]Variables with the subscript a imply new levels after the inflow of aid.

value Hamiltonian for the above stated dynamic problem is set as

$$\mathcal{H} \equiv \frac{[c(t)-\bar{c}]^{(1-\theta)}}{1-\theta} e^{-(\rho-n)t} + \lambda(t)\{((1-\tau)\phi A - \delta_k - n)k(t) + T(t) - c(t)\}$$

where $\lambda(t)$ is the shadow value of wealth. Deriving necessary optimality conditions to this dynamic problem gives

$$\partial\mathcal{H}/\partial c(t) = [c(t)-\bar{c}]^{-\theta} e^{-(\rho-n)t} - \lambda(t) = 0$$

$$\Rightarrow [c(t)-\bar{c}]^{-\theta} e^{-(\rho-n)t} = \lambda(t)$$

$$\partial\mathcal{H}/\partial k(t) = \lambda(t)((1-\tau)\phi A - \delta_k - n) = -\dot{\lambda}(t)$$

Using the resource constraint expressed by 5.4.8 and the optimality conditions derived above, we can derive the economy's system dynamic linear differential equations in $c(t)$, $k_g(t)$ and $k(t)$ expressed as:

$$\dot{c} = \theta^{-1}[c(t)-\bar{c}]((1-\tau)\phi A - \delta_k - \rho) \tag{5.4.9}$$

$$\dot{k} = (1-\tau)\phi A k(t) + T(t) - (\delta_k + n)k(t) - c(t) \tag{5.4.10}$$

$$\dot{k_g}(t) = (\tau + \psi)[\phi A k(t)] - (\delta_g + n)k_g(t) \tag{5.4.11}$$

The macroeconomic system describes a standard perfect foresight equilibrium. It comprises a dynamic system that determines the evolution of private capital and consumption and hence the macroeconomy as a whole, given the evolution of public capital. Equation 5.4.10 captures the internal resource constraints that the representative agent faces: in this context, with the stock of public capital taken as an exogenously determined sequence from the public sector, then as is standard, the evolution of per capita private capital will equal the sum of domestic savings (gross output minus private consumption and taxes to the government) plus lump-sum transfers from the government minus effective depreciation of private capital stock. Equation 5.4.11 on the other hand expresses the constraints faced by the government sector, and estimates that public capital will equal expenditure on productive public investment less the depreciation of existing public infrastructure.

Using the standard procedure for solving the preceding dynamic problem[34] as done in section (5.3.1) above, equilibrium time paths for consumption and private capital can be shown to be given by the following expressions:

$$c(t) = \bar{c} + [c(0)-\bar{c}]e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t} \tag{5.4.12}$$

$$k(t) = \bar{k} + [k(0)-\bar{k}]e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t} \tag{5.4.13}$$

[34]Detailed solution to the model in the appendix.

where initial consumption ($c(0)$) is expressed as

$$c(0) = (\Gamma - \Psi)k(0) + \frac{\Psi}{\Gamma}\bar{c} \tag{5.4.14}$$

$$\Gamma = ((1 + \mu - \tau - \varphi)\phi A - \delta_k + n)$$

$$\Psi = \theta^{-1}((1 - \tau)\phi A - \delta_k - \rho)$$

$\bar{k}$ is the subsistence level of private capital stock,[35] defined as

$$\bar{k} = \frac{\bar{c}}{\phi A(1 + \mu - \psi - \tau) - \delta_k - n} \tag{5.4.15}$$

and

$$\phi A(1 + \mu - \psi - \tau) - \delta_k - n > 0$$

The above solutions are similar to the results derived by Fisher and Turnovsky (1998) for their benchmark linearised dynamic system for the case where public capital is financed through non-distortionary lump-sum taxes.

Implications

As in Steger (2000), the solutions 5.4.12 and 5.4.13 imply the model with subsistence consumption exhibits multiple dynamic equilibria; in particular, we have two steady states where consumption and private capital remain stationary (zero growth) and one asymptotic balanced growth equilibrium at which consumption and private capital grow at the same constant growth rate. Additionally, the inclusion of productivity enhancing public capital provides further implications particularly to the transitional dynamics within and between equilibria.

Subsistence equilibrium

The first steady state is what has been often been referred to the literature as the poverty trap; this is the subsistence steady state and occurs when consumption equals its subsistence level and private capital also equals its subsistence level. Thus in the solutions 5.4.12 and 5.4.13 above, the subsistence steady state occurs when $c(0) = \bar{c}$ and $k(0) = \bar{k}$, so that equation 5.4.12 will simplify into $c(t) = \bar{c}$, thus consumption remains constant at the subsistence level and similarly equation 5.4.13 simplfies into $k(t) = \bar{k}$ the constant subsistence level of private capital[36].

[35]Note that we have used the implication of assumption made with regards to allocation of aid between lump sum transfers and productive investment expressed by equation 5.4.10 and hence transfers, $T(t)$, are captured by the expression $(\mu - \psi)$.

[36]Figures **??**, **??** and 5.4.1 have been drawn using the parameter values in table 5.4.1 which are

The subsistence steady state represents a minimum-development equilibrium with zero growth and applies whenever $k(0) \leq \bar{k}$ and the net marginal product evaluated at the subsistence level of capital is lower than the time preference rate, i.e. $(1-\tau)\phi A - \delta_k - \rho < 0$. Intuitively, when an economy is caught in the poverty trap individuals are simply not able and are less willing substitute consumption intertemporally, and hence the subsistence steady state becomes the long run solution to the dynamic problem.

The subsistence equilibrium exists whenever the economy is evaluated as starting at or below $\bar{c}$ level of consumption and $\bar{k}$ private capital stock; in such a case, the intertemporal elasticity of substitution is zero for some positive consumption (resulting from the SGP used) as the opportunity cost of investment is too high for the poor agents. An economy that starts from this level will remain indefinitely at the subsistence level; furthermore an economy that starts with private capital below $\bar{k}$ will maintain its consumption at the subsistence level and keep depleting its capital stock.

Note that the formula for the subsistence level of private capital given by (5.4.15) includes components that capture the effect of aid; it can be seen from the equation that ${}^{\partial \bar{k}}/_{\partial a(t)} < 0$ implying that an increase in foreign aid will help make the subsistence constraints to private capital accumulation less significant. The effect of an increase in the flow of foreign aid on subsistence level of capital are captured in two ways, depending on the government's allocation of aid between lump-sum transfers and productive aid.

The first is a direct effect when aid is used to finance lump sum transfers the agent receives from the government sector, this effect is represented by $(\mu - \psi)$ in equation (5.4.15). Lump-sum transfers enter directly into the private agent's budget constraint reflecting an increase his aggregate lifetime income that leaves the agent with more resources for both consumption and also improving the propensity to save. With this channel, aid can help private capital to exceed the subsistence level.

The second effect is captured by ϕ, when aid is used to accumulate public capital available to the agent that raises the productivity of private capital. Through this channel, aid can help raise the net marginal product of capital to levels exceeding the time preference; high returns to private capital increases the propensity to save implying individuals are more

employed in the numerical simulations conducted in subsection 5.4.5.

willing to substitute consumption.

As long as consumption remains at the subsistence level and hence the economy is evaluated at $k(0) \leq \bar{k}$, the economy will remain at the subsistence equilibrium even after an external resource (aid) transfer. If however foreign aid increases both private consumption and capital above the subsistence level, then the economy will start from some level where $k(0) > \bar{k}$ - in that case, the starting point is no longer the subsistence equilibrium and both consumption and capital may record positive growth. This is the argument behind Sachs et al. (2004) and other *Big Push* proponents.

Knife-edge equilibrium
The second steady state represents a knife-edge equilibrium in which consumption and capital are both slightly above subsistence but the net marginal product of private capital exactly equals the time preference rate i.e. $k(0) > \bar{k}$ and $(1-\tau)\phi A - \delta_k - \rho = 0$.

Initially, the economy starts off with the net marginal product of capital above the time preference so that the representative agent has ability and willingness to substitute consumption intertemporally. As the economy grows, the net marginal product of capital diminishes and the asymptotic marginal product of private capital might be too low to guarantee unbounded growth. Eventually the marginal product of private capital converges to exactly equal the time preference rate i.e $(1-\tau)\phi A - \delta_k - \rho = 0$ and the economy collapses into a continuum of dynamic steady state with zero growth where both consumption and capital are slightly above their subsistence levels.

In Steger (2000) model, when an economy is in this equilibrium foreign resource transfers such as aid may increase the level of consumption and private capital. Since initial consumption is already above subsistence, so long as the external transfers do not have an effect on the productivity of private capital, the net marginal product would remain equal to the time preference and hence aid would still not stimulate sustained growth.

In our model aid transfers some of the external receipts are used in the accumulation of public capital, which enhances the productivity of private capital , rising from ϕA to $\phi_a A$. This may help sustain the net marginal product of private capital above the time preference rate i.e. $(1-\tau)\phi_a A - \delta_k - \rho > 0$. With marginal product more than time preference and capital stock already higher than the subsistence level, the economy can

take off along its transitional path to the asymptotic balanced-growth equilibrium.

Asymptotic balanced-growth equilibrium

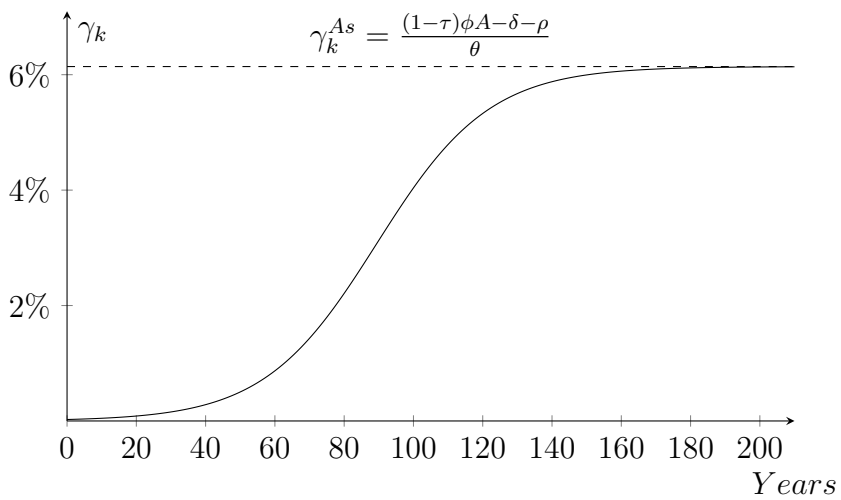
The third dynamic equilibrium represents the asymptotic balanced-growth equilibrium with a constant growth rate for both consumption and private capital; this steady state occurs when the asymptotic marginal product of capital exceeds the time preference rate i.e. $(1-\tau)\phi A - \delta_k - \rho > 0$ for all $k(0) > \bar{k}$. The growth rates of private capital and consumption will approach their common asymptotic balanced-growth steady state value and the economy pursues unbounded growth (shown in figure (5.4.1)). Using solution 5.4.12 and using the same process as shown in section (5.3.1), we find that the asymptotic balanced-growth rate of consumption is found to be

$$\gamma_c = \lim_{t\to\infty} \frac{\dot{c}(t)}{c(t)} = \theta^{-1}((1-\tau)\phi A - \delta_k - \rho)$$

Further, in this equilibrium both consumption and private capital must grow asymptotically at the same rate, which is also confirmed by the solution in equation 5.4.13, hence the growth rate of capital is also expressed as

$$\gamma_k = \lim_{t\to\infty} \frac{\dot{k}(t)}{k(t)} = \theta^{-1}((1-\tau)\phi A - \delta_k - \rho)$$

Figure 5.4.1: Time path for the growth rate of capital and output



As will be discussed in more details in the following sections, the effect of aid on the growth rate of output (as well as consumption and private capital) depends on the allocation of aid between pure aid (lump-sum transfers) and productive aid. Lump-sum transfers to the private sector will only accelerate the economy along its transitional path to the asymptotic steady state. Productive aid on the other hand increases private capital productivity, and hence alters the long run aggregate investment rate pushing the economy on to a higher balanced-growth equilibrium rate for consumption and capital.

Discussion

Multiplicity of equilibria in this model is a result of the preferences used and not the inclusion of public capital in the model. Contrast to standard the Ramsey model, the model with Stone-Geary preferences results in additional stable equilibrium when $c = \bar{c}$ and $k = \bar{k}$. Furthermore, the model also implies that when capital stock is below the subsistence level, then the economy may not be able to attain the high income asymptotic equilibrium. An economy that starts at the low income equilibrium can remain there for a significantly long time.

Foreign aid transfers represent a critical source of income particularly for economies that are caught up around the subsistence equilibrium. Since agents at the low income equilibrium are too poor to substitute consumption, foreign aid may be able to raise consumption beyond the subsistence levels hence increase the agent's ability to save. This would be reflected in an increase in savings allowing capital to also increase beyond its subsistence levels.

This is the idea underlying Sachs et al. (2004) and other *Big Push* proponents; the notion that foreign resource transfers can provide a jump for economies caught up in poverty traps to a position where initial capital is evaluated above the subsistence level. Once the economy is pushed on to a level higher than the subsistence levels standard market economy dynamics would help transition to the high income equilibrium, something that is not possible when the economy is at subsistence.

It is worth mentioning that critics of the big push idea argue that foreign aid does not often result in an increase in private consumption at all. Rather, it only leads to increase in the size of government and its operational expenditures leaving precious little for productive expenditures or indeed transfers to the private sector. Boone (1996) finds that foreign aid does not significantly increase investment (private and public) and growth, nor benefit the poor as measured by improvements in human development indicators, but it does increase the size of government. Remmer (2004) adds that aid promotes not only increased spending but also reduces revenue generation hence potentially self-defeating the efforts to promote market-oriented programs through development assistance.

Nonetheless, we assume that aid is allocated to transfers and public capital accumulation

and so it can indeed have the effects as argued by the big push proponents. Thus aid can help the economy to jump from the subsistence equilibrium to a position where the economy can take off to pursue the high income equilibrium. Furthermore, the transitional dynamics in the model with SGP differs substantially with the standard Ramsey model without subsistence consumption. This mainly arises from the fact that in the model with SGP, the saving rate increases as the ability to save increases during the transition to the balanced-growth equilibrium, unlike in the standard model where the saving rate is constant.

5.4.3 Transitional Dynamics

An economy will take off when the net marginal product of capital exceeds the time preference rate and consumption (and capital) exceeds the subsistence level i.e. whenever individuals are willing to save and have the ability to save and invest. When the economy is at the low income equilibrium, agents have no ability to save and hence, as already said, it will remain there for a long time[37].

However over longer periods of time, even in the absence of external resource transfers, output gradually increases even for economies at the low income equilibrium so that consumption begins to exceed the subsistence levels. Once this happens, the economy is no longer at the subsistence equilibrium (since $k(0) \neq \bar{k}$) and the economy would slowly take off; both per capita consumption and capital stock would gradually grow and the speed of transition will depend on how close to the subsistence levels the starting (initial) capital is evaluated.

Without an external resource transfer, once $k(0)$ exceeds $\bar{k}$ the economy is on a transitional path; however initial capital is very close to the subsistence levels, as such it would take a significantly long time for the economy to reach its asymptotic balance-growth equilibrium.

Along the transitional path, at low levels of capital the net marginal product of capital is increasing[38] over time giving agents incentives to save. Further as output (and hence con-

[37]Likewise, when the economy is at the knife-edge equilibrium, agents have ability to save but returns to capital are too low to sustain long run growth and hence the economy collapses to the stable equilibrium.

[38]From the properties of the production function, i.e. $f_k > 0$ and $f_{kk} < 0$

sumption) increases so will the the intertemporal elasticity of substitution[39]. Rising IES and returns to private capital will lead to a rapid rise in capital, compared to the increase in consumption - as such the consumption-capital ratio (c/k-ratio) declines monotonically.

As capital continues to grow its net marginal product will begin fall, as will the agent's incentives to save; when this happens, consumption will begin to grow faster than capital as agents save less and consume more. Reduction in capital productivity will also imply decline in output growth as the economy approaches the asymptotic steady state level. When the economy reaches the balanced-growth equilibrium capital, output and consumption will grow at the same constant rate and the c/k-ratio will converge to its constant balanced growth equilibrium rate.

In the case where an economy receives foreign aid transfers, the resulting increase in resources imply that the representative agent's ability to save increases more rapidly than in the case without aid. The IES will rise faster implying that capital will also grow even more quicker compared to consumption. Additionally, should some of that aid be used to co-finance public capital accumulation, it will increase private capital productivity quicker than in the case without aid (or quicker than when aid is only used as transfers), which implies a higher growth rate for output. Thus aid inflows will accelerate the rate at which the economy transitions from the subsistence equilibrium to the balanced-growth steady state.

Once the economy moves on to its transitional path towards the self-sustaining balanced growth equilibrium, the saving rate increases along with per capita incomes and will approach the asymptotic steady state. Employing the same methodology to derive the saving rate as in section 5.3, it can be shown that the saving rate in our model can be expressed as[40]

$$s_y(t) = \left[\frac{(1-\tau)\phi A - \delta_k - \rho}{\theta((1-\tau)\phi A - \delta_k - n)}\right]\left[\frac{k(t) - \bar{k}}{k(t)}\right] \tag{5.4.16}$$

As previously done, we can use equation 5.4.16 to distinguish the two components that make up the saving rate, namely the willingness to save and the ability to save. The willingness to save is determined by preferences and production technology parameters, and in this framework it is represented by the term $\left[\frac{(1-\tau)\phi A-\delta-\rho}{\theta((1-\tau)\phi A-\delta-n)}\right]$ while the ability to

[39]Recall that $IES = \frac{c-\bar{c}}{\theta c}$, hence as consumption increases, so does the IES.
[40]Detailed solution in appendix 5.B

save is determined by the proportional difference between capital and the subsistence level, i.e. $\frac{k(t)-\bar{k}}{k(t)}$.

In our framework, when aid is allocated to lump sum transfers, it enters directly into the private agent's budget constraint and affects the agents ability to save in the same manner to some of the studies in the literature who take all external receipts as direct transfers into the agent's budget constraint, such as Kraay and Raddatz (2007). In this form, foreign aid represents a net increase in the agent's lifetime resources, hence it has a 'wealth effect' and therefore may increase either or both consumption and the agent's stock of capital; the net effect of this allocation of aid is to increase the ability to save. Additionally, note that aid component $(\mu - \psi)$, which gives aid allocated to transfers as a fraction of aggregate output, is part of the definition for the subsistence level of capital (equation 5.4.15); thus further enhancing the ability to save. However, just as in the earlier studies, we also find that pure aid to the agent's budget constraint does not affect the willingness to save since it is only determined by preferences and technology parameters.

In contrast, in our model not only does foreign aid affect the ability to save but also the willingness to save, whenever aid is allocated to public capital accumulation. As shown earlier, if aid enables an expansionary fiscal policy that leads to a higher public capital ratio, the increase in the stock of public capital raises the marginal product of capital (in the example in section 5.4.2, the marginal product rises from $f_k = \phi A$ in the absence of aid to a higher level $f_k = \phi_a A$ after aid). As a result the net marginal product of private capital in saving rate equation (5.4.16), made of the technology and preference parameters is higher with aid $((1-\tau)\phi_a A - \delta_k - \rho)$ than in the case with no aid $((1-\tau)\phi A - \delta_k - \rho)$.

The intuition behind this result is that higher returns from private capital provides incentives for agents more savings and investment therefore increasing the marginal propensity to save (in other words the willingness to save). These aspects will later be discussed in more detail in the forthcoming sections.

As savings and investment increase, there will be a rapid accumulation of private capital beyond the subsistence level so that over time $(k(t)-\bar{k}) \to k(t)$ and hence as the economy approaches the balanced-growth steady state, the ability to save $({}^{k(t)-\bar{k}}/_{k(t)})$ approaches 1

and the economy's saving rate approaches its steady state value expressed as

$$s^{As} = \left[\frac{(1-\tau)\phi A - \delta_k - \rho}{\theta((1-\tau)\phi A - \delta_k - n)}\right] \tag{5.4.17}$$

So long as the initial stock of private capital exceeds the subsistence level, i.e. $k(0) > \bar{k}$, equation 5.4.16 implies that the saving rate will be positive when the asymptotic marginal product of capital is greater than the time preference rate, that is $(1-\tau)\phi A - \delta_k - \rho > 0$ and it will be negative when $(1-\tau)\phi A - \delta_k - \rho < 0$, just as it was found in Steger (2000). Through the productivity enhancing public capital, we find that foreign aid will not only affect the rate at which the economy moves from the subsistence equilibrium to its balanced-growth steady state, but also that it will have an effect on the constant steady state saving rate. The time path of the growth of capital will equal the growth rate of aggregate output; it monotonically increases and converges towards the asymptotic balanced growth equilibrium value expressed as

$$\lim_{t\to\infty} \frac{\dot{y}}{y} = \lim_{t\to\infty} \frac{\dot{k}}{k} = \theta^{-1}((1-\tau)\phi A - \delta_k - \rho) \tag{5.4.18}$$

The growth rate expressed in equation 5.4.18 reveals that, *ceteris paribus*, the effect of change in the average level of aid inflows depends crucially on the allocation of aid receipts into either pure transfers to the private sector or to productive investment in public capital accumulation, represented by the parameter φ. The allocation rule affects the accumulation of public capital either through the wealth effect or indeed by increasing net marginal product of private capital whenever the stock of public capital is increased; by directly impinging on the production process (through use of more productive private capital), the increase in the stock of public capital in turn this will alter asymptotic marginal product of capital in equation 5.4.18. As long as some aid is used to finance public investment and accumulate public capital, it will lead to an increase in the asymptotic growth rate of both capital and output, shifting the optimal growth path to a higher level.

The growth model with Stone-Geary preferences (SGP) is able to reproduce some of the stylised facts of economic growth[41], for instance the positive correlation between the level of per capita output(income) and the aggregate saving rate; positive correlation between the growth rate of incomes and per capita incomes ($\beta - divergence$); in the long run factor accumulation only has minimal level effects on output but does not explain

[41]The general stylized facts of economic growth were formulated by Kaldor (1961) and later extended by Romer (1989) by five other prominent features from growth data.

the cross-country variation in the growth rate of incomes, rather it is the productivity of capital that is able to account for the differences in growth rates; further, the model shows that government policies may have an influence on long run growth. Additionally, the model also exhibits other useful properties that are in line with empirical experiences such as variable IES which increases with incomes (and consumption), Temple et al. (2014).

5.4.4 Dynamic Effects of Foreign Aid and Its Allocation

In order to illustrate effects of aid and its allocation of into the two forms of aid uses (pure aid and productive aid) on the economy, let us consider the two extreme values of φ, where $\varphi = 0$ represents the case where all aid is used as pure transfers to the private sector on the one hand and $\varphi = 1$ representing the case where all the aid is used productively for the accumulation of public capital.

Let us begin with the case where all aid receipts are used in the pure form (i.e. $\varphi = 0$) so that all the aid receipts are transferred as lump sum to the private sector. When all the aid is allocated to the private sector as lump sum transfers, it means that accumulation of public capital will now be entirely financed by tax revenues, implying that foreign aid will not form part of $G(t)$, and so it will neither form part of the expression for ϕ. Public capital will still have an effect on the net marginal product of private capital, however since only revenues from domestic income taxes are used in public capital accumulation, changes to aid inflows will have no effect on the productivity of private capital.

Additionally, the presence of $T(t)$ in the agent's budget constraint reflects an immediate increase in the agent's available income which can be used for consumption and to increase savings thus affecting his ability to save. This effect of aid has been explicitly shown in our model through equation for the subsistence capital which reveals that $\bar{k}$ approaches 0 as lump sum transfers increase. This implies that subsistence constraints on households becomes less significant as a result of extra incomes from the lump-sum transfers. The subsistence level of capital when all the aid is transferred to the private sector (so that $(\mu - \psi) = \mu$) will now be expressed as

$$\bar{k} = \frac{\bar{c}}{\phi A(1 + \mu - \tau) - \delta_k - n}$$

Thus, while the productivity of private capital remains unchanged (at ϕA), income from

aid financed transfers allows households to save; as subsistence constraints become less significant, the ability to save $\left(\frac{k(t)-\bar{k}}{k(t)}\right)$ approaches 1 and the saving rate moves towards the long run rate.

Intuitively, what this suggests is that since public capital is now entirely financed from domestic revenues primarily through taxes, without external resources to aid the accumulation of public capital, there is simply too little stocks of public capital (and the existing stock is often of very poor state) to increase the net marginal product of private capital sufficiently enough. This is because the experience for most developing countries is that raising adequate tax revenues to sufficiently provide the required levels of public investment goods/services is a difficult task hence low income countries are often characterised by low stocks of public capital and the existing capital is of very poor quality.

As a result, returns from private capital will remain low and agents are less willing to substitute consumption intertemporally, albeit the fact that their ability to save and invest has increased from the receipt of lump sum transfers. This result is reflected in the saving rate equation, where it is evident that aid receipts used in the pure form will only affect the agent's ability to save without altering the willingness to save. The effect of aid will be to accelerate the transition of the saving rate from the subsistence steady state to its balanced-growth equilibrium, but the asymptotic rate of savings will be the same as when there is no aid flows.

Furthermore, from the asymptotic growth rate of output in equation (5.4.18), it is also clear that aid used entirely in the pure form will not affect the constant steady state growth rate of both capital and output, since the only channel through which it would have any impact in this set up would be through the accumulation of private capital productivity enhancing public capital, therefore if external transfers are not being use for the purpose of accumulating public capital, then they will not have any affect on the net marginal product of private capital.

The implication of this result is therefore that when all aid is distributed as lump sum transfers to the private sector, it will only have short run effects on private capital without altering the steady state rate of output growth; as we found to be the case for the saving rate, foreign transfers will accelerate the transition for the growth rate of output from the

subsistence equilibrium to the asymptotic steady state, but they will not shift the optimal rate itself.

Let us now take a look at what the impact of foreign aid would be in our model it was all used productively for the sole purpose of accumulating public capital, i.e. $\varphi = 1$. Firstly, this means there are no lump sum transfers to the private sectors, thus we will not have $T(t)$ implying no direct extra income from the government sector into the agent's budget constraint. From this perspective, there is no immediate wealth effect of aid transfers on the agent's ability to save[42]; further, without transfers in the budget constraint, the equation for the subsistence level of capital will now have $(\mu - \varphi) = 0$ and hence initially the subsistence level of capital will remain as high as if no foreign aid has been received i.e.

$$\bar{k} = \frac{\bar{c}}{\phi A(1-\tau) - \delta_k - n}$$

However, as the stock of public capital is accumulated ϕ increases towards ϕ_a and the subsistence level of capital decreases towards

$$\bar{k} = \frac{\bar{c}}{\phi_a A(1-\tau) - \delta_k - n}$$

Thus over time, as public capital is accumulated private capital productivity increases leading to higher output which implies that subsistence constraints become less significant. In other words, while there is no immediate wealth effect of aid when it is entirely allocated to public capital allocation, it kicks in gradually as increasing private capital productivity leads to higher output/incomes. As the wealth effect is realised, the ability to save rises leading to a more rapid increase in the saving rate and hence private capital accumulation. Thus, just as lump-sum transfers productive aid also affects the agent's ability to save only that in this case the effect is not instant.

From the discussion, one can note that in the case where aid is used productively for public capital accumulation, the effect of aid on the ability to save is not as immediate as was the case with transfers, rather it is gradual as the additional public capital stock is accumulated over time and so does its effects on the productivity of private capital. In the

[42]If we adopted the proportional tax rates, then since the entire flow of aid is being used in public capital accumulation, it could allow the recipient government to reduce income taxes which would result in higher disposable incomes for households; thus through the possibility of relieving tax burden on households, productive aid could still have an indirect but immediate effect on the household's ability to save. For now though, we assume that taxes are constant and hence they do not respond to changes in aid flows.

case when aid is used for transfers, it constitutes an immediate direct exogenous resource injection that increases the agent's lifetime resources and hence an immediate jump in the ability to save. Once the full effects of the additional public capital are realised, higher returns to capital will translate into a more rapid rate of growth of output and higher output increases the available resources for the private agent, leading to the wealth effect on the ability to save.

Secondly, unlike in the existing literature, a key result of the chapter is that productive aid affects the agent's willingness to save. To show this, we consider the saving rate expressed by equation 5.4.16. As already shown, an injection of aid leads to an increase in the stock of public capital that raises the parameter ϕ (to ϕ_a) and hence an increase in aid would result in increase in the first bracket on the right hand side of equation, which describes the willingness to save, to

$$\left[\frac{(1-\tau)\phi_a A - \delta_k - \rho}{\theta((1-\tau)\phi_a A - \delta_k - n)}\right]$$

The intuition behind this results is simply to do with the enhanced productivity of private capital as a result of higher public capital. As has already been said of the effect of aid in this form, the change in the willingness to save will be gradual as in line with the public investment goods are accumulated.

Unlike in the case where all the aid is used as lump sum transfers to the private sector, productive aid increases public capital accumulation adequately enough to enhance the net marginal product of private capital sufficiently to provide incentives to agents towards more savings and investment. Since the willingness to save is determined by preferences and technology, by altering the production technology towards productivity enhanced private capital, foreign aid alters the willingness to save.

Additionally, the asymptotic steady state rate of savings is also affected in a similar manner, which implies that changes to aid flows will shift the optimal saving rate (i.e. an increase in aid shifts the asymptotic saving rate upwards). This is the key result from this chapter, that foreign aid when used appropriately can not only accelerate transition to a higher income equilibrium, but also affect the long run rate of savings which implies a shift in the long run growth rate of capital and output.

Lastly, let us consider the effect of productive aid on the long run growth of output; from

equation 5.4.18 we have the rate of output growth at the balanced-growth steady state expressed as $\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)$. An injection of productive foreign aid implies an increase in the rate of growth of long run output through the increased productivity of private capital such that equation 5.4.18 is now expressed as $\theta^{-1}((1-\tau)\phi_a A - \delta_k - \rho)$. As has already been discussed, productive aid increases net marginal product of capital and hence the economy's long run growth.

5.4.5 Numerical Analysis of the Effects of Aid

In this section, we conduct numerical analysis to obtain further insight and illustrate the dynamic effects of foreign aid inflows on the transitional paths for long run growth of output and the saving rate. Using standard parameter values (shown in table 5.4.1 below) as used in Steger (2000), Kraay and Raddatz (2007) and Chatterjee and Turnovsky (2005) we conduct a calibration exercise to illustrate the effect of foreign resource transfers on the time path of the economy.

The parameter values for δ_k, ρ, n and α[43] in table 5.4.1 used in the simulations of our model are chosen to reflect the situation in small open economies as used in real business cycle literature (e.g. Kehoe and Perri (2002)). The relative-risk aversion coefficient, θ, is consistent with low income countries (see Kraay and Raddatz (2007)); the policy parameters (τ and $\bar{g}$) and the parameter reflecting the relative size of foreign resource transfers (μ) are standard in the literature (see for instanceTurnovsky (2009) and Chatterjee and Turnovsky (2007)).

We start from a low income equilibrium position without any aid inflows and the ability to save and invest is close to zero (using our parameter values, the ability to save in the absence of foreign aid flows is assumed to begin at $(k(t) - \bar{k})/(k(t) = 0.009)$. In this case, as already noted earlier, all the public capital is accumulated using only domestically collected income tax revenues. The experience for most developing countries is that domestic resources are inadequate to sufficiently finance the necessary levels of public capital (new investment or maintenance of existing public capital goods/services) required to raise productivity of private capital high enough that it motivates agents to save and

[43]The value for α=0.5 is higher than the 0.36 used inKehoe and Perri (2002) but corresponds to the average share of capital in value added in low-income countries (Kraay and Raddatz (2007)).

invest more.

Table 5.4.1: Parameter values for the benchmark economy

Preference parameters	$\theta = 2$; $\rho = 0.05$
Population growth	$n = 0.03$
Subsistence consumption	$\bar{c} = 2$
Production parameters	$\alpha = 0.5$; $\upsilon = 0.3$; $A = 1.7$
Depreciation rates	$\delta_k = 0.05$; $\delta_g = 0.04$
Policy parameters	$\tau = 0.15$; $\bar{g} = 0.05$; $0 \leq \varphi_a \geq 1$
Transfers (Aid)	$\mu_0 = 0$; $\mu_a = 0.05$

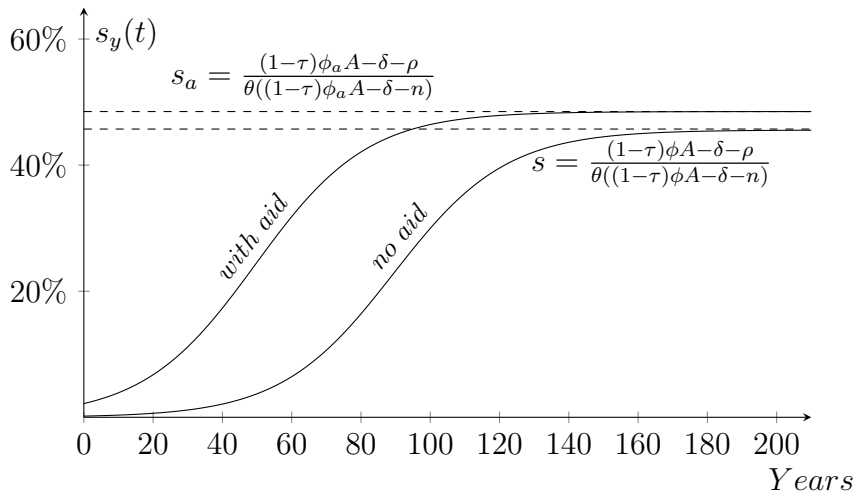
Notes: The parameter μ_0 represents an economy without foreign aid inflows while μ_a represents to the economy after the receipt of aid.

Figure 5.4.2 illustrates the time path for the saving rate in our model. The line marked *no aid* represents the time path for the saving rate in the case that the economy does not receive any foreign aid transfers. Transition to the steady state takes longer compared to the case Steger's model[44]. This is because of the impact of taxes on private incomes; taxes levied on the private sector comprise a reduction on the household's level of income, which further reduces the household's ability to save and invest unlike the case in Steger's model that has no taxes. In the absence of exogenous transfers, government can only afford limited investment in public capital using tax revenues and often the quality of public capital goods is so poor so that it does little to improve the productivity of private capital. As a result, despite the presence of public capital, the net effect of taxes is merely to reduce the ability to save and hence growth of savings will be lower and it takes longer to transition to the balanced-growth steady state level. This is similar to the results from Barro (1991*b*) that the disincentive effect from taxes to finance public investment often exceed the productivity gains from public investment.

An inflow of aid to the government sector (aid as fraction of aggregate output increase from $\mu = 0$ to $\mu = 0.05$) raises the aggregate resources in the economy, may thus significantly augment consumption, private savings and crucially the resources available for investment into public capital. For the simulations in this section, the government allocates 70% of the aid ($\varphi = 0.7$) of the aid towards investment in public capital goods while 30% towards lump sum transfers to the private sector. With this aid inflow, the economy's ability to

[44]It may not be immediately clear to see this since our model calibration adopts parameterisation from Chatterjee and Turnovsky (2005) and Kraay and Raddatz (2007). To illustrate this point, we calibrate using Steger (2000) parameterisation, and the results of this simulation are shown in appendix **??** figures (5.E.1 and 5.E.2).

Figure 5.4.2: Effect of aid on the time path of saving rate



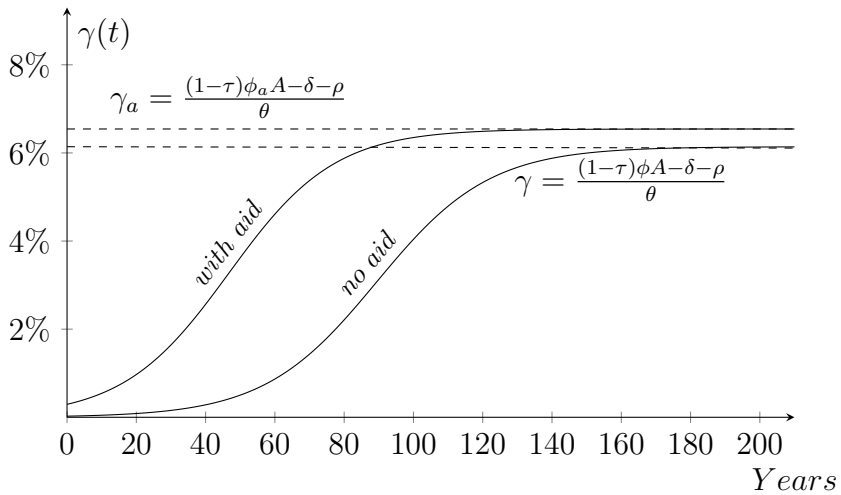
save jumps from $(k(t) - \bar{k})/k(t) = 0.009$ to $(k(t) - \bar{k})/k(t) = 0.17$ while at the same time the extra financing for public capital raises the public capital ratio from $\bar{g}$ to $\bar{g}_a$; the rise in stock of public capital enhances the productivity of private capital giving incentives for households to save and invest more.

In figure 5.4.2, the time path for the saving rate after infusion of foreign aid transfers is illustrated by the line marked *with aid*. Foreign transfers push the ability to save upwards so that the economy starts off with already higher savings and with the rise the willingness to save, the saving rate increases rapidly as the economy transitions towards the asymptotic balance-growth equilibrium. Furthermore, with private capital productivity enhanced, the rise in the willingness to save represents a shift in household's preferences and hence the economy does not only accelerate to its optimal growth rate, it also shifts on to a higher level balanced-growth equilibrium rate, as shown in 5.4.2.

The effect of aid on the growth rate of output resembles the effect on the saving rate. In the benchmark case when the economy has not received any aid flows, growth of output is very slow and takes up to 170 years to fully transition from the subsistence equilibrium with zero growth to the balanced-growth steady state. The inadequate and poor standard of public capital leaves productivity of private capital low, as such output grows at a slow pace. In figure 5.4.3, this is represented by the line *no aid*.

The line *with aid* in the figure 5.4.3 shows the effect of foreign aid inflows on the growth of per capita output (and per capita stock of private capital). An increase in aid raises the

Figure 5.4.3: Effect of aid on the time path of growth rate of capital and output



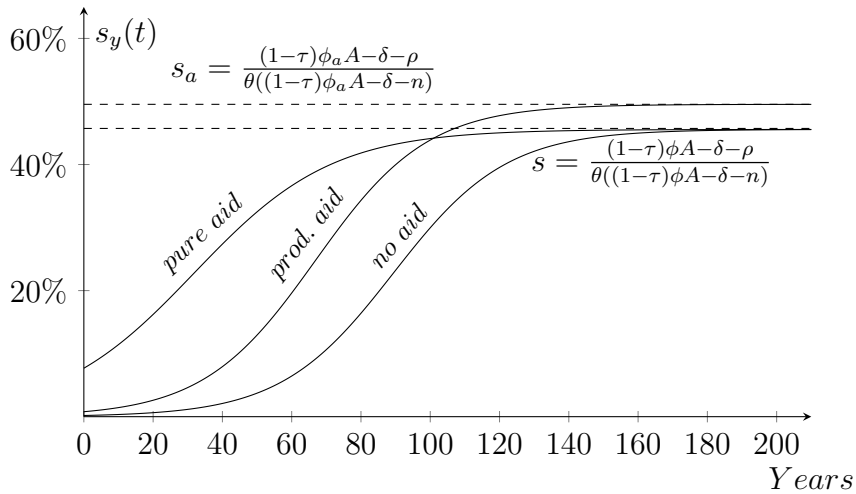
saving rate as discussed already, leading to rise in private capital. As capital increases, the net marginal product of private capital increases and hence output grows faster. Further, in a similar manner as shown with the case for saving rate, due to the increase in private capital productivity the economy will not only accelerate to the optimal growth equilibrium level, but it also shifts on to a higher level balanced-growth steady state level.

A few points worth noting: firstly, the length of time that low growth persists depends crucially on how close the initial level of capital is to the subsistence level. This may suggest that persistent low output (as well as consumption) and slow capital accumulation that often characterise low income countries may be explained by assuming that these countries are close to their subsistence level of consumption (this assumption is backed by empirical data as revealed by table 5.1.1). Secondly, using the model's parameterization, the steady-state saving rate before aid is about 44% while after aid receipt it increases to about 49%. These magnitudes are evidently very high, however they can easily reduced by altering the parameters (such as increasing the discount rate), ρ without significantly affecting the properties of the model solutions.

Let us now consider the effect of the aid allocation rule between pure transfers ($\varphi = 0$) and productive investment in public capital accumulation ($\varphi = 1$). As has been discussed earlier, when foreign aid is used as transfers to the private sector, they represent an increase on the household's lifetime income and thus increasing the ability to save while leaving the willingness to save unchanged. The economy accelerates to its optimal growth path, but since preferences and technology, which determine the willingness to save, are

not affected, the economy will converge to the same asymptotic balanced-growth equilibrium level of savings as in the benchmark case without any foreign aid transfers. This is illustrated in figure (5.4.4), the line marked *no aid* represents the benchmark situation without any aid flows, that marked *pure aid* represents the time path for savings when all the aid is used as transfers.

Figure 5.4.4: Effect of aid on the time path of saving rate

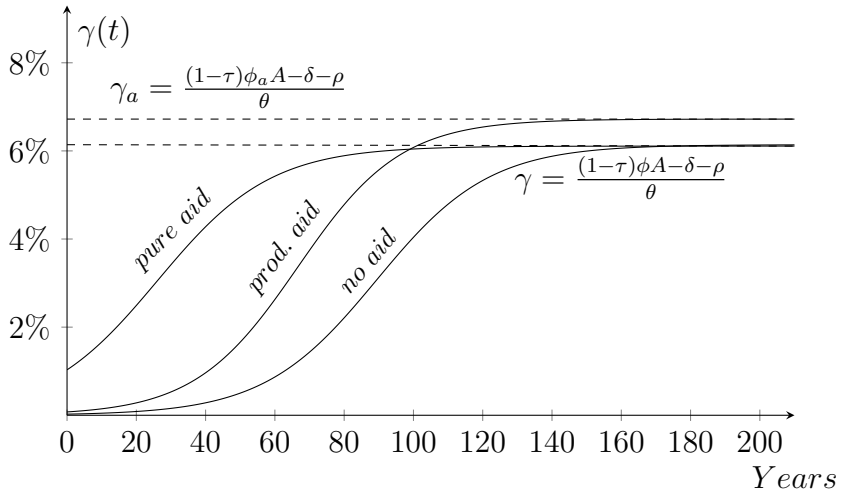


On the other hand, when all the aid is used to finance accumulation of public capital, there is no direct impact on agent's budget constraint, however the crucial effect of this allocation is on the productivity of private capital – an increase in aid will result in a rise in the stock of public capital which enhances the returns from private capital. This increase in returns will alter the household's marginal propensity to save towards higher savings and investment, which means an increases in the willingness to save. Further, the increase in private capital will result in higher output, and hence it also increases in the ability to save. These effects will see the economy's saving rate increase more rapidly than when aid is used as transfers, implying faster acceleration to the balanced-growth steady state. Additionally, because of the change in marginal product of capital, the economy will in this case shift on to a higher optimal growth path, represented by line marked *prod. aid* in figure (5.4.4).

Similar effects are observed on the growth rate of per capita output (and capital), illustrated in figure (5.4.5). An injection of foreign aid which is allocated to the private sector in the form of lump sum transfers increases the saving rate which in turn increases the stock of private capital. Increases in capital will lead to increases in the growth of per

capita output, but since the saving rate converges to the same asymptotic equilibrium rate as the benchmark (with no aid), the growth rate of output will also converge to the benchmark level of balanced growth equilibrium when aid is totally used as transfers only. In figure (5.4.5), the benchmark is represented by the line marked *no aid* while the line marked *pure aid* represents the time path for per capita output growth when the economy receives aid and it is used only as pure transfers to the private sector.

Figure 5.4.5: Effect of the allocation of aid on the time path of growth rate of capital and output



When all the aid is used for accumulation of capital, not only does the saving rate rise more rapidly than the case for transfers, but also that the change in technology (that comes in from the productivity enhancing public capital) increases returns from private capital and hence alters the agent's marginal propensity to save; as a result, the saving rate shifts onto a higher asymptotic balanced-growth level, as already shown in figure (5.4.4). The higher saving rate will be reflected in an increase in the economy's aggregate investment rate leading to higher output.

Note that in the initial stages foreign transfers, when entirely used to accumulate public capital, will not have an immediate impact on private capital accumulation, rather it will only be gradual as the additional public capital stock is accumulated. Over time, as the positive effects of government capital stock come kick in, the expansionary effect dominates private capital stock increase more rapidly, as will the growth of per capita output. The change in production technology that leads to higher returns from private capital is reflected in the shift of the optimal growth path to a higher equilibrium growth

rate, as illustrated by the line marked *prod. aid* in figure (5.4.5).

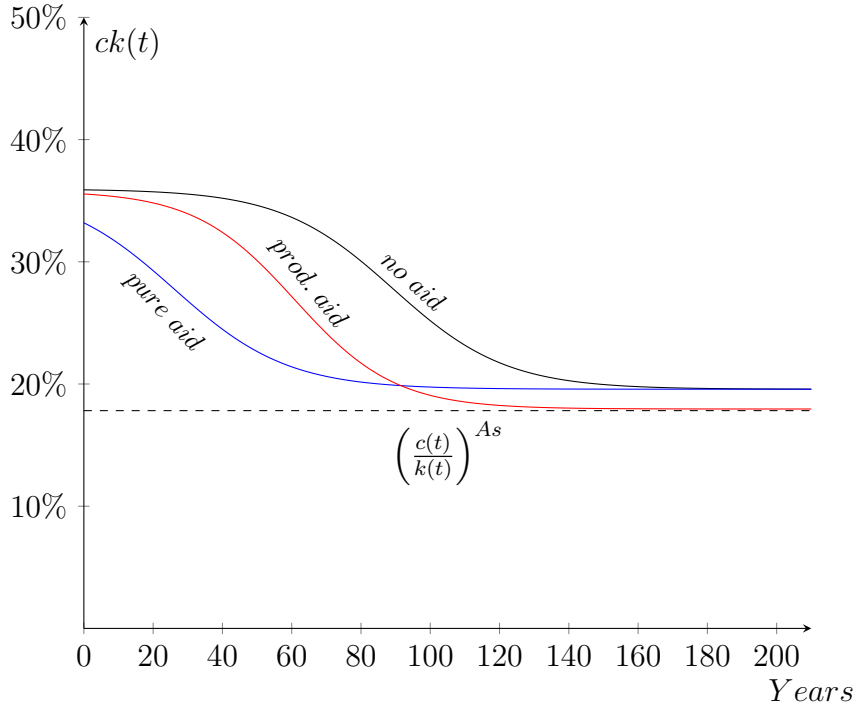
Finally, we illustrate how aid (and its allocation between public capital accumulation and lump sum transfers) affects the transition to the asymptotic balanced-growth equilibrium. The transition dynamics for the benchmark economy without any foreign transfers has already been discussed in section 5.3. In the figure (5.4.6), this is illustrated by the line marked *no aid*. It represents a small developing country with private capital close to the subsistence level so that the ability to save is close to zero; as time goes, both consumption and capital grow and pursue the asymptotic unbounded growth rate. However, in the initial periods savings are minimal while consumption is stagnant at the subsistence level of consumption so that the $c(t)/k(t)$-ratio is constant in the subsistence equilibrium.

As output gradually begins to increase, the ability to save will begin to rise and so both capital and consumption increase. With the increase in capital the net marginal product of capital will also increase giving further incentive to the agent's to save even more, and this will be reflected by increase in the intertemporal elasticity of substitution (IES) between consumption and savings. As the returns from capital continue to rise, capital will grow faster than consumption as such the $c(t)/k(t)$-ratio declines. As the economy accumulates more capital, investment increases leading to more output, and in turn high output will also lead to higher consumption levels.

As the economy approaches the asymptotic balanced-growth equilibrium, diminishing returns to capital implies that further increases in capital will lead to a reduction in returns from capital and as such agents will start to save less and the IES will also fall. Consumption will begin to grow quicker than capital until they both grow at the same rate. Once capital and consumption achieve the common unbounded growth rate, the economy would have transitioned to the balanced-growth equilibrium.

An inflow of aid, when used as lump sum transfers to the private sector, causes an instant downward shift of the transitional path of the c(t)/k(t)-ratio. Instead of starting with capital close subsistence, transfers will lift the agent's resources uplifting the ability to save and the saving rate. The growth path of capital stock rises faster than the growth path of consumption and the substitution of investment for consumption continues to rise, leading to a rapid decline in the $c(t)/k(t)$-ratio. As already discussed, foreign aid in this

Figure 5.4.6: Effect of aid and its allocation on the time path for the consumption-capital ratio



form only increases the agent's lifetime resources without altering his preferences, as such the aggregate investment rate in the long run does not change. This is illustrated in figure (5.4.6) above by the line marked *pure aid*; the $c(t)/k(t)$-ratio will converge to the same asymptotic balanced-growth steady state level as the benchmark. The effect of aid is thus merely accelerating the transition of the economy from the subsistence equilibrium to its optimal unbounded-growth rate equilibrium, without altering the equilibrium position.

When foreign aid is used only for accumulation of public capital, it is not immediately reflected in the private agent's budget constraint as is the case with transfers, in the initial stages capital is still very low and the $c(t)/k(t)$-ratio starts from the same level as the benchmark, as indicated by the line marked *prod. aid* of figure (5.4.6). The increase in public capital stock, from the extra financing as a result of the aid inflow, enhances the productivity of private capital so that even at the low level, the returns from capital are still high enough to alter the agent's preferences towards higher savings. As agents save more, capital increases and so will output; increase in output leads to an increase in the ability to save further increasing the saving rate. As a result of the increase both the ability to save and the willingness to save (changes in preferences towards more shows an increases in their will to save), the slope of the $c(t)/k(t)$-ratio in this case is steeper than

when aid is used for transfers only, so that the rate of transition to the balanced-growth rate equilibrium is much higher. Furthermore, because of the changes in the agent's production technology, the aggregate investment rate also changes so than in the long run the economy will shift to a lower constant c(t)/k(t)-ratio; the economy would have moved to a level where capital is relatively higher than in the benchmark and hence the economy shifts to a higher optimal unbounded-growth rate of both capital and output.

5.5 Conclusion

Subsistence constraints has clear influence on the process of growth; it restricts agent's ability to save when the levels of income are around the subsistence. In line with empirical experiences, the model displays a variable intertemporal elasticity of substitution for consumption, which is a measure of the ability and willingness to save - it is shown in the model to increase with incomes (and consumption). At the same time, empirical evidence also shows that, especially in developing countries with low domestic savings to adequately finance domestic investment requirements, Government often plays a key role in providing publicly accessible capital goods that are relevant for production.

This chapter presents a model that takes into account both subsistence considerations and public capital; in particular the analysis concentrates on the role that foreign aid transfers can play on the long run growth of output through these two mechanisms. With incomes so low, developing countries face critical consumption constraints and at the same time the Governments face massive challenges to raise adequate public resources, through taxes, to sufficiently provide required public services. As a result, foreign aid transfers assume a critical component in the development/economic growth of such countries. Through the model developed in this chapter, we provide a theoretical framework for analysing further mechanism through which foreign aid transfers can affect long run economic growth. The results from the analysis in the chapter provide testable hypothesis on the relationship between aid and growth as well as policy implications.

The results from the model reveal that the effects of foreign aid on long run growth depend on government policy regarding its allocation between lump-sum transfers to the private sector or financing for public investment goods; foreign aid when used as lump-

sum transfers to the private sector (traditional Keynes-Ohlin type of aid) has effects only in terms of accelerating the transition to the balanced-growth steady state, however it does not alter the aggregate investment rate and hence does not affect the rate of growth in the long run. On the other hand, productive aid (transfers used to co-finance public investment) generates dynamic adjustments in the long run growth rate of output as public capital is accumulated.

It must be pointed out that the theoretical framework developed in this chapter has not considered two important issues that may be of importance to the results: firstly, we do not include considerations of differences in the elasticity of substitution in production (between the two factor inputs), we assume in our framework that it is constant. Chatterjee and Turnovsky (2005) show in their analysis that the macroeconomic effects of aid depend crucially on the elasticity of substitution in production. Secondly, we also abstract from congestion considerations, in our framework we assume that the stock of public capital is a 'pure good', that is not subject to congestion. Barro and Sala-I-Martin (1995) and Fisher and Turnovsky (1998) argue that virtually all public services are characterised by some degree of congestion, which may have important implications on the effect of public capital on private capital accumulation.

Appendix

5.A Solving Steger (2000) Model

The representative agent's problem can be solved as follows:

$$\max_{\{c(t)\}} \int_0^\infty \frac{[c(t)-\bar{c}]^{(1-\theta)}}{1-\theta} e^{-(\rho-n)t} dt$$

subject to the following resource constraints:

$$\dot{k} = (A-\delta-n)k(t) - c(t) \tag{5.A.1}$$

$$\bar{c} \leq c(t) \leq Ak(t)$$

Thepresent-value Hamiltonian for the dynamic problem is set as:

$$\mathcal{H} \equiv \frac{[c(t)-\bar{c}]^{(1-\theta)}}{1-\theta} e^{-(\rho-n)t} + \lambda(t)\{(A-\delta-n)k(t) - c(t)\}$$

Deriving necessary optimality conditions gives

$$\frac{\partial \mathcal{H}}{\partial c(t)} = [c(t)-\bar{c}]^{-\theta} e^{-(\rho-n)t} - \lambda(t) = 0$$

$$\Rightarrow [c(t)-\bar{c}]^{-\theta} e^{-(\rho-n)t} = \lambda(t) \tag{5.A.2}$$

$$\frac{\partial \mathcal{H}}{\partial k(t)} = \lambda(t)(A-\delta-n) = -\dot{\lambda}(t) \tag{5.A.3}$$

Use $\lambda(t)$ from equation (5.A.2) and solve the differential equation for $\dot{\lambda}(t)$ in equation (5.A.3):

$$[c(t)-\bar{c}]^{-\theta} e^{-(\rho-n)t}(A-\delta-n) = -[-\theta([c(t)-\bar{c}]^{-\theta-1} e^{-(\rho-n)t} * \dot{c}(t)) + (-\rho-n)e^{-(\rho-n)t} * [c(t)-\bar{c}]^{-\theta}]$$

Divide both sides of the above expression by $[c(t)-\bar{c}]^{-\theta} e^{-(\rho-n)t}$ to get:

$$A-\delta-n = \frac{\theta\dot{c}(t)}{c(t)-\bar{c}} + \rho - n$$

$$\Rightarrow A-\delta-\rho = \frac{\theta\dot{c}(t)}{c(t)-\bar{c}}$$

Re-arranging, we get

$$c(t)-\bar{c} = \frac{\theta}{A-\delta-\rho}\dot{c}(t)$$

$$\Rightarrow \dot{c}(t) = [c(t)-\bar{c}]\theta^{-1}(A-\delta-\rho)t$$

Hence the canonical system that governs the dynamics of the economy consists of two

linear differential equations in $c(t)$ and $k(t)$ expressed as:

$$\dot{k}(t) = (A - \delta - n)k(t) - c(t) \tag{5.A.4}$$

$$\dot{c}(t) = [c(t) - \bar{c}]\theta^{-1}(A - \delta - \rho)t \tag{5.A.5}$$

Using the F.O.C for capital expressed by equation (5.A.3) to find $\lambda(t)$

$$\int e^{(A-\delta-\rho)t}[\dot{\lambda}(t) + (A - \delta - \rho)t\lambda(t)]dt = 0$$

$$\Rightarrow \lambda(t) = \lambda(0)e^{-(A-\delta-\rho)} \tag{5.A.6}$$

Substitute equation (5.A.6) into equation (5.A.2) to get the optimal path for consumption, c(t)

$$[c(t) - \bar{c}]^{-\theta}e^{-(\rho-n)t} = \lambda(0)e^{-(A-\delta-\rho)}$$

Solve the expression above to obtain:

$$c(t) = \bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}(A-\delta-\rho)t} \tag{5.A.7}$$

To pin down the value of initial consumption, $c(0)$, we use the capital accumulation (5.A.4) and replace in it the solution for the time path of consumption expressed by (5.A.7) to obtain

$$\dot{k} = (A - \delta_k - n)k(t) - (\bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}((1-\tau)\phi A-\delta_k-\rho)t})$$

$$\dot{k} - (A - \delta_k - n)k(t)) = -\bar{c} - [c(0) - \bar{c}]e^{\theta^{-1}((1-\tau)\phi A-\delta_k-\rho)t}$$

Now let $\zeta = (A - \delta_k - n)$ and $\xi = \theta^{-1}(A - \delta_k - \rho)$, so the above expression could be rewritten as

$$\dot{k} - \zeta k(t) = -\bar{c} - [c(0) - \bar{c}]e^{\xi(t)}$$

Multiplying both sides of the equation with $e^{-\zeta(t)}$, we obtain

$$\dot{k}e^{-\zeta(t)} - \zeta k(t)e^{-\zeta(t)} = -\bar{c}e^{-\zeta(t)} - [c(0) - \bar{c}]e^{(\xi-\zeta)t}$$

$$\Rightarrow k(t)\dot{e}^{-\zeta(t)} = \frac{\bar{c}e^{-\zeta(t)}}{\zeta} + \frac{[c(0) - \bar{c}]}{\xi - \zeta}e^{(\xi-\zeta)t}$$

$$\Rightarrow k(t) = \frac{\bar{c}}{\zeta} + \frac{[c(0) - \bar{c}]}{\xi - \zeta}e^{(\xi)t}$$

Since we take the initial endowment ($k(0)$) as given, we can use it in the above expression and get

$$k(0) = \frac{\bar{c}}{\zeta} + \frac{[c(0) - \bar{c}]}{\xi - \zeta} \Rightarrow \frac{\zeta\bar{c} - \xi\bar{c} + \zeta c(0) - \zeta\bar{c}}{\zeta(\zeta - \xi)}$$

$$k(0) = \frac{-\xi\bar{c} + \zeta c(0)}{\zeta(\zeta - \xi)} \Rightarrow \zeta(\zeta - \xi)k(0) + \xi\bar{c} = \zeta c(0)$$

So

$$c(0) = (\zeta - \xi)k(0) + \frac{\xi}{\zeta}\bar{c} \tag{5.A.8}$$

To find the optimal path for capital, we substitute the solution for consumption expressed by equation (5.A.7) into the agent's budget constraint (5.A.1)

$$\begin{aligned}
\dot{k}(t) &= (A - \delta - n)k(t) - c(t) \\
\Rightarrow \dot{k}(t) - (A - \delta - n)k(t) &= -c(t) \\
\dot{k}(t)e^{-(A-\delta-n)t} - (A - \delta - n)k(t)e^{-(A-\delta-n)t} &= -c(t)e^{-(A-\delta-n)t} \\
\int e^{-(A-\delta-n)t}\left[\dot{k}(t) - (A - \delta - n)k(t)\right] dt &= \\
-\int \left[\bar{c}e^{-(A-\delta-n)t} + [c(0) - \bar{c}]e^{\theta^{-1}(A-\delta-\rho)t}e^{-(A-\delta-n)t}\right] dt & \\
\Rightarrow k(t) = -e^{(A-\delta-n)t}\int \left[\bar{c}e^{-(A-\delta-n)t} + [c(0) - \bar{c}]e^{\theta^{-1}(A-\delta-\rho)t}e^{-(A-\delta-n)t}\right] dt &
\end{aligned}$$

$$k(t) = -\frac{\bar{c}}{A - \delta - n}e^{-(A-\delta-n)t} + \frac{\theta(c(0) - \bar{c})}{A - \delta - \rho - \theta(a - \delta - n)}e^{-Xt} + c \tag{5.A.9}$$

where

$$-X = \frac{A - \delta - \rho}{\theta} - (A - \delta - n)$$

The following parameter restrictions (conditions) must hold:

$\rho > n$	(to ensure that the discounted utility is finite)
$A - \delta - n > 0$	(interpreted to imply positive interest rates)
$c = 0$	(transversality condition)
$\lim_{t\to\infty}[\lambda(t)e^{-(\rho-n)t}k(t)] = 0$	(transversality condition)
$\lim_{t\to\infty}[\lambda(t)e^{-(A-\delta-n)t}k(t)] = 0$	(transversality condition)

Simplifying equation (5.A.8) further yields

$$k(t) = \frac{\bar{c}}{A - \delta - n} + \frac{(c(0) - \bar{c})}{X}e^{\frac{A-\delta-\rho}{\theta}} + ce^{(A-\delta-n)t} \tag{5.A.10}$$

$$\Rightarrow k(t) = \frac{\bar{c}}{A - \delta - n} + \frac{(c(0) - \bar{c})}{X}e^{\frac{A-\delta-\rho}{\theta}}$$

$$\Rightarrow k(0) = \frac{\bar{c}}{A - \delta - n} + \frac{(c(0) - \bar{c})}{X} + c = \frac{\bar{c}}{A - \delta - n} + \frac{(c(0) - \bar{c})}{X}$$

Define

$$\bar{k} = \frac{\bar{c}}{A - \delta - n}$$

then we have

$$k(0) - \bar{k} = \frac{\bar{c}}{A - \delta - n} + \frac{(c(0) - \bar{c})}{X} - \frac{\bar{c}}{A - \delta - n} = \frac{(c(0) - \bar{c})}{X}$$

which can hence be re-written to give the optimal path for capital, expressed as:

$$k(t) = \bar{k} + [k(0) - \bar{k}]e^{\theta^{-1}(A-\delta-\rho)t} \tag{5.A.11}$$

The growth rate of consumption in the balanced-growth equilibrium is given as $\lim_{t\to\infty} \frac{\dot{c}(t)}{c(t)}$; hence we first differentiate the solution expressed by equation (5.A.7) with respect to time to get:

$$\dot{c}(t) = [c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)e^{\theta^{-1}(A-\delta-\rho)t}$$

hence the balanced-growth equilibrium growth rate is expressed as

$$\lim_{t\to\infty} \frac{\dot{c}(t)}{c(t)} = \frac{[c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)e^{\theta^{-1}(A-\delta-\rho)t}}{\bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}(A-\delta-\rho)t}} \tag{5.A.12}$$

$$\Rightarrow \lim_{t\to\infty} \left(\frac{e^{\theta^{-1}(A-\delta-\rho)t}}{e^{\theta^{-1}(A-\delta-\rho)t}}\right) \left(\frac{[c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)}{\left[\frac{\bar{c}}{e^{\theta^{-1}(A-\delta-\rho)t}}\right] + [c(0) - \bar{c}]}\right)$$

$$\Rightarrow \lim_{t\to\infty} \left(\frac{[c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)}{\left[\frac{\bar{c}}{e^{\theta^{-1}(A-\delta-\rho)t}}\right] + [c(0) - \bar{c}]}\right)$$

Note that $\lim_{t\to\infty} e^{\theta^{-1}(A-\delta-\rho)t} \to \infty$; hence $\lim_{t\to\infty} \left[\frac{\bar{c}}{e^{\theta^{-1}(A-\delta-\rho)t}}\right] \to 0$. Therefore

$$\lim_{t\to\infty} \frac{\dot{c}(t)}{c(t)} = \left(\frac{[c(0) - \bar{c}]\theta^{-1}(A - \delta - \rho)}{[c(0) - \bar{c}]}\right) = \theta^{-1}(A - \delta - \rho)$$

Similarly, the growth rate of capital in the balanced-growth equilibrium is given as $\lim_{t\to\infty} \frac{\dot{k}(t)}{k(t)}$; we thus differentiate the solution expressed by equation (5.A.11) with respect to time to get:

$$\dot{k}(t) = [k(0) - \bar{k}]\theta^{-1}(A - \delta - \rho)e^{\theta^{-1}(A-\delta-\rho)t}$$

then the balanced-growth equilibrium growth rate for capital is expressed as

$$\lim_{t\to\infty} \frac{\dot{k}(t)}{k(t)} = \frac{[k(0) - \bar{k}]\theta^{-1}(A - \delta - \rho)e^{\theta^{-1}(A-\delta-\rho)t}}{\bar{k} + [k(0) - \bar{k}]e^{\theta^{-1}(A-\delta-\rho)t}}$$

Using the same way we solved for the balanced-growth equilibrium growth rate of consumption, we can show that

$$\lim_{t\to\infty} \frac{\dot{c}(t)}{c(t)} = \lim_{t\to\infty} \frac{\dot{k}(t)}{k(t)} = \theta^{-1}(A - \delta - \rho)t \tag{5.A.13}$$

Using the linear differential equations (equations (5.A.4 and 5.A.5) to derive the policy function:

$$\dot{c} = [c(t) - \bar{c}]\theta^{-1}(A - \delta - \rho)$$

$$\dot{k} = (A - \delta - n)k(t) - c(t)$$

$$c'k(t) = \frac{\dot{c}}{\dot{k}} = \frac{[c(t) - \bar{c}]\theta^{-1}(A - \delta - \rho)}{(A - \delta - n)k(t) - c(t)} = \frac{c'k(t)\theta^{-1}(A - \delta - \rho)}{(A - \delta - n) - c'k(t)}$$

simplifying the above gives

$$c'k(t)[(A - \delta - n) - c'k(t)] = c'(k(t))\theta^{-1}(A - \delta - \rho)$$

$$c'k(t) = \frac{c(t) - \bar{c}}{k(t) - \bar{k}} = (A - \delta - n) - \theta^{-1}(A - \delta - \rho)$$

$$\Rightarrow c(t) = z[k(t) - \bar{k}] + \bar{c} \tag{5.A.14}$$

where

$$z = [A - \delta - n] - \theta^{-1}[A - \delta - \rho]$$

To find the transitional path of the saving rate $s_y(t)$:

$$s_y(t) = y(t) - c(t) \rightarrow \frac{s(t)}{y(t)} = \frac{y(t) - c(t)}{y(t)}$$

$$s_y(t) = \frac{s(t)}{y(t)} = \left(1 - \frac{c(t)}{y(t)}\right) \tag{5.A.15}$$

Simplifying the policy function (5.A.14) to solve for $c(t)$ gives:

$$c(t) = [(A - \delta - n) - \theta^{-1}(A - \delta - \rho)][k(t) - \bar{k}] + [(A - \delta - n)\bar{k}]$$

$$c(t) = [(A - \delta - n)(k(t) - \bar{k})] - [(\theta^{-1}(A - \delta - \rho))(k(t) - \bar{k})] + [(A - \delta - n)\bar{k}]$$

$$-c(t) = [(\theta^{-1}(A - \delta - \rho))(k(t) - \bar{k})] - [(A - \delta - n)k(t)] \tag{5.A.16}$$

In an equilibrium position of the balance of payments, the following identity holds:

$$i(t) = s(t)$$

hence

$$(A - \delta - n)k(t) - c(t) = s(t)$$

$$(A - \delta - n)k(t) - c(t) = y(t) - c(t)$$

Adding $c(t)$ to both sides of the above equation and then multiplying each side by $\frac{c(t)}{y(t)}$ will yield:

$$(A - \delta - n)k(t)\left(\frac{c(t)}{y(t)}\right) = c(t)$$

Substituting $-\left(\frac{c(t)}{y(t)}\right) = s_y(t) - 1$ from equation (5.A.15) and $c(t)$ from equation (5.A.16)

into the expression above yields:

$$(A-\delta-n)k(t)s_y(t) = (\theta^{-1}(A-\delta-\rho))(k(t)-\bar{k})$$

$$\Rightarrow s_y(t) = \left[\frac{A-\delta-\rho}{\theta(A-\delta-n)}\right]\left[\frac{k(t)-\bar{k}}{k(t)}\right] \tag{5.A.17}$$

In the balanced growth equilibrium, the ability to save, $\left[\frac{k(t)-\bar{k}}{k(t)}\right]$, converges to 1 so that the asymptotic steady state rate of savings monotonically converges to:

$$s_y(t) = \left[\frac{A-\delta-\rho}{\theta(A-\delta-n)}\right] \tag{5.A.18}$$

5.B Solution to the model with public capital

The solution to the representative agent's problem is in many ways derived in the same manner as the solution to Steger (2000) model presented in appendix 5.A

The agent's problem is expressed as:

$$\max_{\{c(t)\}} \int_0^\infty \frac{[c(t)-\bar{c}]^{(1-\theta)}}{1-\theta} e^{-(\rho-n)t} dt$$

subject to:

$$\dot{k}(t0 = (1-\tau)y(t) + T(t) - (\delta_k + n)k(t) - c(t) \tag{5.B.1}$$

$$k(t) > 0; \qquad k_g(0) > 0$$

Per capita output, $y(t)$, is produced using a CES production function, given as:

$$y(t) = [\alpha(Ak(t))^\upsilon + (1-\alpha)(A_g k_g(t))^\upsilon]^{1/\upsilon} \tag{5.B.2}$$

For simplicity, assume that $A_g = 1$.

To solve the model, utilise assumption on public capital

$$\dot{k}_g(t) = \bar{g}y(t) = (\tau + \psi)y(t) - (\delta_g + n)k_g(t)$$

This can be re-written as

$$(\tau + \psi - \bar{g})y(t) = (\delta_g + n)k_g(t)$$
$$k_g(t) = \left(\frac{\tau + \psi - \bar{g}}{\delta_g + n}\right) y(t)$$

which we combine with the production function to yield

$$k_g(t) = \left[\frac{\tau + \psi - \bar{g}}{\delta_g + n}\right] \left[\{\alpha(Ak(t))^{\upsilon} + (1-\alpha)(k_g(t))^{\upsilon}\}^{1/\upsilon}\right]$$
$$k_g(t)^{\upsilon} - \left[\left\{\frac{\tau + \psi - \bar{g}}{\delta_g + n}\right\}^{\upsilon} (1-\alpha)k_g(t)^{\upsilon}\right] = \left[\frac{\tau + \psi - \bar{g}}{\delta_g + n}\right]^{\upsilon} \alpha Ak(t)$$
$$k_g(t)^{\upsilon}\left[1 - \frac{(\tau + \psi - \bar{g})^{\upsilon}(1-\alpha)}{(\delta_g + n)^{\upsilon}}\right] = \left[\frac{\tau + \psi - \bar{g}}{\delta_g + n}\right]^{\upsilon} \alpha Ak(t)$$
$$k_g(t)^{\upsilon}\left[\frac{(\delta_g + n)^{\upsilon} - (\tau + \psi - \bar{g})^{\upsilon}(1-\alpha)}{(\delta_g + n)^{\upsilon}}\right] = \left[\frac{\tau + \psi - \bar{g}}{\delta_g + n}\right]^{\upsilon} \alpha Ak(t)$$
$$k_g(t) = \left[\frac{\delta_g + n}{(\delta_g + n) - (\tau + \psi - \bar{g})(1-\alpha)^{1/\upsilon}}\right] * \left[\frac{(\tau + \psi - \bar{g})\alpha^{1/\upsilon}}{(\delta_g + n)}\right] Ak(t)$$

which simplifies to obtain

$$k_g = \left[\frac{\alpha^{1/\upsilon}(\tau + \psi - \bar{g})}{(\delta_g + n) - ((\tau + \psi - \bar{g})(1-\alpha))^{1/\upsilon}}\right] Ak(t) = \Omega Ak(t)$$

where

$$\Omega = \left[\frac{\alpha^{1/\upsilon}(\tau + \psi - \bar{g})}{(\delta_g + n) - ((\tau + \psi - \bar{g})(1-\alpha))^{1/\upsilon}}\right]$$

Substitute the above equation for $k_g(t)$ into the production function (5.4.1) to get

$$y(t) = \{\alpha(Ak(t))^{\upsilon} + (1-\alpha)(\Omega Ak(t))^{\upsilon}\}^{1/\upsilon}$$
$$y(t) = (\alpha + (1-\alpha)\Omega^{\upsilon})^{1/\upsilon} Ak(t)$$

or

$$y(t) = \phi Ak(t) \tag{5.B.3}$$

where $\phi = (\alpha + (1-\alpha)\Omega^{\upsilon})^{1/\upsilon}$ Substitute above equation for $y(t)$ into the agent's budget constraint to get

$$\dot{k}(t) = (1-\tau)\phi Ak(t) + T(t) - (\delta_k + n)k(t) - c(t) \tag{5.B.4}$$

The agent therefore maximises his utility subject to the above budget constraint. Thepresent-value Hamiltonian for the above stated dynamic problem is set as:

$$\mathcal{H} \equiv \frac{[c(t) - \bar{c}]^{(1-\theta)}}{1-\theta} e^{-(\rho - n)t} + \lambda(t)\{((1-\tau)\phi A - \delta_k - n)k(t) + T(t) - c(t)\}$$

Deriving necessary optimality conditions to this dynamic problem gives

$$\partial\mathcal{H}/\partial c(t) = [c(t) - \bar{c}]^{-\theta} e^{-(\rho-n)t} - \lambda(t) = 0$$

$$\Rightarrow [c(t) - \bar{c}]^{-\theta} e^{-(\rho-n)t} = \lambda(t)$$

$$\partial\mathcal{H}/\partial k(t) = \lambda(t)((1-\tau)\phi A - \delta_k - n) = -\dot{\lambda}(t)$$

Together with the economy's resource constraints and the optimality conditions derived above, the economy's system dynamic linear differential equations in $c(t)$, $k_g(t)$ and $k(t)$ are derived, in a similar way as in appendix 5.A, as:

$$\dot{c} = [c(t) - \bar{c}]\theta^{-1}((1-\tau)\phi A - \delta - \rho) \tag{5.B.5}$$

$$\dot{k} = (1-\tau)\phi A k(t) + T(t) - (\delta_k + n)k(t) - c(t) \tag{5.B.6}$$

$$\dot{k_g}(t) = (\tau + \psi)[\phi A k(t)] - (\delta_g + n)k_g(t) \tag{5.B.7}$$

Using the F.O.C for capital to find $\lambda(t)$

$$\int e^{(A-\delta-\rho)t}[\dot{\lambda}(t) + ((1-\tau)\phi A - \delta_k - \rho)\lambda(t)]dt = 0$$

$$\Rightarrow \lambda(t) = \lambda(0)e^{-((1-\tau)\phi A - \delta_k - \rho)} \tag{5.B.8}$$

Substitute into equation the F.O.C for consumption to get the optimal path for consumption, c(t)

$$[c(t) - \bar{c}]^{-\theta} e^{-(\rho-n)t} = \lambda(0)e^{-((1-\tau)\phi A - \delta_k - \rho)}$$

Solve the expression above to obtain:

$$c(t) = \bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t} \tag{5.B.9}$$

To pin down the value of initial consumption, $c(0)$, we use the capital accumulation (5.B.6) and replace in it the solution for the time path of consumption expressed by (5.B.9) to obtain

$$\dot{k} = (1-\tau)\phi A k(t) + (\mu - \varphi)\phi A k(t) - (\delta_k + n)k(t) - (\bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t})$$

$$\dot{k} = (1 + \mu - \tau - \varphi)\phi A k(t) - (\delta_k + n)k(t) - (\bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t})$$

$$\dot{k} = ((1 + \mu - \tau - \varphi)\phi A - \delta_k - n)k(t) - (\bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t})$$

$$\dot{k} - (((1 + \mu - \tau - \varphi)\phi A - \delta_k - n)k(t)) = -\bar{c} - [c(0) - \bar{c}]e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t}$$

Now let $\Gamma = ((1 + \mu - \tau - \varphi)\phi A - \delta_k - n)$ and $\Psi(t) = \theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t$, so the above expression could be rewritten as

$$\dot{k} - \Gamma k(t) = -\bar{c} - [c(0) - \bar{c}]e^{\Psi(t)}$$

Multiplying both sides of the equation with $e^{-\Gamma(t)}$, we obtain

$$\dot{k}e^{-\Gamma(t)} - \Gamma k(t)e^{-\Gamma(t)} = -\bar{c}e^{-\Gamma(t)} - [c(0) - \bar{c}]e^{(\Psi-\Gamma)t}$$
$$\Rightarrow k(t)\dot{e}^{-\Gamma(t)} = \frac{\bar{c}e^{-\Gamma(t)}}{\Gamma} + \frac{[c(0) - \bar{c}]}{\Psi - \Gamma}e^{(\Psi-\Gamma)t}$$
$$\Rightarrow k(t) = \frac{\bar{c}}{\Gamma} + \frac{[c(0) - \bar{c}]}{\Psi - \Gamma}e^{(\Psi)t}$$

Since we take the initial endowment ($k(0)$) as given, we can use it in the above expression and get

$$k(0) = \frac{\bar{c}}{\Gamma} + \frac{[c(0) - \bar{c}]}{\Psi - \Gamma} \Rightarrow \frac{\Gamma\bar{c} - \Psi\bar{c} + \Gamma c(0) - \Gamma\bar{c}}{\Gamma(\Gamma - \Psi)}$$
$$k(0) = \frac{-\Psi\bar{c} + \Gamma c(0)}{\Gamma(\Gamma - \Psi)} \Rightarrow \Gamma(\Gamma - \Psi)k(0) + \Psi\bar{c} = \Gamma c(0)$$

So

$$c(0) = (\Gamma - \Psi)k(0) + \frac{\Psi}{\Gamma}\bar{c} \tag{5.B.10}$$

To find the optimal path for capital, again in the same manner as in the previous section of the appendix, we substitute the solution for consumption into the agent's budget constraint (note that this time, the budget constraint includes transfers from the government, $T(t) = (\mu - \varphi)y(t)$ which will be included) to obtain:

$$\dot{k}(t)e^{\theta^{-1}((1-\tau)\phi A-\delta_k-\rho)}t - ((1 + \mu - \tau - \varphi)\phi A - \delta_k - n)k(t)e^{\theta^{-1}((1-\tau)\phi A-\delta_k-\rho)t} = -c(t)e^{\theta^{-1}((1-\tau)\phi A-\delta_k-\rho)t}$$
$$\Rightarrow k(t) = -\frac{\bar{c}}{((1 + \mu - \tau - \varphi)\phi A - \delta_k - n)}e^{\theta^{-1}((1-\tau)\phi A-\delta_k-\rho)t} +$$
$$\frac{\theta(c(0) - \bar{c})}{((1 - \tau)\phi A - \delta_k - \rho) - \theta((1 + \mu - \tau - \varphi)\phi A - \delta_k - n)}e^{-Xt} + c$$

where

$$-X = \frac{(1 - \tau)\phi A - \delta_k - \rho}{\theta} - ((1 + \mu - \tau - \varphi)\phi A - \delta_k - n)$$

Simplifying further the equation for $k(t)$ in a similar manner as before will yield the optimal path for private capital expressed as:

$$k(t) = \bar{k} + [k(0) - \bar{k}]e^{\theta^{-1}((1-\tau)\phi A-\delta_k-\rho)t} \tag{5.B.11}$$

where

$$\bar{k} = \frac{\bar{c}}{\phi A(1 + \mu - \psi - \tau) - \delta_k - n}$$

The growth rate of consumption in the balanced-growth equilibrium is $\lim_{t\to\infty}\frac{\dot{c}(t)}{c(t)}$;

$$\dot{c}(t) = [c(0) - \bar{c}]\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t}$$

hence the balanced-growth equilibrium growth rate is expressed as

$$\lim_{t\to\infty}\frac{\dot{c}(t)}{c(t)} = \frac{[c(0) - \bar{c}]\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t}}{\bar{c} + [c(0) - \bar{c}]e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t}} \tag{5.B.12}$$

Similarly, the growth rate of capital in the balanced-growth equilibrium is given as $\lim_{t\to\infty}\frac{\dot{k}(t)}{k(t)}$:

$$\dot{k}(t) = [k(0) - \bar{k}]\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t}$$

hence the balanced-growth equilibrium growth rate is expressed as

$$\lim_{t\to\infty}\frac{\dot{k}(t)}{k(t)} = \frac{[k(0) - \bar{k}]\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t}}{\bar{k} + [k(0) - \bar{k}]e^{\theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t}} \tag{5.B.13}$$

Using the same approach used to solve for the balanced growth rate in section (5.A.12), we can obtain the common asymptotic balanced-growth equilibrium rate of growth of consumption, capital and hence output:

$$\lim_{t\to\infty}\frac{\dot{c}(t)}{c(t)} = \lim_{t\to\infty}\frac{\dot{k}(t)}{k(t)} = \theta^{-1}((1-\tau)\phi A - \delta_k - \rho)t \tag{5.B.14}$$

Use the linear differential equations to derive the policy function:

$$\Rightarrow c(t) = z[k(t) - \bar{k}] + \bar{c} \tag{5.B.15}$$

where

$$z = [(1-\tau)\phi A - \delta_k - n] - \theta^{-1}[((1-\tau)\phi A - \delta_k - \rho)]$$

The transitional path for the saving rate is also derived as in section (5.A.12) to obtain:

$$s_y(t) = \left[\frac{(1-\tau)\phi A - \delta_k - \rho}{\theta((1-\tau)\phi A - \delta_k - n)}\right]\left[\frac{k(t) - \bar{k}}{k(t)}\right] \tag{5.B.16}$$

In the balanced growth equilibrium, the asymptotic steady state rate of savings monotonically converges to:

$$s_y(t) = \left[\frac{(1-\tau)\phi A - \delta_k - \rho}{\theta((1-\tau)\phi A - \delta_k - n)}\right] \tag{5.B.17}$$

5.C Tables

Table 5.C.1: Parameter values for the Steger model simulation

Preference parameters	$\theta = 3$; $\rho = 0.01$
Population growth	$n = 0.03$
Subsistence consumption	$\bar{c} = 2$
Production parameters	$A = 0.1$
Depreciation rates	$\delta = 0.02$

Table 5.C.2: List of high income countries: OECD

Australia	Denmark	Hungary	Korea, Rep.	Portugal	United Kingdom
Austria	Estonia	Iceland	Luxembourg	Slovak Republic	United States
Belgium	Finland	Ireland	Netherlands	Slovenia	
Canada	France	Israel	New Zealand	Spain	
Chile	Germany	Italy	Norway	Sweden	
Czech Republic	Greece	Japan	Poland	Switzerland	

Table 5.C.3: List of upper middle income countries

Albania	Brazil	Fiji	Libya	Namibia	St. Vincent
Algeria	Bulgaria	Gabon	Macedonia, FYR	Palau	Suriname
American Samoa	China	Grenada	Malaysia	Panama	Thailand
Angola	Colombia	Iran	Maldives	Paraguay	Tonga
Azerbaijan	Costa Rica	Iraq	Marshall Islands	Peru	Tunisia
Belarus	Cuba	Jamaica	Mauritius	Romania	Turkey
Belize	Dominica	Jordan	Mexico	Serbia	Turkmenistan
Bosnia and Herzegovina	Dominican Republic	Kazakhstan	Mongolia	South Africa	Tuvalu
Botswana	Ecuador	Lebanon	Montenegro	St. Lucia	

Table 5.C.4: List of lower middle income countries

Armenia	Egypt	Kenya	Morocco	Senegal	Uzbekistan
Bangladesh	El Salvador	Kiribati	Myanmar	Solomon Islands	Vanuatu
Bhutan	Georgia	Kosovo	Nicaragua	Sri Lanka	Vietnam
Bolivia	Ghana	Kyrgyz Republic	Nigeria	Sudan	West Bank and Gaza
Cabo Verde	Guatemala	Lao PDR	Pakistan	Swaziland	Yemen
Cameroon	Guyana	Lesotho	Papua New Guinea	Syrian	Zambia
Congo Republic	Honduras	Mauritania	Philippines	Tajikistan	
Cote d'Ivoire	India	Micronesia	Samoa	Timor-Leste	
Djibouti	Indonesia	Moldova	Sao Tome and Principe	Ukraine	

Table 5.C.5: List of low income countries

Afghanistan	Chad	Guinea	Malawi	Sierra Leone	Zimbabwe
Benin	Comoros	Guinea-Bissau	Mali	Somalia	
Burkina Faso	Congo (DRC)	Haiti	Mozambique	South Sudan	
Burundi	Eritrea	Korea	Nepal	Tanzania	
Cambodia	Ethiopia	Liberia	Niger	Togo	
Central African Republic	Gambia, The	Madagascar	Rwanda	Uganda	

Table 5.C.6: List of Sub-Saharan Africa countries (all income levels)

Angola	Chad	Gabon	Madagascar	Nigeria	South Sudan
Benin	Comoros	Gambia, The	Malawi	Rwanda	Sudan
Botswana	Congo (DRC)	Ghana	Mali	Sao Tome and Principe	Swaziland
Burkina Faso	Congo, Republic	Guinea	Mauritania	Senegal	Tanzania
Burundi	Cote d'Ivoire	Guinea-Bissau	Mauritius	Seychelles	Togo
Cabo Verde	Equatorial Guinea	Kenya	Mozambique	Sierra Leone	Uganda
Cameroon	Eritrea	Lesotho	Namibia	Somalia	Zambia
Central African Republic	Ethiopia	Liberia	Niger	South Africa	Zimbabwe

Table 5.C.7: List of least developed countries (UN classification)

Afghanistan	Central African Republic	Gambia	Madagascar	Rwanda	Timor-Leste
Angola	Chad	Guinea	Malawi	Sao Tome And Principe	Togo
Bangladesh	Comoros	Guinea-Bissau	Mali	Senegal	Tuvalu
Benin	Congo (DRC)	Haiti	Mauritania	Sierra Leone	Uganda
Bhutan	Djibouti	Kiribati	Mozambique	Solomon Islands	Tanzania
Burkina Faso	Equatorial Guinea	Lao	Myanmar	Somalia	Vanuatu
Burundi	Eritrea	Lesotho	Nepal	South Sudan	Yemen
Cambodia	Ethiopia	Liberia	Niger	Sudan	Zambia

Table 5.C.8: List of highly indebted poor countries

Afghanistan	Comoros	Guinea-Bissau	Mali	Rwanda	The Gambia
Benin	Côte d'Ivoire	Guyana	Mauritania	Sao Tome and Principe	Togo
Burkina Faso	Congo, Dem. Rep	Haiti	Mozambique	Senegal	Uganda
Burundi	Eritrea	Honduras	Nicaragua	Sierra Leone	Zambia
Cameroon	Ethiopia	Liberia	Níger	Somalia	
Central African Republic	Ghana	Madagascar	Bolivia	Sudan	
Chad	Guinea	Malawi	Republic of Congo	Tanzania	

Chapter 6

Conclusion

The main objective of this thesis was to make a contribution to the literature on the causal relationship between foreign aid and economic growth. To achieve this objective, we undertook the following: (i) a critical re-examination of the existing cross-country evidence on the aid-growth nexus; (ii) conduct a within-country analysis of the impact of foreign aid flows on the growth of average nighttime light density at the district-level in Malawi; and (iii) develop a theoretical model showing the link between aid and economic growth and welfare for economies facing subsistence constraints.

In chapter 3, we provide a critical analysis of the existing empirical evidence on the aid-growth link. We consider the most commonly used approach in aid studies, cross-country growth regressions, to shed further insight on possible sources of the observed lack of robustness of results from this approach. We use one of the popular strand of aid effectiveness literature in recent years, which states that aid can stimulate economic growth but only in an environment with good macroeconomic policies. Drawing on results from one of the influential studies, we conduct various robustness checks and show that cross-sectional sample variation is likely to lead to different results, making cross-country results fragile to sample composition. Particularly, we show that altering the country composition with respect to country income classes may lead to varying conclusions on the estimated effect of aid. We find that increasing the number of middle income countries in the sample is likely to lead to an estimated positive and significant coefficient of aid. Increasing low income countries is likely to lead to the opposite conclusions about the effect of aid. We find that longitudinal sample variation does not affect estimated results as much. Additionally, in this Chapter we analyse the evolution of the impact of aid over time. Looking at the period 1970-2013, we observe that in general the effect of aid on growth has weakened during the period. However, when we distinguish between the country classifications, we find that the effect has been stronger between 1990-2013 for low

income countries than it was between 1970-1989. For middle income countries, we find that the opposite is true, the relationship was stronger between 1970-89 than it has been since 1990. Finally, we explore a possible explanation for the observed evolution of aid between the two groups of countries and find that a shift in international aid policies as well as currency crises may have contributed to the observed evolution. Given the findings with regards to the cross-country approach in general, a more appropriate avenue for future research on the aid-growth link may be detailed within-country estimations. With better data becoming available at the sub-national level, better insights on the relationship between aid and growth could be derived by analysing in more detail factors that affect aid's effectiveness in stimulating growth within an economy.

In Chapter 4, we investigate the causal effect of foreign aid on average growth of nighttime light density which is used to proxy economic growth in Malawi. With the noted reservations about cross-country approach, in this Chapter we conduct a detailed within-country analysis using panel data that enables us control for potential bias that may arise from unobserved heterogeneity, reverse causation and other sources of endogeneity of aid. Due to the lack of readily available data that can be used to measure economic growth at the sub-national level, there is scant within-country evidence of the effect of aid. The few existing within-country studies of aid measure its impact on micro-level outcomes such as disease incidence, primary school attendance etc. The analysis in this Chapter makes a contribution to fill this gap.To isolate the causal impact of aid on growth, we employ two exogenous determinants of within-country aid disbursement: First, the ethnic affinity of a district with the sitting President measured as the proportion of a district's population that is co-ethnic with the President. Second, political switching which is measured as the portion of Parliamentarians in a district that are susceptible into induced political defections. We show that these two variables are valid instruments i.e they are both plausibly exogenous and relevant, which gives confidence to the causal effect derived from our two-stage least squares fixed effects regression. The panel data covers Malawi's 28 administrative districts for the period 1999-2013. Using the two instruments, alone or together, we identify a robust and quantitatively significant role for aid flows in causing higher growth in average nighttime light density. We find a hump-shaped growth response over the course of three years. The availability of new data that can be used to measure sub-national level economic growth has opened up an avenue for further research on the

effect of aid. We have exploited this in this Chapter and similar future studies for other aid-recipient countries could help bridge the gap in within-country evidence of the effects of aid and possibly reduce the pessimism regarding aid effectiveness. Additionally, while there is evidence on the role of ethnicity (via birthplace) more broadly, the instrument based on attraction of political defections could be tried in other countries.

Finally, in Chapter 5 we develop a theoretical model formulated in an intertemporal optimising framework. The model enables us to show in a single framework the interactions between different uses of foreign aid and how they affect the relationship between foreign aid and economic growth. The model also takes into account subsistence constraints and how they affect accumulation of private savings by the agent. Consideration of subsistence constraints is very relevant to when discussing low-income countries, who are the primary beneficiaries of aid. The inclusion of subsistence constraints imply that our model generates multiple steady states, with the long run outcomes dependent on the initial conditions of the economy with respect to the subsistence levels. Our analysis shows that the effect of aid depends on how the recipient Government uses it: if allocated to lumpsum transfers (pure aid form), aid will only accelerate the economy to its long-run growth, but it does not alter the long run rate of growth. When aid is allocated to the accumulation of productivity-enhancing public capital, it raises the long run rate of growth of output. We also consider the effects of aid on welfare: we show that both pure aid and productive aid have a positive effect on welfare, however productive aid has higher effect on welfare than pure aid. The analysis points to a trade-off in aid policy between growth maximising (all the aid allocated to productive aid) or welfare maximising (optimal welfare achieved when some proportion of aid is allocated to pure aid). Most of the existing empirical aid-growth literature measures its effect only focusing on total aid flows without consideration on how it is actually used. There is scope for exploring empirically the effects of different forms of aid on private investment and growth.

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