DISTRIBUTIONAL EFFECTS OF DISTINCT AID TYPES ON LOCAL ECONOMIC DEVELOPMENT IN MALAWI: NEW EVIDENCE a

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DISTRIBUTIONAL EFFECTS OF DISTINCT AID TYPES ON LOCAL ECONOMIC DEVELOPMENT IN MALAWI: NEW EVIDENCE[a]

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Abstract

This paper brings the aid effectiveness debate to the sub-national level. Using the change in night lights as an alternative measure of economic activity, we hypothesize the non-robust results regarding the effects of aid types on development in the previous literature to arise due to the effects of aid being treated as a unitary component. Using geo-coded data for donor aid to first-level 2,124 administrative regions (ADM1) and 2,082 second-level administrative regions (ADM2) in Malawi over the 1996-2011 period, we test whether aid type affects development, measured as locational nighttime light growth. Our preferred identification strategy exploits variation arising from a town receiving a specified aid type. Results in some geographical locations and towns indicate that we do not have sufficient evidence to reject the null hypothesis of the research study at 5% level. However, other geographical locations like Zomba indicate that aid category has a significant bearing on local economic growth. This is supported by a significant p=2.76% value which implies that categorical aid drives economic growth. Cross city evidence shows that category aid type brings both negative and positive results depending on location within the country.

JEL Classifications: F35, O19, O55, R11

Keywords: Deaton-Bauer foreign aid paradox, nighttime data, Malawi

1. INTRODUCTION

An established body of literature treats foreign aid as a unitary concept starting with Griffith and Enos (1970) and Friedman (1995). This phenomenon has been reported for both individual countries (Wroe, 2012) and panel analyses (Durbarry, 2004 and Moreira, 2005). Empirical attempts to question the effectiveness of aid in developing countries have continued unabated. The results have been mixed with one camp supporting the motion that aid fosters growth and reduces poverty (Clemens *et al,* 2004; Sachs, 2006, 2018; Karbo and Sen, 2014; Galian *et al* 2017; Ndikumana and Pickbourn, 2017) and the other side arguing otherwise (Easterly, 2005,

[a] This paper is a substantially revised version of an earlier paper circulated under the title “Distinct Aid Types and Local Economic Development in Malawi: New Evidence”.

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2006 and Moyo, 2009a and b). Given the economic benefits of aid to the recipient countries (Clemmens et al., 2004; Easterly, 2006 and Hühne et al., 2015), it is surprising that aid to development countries is still mainly treated as a unitary concept. This is despite a call to categorize aid to observe distributional effects of distinct aid types on growth (Khomba and Trew, 2019; Schmid, 2013 and Clemmens et al., 2011). Moreover, to the best of our knowledge, virtually no research has attempted to test for causality between distinct aid categories and local economic development in any African town, district or province. Also, there is almost no attempt which has been done to address this phenomenon using a novel database of economic activity-the night time data at micro-level. In this paper, we endeavor to fill this gap by categorizing aid projects in order to observe which types affect economic activity in Malawi's districts and towns using geographically disaggregated data for the 1996-2011 period.[4] The night lights dataset and geocoded aid dataset used in this paper allow for this phenomenon to be interrogated at a microeconomic level. We address two main research questions: i) which aid types promote local economic development? and ii) does the quantity of each aid category foster economic activity?

Coverage of aid in the popular press implies that certain categories of aid impact growth than others.[5] We examine the disaggregation of aid flows into Malawi as a unitary hypothesis problem (Clemmens et al., 2004). We look at growth effects of distinct aid categories over the 1996-2011 period to better understand the strategies of the most effective donors, in order to isolate the channels through which aid works.[6]

To address the questions raised in this paper, we use a novel aid database that includes annual disbursements at each project location and aid type and a night's lights dataset as a new measure of economic activity. We find that distinct categories of aid have varying effects on local economic activity in towns in Malawi for the sample period. Reconstruction aid and/or developmental aid has a statistically strong effect on boosting economic growth as measured by night lights density. Military aid on the contrary has a negative effect on local economic development.[7] The type of

[4] We focus on this time period because we have geocoded aid data from 1996 to 2011 and no further. It would be interesting to generalize our results in a longer time series and in a panel analysis.

[5] Reconstruction aid in Rwanda, for example, is often credited for the increase in economic activity more than military aid in Democratic Republic of Congo.

[6] After more than five decades of foreign aid programs and established literature on the effect of foreign aid on economic growth in developing economies, the discrete impacts of distinct aid types on local growth is still unknown. This paper contends that results from previous studies have in aggregate been inconclusive largely because of data limitations. Further, the nature of the relationship (for example, positive or negative) varies across aid types and across towns and pro.

[7] Former President Barack Obama talked a lot about changing the way America relates to the world, and during his administration, few areas were as ripe for reform as those relating to policies on foreign aid and how a heavy share on military aid have contributed to economic stagnation in poor countries. https://www.wsj.com/articles/SB123327734124831471. This was followed up by the Trump administration which, as of 2020, is preparing possible cuts of $250 million in military aid to Iraq, funds already approved

aid, as opposed the amount of aid, received in a location strongly explains shifts in a town's production curve and increase/decrease in night density. The increase in night density over time in a town is associated with a sustained flow of reconstruction aid. However, we find no effect of running aid projects on economic activity.

Apart from contributing to the existing literature on aid and economic growth, this paper relates to at least three other strands of research. First, our work partially answers a call by Minoiu and Reddy (2010), Schmid (2013) and Khomba and Trew (2019) for researchers to examine the growth effects of distinct aid types on local economic development. Second, the increase in aid volumes to Africa and the worsening of economic conditions has been the subject of considerable interest among development economists (e.g., Ravenhill, 1990; Lancaster, 1999; Easterly, 2003; Bräutigam and Knack, 2004 and Collier, 2006).[8] By examining the effects of different aid projects on economic activity in local towns, this paper extends our understanding of the flow of aid to Malawi. Third, the flow of aid to developing countries has increasingly caught the attention of academics (Bräutigam and Knack, 2004; Andrews, 2009). Given that the existing development economics literature's main premise is that the effects of aid on economic activity are uniform, this paper, with its focus on distinct categories of aid projects to towns in Malawi, helps challenge the conventional premise of whether the varying aid projects have the same effect on growth. Specifically, the paper addresses the question: do different aid types produce varying economic effects in local towns in Malawi?

We organize the rest of the paper as follows. Section 2 briefly reviews literature related to the current study. Section 3 describes the data construction process, and the methods used in this study. In section 4 we present empirical results. Section 5 summarizes the findings and suggests directions for further research in this area.

by Congress. https://www.wsj.com/articles/u-s-looks-at-cuts-to-military-aid-to-iraq-if-troops-are-asked-to-leave-11579046148

[8] In 2019 Malawi received about US$185.13 million in foreign assistance from ODAs (https://www.foreignassistance.gov/explore/country/Malawi).

2. RELATED LITERATURE

The aid literature has generally relied on two main assumptions that: (a) aid has a solely contemporaneous effect on economic growth, and (b) the amount of aid flows positively correlates with growth.[9] While a comprehensive literature review is beyond the scope of our paper, we review several key contributions

A central issue in development economics upholds the idea that foreign aid is a unitary component. Under the unitary hypothesis problem, aid has often been treated as a homogenous component (Clemmens et al., 2004 and Tan, 2009). Several scholars have suggested that aid should be disaggregated into specific categories (Schmid, 2013; Clemmens et al., 2011; Brech and Potrafke, 2014; Khomba and Trew, 2019) despite this, empirical attempts to prove or refute this are scant.

A growing literature has underlined the possibility that aid of different types have different effects. For example Clemens *et al* (2004) examine the impact of aid devoted to support budgets and balance of payments (BOP) needs, infrastructure development, agriculture and industry[10]. The study takes the view that aid allocated to these sectors is likely to have a discernable impact on growth in the short-run. They find that aid is effective, with estimates suggesting that a $1 increase in short-impact aid raises income, on average, by $1.64 (in present value). The authors state that aid which is aimed at supporting democracy, the environment, health, and education is likely to have a long-term impact on growth, but do not statistically identify its effect[11].

This study relates most closely to the recent development economics literature on aid effectiveness. The literature is growing rapidly. Easterly (2003, 2006) stresses the need for improving quality of aid before increasing quantity; Bowen (1995), Dreher and Lohmann (2015) confirm this for the worldwide sample while Schmid (2013), De and Becker (2015) confirm this for

[9] Some scholars contend that foreign aid should give up on growth and have more modest objectives like raising consumption levels. This literature builds on work by Bauer (1976), Deaton (2006), Easterly (2006) and Moyo (2009) and maintains that foreign aid displaces the processes of institutional maturation essential to development, including the capacity of the state to collect revenue. This gives birth to the "Deaton-Bauer foreign aid paradox" which holds that if conditions for development are present, aid is not required and when local conditions are hostile to development, aid is not useful, and it will do harm if it perpetuates those conditions.

[10] Other works include Gomanee, Girma, and Morrissey (2002) who focus on the effect of foreign aid aggregate without relief aid and technical assistance; Miquel-Florensa (2007) who analyses the efficacy of restricted vs. unrestricted aid; Mishra and Newhouse (2007), who isolate the effect of aid for heath purposes on infant mortality; and Asiedu and Nandwa (2006) who examine whether aid spent on education is pro-growth.

[11] Identifying the growth effects of aid categories is made difficult by the unavailability of data in disaggregated form for recipient countries. As data become available, analyses in this direction should become possible.

country cases. The work by Dalgaard *et al* (2004) stresses the point that aid can play a conducive role in alleviating poverty. De and Becker (2015) and Chasukwa and Banik (2019), focus on multilateral and bilateral aid effectiveness in Malawi; Easterly (2005), Sachs (2006, 2018) and De Renzio (2016) maintain that the future of development assistance, and the realization of its potential impact on poverty and development, depends crucially on the efforts donor governments and their aid agencies will spend in the coming years to address accountability dilemmas that lie at the heart of donor behavior. Khomba and Trew (2019) suggest that bilateral aid can better explain growth than multilateral aid. Our paper extends this literature by focusing on a more disaggregated analysis of aid and growth in locations and towns in Malawi.

More recently, in the same spirit with our study, Demir and Duan (2020) provide evidence on the effect of aid on sub-national level. Their work uses spatial analysis to investigate international aid effectiveness and aid spillovers at the sub-national level from World Bank aid projects in 3,764 second-order administrative divisions (ADM2) in 48 countries in Sub-Saharan Africa over the period 1995-2014 and finds that aid at the local level (ADM2) promotes economic growth at an economically and statistically significant level and substantial positive aid spillovers across adjacent localities (ADM2). They also argue that aid flows at more aggregate levels (ADM1 and country level) have the opposite effect and reduce economic growth

We also extend the works of Schmid (2013), Dreher and Lohmann (2015), Khomba and Trew (2019) and Demir and Duan (2020) in three ways. First, we do not exclusively focus on aid as a unitary component, but extend our examination to behind the scenes effects of aid on growth by categorizing aid projects in order to observe which types impact on economic activity in Malawi's districts and towns using geographically disaggregated data. Second, we test for causality by looking at growth effects of distinct aid categories over the 1996-2011 period. Third, we use spatial analysis and a novel aid database that includes annual disbursements at each project location and aid type and a night's lights dataset as a new measure of economic activity.

Our paper has a much more distant relation to an extensive literature that looks at the role of institutions (Barro, 1996; Islam *et al,* 2002; Bräutigam and Knack, 2004 and Glaeser *et al*, 2004), which in turn is related to the literature on the determinants of foreign aid (Gang and Khan, 1990; Ali and Isse, 2006 and Zimmerman, 2007) and the literature on aid effectiveness (Easterly, 2003, 2005; Doucouliagos and Paldam, 2008, 2009). Although we share an interest in foreign aid and growth, our paper deals with a different subject than these papers do-we are looking at disaggregation of aid flows into Malawi as a unitary hypothesis problem (Clemmens et al., 2004)

and looking at growth effects of distinct aid categories to better understand the strategies of the most effective donors, in order to isolate the channels through which aid affects local economic development.

Unlike many of the previous studies, we simultaneously (i) focus on the distinction between different aid types and (ii) the strategies of the most effective donors, in order to isolate the channels through which aid affects local economic development. We provide new and robust evidence that categorical aid drives economic growth. Cross city evidence shows that category aid type brings both negative and positive results depending on location within a country. There are cities and locations where aid type does not matter.[12] This speaks to different levels of growth between different cities in Malawi.

3. DATA CONSTRUCTION AND METHODOLOGY

This section describes how we select and organize the data series.

3.1. Description of data collection and organization

Critically, this paper requires tracing of aid projects in administrative regions (ADM1) and second-level administrative regions (ADM2) in Malawi over the 1996-2011 period from 31 donors for seven specific aid types. The data collection exercise is complicated by the fact that commonly used aid datasets such as Word Bank and AidData (Nielsen *et al*., 2010 and Dreher and Lohmann, 2015) and Aid Management Platform (AMP) do not contain information on aid types as well as the whole universe of aid allocations for specific locations. Hence, we construct a unique instrumental variable called aid_type to measure aid quality for the sample period. We do this by interpreting each project description both from the recipient and donor sides. First, we use the geocoded aid dataset which assigns coordinates to aid projects. We improve this database by disaggregating aid data into aid for (i) economic, (ii) social, (iii) reconstruction, (iv) military, (v) sustainability and (vi) residual/other purposes.[13] We hand-collect information about aid projects locations culled from a combination of public domain sources and websites to form a unique dataset.

[12] In these locations we hypothesize that there are other drivers of economic growth. It will be interesting to test the role of remittances and other capital flows in explaining the observed growth.

[13] We adopt and refine this classification from Bjørnskov (2019). Types of foreign aid. In *Lessons on Foreign Aid and Economic Development* (pp. 33-61). Palgrave Macmillan, Cham.

We supplement these sources with a secondary data set with information on nighttime data. We get data on luminosity, nighttime image and intensity of nighttime lights from the US Department of Defense as modified by the Defense Meteorological Satellite Program Operational Linescan System (DMSP-OLS) which is measured from space and the raw data covers the 1992-2015 periods. This dataset has been extensively used in the development economics literature (See for example, Chen and Nordhaus, 2011 and Nordhaus and Chen, 2015 and Mellander *et al,* 2015). These data measure economic activity at town and district levels from space satellites. We devise a proxy to measure local economic development using nighttime lighting measured from satellite images (luminosity). The data statistics are measured on a scale of 0-63, with higher values representing higher nighttime density. We collect data on other development indicators from the World Development Indicators database.[14] The statistics are available for our sample period 1996-2011.

[14] Data for these variables can be accessed at https://databank.worldbank.org/source/world-development-indicators

For this paper, we make use of AidData's geo-coded data for aid projects by 31 donors to Malawi- the only African country with comprehensive geocoded data available for a reasonably long period of time and at subnational level. The raw dataset contains the project's unique identifier, date of approval, the (anticipated) date of termination, and the amounts committed to and disbursed in the project over its entire duration. To calculate project-specific annual disbursements, we link the project database to the donor's documentation of project-specific financial flows, including the precise date of project disbursements. We transform these disbursements into constant 2011 US$. A second variable of interest is the number of aid types per location rather than amounts of aid. This variable is a novel feature in literature to try and quantify the effects of aid quality on economic development in local regions (Chakanyuka *et al*, 2020)

AidData covers projects that have been approved over the 1996-2011 period, comprising total disbursements of nearly 28 bn US$ to Malawi. For each project, detailed information on its locations is recorded, with different degrees of precision: Some projects are implemented in a limited geographical area, such as a village or city. Others are realized at more aggregate levels, such as a municipality, a district or greater administrative region. In the same with in Findley et al. (2011), Strandow et al. (2011) and Dreher and Lohmann (2015), the geo-coding is implemented by experienced coders in a double-blind process. Information on project locations come from various donor sources, most importantly project-specific planning or implementation documents. In the next step, coordinates of these locations are extracted from geographic online services providing names and coordinates of administrative divisions, populated areas, and other places of interest. Obviously, the coding precision reflects the sectoral composition of aid. We construct a new set of aid categories building on works by Bjørnskov, (2019), Khomba and Trew (2019) and Schmid (2013).

In total, close to 90 percent of all project locations geo-coded by AidData are assigned to a distinguishable subnational location. Since this paper focuses on sub-national projects' effects on sub-national growth, we exclude projects that are nation-wide in scope, for which no or unclear information on location is provided, and projects that are directly allocated to a government entity, as these cannot be attributed to specific regions.

We use the available project information on longitude and latitude of respective locations to match the aid projects to Malawi's first and second Administrative Regions (ADM1 and ADM2) using data from the Global Administrative Areas (GADM) database. ADM1 regions are the governmental units directly below the nation state, such as counties, regions, provinces, municipalities, or districts, among others. ADM2 regions are those regions that are directly below the ADM1 level, like districts, municipalities, and communes.

As is common in the literature on aid effectiveness, we average our data to smooth changes over the business cycle. We follow Galiani *et al*. (2014) and build averages over three years. This is useful for our preferred identification strategy below, as donors commit funds to the IDA in so-called replenishment rounds that span these three-year periods.

3.1.1. Aid Distribution Across Donors

We classify aid according to types and nature (Table 1).

Table 1. Aid disaggregation

Aid Category	Count (1)	Grant (2)	Loan (3)	Technical Assistance (4)	Total Percentage (5)
Economic	943	849	79	15	37.38%
Military	120	118	0	2	4.76%
Reconstruction	369	265	102	2	14.63%
Relief	123	119	3	1	4.88%
Social	891	783	98	10	35.32%
Sustainability	76	75	0	1	3.01%
Unspecified/residual	1	1	0	0	0.04%

Note: Aid types are defined according to purposes of use and aid project description. This table presents the summary statistics for the aid types and donor types in Malawi for the 1996-2012 period.

Source: Own calculations from AidData database.

3.2. Coordination Among Donors

Table 2. Donor types

Donor	(1) Total Cum. Comm	(2) Total Cum. Disb	(3) Difference	(4) Count
AfDB	4401081984.86	3258200453.88	1142881531	242
BADEA	197400000	107901694	89498306	26
AusAid	238000000	25500000	212500000	17
CIDA	75987925.20	71020233.01	4967692.19	15
EU	42685155935.05	12978924386.46	29706231549	603
FICA	78323133.47	63708452.32	14614681.15	67
FAO	53723216	35975909	17747307	91
GIZ	629292590.87	716328506.98	(87035916.11)	94
Global Fund	779550446	296953926	482596520	6
ICEIDA	21013482	15472806	5540676	9
IFAD	543889082.22	280636993.08	263252089.1	30
Irish Aid	19203647.67	31888731.60	(12685083.93)	30
Japan	1373828.53	2619985.95	(1246157.42)	9
JICA	70721601.73	40389160.21	30332441.52	20
KFWB	63683104.54	44655055.64	19028048.9	12
Kuwait Fund	353068062.83	12312147.72	340755915.1	11
MDTF	177001017.76	171297827.55	5703190.21	3
NORAD	1138673651.97	1324936195.70	(186262543.7)	304
OPEC Fund	256500000	23309832	233190168	19
P.R. China	133000000	126766009.33	6233990.67	2
Rep. India	30000000	5669698	24330302	1
DfID	867772584.15	843344416.04	24428168.11	215
UNAIDS	0.00	1833771	(1833771)	18
UNDP	153750803	497371155	(43620352)	133
UNESCO	458600	55059	403541	26
UNHCR	101590908	5979478.01	95611429.99	8
UNIDO	2881570	5579001	(2697431)	11
USAID	2678291085	1699416740	978874345	283
US CDC	0.00	165319335	(165319335)	40
World Bank	3767083216.18	2732543323	1034539893	115
WFP	4774468866.60	2368194426	2406274441	46

This table reports the total dollar values of foreign aid flows and a summary of aid projects commissioned to Malawi by each donor. The difference between cumulative commitment and cumulative disbursement may reflect aid leakage or capture by elites as documented in Andersen, *et al* (2020). AfDB means African Development Bank, BADEA for Arab Bank for Economic Development in Africa, AusAid for Australian Agency for International Development, CIDA for Canadian International Development Agency, EU for European Union, FICA for Flemish International Cooperation Agency, FAO for Food and Agriculture Organization, GIZ for German Agency for International Cooperation, Global Fund, ICEIDA for Icelandic International Development Agency, IFAD for International Fund for Agricultural Development, Irish Aid, JICA for Japan International Cooperation Agency, KFWB for KFW Bankengruppe, Kuwait Fund, MDTF for Multi-Donor Trust Fund, NORAD for Norwegian Agency for Development Cooperation, OPEC Fund, P.R. China for People's Republic of China, Rep. India for Republic of India, DfID for UK Department for International Development, UNAIDS, UNDP, UNESCO, UNHCR, UNIDO, USAID for US Agency for International Development, US CDC for US Center for Disease Control and Prevention, World Bank and WFP for World Food Program.

Source: Own calculations from AidData database.

3.3. Donor Aid Project Values in Malawi

Table 3. Disaggregation of aid flows according to donor and project categories

Year	Cum. commitment (1)	Number of projects (2)	Number of donors (3)	Year on Year Growth in aid (%) (4)
1996	24,946,197.94	1	1	0.00
1997	3,934,993.90	1	1	-0.84
1998	123,904,998.38	4	1	30.49
1999	1,399,547,179.16	51	3	10.30
2000	645,846,191.69	63	5	-0.54
2001	134,726,046.64	12	5	-0.79
2002	123,164,044.76	20	6	-0.09
2003	1,440,212,495.88	98	10	10.69
2004	3,916,767,089.82	239	13	1.72
2005	34,861,952,289.03	390	14	7.90
2006	6,454,910,748.76	298	13	-0.81
2007	3,974,044,411.07	267	13	-0.38
2008	6,167,047,535.31	298	18	0.55
2009	1,321,817,976.10	167	15	-0.79
2010	1,306,255,925.81	151	17	-0.01
2011	46,144,297.69	6	1	-0.96

There seem to be a positive correlation between donor cooperation and cumulative disbursements. The total value of aid to Malawi over the sample period 1996-2011 is about U$61.9 billion from 2,066 projects sponsored by 136 donors.

Source. Own calculations, AidData

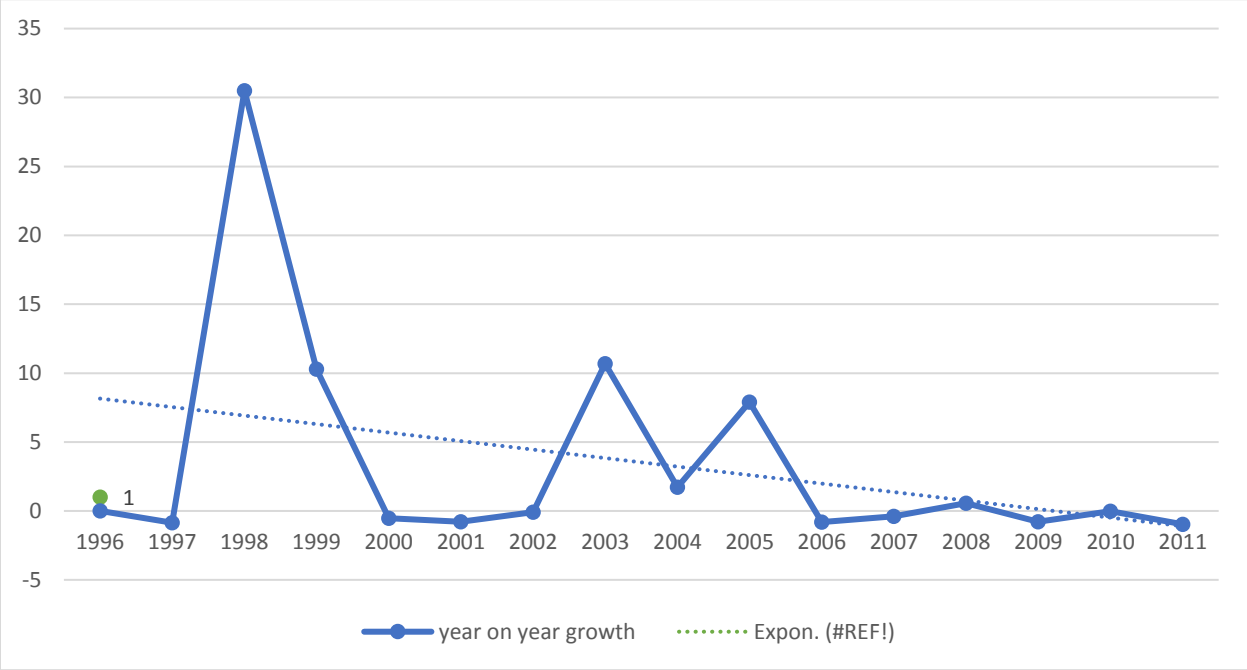

Figure 1. Year on Year growth in aid disbursements to Malawi for the 1996-2011 sample period.
Source. Own calculations, AidData

3.4. Control Variables

The values of the independent variables for the analysis were gathered from the AidData database of the sampled country. Given the nature of the data, a number of variables had to be subjectively determined. Specifically, the dataset rarely included a direct classification of aid into distinct types. Unfortunately, except for Bjørnskov (2019) there is hardly any reference literature which categories aid into different categories. From the present literature, it is not possible to decipher the exact types of foreign aid flowing into Malawi.

In evaluating the foreign aid-local economic development link, the main regression test requires that to determine whether specific types of aid matter for growth, a clear categorical approach to disaggregating aid data be made. Therefore, we categorise aid into (7) types: (a) economic; (b) military; (c) reconstruction; (d) relief; (e) social; (f) sustainability and; (g) unspecified/residual. In addition to the aforementioned factors, we also make provision for the amount of foreign aid as well as for town and time fixed effects. Finally, provision is also made to include an instrumental variable for residual aid (unclassified aid flows) and the number of aid projects in a specific town. Each of the included variables captures our interpretation, from the database, expectation of the distributional effect that any particular aid type would have on local economic development, as

well as controlling for potential differences in donor behaviour to better understand the strategies of the most effective donors, in order to isolate the channels through which aid works.. A summary of the control variables is available in Table 1 and Appendix A.

3.5. Night-Time Lights

Nighttime lights data have been gathered from satellites for more than two decades and have been carefully filtered into a series of high resolution data with observations beginning in 1992 (See Chen and Nordhaus, 2011 and Nordhaus and Chen, 2015; Dzingirai and Chekenya, 2020).

Academics have made extensive use of luminosity in economic analyses. For example, a search on Google Scholar found almost 13,200,000 studies since 2000 that have used nighttime lights to study economic phenomena. Previous studies, primarily in the field of geoscience and economics, have used nighttime image data as a proxy for socioeconomic development of particular geographic areas (Doll et al., 2000; Sutton and Costanza, 2002; Ebener *et al*., 2005; Elvidge *et al*., 2007; 1997; Sutton *et al*., 2007; Henderson *et al*., 2011, 2012; Obikili, 2015; Pfeifer *et al*, 2018). Elvidge *et al*. (2007) conclude 'Nighttime lights provide a useful proxy for development and have great potential for recording humanity's presence on the earth's surface and for measuring important variables such as annual growth for development'. In the past decade, researchers have undertaken a series of tests to support this conclusion. For instance, Doll et al. (2000) extrapolate 18 latitude by 18 longitude grid cell gross domestic product (GDP) by applying the coefficient of log–log relationship obtained at the country level, and conclude that lit-area-derived PPP–GDP grid map model global economic activity 'very well'. Ebener *et al*. (2005) and Sutton *et al*. (2007) also use percent frequency of lighting to predict GDP per capita at the national and sub-national level.[15]

The primary nighttime image data were gathered by US Department of Defense satellites starting in the mid-1960s to determine the extent of worldwide cloud cover. The data were later declassified and made publicly available as the Defense Meteorological Satellite Program Operational Linescan System (DMSP-OLS), and have been used to measure economic development of certain geographic areas as described above. All data are available for our sample period 1996–2011.

The raw data can be acquired in two spatial resolution modes. The full resolution data, also referred to as 'fine' data, have nominal spatial resolution of 0.5 km. The 'smoothed' data are an

[15] GDP per capita data accessed from World Bank data archive at http://data.worldbank.org/.

average of 55 blocks of fine data and have a nominal spatial resolution of 2.7 km. The data that we obtain from the National Oceanic and Atmospheric Administration–National Geophysical Data Center are constructed using the smoothed spatial resolution mode, at a resolution of 30 arc-seconds, covering 1808 W to 1808 E longitude and 758 N to 658 S latitude.

There are different versions of the data; three of particular importance are the 'raw', the 'stable lights' and the 'calibrated' versions. After considerable testing, we have relied on the stable lights version.

We use the night lights data to examine some trends on aid and growth within Malawi. We show that there is variation in the effects of aid on growth across towns and locations in Malawi. This paper builds on the works of Chen and Nordhaus (2011), Henderson *et al*. (2012), Hodler and Raschky (2014), Nordhaus and Chen (2015) and Dzingirai and Chekenya (2020) in using night lights to measure economic activity of subnational administrative units. The night lights allow us to estimate the more conventional measure of growth of GDP for towns and locations in Malawi.

3.6. AidData

We collect data on foreign aid flows from the AidData database. This dataset is based on the donor-reported aid information captured in the Malawi Aid Management Platform (AMP), hosted by the Malawi Ministry of Finance. Using project documents, gathered from in-country donor offices during three missions to Lilongwe, the AidData and CCAPS teams added standardized geocodes using the UCDP/AidData methodology. In total, projects from 30 donor agencies are geocoded for 548 projects, representing $5.3 billion in total commitments (approximately 80% of the total external assistance to Malawi reported to the government from 2000-2011). It represents the first effort to sub-nationally geocode all donors in a single partner country, and the first initiative of the sort envisioned by the Open Aid Partnership, an initiative spearheaded by the World Bank to increase the openness and effectiveness of development assistance at the subnational level.[16]

3.7. Methodology

The main objective of our empirical examination is to examine the distributional effects of distinct aid types in local towns in Malawi. For that purpose, we thus have a panel data set for each aid type indicator. Allowing for fixed time and town effects, the baseline light density growth regression model is[17]: We present a spatial dynamic panel model that estimates the effectiveness of aid on night light intensity. We estimate the following equation.

[16] An interactive map displaying these data along with data on armed conflict, governance, and climate security vulnerability can be viewed at www.strausscenter.org/ccaps/mappingtool.

[17] We rely on satellite data on nighttime light intensity. Night time light intensity and GDP are observed to have a strong correlation (Henderson *et al* 2012).

$$\Delta LD_{i,t} = \beta_0 + \beta_1 LD_{i,t-1} + \beta_2 AidAm_{i,t-1} + \beta_3 AidCat_{i,t} + X'_{i,t-1}\beta + \mu_i + \gamma_t + \varepsilon_{i,t} \quad (1)$$

where $LD_{i,t}$ is the log light density in country i at time period t, $\Delta LD_{i,t} = LD_{i,t} - LD_{i,t-1}$, $AidAm_{i,t}$ is the log of aid amount disbursements, $AidCat_{i,t}$ is the different categorized aid projects to Malawi, X is a vector of control variables and μ_i and γ_t are town and time fixed effects. Robust standard errors are clustered at the level of the town in regression.

A first concern with the specification in equation (1) is that aid disbursements are not random. We can expect huge aid disbursements to be given to districts and towns with the lowest expected growth, or those that have suffered negative economic shocks in the past. Conversely, it may be that, particularly within a town, developmental aid is given to areas that show the greatest potential for generating growth. We may face attenuation bias since we consider both completed and undergoing aid projects.

To take care of these concerns, we employ two novel instruments introduced in (Khomba and Trew, 2019) to the effects of aid type. We use instruments in the following systems,

$$\Delta LD_{i,t} = \beta_0 + \beta_1 \overline{Aid}_{i,t-1} + \beta_2 LD_{i,t-1} + \beta_3 \overline{Aid\ Cat}_{i,t} + X'_{i,t-1}\beta + \mu_i + \gamma_t + \varepsilon_{i,t} \quad (2)$$

$$AidCat_{i,t} = \alpha_0 + \alpha_1 z_{i,t} + \alpha_2 LD_{i,t-1} + X'_{i,t}\alpha + \mu_i + \gamma_t + \tau_{i,t} \quad (3)$$

where z is an instrumental variable component. For the instrument to be valid in our empirical analyses, we assume that it must be relevant ($\alpha_1 \neq 0$) and exogenous ($cov(z_{i,t}\varepsilon_{i,t}) = 0$)[18]

4. RESULTS

This section presents regression results. The six categories of aid described in chapter 3 are coded into numerical values and are regressed as a categorical type variable representing aid category. Causal links between the varying types of aid and local economic growth are examined using geocoded data. Panel regressions are performed to investigate both conceptual and policy implications. The regressions are performed at 5% level of significance per panel. Results in some geographical locations and towns indicate that we do not have sufficient evidence to reject the null hypothesis of the research study at 5% level. However, other geographical locations like Zomba indicate that aid category has a significant bearing on local economic growth. This is

[18] Satisfying one of the Classical Linear Regression Model assumptions.

supported by a significant p=2.76% value which implies that categorical aid drives economic growth. Cross city evidence shows that category aid type brings both negative and positive results depending on location within a country. There are cities and locations where aid type does not matter. This speaks to different levels of growth between different cities in Malawi. We analyse the overall impact of aid type on economic growth at national level using a comprehensive model and obtain the parameters below.

Table 4. Panel regression results for 26 towns in Malawi for the 1996-2011 sample period.

Panel A-F

	Coeff	Std error	t-stat	p-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Panel A: Balaka								
Intercept	0.098	0.405	0.241	0.811	(0.719)	0.914	(0.719)	0.914
LD (t-1)	0.026	0.022	1.178	0.245	(0.019)	0.071	(0.018)	0.071
AidM (t-1)	0.002	0.025	0.087	0.931	(0.048)	0.052	(0.048)	0.052
CAT	(0.02)	0.036	(0.54)	0.592	(0.092)	0.053	(0.092)	0.053
Panel B: Blantyre								
Intercept	0.967	0.507	1.903	0.060	(0.041)	1.970	(0.041)	1.970
LD (t-1)	0.044	0.063	0.695	0.488	(0.082)	0.170	(0.082)	0.170
AidM (t-1)	(0.079)	0.032	(2.427)	0.017	(0.143)	(0.014)	(0.143)	(0.014)
CAT	(0.001)	0.061	(0.015)	0.988	(0.122)	0.121	(0.122)	0.120
Panel C: Chikwawa								
Interpret	(0.199)	0.533	(0.372)	0.711	(1.269)	0.872	(1.269)	0.872
LD (t-1)	(0.006)	0.086	(0.071)	0.944	(0.177)	0.166	(0.178)	0.166
AidM (t-1)	(0.003)	0.030	(0.102)	0.919	(0.064)	0.058	(0.064)	0.058
CAT	0.054	0.039	1.367	0.177	(0.025)	0.134	(0.025)	0.134
Panel D: Chiradzulu								
Interpret	0.523	0.936	0.558	0.584	(1.462)	2.508	(1.462)	2.508
LD (t-1)	(0.307)	0.235	(1.308)	0.209	(0.804)	0.190	(0.804)	0.190
AidM (t-1)	0.023	0.048	0.488	0.632	(0.079)	0.126	(0.079)	0.126
CAT	0.025	0.161	0.157	0.877	(0.316)	0.367	(0.316)	0.367
Panel E: Chitipa								
Interpret	(0.529)	0.301	(1.759)	0.090	(1.148)	0.089	(1.148)	0.089
LD (t-1)	0.085	0.066	1.288	0.209	(0.051)	0.220	(0.051)	0.220
AidM (t-1)	0.030	0.016	1.841	0.077	(0.003)	0.063	(0.003)	0.063
CAT	0.026	0.031	0.831	0.413	(0.038)	0.091	(0.038)	0.091
Panel F: Dedza								
Interpret	(0.029)	0.393	(0.074)	0.941	(0.814)	0.755	(0.814)	0.755
LD (t-1)	0.065	0.110	0.594	0.555	(0.154)	0.284	(0.154)	0.284
AidM (t-1)	(0.05)	0.020	(0.234)	0.816	(0.045)	0.036	(0.045)	0.036
CAT	(0.071)	0.041	(1.716)	0.091	(0.154)	0.012	(0.154)	0.012

(Continued)

Table 4

Panel G-L

	Coeff	Std error	t-stat	p-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Panel G: Dowa								
Intercept	0.753	0.081	1.576	0.121	(0.205)	1.710	(0.205)	1.710
LD (t-1)	(0.235)	0.052	(3.200)	0.002	(0.382)	(0.088)	(0.382)	(0.088)
AidM (t-1)	(0.019)	0.052	(0.746)	0.459	(0.071)	0.032	(0.071)	0.032
CAT	0.004	0.004	0.139	0.890	(0.055)	0.063	(0.055)	0.063
Panel H: Karonga								
Intercept	0.177	0.681	0.261	0.796	(1.199)	1.554	(1.199)	1.554
LD (t-1)	(0.339)	0.131	(2.582)	0.014	(0.604)	(0.074)	(0.604)	(0.074)
AidM (t-1)	0.026	0.039	0.666	0.509	(0.053)	0.104)	(0.053)	0.105
CAT	0.042	0.034	1.234	0.224	(0.027)	0.111	(0.027)	0.111
Panel I: Kasungu								
Interpret	(0.209)	0.295	(0.709)	0.481	(0.799)	0.380	(0.799)	0.380
LD (t-1)	(0.067)	0.116	(0.579)	0.565	(0.165)	0.300	(0.165)	0.300
AidM (t-1)	(0.005)	0.008	(0.671)	0.504	(0.010)	0.020	(0.010)	0.020
CAT	0.028	0.021	1.328	0.188	(0.014)	0.069	(0.014)	0.069
Panel J: Lilongwe								
Interpret	(0.193)	1.189	(0.162)	0.871	(2.541)	2.155	(2.541)	2.155
LD (t-1)	0.023	0.034	0.074	0.941	(0.595)	0.641	(0.595)	0.641
AidM (t-1)	(0.002)	0.052	0.060	0.953	(0.070)	0.066	(0.070)	0.066
CAT	(0.043)	0.078	(0.600)	0.550	(0.183)	0.098	(0.183)	0.098
Panel K: Machinga								
Interpret	(0.189)	0.821	(0.231)	0.816	(1.814)	1.436	(1.814)	1.436
LD (t-1)	(0.022)	0.052	(0.416)	0.678	(0.126)	0.082	(0.136)	0.082
AidM (t-1)	0.021	0.052	0.405	0.686	(0.082)	0.124	(0.082)	0.124
CAT	0.073	0.0078	0.933	0.353	(0.082)	0.229	(0.082)	0.229
Panel L: Mangochi								
Interpret	0.038	0.440	0.086	0.932	(0.836)	0.912	(0.836)	0.912
LD (t-1)	(0.043)	0.045	(0.936)	0.352	(0.133)	0.048	(0.133)	0.048
AidM (t-1)	(0.015)	0.026	(0.583)	0.561	(0.067)	0.036	(0.067)	0.036
CAT	0.073	0.052	1.408	0.162	(0.030)	0.177	(0.030)	0.177

(*Continued*)

Table 4

Panel M-R

	Coeff	Std error	t-stat	p-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Panel M: Mchinji								
Intercept	(0.030)	0.221	(0.136)	0.893	(0.476)	0.416	(0.476)	0.416
LD (t-1)	(0.014)	0.056	(0.248)	0.805	(0.127)	0.099	(0.127)	0.099
AidM (t-1)	0.001	0.007	0.144	0.886	(0.013)	0.015	(0.013)	0.015
CAT	0.005	0.016	0.338	0.737	(0.027)	0.037	(0.027)	0.037
Panel N: Mulanje								
Intercept	(0.231)	0.185	(1.248)	0.218	(0.604)	0.141	(0.604)	0.141
LD (t-1)	0.079	0.059	1.332	0.189	(0.040)	0.198	(0.040)	0.198
AidM (t-1)	0.007	0.006	1.163	0.250	(0.005)	0.019	(0.005)	0.019
CAT	(0.003)	0.010	(0.267)	0.791	(0.024)	0.018	(0.024)	0.018
Panel O: Mwanza								
Interpret	(0.767)	0.772	(0.994)	0.340	(2.449)	0.915	(2.449)	0.915
LD (t-1)	0.452	0.294	1.536	0.151	(0.189)	1.093	(0.189)	1.093
AidM (t-1)	0.004	0.041	0.104	0.919	(0.084)	0.093	(0.085)	0.093
CAT	(0.008)	0.050	(0.147)	0.885	(0.133)	0.116	(0.133)	0.116
Panel P: Mzimba								
Interpret	(0.914)	0.976	(0.936)	0.351	(2.845)	1.061	(2.844)	1.016
LD (t-1)	(0.084)	0.255	(0.330)	0.742	(0.589)	0.420	(0.589)	0.420
AidM (t-1)	0.060	0.035	1.723	0.087	(0.009)	0.129	(0.009)	0.129
CAT	(0.017)	0.059	(0.297)	0.767	(0.133)	0.098	(0.133)	0.098
Panel Q: Nkhata Bay								
Interpret	1.266	0.980	1.291	0.204	(0.713)	3.244	(0.713)	3.244
LD (t-1)	(0.215)	0.143	(1.540)	0.140	(0.503)	0.074	(0.503)	0.074
AidM (t-1)	(0.072)	0.061	(1.194)	0.239	(0.195)	0.050	(0.195)	0.050
CAT	0.137	0.108	1.269	0.211	(0.081)	0.355	(0.081)	0.355
Panel R: Nkhotakota								
Interpret	0.026	0.270	0.096	0.924	(0.513)	0.565	(0.513)	0.565
LD (t-1)	(0.046)	0.045	(0.936)	0.315	(0.136)	0.045	(0.136)	0.045
AidM (t-1)	(0.005)	0.015	(1.011)	0.740	(0.035)	0.025	(0.035)	0.025
CAT	0.022	0.029	(0.333)	0.439	(0.035)	0.080	(0.035)	0.080

(*Continued*)

Table 4

Panel S-X

	Coeff	Std error	t-stat	p-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Panel S: Nsanje								
Intercept	0.336	0.308	1.092	0.281	(0.284)	0.957	(0.284)	0.957
LD (t-1)	(0.100)	0.120	(0.827)	0.413	(0.342)	0.143	(0.342)	0.143
AidM (t-1)	(0.001)	0.012	(0.071)	0.944	(0.025)	0.023	(0.025)	0.023
CAT	(0.015)	0.025	(0.567)	0.568	(0.065)	0.036	(0.065)	0.036
Panel T: Ntcheu								
Intercept	0.553	0.426	1.298	0.200	(0.302)	1.408	(0.302)	1.408
LD (t-1)	(0.712)	0.098	(1.746)	0.087	(0.369)	0.026	(0.369)	0.026
AidM (t-1)	(0.013)	0.021	(0.638)	0.526	(0.055)	0.028	(0.055)	0.028
CAT	(0.015)	0.025	(0.617)	0.540	(0.0065)	0.035	(0.066)	0.035
Panel U: Ntchisi								
Interpret	(2.184)	3.620	(0.603)	0.550	(9.506)	5.138	(9.506)	5.138
LD (t-1)	0.339	0.835	0.406	0.687	(1.350)	2.027	(1.350)	2.027
AidM (t-1)	0.049	0.218	0.207	0.387	(0.396)	0.486	(0.396)	0.486
CAT	(0.011)	0.216	(0.050)	0.961	(0.449)	0.427	(0.449)	0.427
Panel V: Phalombe								
Interpret	(0.451)	0.995	(0.454)	0.652	(2.452)	1.550	(2.452)	1.550
LD (t-1)	(0.15)	0.089	(1.670)	0.102	(0.327)	0.030	(0.327)	0.030
AidM (t-1)	0.068	0.069	0.896	0.329	(0.071)	0.206	(0.071)	0.208
CAT	(0.111)	0.121	(0.919)	0.363	(0.356)	0.133	(0.356)	0.133
Panel W: Rumphi								
Interpret	0.677	0.941	0.720	0.476	(1.222)	2.577	(1.222)	2.577
LD (t-1)	0.252	0.117	2.161	0.036	0.017	0.488	0.017	0.488
AidM (t-1)	(0.021)	0.056	(0.376)	0.709	(0.133)	0.091	(0.133)	0.091
CAT	0.107	0.104	1.026	0.311	(0.104)	0.318	(0.104)	0.318
Panel X: Salima								
Interpret	(0.063)	0.484	(0.131)	0.897	(1.031)	0.905	(1.031)	0.905
LD (t-1)	(0.066)	0.123	(0.540)	0.591	(0.311)	0.179	(0.311)	0.179
AidM (t-1)	(0.009)	0.029	(1.319)	0.751	(0.067)	0.048	(0.067)	0.048
CAT	0.069	0.073	(0.945)	0.348	(0.077)	0.215	(0.077)	0.215

(*Continued*)

Table 4

Panel Y-Z

	Coeff	Std error	t-stat	p-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Panel Y: Thyolo								
Intercept	0.379	2.700	0.140	0.889	(5.031)	5.788	(5.031)	5.788
LD (t-1)	(0.489)	1.141	(0.429)	0.670	(2.775)	1.797	(2.775)	1.797
AidM (t-1)	(0.001)	0.061	(0.445)	0.658	(0.149)	0.095	(0.149)	0.095
CAT	0.181	0.202	0.899	0.370	(0.223)	0.586	(0.223)	0.586
Panel Z: Zomba								
Intercept	0.178	1.001	0.178	0.859	(1.805)	2.161	(1.805)	2.161
LD (t-1)	(0.144)	0.073	(1.967)	0.052	(0.288)	0.001	(0.288)	0.001
AidM (t-1)	(0.025)	0.064	(0.384)	0.702	(0.151)	0.102	(0.151)	0.102
CAT	0.245	0.138	1.781	0.078	(0.028)	0.518	(0.028)	0.512

Regression results from equations (2) and (3) reporting coefficients, standard error and p-values for the linear models estimated.

Table 5. Regression statistics

Town	Multiple R	R-squared.	Adjusted R-squared	Std. Error	Observations
Balaka	0.185	0.034	(0.033)	0.306	47
Blantyre	0.237	0.056	0.029	0.662	109
Chikwawa	0.196	0.038	(0.015)	0.375	58
Chiradzulu	0.356	0.127	0.167	0.776	20
Chitipa	0.407	0.165	0.069	0.334	30
Dedza	0.254	0.064	0.020	0.352	68
Dowa	0.416	0.173	0.127	0.251	58
Karonga	0.403	0.163	0.100	0.350	44
Kasungu	0.196	0.038	(0.003)	0.227	73
Lilongwe	0.047	0.002	(0.016)	1.021	171
Machinga	0.118	0.014	(0.011)	1.148	121
Mangochi	0.173	0.030	0.000	0.603	102
Mchinji	0.073	0.005	(0.064)	0.112	47
Mulanje	0.208	0.043	(0.015)	0.099	53
Mwanza	0.420	0.176	(0.030)	0.242	16
Mzimba	0.161	0.026	0.005	5180.1	142
Nkhata Bay	0.308	0.095	0.030	0.992	46
Nkhotakota	0.140	0.020	(0.023)	(0.283)	73
Nsanje	0.156	0.024	(0.042)	0.278	48
Ntcheu	0.252	0.064	0.010	0.212	56
Ntchisi	0.081	0.007	(0.070)	1.896	43
Phalombe	0.288	0.083	0.024	1.344	51
Rumphi	0.350	0.122	0.060	0.980	46
Salima	0.147	0.021	(0.027)	0.768	65
Thyolo	0.136	0.018	(0.035)	1.665	59
Zomba	0.247	0.061	0.036	1.565	116

Note. This table presents the summary statistics for the aid types and donor types in Malawi for the 1996-2012 period. The regressions are performed at 5% level of significance. Significance refers to the mean being significantly larger in that particular subsample.

Table 6. Town Effects

Town (i)	Town Effect (μ_i)	Observations (n)
Balaka	0.10	47
Blantyre	0.10	109
Chikwawa	(0.10)	58
Chiradzulu	0.52	20
Chitipa	(0.52)	30
Dedza	(0.03)	68
Dowa	0.75	58
Karonga	0.18	44
Kasungu	(0.21)	73
Lilongwe	(0.19)	171
Machinga	(0.19)	121
Mangochi	0.04	102
Mchinji	(0.03)	47
Mulanje	(0.23)	53
Mwanza	(0.77)	16
Mzimba	(0.91)	142
Nkhata Bay	1.27	46
Nkhotakota	0.03	73
Intercept	0.34	48
Ntcheu	0.55	56
Ntchisi	(2.18)	43
Phalombe	(0.45)	51
Rumphi	0.68	46
Salima	(0.06)	65
Thyolo	0.38	59
Zomba	0.18	116

We account for unobserved, time-invariant town heterogeneity and show that using supra-town dummies (by geography) in a country-random effects model appears to be a sufficient substitution for omitted country fixed effects.

Table 7. Time Effects

Time (t)	Time Effect (y_t)	Observations (n)
1997	0.0001	1
1998	0.0002	2
1999	0.0006	48
2000	0.0070	58
2001	0.0010	8
2002	0.0016	13
2003	0.0095	78
2004	0.0254	209
2005	0.0431	355
2006	0.0315	259
2007	0.0283	233
2008	0.0304	250
2009	0.0155	128
2010	0.0145	116
2011	0.0005	4

We include time effects to control for our regression variables which are constant across towns and locations but vary over time. Year effects (more simply known as “year dummies” or “dummies for each of the years in our dataset [excluding the first year]”) capture the influence of aggregate (time-series) trends. We conclude that the estimated relationship between aid types and local economic growth (nighttime coverage) is not affected by omitted variable bias due to factors that are constant over time.

Table 8. Summary statistics

	Coefficients	Standard error	t-Stat	p-value
Intercept	0.214	0.143	1.495	0.001
$LD_{i,t-1}$	(0.129)	0.0122	(10.546)	2.97E
$AidAm_{i,t-1}$	(0.004)	0.009	(0.443)	0.007
$AidCat_{i,t}$	0.024	0.071	1.384	0.002

Note. Results above indicate that growth may be experienced at national level despite the absence of foregn aid. That will be a result of other drivers not of interest on this study. This is evidenced by the significant intercept term at 5% level. Probability values of the aid amounts and aid category also indicate that growth can be accelerated by foreign aid at national level.

5. CONCLUSION

Examining the causal links between the varying types of aid and local economic growth has both conceptual and policy implications. The study of the consequences of aid using geographically disaggregated data, with particular attention to unbundling the different types of assistance, could significantly improve our understanding of the effectiveness of foreign aid. Papers that consider categorizing aid projects in order to observe which types of aid impact economic activity are scant. This study is an addition to the dearth of literature on disaggregated aid information and economic development. Many assumptions are made about the link between foreign aid and growth, so this paper is an important contribution to knowledge as it highlights the reality in Malawi of aid type dynamics and economic activity. In any case, improving quality of aid should come before increasing quantity before more money is lost.

Although examining the causal links between the varying types of aid and local economic growth sheds light on the foreign aid debate, further questions remain. The present paper also has a number of limitations that could be addressed in future work. First, the study offers a static view of the link between aid types and growth in subnational localities in Malawi. It may be interesting to generalize results from this study to a panel case over long periods of time. We leave this for a follow-up study. Second, the most immediate opportunity is application of our methodology to the other countries with geo-coded AidData. We expect to expand our analysis by taking into account other determinants of aid effectiveness at the local level, including the characteristics of donors, and varieties of targeted development programs.

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APPENDIX A

Variable	Source	Description
Nighttime light intensity	NOAA	Sum of nighttime light intensity values falling within the borders of an administrative region
Total aid (p.c.)	AidData (2015) / World Bank	Average annual disbursement through donor projects within a region divided by regional population, 2011 US$
Unspecified (residual)	AidData (2015) / Clemens et al. (2012)	Unclassified aid to Malawi
No. of projects (p.c.)	AidData (2015)	Average annual number of project with non-zero disbursements within a region divided by regional population
Economic aid	AidData (2015)	Sum of foreign aid for economic purposes include trade and intergration
Military aid	AidData (2015)	Sum of aid to support military expenditure.
Reconstruction aid	AidData (2015)	Sum of total aid for road reconstruction, bridges, ICT and development.
Relief aid	AidData (2015)	Sum of humanitarian aid assistance for disaster management
Social aid	AidData (2015)	Sum of foreign aid for basic goods provision like education, healthcare.
Sustainability aid	AidData (2015)	Sum of aid in form of development finance for and climate trade finance.

Table A1. Description of key variables
Source. NOAA: National Oceanic and Atmospheric Administration and CIESIN: Center for International Earth Science Information Network