The Effect of Facebook's Free Basics Program on Economic Development in Africa

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Abstract
Facebook' digital service, Free Basics, is giving people with a mobile phone in 65 developing nations access to the internet for free. This study examines the effect of this program on economic development with a difference-in-differences approach in 12 African countries as well as the discrepancy of such effect in rural and urban areas. Findings support previous theories of endogenous growth (Romer 1990), decentralised information processing (Hayek 1945) and supply-push & demand-pull mechanisms of urbanisation (Todaro 1969). Free Basics yields a positive effect on economic development after two years. However, this effect only applies to urban areas, nurturing a discussion on Free Basics influence on spatial inequality. The study concludes with a brief research agenda on patterns and obstacles of adoption of Free Basics, especially in rural areas and leaves policymakers in developing nations with some recommendations on digital policy.

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1 Introduction

Today, an unprecedented volume of processes ranging from a simple exchange of information with relatives to the acquisition of a new skill can take place online. This makes access to the internet an ever more critical factor for socioeconomic development (Czernich et al. 2011).

Internet penetration and use has reached a close to universal level in most developed nations, whereas the use of digital services is still low in large parts of the developing world (WB 2021a). Rapidly accelerating internet penetration rates are credited to help leap-frog countries out of poverty or accelerate economic growth (Bahia et al. 2020). This however, misses the important fact that most often accelerated rates of internet penetration are driven by urban and more affluent areas of countries being connected to the grid, whereas rural areas remain unconnected and/or rural populations are unable to afford the use of mobile data, driving digital inequality and hindering inclusive growth (James 2010).

The Economist Intelligence Unit's inclusive internet index combines a range of indicators such as cost of mobile phones, network coverage or trust in online privacy to showcase the advancement of economies in four categories: Availability, Affordability, Relevance and Readiness. One key insight from their method is that the cost of access to the internet relative to average income and the level of competition in the Internet marketplace is on average lowest for low-income countries. In response to this, one of the leading tech goliaths, Facebook, has launched a program called Free Basics (FB) as part of its global Connectivity initiative (Facebook 2021). Intended to give those without financial means to afford mobile data access to the internet, the program takes the shape of an app, available to download in selected developing countries across the globe (see figure 1). The app enables free access to several services, including for instance BBC, Wikipedia and Facebook itself. Users merely require a sim-card and can then use all services included in the FB app without paying for mobile data. Today, over 100 million people globally are using FB (Nothias 2020).

This paper explores the effect of the availability of Facebook's FB service on economic output as well as the discrepancy in such effect between urban and rural areas. By means of a difference-in-differences analysis comparing twelve paired African countries (of which FB is available in one while never having been launched in the other).

2 Related Literature

Below I will review literature concerning the effect of Information and Communications Technology (ICT) on economic development and urbanisation, both theoretically and empirically to lay the foundation for my own study. Additionally, I will showcase the lack of literature concerning Facebook's FB program and its effects.

2.1 ICT & Economic Development

Endogenous growth theory postulates the creation and dissemination of information and knowledge as a key propellant of economic growth (Lucas 1988, Romer 1990). Rapidly spreading information fosters competition and entrepreneurship, eases the adoption of new technologies, and improves job matching (Czernich et al. 2011, Benhabib & Spiegel 2005). In other words, a rapid spread of information can lead to faster spillovers of knowledge boosting economic development.

Friedrich von Hayek's work on the importance of decentralised information processing further supports this (1945). Following Hayek's theory, each agent in a system employs available information to generate new informational output. As each agent is privy to a perspective and understanding of the information they employ, each agent enriches the prior stock of information, ultimately benefiting all agents. Aligning with endogenous growth theory, accelerating the rate of information processing aids economic growth through greater competition, flourishing innovation, cost reductions due to more rapid technology adoption and the rise of new business models, such as for instance those relying on the spatial exchange of batches of information (Jorgensen et al. 2008). A famous example of this business model is Facebook, connecting millions of people through digital space, exchanging different forms of information every day.

Empirical literature has studied several dimensions of effects of the internet on economic development. One strand of literature has focussed productivity gains on the firm-level facilitated by ICT through for instance upskilling of labour, new work practices or job matching (Bresnahan et al. 2002, Bloom & Van Reenen 2007, Litan & Rivlin 2001). Another strand of literature covers individual-level effects. A rapid dissemination of information drives a more informed public, raises awareness of job market opportunities and fuels private innovation (Czernich et al. 2011). An internet connection makes the job search more efficient and transparent, leading to economy-level productivity gains (Autor 2000). Additionally, a personal internet connection

has been found to facilitate entrepreneurship, an accelerator of economic growth (Fairlie 2006, Audretsch 2007). Other studies have focussed on macro-level effects of the internet. Lehr et al. (2006) estimate the effect of mass-market broadband between 1998 and 2002 in the US, finding significantly more growth in employment, business density and IT-intensive sectors in communities with access. Czernich et al. (2011) find that a 10-percentage-point increase in internet penetration raises average annual per capita growth by 0.9–1.5 percentage-points in a number of OECD countries. Pradhan et al. (2018) confirm these results. The consensus in the literature postulates a positive effect of the internet on economic growth across regions and sectors, including different approaches to measuring growth and internet penetration (Cohen-Almagor 2013, Cardona et al. 2013). Barely any literature estimates these effects in Africa or Asia.

2.2 ICT & Urbanisation

The dominant paradigm upon most theoretical and empirical literature on urbanisation rests on the theory that a positive urban–rural income differential causes a continuous flow of rural migrants into cities, where rural supply-push and urban demand-pull factors are the primary drivers of urbanisation (Todaro 1969, Wan & Zhang 2017). Another strand of research contends that cost or distance are major drivers of migration. Greenwood (1997) lists several dominant factors deterring migration, namely high out-of-pocket moving costs, high information search costs as well as high psychological cost of leaving home. Empirical evidence from different continents has affirmed this theory (Vanderkamp 1971, Beals, et al. 1967).

Hayek's as well as Romer's work lend corroboration to the process of urbanisation. More rapidly spreading information can lower information search costs, easing for instance psychological costs of leaving home, through for instance reading up about one's destination. Further, greater availability of information can aid job searches in distant areas through job market platforms (Braseman et al. 2020). Empirical work on migration networks lends some evidence to this theory, finding that having access to networks of migrants helps reduce migration costs by providing information on housing and jobs (Mckenzie & Rapoport 2007).

ICT has fuelled urbanisation, breeding clusters of knowledge-intensive industries, providing high-paid and creative jobs in urban areas (Clark et al. 2018). These jobs have, consistent with prevalent urbanisation theory, pulled workers into the large cities, creating knowledge spillovers and increasing the rural-urban divide (Braese-

mann et al. 2020). As a symptom of urbanisation, rural communities frequently fall behind on several dimensions ranging from income to the provision of basic public services (Glasmeier 2018). Large volumes of research postulate that a lack of affordability and availability of broadband and mobile Internet as well as 'digital literacy' in rural areas inhibits the adoption of ICT and drives spatial inequality (Stern et al. 2009, Salemink et al. 2017, Hargittai 2002). In sum, benefits of the internet, unlike Hayek might have predicted, remain unevenly distributed, favouring cities and neglecting rural areas.

2.3 Free Basics

FB is a symptom of Mark Zuckerberg's vision to increase global connectivity. In his white paper "Is Connectivity a human right?" (2013), he publicised Facebook's efforts to connect every human to the internet to nourish the global knowledge economy. Zuckerberg defends the causal link between ICT and economic development, advertising FB as a means to ease hindrances for those in poverty and rural areas to use the internet (Arora 2019). Since its inauguration, FB has been launched in 65 countries (most of which are in Africa), connecting over 100 million people, according to Facebook (Nothias 2020). Literature covering FB is still scarce with most quantitative information having been collected outside of academia. The news platform Quartz conducted a mobile-phone-based survey with 500 participants, finding that 65% of Nigerians believe "Facebook is the Internet" (Mirani 2015). Other research organisations have found that more people report using Facebook than the Internet (Galpaya 2012). This has sparked far reaching debates about FB' interference with net neutrality, famously leading to it being banned in India in 2015 (Orriss 2014, Pei & Olgado 2021, Prasad 2018, Willems 2016, Global-Voices 2017). This debate is beyond the scope of this paper but encompasses the design of FB' service, whereby Facebook selects websites for users to access as well as easing the access to Facebook over other services (Bhatia 2016).

FB is a daily source of information and connection for more than 100 million people. While literature from ICT studies has delivered ample evidence of a positive relationship between ICT and economic as well as urban development, no study has yet attempted to examine the purview of Facebook's endeavour to connect the world with regard to economic growth and urbanisation. This paper seeks to do just that. In the subsequent sections, I will attempt to answer the following research question:

> *What is the effect of Facebook's Free Basics Program on Economic Growth in urban and rural areas in Africa?*

3 Methodology

The core of this paper is a quasi-experimental difference-in-differences approach to study the effect of the availability of FB in twelve African countries (see figure 1). I exploit the subnational variation in nightlight luminosity as a proxy for economic output, comparing the difference-in-differences of nightlight luminosity in 6 neighbour-country-pairs. In each pair, FB has been made available in one country and has never been launched in the other. As the program was launched at different points in time within Africa, I examine the difference between the year it was launched and one(two) year(s) later in an event-study-like design. In addition, I compare the differential between urban and rural economic output during the same period.

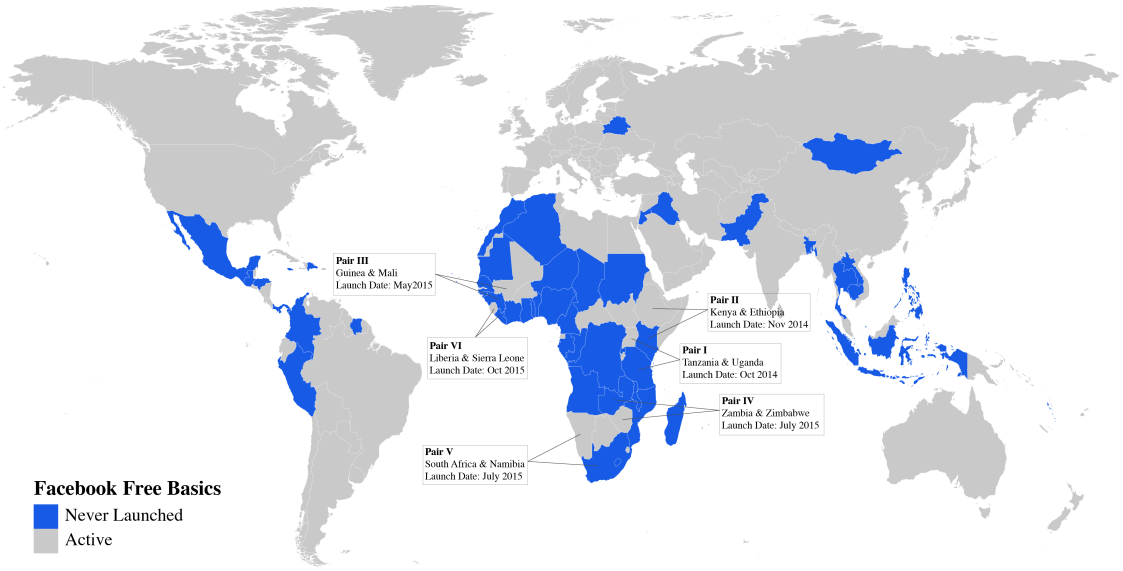

Figure 1: Free Basics around the World - February 2021 (compiled by the author)

3.1 The Data

3.1.1 Nightlight Luminosity Data

Global satellite-observed nighttime-lights have widely been applied throughout geospatial literature for a range of purposes such as estimating GDP or energy consumption (Henderson et al 2012, Chen & Nordhaus 2019). The latest data source for global

nightlight imaging, Visible Infrared Imaging Radiometer Suite (VIIRS), has been found to closely mirror economic activity, even in low density rural areas, capturing spatial inequality accurately (Elvidge et al. 2013, Gibson et al. 2020, Gibson et al. 2021). This data is available globally for every year since 2012 (Elvidge et al. 2017). Following Bruederle & Hodler's method, I use the log-transformation of nightlight luminosity for my model, giving more weight to variation in nighttime-lights in lower segments where observations are concentrated (2018). Literature suggests adjusting for gas flares from oil production when working with nighttime-lights as a proxy for economic output to alleviate distortions of estimates of economic activity (Elvidge et al. 2016). However, this study does not cover any country exhibiting gas flares, rendering this unnecessary (NOAA 2021).

3.1.2 Subnational Boundaries

To exploit within-country variation of nightlights I compute luminosity for subnational administrative areas in each country (GADM 2021). Table 1 outlines the administrative levels per country used for my analysis. Administrative levels are chosen to facilitate a clean distinction of rural and urban areas and keep the number of regions in each country of each pair as equal as possible.

Table 1: Data Granularity

Country	**Admin Level (No. Regions)**
Tanzania	District (183)
Uganda	County (166)
Zambia	District (72)
Zimbabwe	District (60)
Guinea	Sub-Prefecture (336)
Mali	Arrondissement (289)
Liberia	Clan (66)
Sierra Leone	Chiefdom (153)
South Africa	Local Municipality (234)
Namibia	Constituency (107)
Kenya	Constituency (301)
Ethiopia	Zone (79)

3.1.3 Demographic Health Surveys

I classify each area into either rural or urban to examine the differential between their respective luminosity. Each survey cluster (30 responses) of the Demographic Health Surveys conducted by USAID is attached with 1) a label of having been conducted in a rural or urban setting and 2) a geolocation (DHS 2021). By cross-referencing geolocations of surveys with administrative areas in each country, I compute a classification for each subnational area, counting urban and rural survey clusters per area and classifying them based on a majority vote.

3.2 Difference-in-Difference Analysis

By means of a quasi-experimental econometric technique, the Difference-in-Difference approach, I am exploiting variation of nightlight luminosity as a proxy for economic output in 12 paired regions, of which one respectively has been exposed to the treatment of this study, the availability of Facebook's FB, i.e. the availability of mobile data free of charge. Causal inference with this technique depends most critically on two assumptions. The common trends of both regions as well as the conditional independence of the treatment. The necessity for common trends is illustrated by the graph below. As one compares the difference of an outcome in two regions in-between two time periods, any dissimilarity of trends in the outcome pre-treatment would disable the difference-in-difference estimate (figure 2).

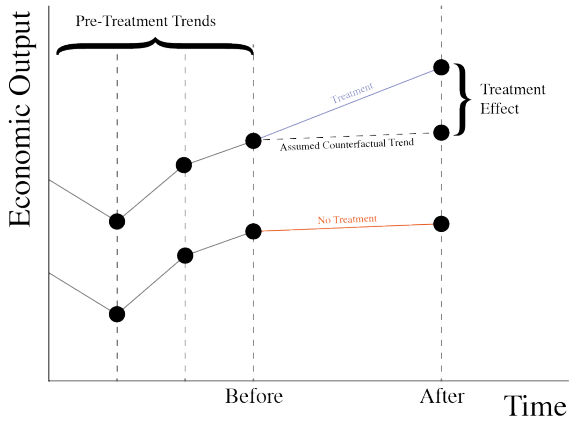

Figure 2: Difference-in-Differences Conceptual Illustration

The case selection for this paper from the pool of African countries where FB is active is largely driven by the common-trends assumption. After testing each neigh-

bouring country pair for the similarity of 2-3 years of pre-treatment trends, 6 country pairs were found to exhibit matching trends (see Appendix A1-A6). As Facebook's FB program was not implemented at the same time in the treated countries of interest, the pre- and post-treatment year differs from pair to pair (for robustness, the analysis is run for both 1 and 2-year gaps between pre- and post-treatment).

Table 2: Country Pairs

Pair	**Country Pair (Treated in Bold**	**Treatment Implementation**
I	**Tanzania** & Uganda	2014
II	**Kenya** & Ethiopia	2014
III	**Guinea** & Mali	2015
IV	**Zambia** & Zimbabwe	2015
V	**South Africa** & Namibia	2015
VI	**Liberia** & Sierra Leone	2015

The conditional independence assumption postulates a random assignment of the treatment to the unit of interest. As Facebook's strategy was to launch FB in the entire developing world, the actual assignment depends merely on compliance of governments and telecommunications providers. However, a test of significance of the correlation between the presence of Facebook's FB in all developing countries globally and common World Bank indicators of government strength lends support to the assumption that the assignment of the treatment is random (WB 2021b) (see appendix A7). I hence intend to run the following regression model to answer my research question:

$$log(luminosity)_{it} = \alpha + FB(i) + PrePost_t + FB : PrePost_{it} + PairFixedEffects_p + r\_u_i + \epsilon$$

Where FB is a treatment dummy, $PrePost$ a time dummy, $FB : PrePost$ an interaction term between time and treatment, are a set of country-pair-level fixed effects and r_u_i is a rural-urban dummy. Based on the common-trends assumption within each country pair, I assume that the variation of unobserved components in outcomes in each pair is correlated, i.e. that paired countries are subject to similar unobserved mechanisms, driving the similarity of their economic development. To sufficiently control for this, I follow Abadie et al. (2017) and Roodman et al. (2019), using a bootstrap approach to cluster the standard errors (SE) at the country-pair-level in addition to the $PairFixedEffects$.

The scope of this study attempts to pave the way for future researchers interested in this topic, uncovering if FB affects economic development and to which extent this effect differs for rural and urban areas. Accordingly, I hypothesise that (1) FB has a non-zero effect on log-nightlight-luminosity and (2) the effect of FB on economic output differs significantly for urban and rural areas.

4 Results

In the following, I will present the regression output of the entire dataset with a 1-year gap between pre- and post-treatment as well as treatment effect coefficients for all combinations of only rural and urban areas as well as 1- and 2-year gaps.

Table 3: Regression Results

	Dependent variable: **log_Luminosity**		
Bootstrapped SE are in Bold Font	*OLS* White SE	Robust SE	Clustered at Pair Level
	(1)	(2)	(3)
Treatment	0.737***	0.737***	0.737***
	(0.053)	(0.055)	(0.257)
Pre_Post	0.317***	0.317***	0.317
	(0.056)	(0.058)	(0.475)
r_u	1.558***	1.558***	1.558***
	(0.051)	(0.077)	(0.239)
Pair II	0.077	0.077	0.077*
	(0.062)	(0.065)	(0.046)
Pair III	0.079	0.079*	0.079***
	(0.055)	(0.047)	(0.016)
Pair IV	−0.517***	−0.517***	−0.517***
	(0.084)	(0.080)	(0.009)
Pair V	0.168***	0.168**	0.168***
	(0.064)	(0.075)	(0.048)
Pair VI	0.186***	0.186***	0.186***
	(0.071)	(0.053)	(0.042)
Treatment:Pre_Post (1-year)	−0.422***	−0.422***	−0.422
	(0.073)	(0.074)	**(0.268)**
" (1-year & only rural)	−0.428***	−0.428***	−0.428
	(0.064)	(0.065)	**(0.250)**
" (1-year & only urban)	−0.400	−0.400	−0.400***
	(0.326)	(0.351)	**(0.120)**
" (2-years)	0.253***	0.253***	0.253**
	(0.068)	(0.067)	**(0.125)**
" (2 years & only rural)	0.251***	0.251***	0.251
	(0.056)	(0.056)	**(0.125)**
" (2 years & only urban)	0.157	0.157	0.157**
	(0.301)	(0.305)	**(0.072)**
Constant	−3.104***	−3.104***	−3.104***
	(0.056)	(0.055)	(0.258)
Observations (Rural, Urban)	4,092 (3,418, 674)		
Note:	*p<0.1; **p<0.05; ***p<0.01		

Complete Results can be found at: `https://bit.ly/3wPGgDy`

Treated countries are on average economically stronger. *Pre_Post* indicates a general upward trend in economic output that, however, becomes insignificant when accurately clustering the SE. Urban areas are significantly positively related with economic output. Pair-Fixed-effects supports the hypothesised heterogeneity of country-pairs, all being significantly different to Pair I.

The average treatment effect (ATE), i.e. the interaction term $Treatment : Pre\_Post$ is negative and highly significant with white and robust SE, but becomes insignificant when clustering errors adequately at the country-pair-level with and without employing the bootstrap. In other words, after 1 year, FB does not significantly affect overall economic development in the chosen countries. This also applies to rural areas. The ATE in urban areas after 1 year however is negative and significant when clustering at the country-pair level.

This pattern changes when looking at the effect after two years, where one can observe a positive and significant effect on overall economic development as well as urban economic development (which only becomes significant when clustering the errors adequately). The effect of FB on rural areas remains only significant for white and robust SE, even after two years.

5 Discussion

The findings presented display a delayed effect of FB on economic development after 2 years, aligning with the reviewed theoretical and empirical literature. The results lend evidence in aid of confirming both hypotheses. FB does yield a significant effect on economic development after two years and such effect differs for rural and urban areas.

Several reasons might help explain these findings. Building on the theory of endogenous growth (Romer 1990), decentralised information distribution (Hayek 1945) and push-pull factors of urbanisation (Todaro 1969), greater availability of information after two years of implementation might have contributed to greater rates of entrepreneurship of users, lower information search costs for new job opportunities as well as a reduction of moving boundaries both psychological and logistical. Precise causal mechanisms are left to explore for future researchers.

The absence of a significant effect after one year, might be explained with an initial lack of awareness of FB, whereby previously unconnected users only adopted the

services after already having been available for a certain period. Future researchers might seek to further explore the cause for this delay as well as boundaries to unconnected users to start using the service. Initially, the primary user base of FB might have been a population subgroup which had already been using the internet and was hence in a more suited position to find out about FB, possibly explaining why, one year after its launch, no significant ATE was observed. It might be interesting to learn how many people that use FB did not engage with the internet before. This links back to a potential lack of 'digital literacy' among population groups that are still disconnected to the internet. Despite significantly lowered setup and operating costs to use the internet, the purview of insufficient 'digital literacy' might be more far reaching than prior studies have estimated, disabling population subgroups to access even a service such as FB (Hargittai 2003). Future researchers might want to explore this dimension of hindrances to access the internet with view to FB in greater detail.

The discrepancy between the effect of rural and urban areas might be a result of similar mechanisms. On average more connected communities in urban areas might benefit from personal social connections with an internet connection through which they find out about FB and hence access the internet. With more sparsely connected communities in rural areas, this process might be inhibited and hence explain the lack of an effect. Future studies might want to explore geographic and social patterns of adoption of FB as well as more specific use patterns of the app itself to understand potential avenues for policymakers to leverage FB to propel rural economic development, entrepreneurship and the extension of job market opportunities for currently still disconnected population subgroups. Furthermore, this might illuminate the effect of FB on spatial inequality.

More generally, based on reviewed literature, the idea and mechanism that stands behind FB has potential to help connect the next billion to the internet. The findings of this study, however, showcase that Facebook's global program made to bring the internet to everyone, might not yield the promised effect equally to urban and rural areas. Although the findings do not verifiably indicate a disproportionate uptake of FB in urban areas, the absence of a significant effect in rural areas does invite future research into the field of internet adoption in areas where FB is available. Lastly, the findings of this study might serve to aid future research, advocacy work and policymaking well to reassess the costs and benefits of FB, especially regarding the ongoing discourse of FB' interference with net neutrality in the developing world as well as the monopolisation of information distribution via Facebook's services.

5.1 Limitations

A central limitation of this study is the lack of comprehensive information about usage patterns of FB. Although Facebook claims to have more than 100 million users, there is no way to verify such. In addition, this obscures the specific adoption rates per country, making the assessment of relative influence subject to an assumed similar distribution across adopted countries.

6 Conclusion

This study examined the effect of the availability of Facebook's FB service on economic development which was approximated by nightlight luminosity. Based on previous theoretical literature on growth theory and accelerated information distribution as well as empirical literature of the effect of ICT on economic development and urbanisation, this study hypothesised that FB is likely to yield a positive effect on economic development as well as a disproportionate effect on urban rather than rural development. The empirical findings of this study have supported both such hypotheses, after a two-year delay. Potential mechanisms hindering adoption in rural communities as well as FB' effect on spatial inequality were discussed. These findings invite future research on geographic and social patterns of adoption of FB, its effect as well as more specific use patterns of the app itself to understand both the potential and costs of the presence of FB. This will help policymakers in developing countries make more informed decisions on digital policy and net neutrality.

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Appendix

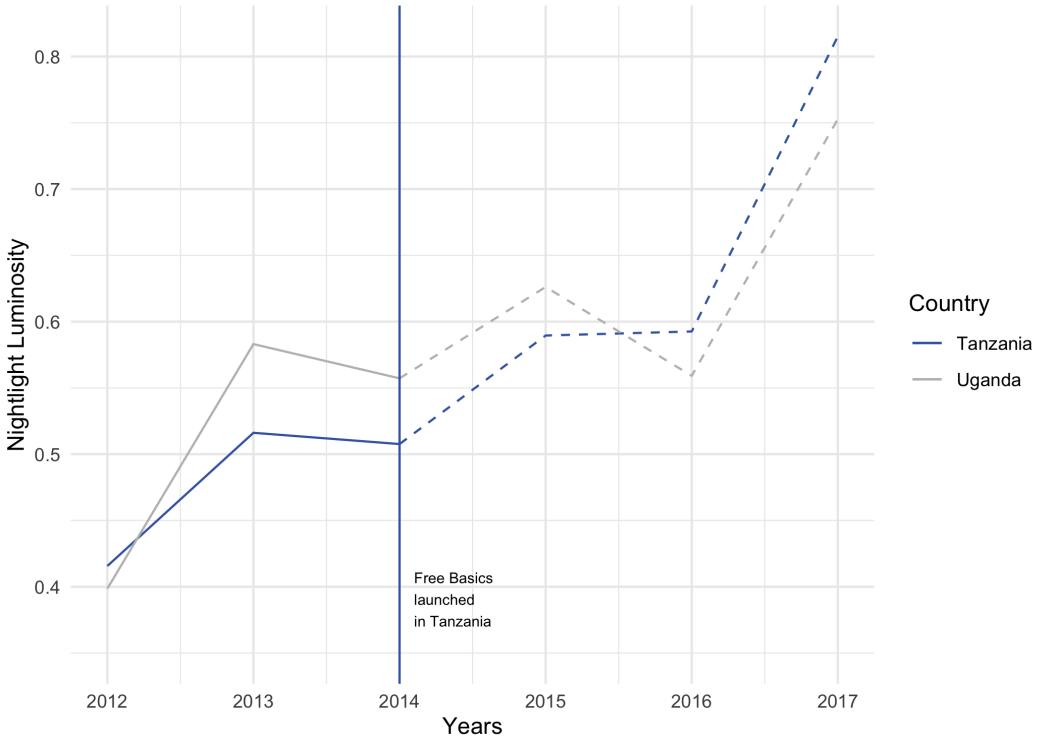

Figure 3: A1: Pair I

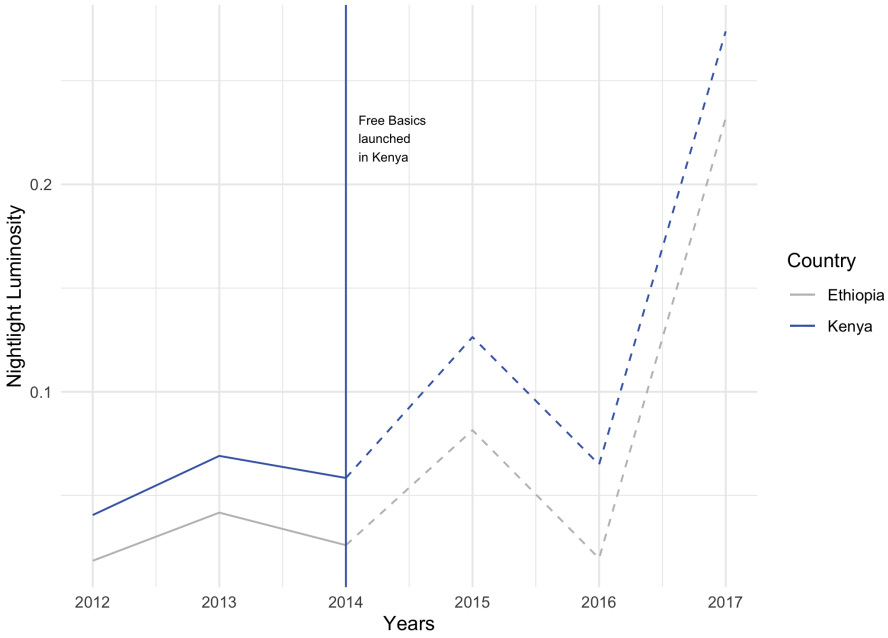

Figure 4: A2: Pair II

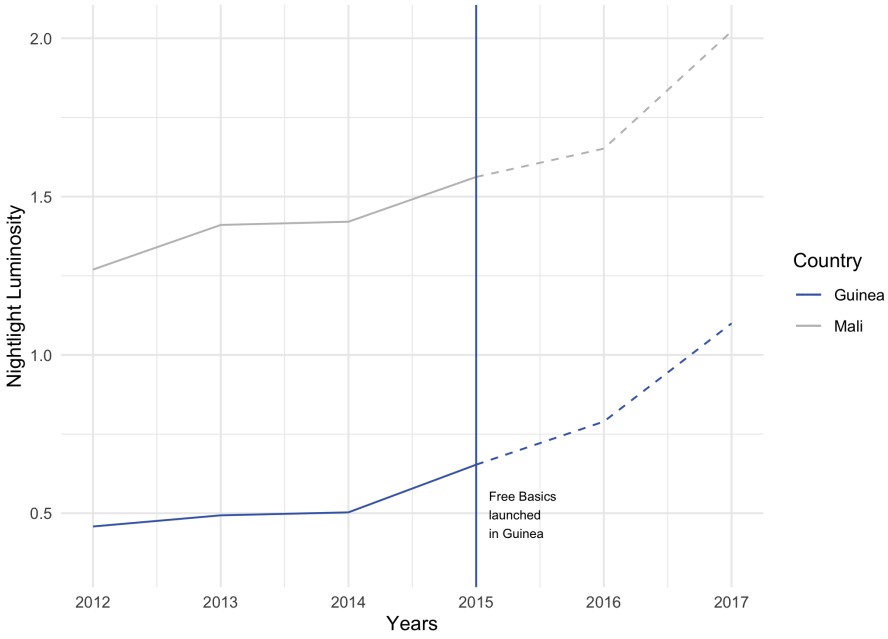

Figure 5: A3: Pair II

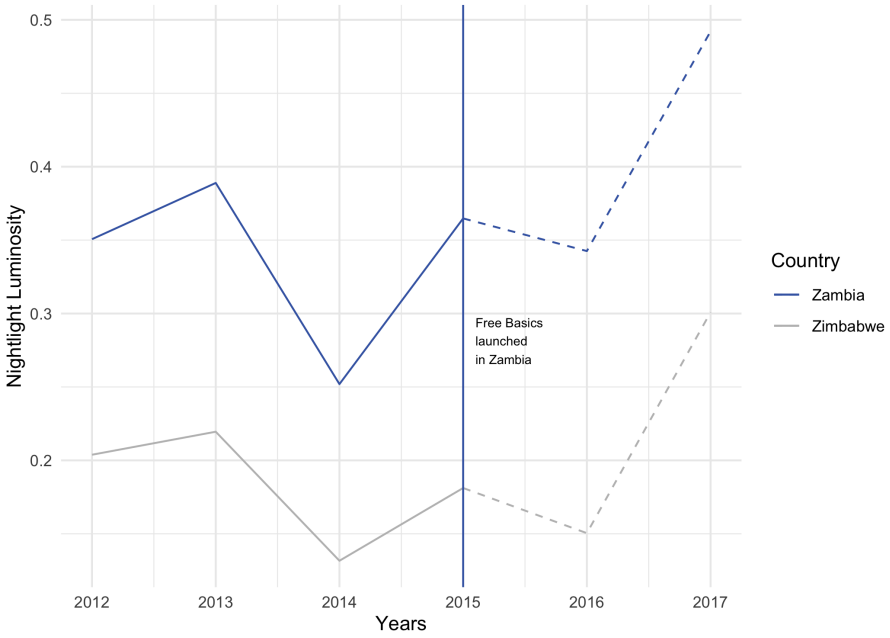

Figure 6: A4: Pair IV

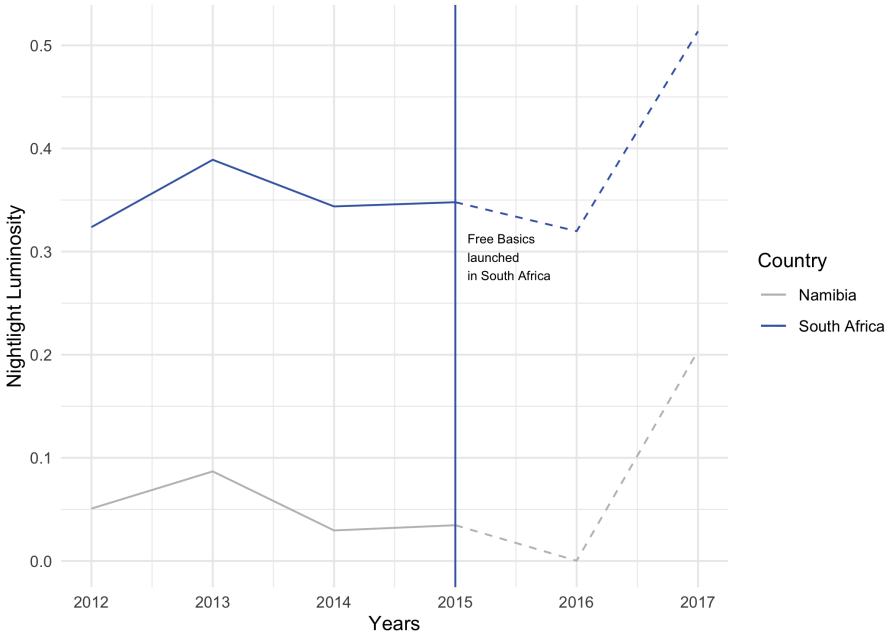

Figure 7: A5: Pair V

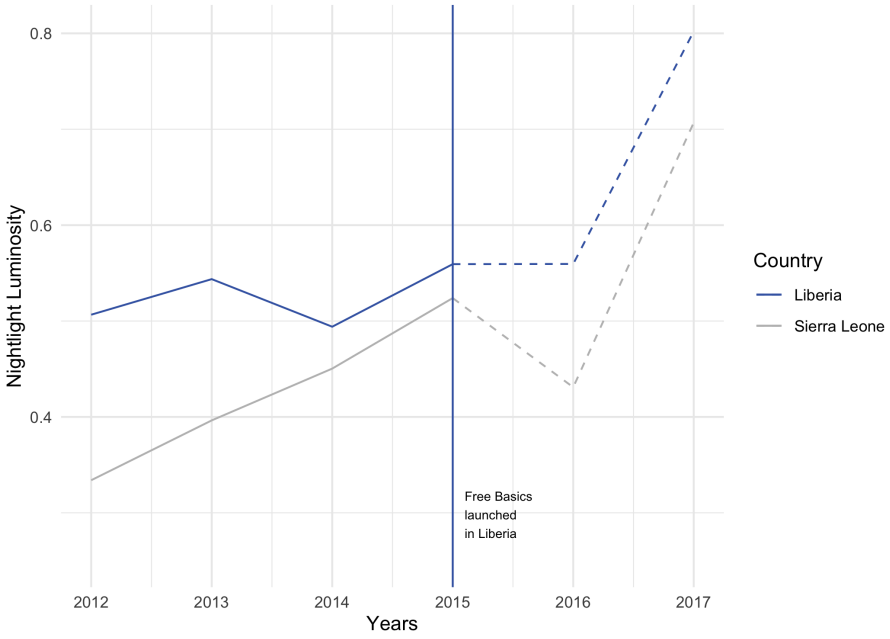

Figure 8: A6: Pair VI

Table 4: A7: Independence of Treatment

Correlation x Availability FB	**P-Value**
Inclusive Internet Index	0.73
Control of Corruption	0.94
Government Effectiveness	0.87
Political Stability	0.94
Regulatory Quality	0.25
Rule of Law	0.75
Voice and Accountability	0.39