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Effects of mobile money on education in Sub-Saharan Africa: Role of financial institutions

Sié Ernest YOUL

Center for Economic and Social Studies, Documentation and Research, University of Thomas SANKARA, Saaba, Burkina Faso

Email: sieernestyoul@gmail.com

ORCID: <https://orcid.org/0009-0001-6262-8288>

David SAWADOGO

Center for Economic and Social Studies, Documentation and Research, University of Thomas SANKARA, Saaba, Burkina Faso

Email: davidsawad7@gmail.com

ORCID: <https://orcid.org/0009-0000-9001-2918>

Kévin Konwona Sidoine KI

Center for Economic and Social Studies, Documentation and Research, University of Thomas SANKARA, Saaba, Burkina Faso


E-mail: kikevinkonwoma@gmail.com

ORCID: <https://orcid.org/0009-0001-4952-9541>

Abstract---Education is considered a fundamental pillar of developing countries, and access to funding is a major challenge. This article examines the effects of mobile money on education using a panel of 34 Sub-Saharan African countries from 2004 to 2020, highlighting the role of financial institutions. The results from two-stage least squares indicate that mobile money enhances education in Sub-Saharan Africa. This effect is greater when mobile money and financial institutions interact. These findings support an integrated strategy that promotes both the expansion of mobile money services and the capacity building of financial institutions to support education in Sub-Saharan African countries. To improve education, policymakers should encourage the integration of mobile payment services into the financial system, whilst establishing a regulatory framework to protect household savings.

Keywords---Mobile money, education, financial institutions, two-stage least squares, Sub-Saharan Africa.

JEL Codes: G21, O16, I20, C33, O550

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Corresponding author: YOUL, S.E., Email: sieernestyoul@gmail.com

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1. Introduction

Education is a fundamental pillar of economic and social development, in both developed and developing countries (Barro, 2001; Lucas, 1988). It plays a central role in the accumulation of human capital, the improvement of productivity, and the reduction of inequalities (Schultz, 1961; Becker, 1962). Endogenous growth theories argue that a significant proportion of the development gaps between countries can be explained by differences in human capital endowments. In advanced economies, sustained investment in the education sector has led to high levels of school enrolment and workforce skills, thereby fostering sustainable economic growth (Mankiw et al., 1995; Romer, 1990).

In Sub-Saharan Africa (SSA), despite efforts in recent decades, particularly in the context of the Sustainable Development Goals (SDGs), educational indicators remain generally low compared with other regions worldwide. The region continues to face numerous challenges, such as low enrolment rates, high dropout rates, and often inadequate educational quality. These shortcomings reflect significant structural constraints, notably household poverty, difficulties in accessing educational infrastructure, and funding constraints (Entwisle & Alexander, 1990; Haveman & Wolfe, 1995). In light of these challenges, identifying innovative mechanisms to support educational investment and academic outcomes is essential. In this regard, the rapid development of financial technologies, particularly mobile money, is opening up new possibilities.

Mobile money can be regarded as a convergent digital innovation that combines telecommunications infrastructure with microfinance (GSMA, 2015). By facilitating access to financial services, mobile money is a key driver of financial inclusion, particularly for populations traditionally excluded from the formal banking system (Demirgüç-Kunt et al., 2020; Suri & Jack, 2016). It thus helps strengthen households' ability to invest in education, notably by facilitating the payment of school fees, securing savings earmarked for education, and improving the management of economic shocks (Nan et al., 2021). Thus, Abiona and Koppensteiner (2022) have shown that households with access to mobile money are better able to smooth their consumption in the face of shocks, thereby helping maintain investment in human capital, particularly in education. Furthermore, by facilitating access to financial services, the development of mobile money enables more effective investment decisions within households and businesses (Jack et al., 2013; Ramada-Sarasola, 2012; Suri, 2017), with knock-on effects on education. Given the potential effects of mobile money, the following research question arises: Does mobile money influence education in Sub-Saharan Africa?

More than a decade after the launch of mobile platforms, the rise of mobile money in sub-Saharan Africa illustrates the scale of these transformations. According to GSMA data, the number of mobile money accounts exceeded half a billion monthly active users in 2024, whilst annual transactions reached nearly \$1.7 trillion. Sub-Saharan Africa remains the epicenter of this phenomenon, with over 1.1 billion registered accounts. This rapid expansion reflects a profound transformation of financial systems and modes of access to financial services in the region.

Despite this momentum, the empirical literature on the effects of mobile money on education remains limited and fragmented. Whilst several studies have analyzed its effects on financial inclusion (Demirgüç-Kunt et al., 2020; Demirgüç-Kunt & Klapper, 2013), on poverty reduction or on household resilience (Suri & Jack, 2016; Riley, 2018), few studies have specifically examined its effects on educational outcomes, with the exception of the studies by Tabetando and Matsumoto (2020) and Abiona and Koppensteiner (2022). Furthermore, existing research highlights that the effects of mobile money are not uniform and depend heavily on the institutional context (Beck et al., 2007; Robinson & Acemoglu, 2012).

The quality of financial institutions, particularly in terms of regulation, financial depth, and banking system efficiency, plays a decisive role in access to and use of financial services. A growing body of literature shows that strong institutions promote financial inclusion and amplify the effects of financial innovations on economic development (Beck et al., 2007; North, 1990; Acemoglu & Robinson, 2012). In this context, financial institutions can play a key moderating role in the relationship between mobile money and education by reinforcing or limiting the impact of these services on households' investment in education.

The aim of this study is to analyze the effect of mobile money on education in SSA, whilst highlighting the role of financial institutions. The value of this work lies in the as-yet little-explored link between mobile money, financial institutions, and education in Sub-Saharan Africa. It thus makes a twofold contribution to the literature. On the one hand, it enriches existing research by extending the analysis of mobile money's effects on education in Sub-Saharan African countries, where educational challenges are significant. On the other hand, it highlights the importance of financial institutions to the effectiveness of financial innovations, thereby enabling the formulation of relevant implications for public policy.

The remainder of this paper is structured as follows. The second section reviews the theoretical and empirical literature on the effects of mobile money on education, highlighting the role of financial institutions. The third section outlines the methodology adopted and the data and variables used. The fourth section presents and discusses the empirical results. Finally, the last section concludes by highlighting the main policy implications.

2. Literature review

The theoretical literature on the link between mobile money and education is primarily rooted in approaches to financial inclusion and human capital. According to Becker (1962), investment in education depends heavily on the financial resources available within households. In this context, any innovation that reduces financial constraints can promote the accumulation of human capital. Thus, mobile money appears to be a key instrument of financial inclusion in countries where traditional banking systems are not widely accessible.

From a theoretical perspective, several channels explain how mobile money impacts education. Firstly, mobile money helps to alleviate liquidity constraints

by facilitating rapid access to the financial resources needed to cover educational expenses. This idea is consistent with the theory of credit market imperfections (Stiglitz & Weiss, 1981), according to which information asymmetry limits poor households' access to credit. In this context, mobile money constitutes an alternative financing mechanism, enabling households to circumvent these constraints. Furthermore, according to Galor and Zeira (1993), liquidity constraints are a major barrier to investment in human capital, particularly in education. By reducing these constraints, mobile money promotes school enrolment. Secondly, mobile money facilitates interpersonal transfers, particularly between urban and rural areas, which contributes to the financing of educational expenditure. This mechanism is consistent with the theory of risk sharing (Townsend, 1994), which holds that households rely on social and family networks to smooth their consumption in the face of shocks. From this perspective, remittances play a vital role in sustaining essential expenditure, including education. Mobile money reinforces these mechanisms by reducing transfer costs and delays, thereby improving households' ability to finance their children's schooling (Jack & Suri, 2014). Thirdly, mobile money offers secure savings opportunities, facilitating the planning of education-related expenditure. This mechanism is consistent with life-cycle and savings theories (Modigliani, 1954), according to which individuals plan their consumption based on their future income. Furthermore, Deaton (1999) shows that access to savings instruments enables households to better smooth their consumption and cope with major expenses, such as education. In this context, mobile money constitutes an accessible and secure savings tool, particularly suited to the unbanked population. Within the framework of development theories based on information and communication technologies (ICT), mobile money is regarded as an inclusive innovation, capable of improving household well-being and access to social services, including education (Heeks, 2002). Thus, mobile money acts as an indirect lever for educational development by improving households' economic capabilities.

Empirical research on the impact of mobile money on education highlights generally positive effects, although these vary by context. The study by Pesando and Rotondi (2021) is a major reference in this field. Drawing on data from demographic and health surveys, the authors find that access to mobile money significantly reduces the likelihood that children will not attend school, as it improves the management of financial resources and the ability to meet education-related expenses. Similarly, the work of Suri and Jack (2016) shows that mobile money (M-Pesa) in Kenya has helped to improve household well-being and reduce poverty. This improvement in well-being is indirectly reflected in increased investment in education, notably thanks to greater income stability. Empirical research has also highlighted the role of mobile money in managing economic shocks. Facilitating rapid fund transfers enables households to smooth consumption and avoid withdrawing children from school during crises (Jack & Suri, 2014). For Koomson et al. (2023), improved financial management through mobile money leads to increased expenditure on human capital, including education. Their findings showed that mobile money improves household well-being through better financial management practices, notably saving and expenditure control, which helps to increase investment in education.

Financial institutions play a crucial role in the relationship between mobile money and education: they act as an essential catalyst for transforming digital inclusion into human capital. Firstly, formal institutions provide the infrastructure and liquidity framework necessary for the expansion of mobile services. According to Aron (2018) and Beck (2015), the interaction between banks and mobile operators is crucial to ensuring the reliability of educational transactions. Far from being at odds, these entities have a complementary relationship in which mobile money acts as a catalyst for access to sophisticated banking products. According to Suri and Jack (2016), this synergy enables households to better smooth their consumption and build savings for contingencies, facilitating the regular payment of school fees despite income volatility. This dynamic is reinforced by the financial policies pursued by banks and regulators. Indeed, the work of Lusardi and Mitchell (2014) and Apiors and Suzuki (2022) has shown that financial training programs provided by institutions improve the adoption of mobile money and steer its use towards productive investments, such as education.

3. Methodology

3.1. Model specification

To examine the link between mobile money and education in Sub-Saharan Africa (SSA), we start from the premise that mobile money serves as a lever for education, consistent with the literature (Jack & Suri, 2014; Abiona & Koppensteiner, 2022). We therefore seek to assess the effect of mobile money on education. Consequently, education is the endogenous variable and mobile money the explanatory variable. Drawing on the above studies, the basic model for capturing the effect of mobile money on education is defined as follows:

$$Edu_{it} = \beta_0 + \beta_1 MM_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

Where *Edu* is the education variable measured by the number of years of schooling and educational returns, *MM* denotes mobile money, approximated by the number of active mobile money accounts, ε is the country-specific error term, *i* and *t* represent the individual and time dimensions respectively.

The matrix of control variables, *X*, comprises macroeconomic variables commonly used in the literature on the relationship between financial inclusion and education. These include GDP per capita, control of corruption, trade openness, inflation, and the population growth rate. To examine the role of financial institutions in the relationship between mobile money and education in Sub-Saharan Africa, we will create an interaction variable between mobile money and financial institutions. By incorporating this interaction variable into Model 1, we obtain the following regression Model 2:

$$Edu_{it} = \beta_0 + \beta_1 MM_{it} + \beta_2 FI_{it} + \beta_3 MM * FI_{it} + \beta_4 X_{it} + \varepsilon_{it} \quad (1)$$

Where *FI* is a measure of financial institutions, and *MM*FI* is an interaction variable between mobile money and financial institutions.

3.2. Data and descriptive analysis of variables

In this study, we use secondary data to estimate the effects of mobile money on education in Sub-Saharan Africa. The study covers the period 2006–2020, a period justified by the availability of mobile money data. These data are drawn from several sources. Data on GDP per capita, trade openness, inflation, and

population growth rates are sourced from the World Bank (WDI, 2021). Data on mobile money are sourced from the International Monetary Fund (2021). Data on corruption are sourced from the World Bank (WGI, 2021). Data on education are sourced from the Penn World Table.

We now present the descriptive statistics for the variables covering the period from 2004 to 2020 for the 34 Sub-Saharan African countries selected for this study (Table A1 in the Appendix). These statistics present the means by variable over the study period in question. Table 1, which presents this descriptive analysis, shows that the average number of years of schooling and the return on education is 1.807 in SSA. This indicates that the level of education is approximately 80.7% higher than the baseline, set at 1 and corresponding to 0 years of schooling. This average also indicates that labor productivity in Sub-Saharan Africa has increased by 80.7% as a result of education. Regarding mobile money, the data show that the average volume of mobile money transactions accounts for 8.91% of GDP in Sub-Saharan Africa. This demonstrates that mobile money plays a vital role in meeting financial needs in Sub-Saharan Africa.

Table 1: Descriptive analysis of variables

Variables	Obs	Mean	Standard deviation	Min.	Max.
Education	480	1.807	0.424	1.107	2.938
Mobile money	415	8.913	17.553	0	143.939
GDP per capita	578	1651.49	1867.607	287.272	10,643.77
Control of corruption	578	-0.604	0.580	-1.581	1.160
Trade opening	578	31.912	16,039	0	82,529
Inflation	578	1.140	0.479	0	4.544
Population growth rate	578	2.492	0.859	-0.616	4.129

Source: Authors

4. Results and Discussion

4.1. Effects of mobile money on education in Sub-Saharan Africa

Analyzing the effects of mobile money on education faces an endogeneity problem linked to reverse causality. Indeed, the development of financial innovations can enhance education, which, in turn, can contribute to the adoption of mobile money (Duflo, 2012). To control for this endogeneity bias, we use instrumental variables and estimate the model using two-stage least squares (2SLS). For the instruments, we use lagged values of mobile money. According to Kpodar (2007), lagged values of endogenous variables can serve as valid instruments. Similarly, Wooldridge (2010) has shown that lagged values of an endogenous explanatory variable can serve as instruments, as they are correlated with the endogenous variable and uncorrelated with the error term. The estimation results obtained using double least squares are presented in Table 2.

These results show that the null hypothesis of the instruments' validity cannot be rejected. Indeed, the Hansen-Sargan test yields a p-value greater than 10 percent. This indicates that the chosen instruments are valid. The results obtained

suggest that mobile money improves education in Sub-Saharan Africa. These findings can be explained by the fact that mobile money facilitates access to financial resources. Indeed, the advent of mobile money services has reduced the constraints on access to financial services that previously weighed on the population. They enable households to receive and transfer money at lower costs than those of the banking system. According to Suri and Jack (2016), mobile money strengthens individuals' resilience to shocks. Thus, mobile money helps to reduce poverty and stimulate productive investment, particularly in education. These authors noted that the advent of M-Pesa in Kenya has fostered economic activity and improved household living standards, which can help to strengthen education. There are three main reasons for these findings. Firstly, mobile money facilitates rapid, low-cost transfers of funds, which increases households' ability to finance their educational expenditure. Similarly, mobile money enables households to save small amounts for their children's education, helping reduce school dropout rates caused by a lack of financial resources. Secondly, mobile services facilitate remittances from the diaspora to their countries of origin. The funds received increase households' disposable income, reduce their financial constraints, and enhance their ability to invest in their children's education and well-being. Finally, mobile money improves risk management and household resilience in the face of shocks. In times of crisis (such as drought or job loss), mobile money can facilitate the emergency transfer of financial resources to help affected families, thereby preventing their children from dropping out of the education system. Our results are consistent with the work of Pesando and Rotondi (2021), who showed that mobile money has helped reduce school dropout rates. They are also consistent with the work by Koomson et al. (2023), which indicated that mobile money improves investment in human capital, particularly in education.

Table 2: Estimation results (2SLS) of the effects of mobile money on education

Variables	Estimates using the two-stage least squares (fixed effects)				
	<i>Dependent variable: education</i>				
	(1)	(2)	(3)	(4)	(5)
Mobile money	0.224*** (0.062)	0.233*** (0.061)	0.222*** (0.061)	0.137** (0.060)	0.133** (0.059)
GDP per capita (log)	1.121*** (0.160)	1.110*** (0.157)	1.166*** (0.160)	0.569*** (0.182)	0.585*** (0.181)
Trade openness		-0.234*** (0.075)	-0.233*** (0.074)	-0.224*** (0.038)	-0.208*** (0.070)
Control of corruption			-0.070* (0.037)	0.023 (0.038)	0.024 (0.038)
Inflation				0.133*** (0.024)	0.132*** (0.023)
Population growth rate					-4.183 (2.957)
Observations	259	259	259	259	259
Anderson cannon. LM stat.	198.807	198.789	199.181	196.903	196.847
Cragg-Donald Wald F-	685.783	682.353	688.842	633.956	629.961

Variables	Estimates using the two-stage least squares (fixed effects)				
	<i>Dependent variable: education</i>				
	(1)	(2)	(3)	(4)	(5)
stat Hansen-Sargan test (P-value)	0.1657	0.1377	0.1206	0.1905	0.2062

*Note: Standard errors are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$,*

Source: Authors

4.2. Role of financial institutions in the relationship between mobile money and education in Sub-Saharan Africa

This section examines the interaction effect between mobile money and financial institutions on education in sub-Saharan Africa. The results, obtained using the two-stage least squares (2SLS) method, confirm the hypothesis that digital finance and traditional finance are complementary (Table 3).

The introduction of the interaction term proves positive and significant, indicating that the effect of mobile money on education is amplified by the level of financial institution development. This result suggests that mobile services and financial institutions (banks, microfinance institutions, etc.) are not substitutes but rather strategic partners. According to Asongu and Odhiambo (2019), institutional financial development provides the infrastructure and regulation necessary to secure mobile transactions, thereby strengthening households' confidence and their ability to mobilize resources for human capital. Thus, mobile money serves as a channel that connects the unbanked population to the formal system, facilitating access to more complex savings or credit products for education. In theory, this interaction results from a reduction in information asymmetries and financial friction costs. The work of Tchamyu et al. (2019) highlights that the interaction between technological innovations and formal financial institutions enables more effective alleviation of the credit constraints faced by low-income families. In this context, financial institutions and mobile money work in tandem to create a more inclusive financial ecosystem. This dynamic not only helps smooth educational expenditure but also maximizes the allocation of resources to productive investments in human capital, in line with Levine's (2005) predictions regarding the role of the financial system in long-term growth.

Table 3: Role of financial institutions in the relationship between mobile money and education in Sub-Saharan Africa

Variables	2SLS estimation
	<i>Dependent variable: education</i>
Mobile money (MM)	0.250*** (0.067)
FI	0.120*** (0.023)
MM*FI	0.114*** (0.024)
GDP per capita (log)	0.375* (0.195)

Variables	2SLS estimation	
	<i>Dependent variable: education</i>	
Trade openness	-0.248***	(0.067)
Control of corruption	0.021	(0.036)
Inflation	0.122**	(0.023)
Population growth rate	-0.353	(0.216)
Observations	259	
Anderson-Canon. LM test.	184.676	
Cragg-Donald Wald F-stat	221.170	
Hansen-Sargan test (P-value)	0.1966	

*Note: Standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$*
Source: Authors

4.3. Robustness analysis of the baseline results

The robustness analysis confirms that the effect of mobile money on education is structural and independent of the statistical measure used. When using the number of active mobile money accounts as an alternative indicator, the results remain positive and significant across all model specifications. This finding supports the argument put forward by Jack and Suri (2014), namely that the expansion of digital financial infrastructure acts as a powerful lever for human capital accumulation by reducing barriers to entry into the financial system.

The robustness of these results stems from financial innovation's capacity to effect a lasting transformation in households' economic behavior in Sub-Saharan Africa. The increase in the number of active mobile money accounts reflects not only technological adoption but also a genuine improvement in families' ability to mobilize resources for schooling.

Table 4: Robustness analysis: use of an alternative measure of mobile money

Variables	Estimates using two-stage least squares (fixed effects)				
	<i>Dependent variable: education</i>				
	(1)	(2)	(3)	(4)	(5)
Mobile money (number of active mobile money accounts)	0.121*** (0.034)	0.097** (0.039)	0.080** (0.036)	0.057** (0.014)	0.056*** (0.014)
GDP per capita (log)	1.280*** (0.317)	1.1396*** (0.328)	1.326*** (0.296)	1.148*** (0.290)	1.209*** (0.294)
Trade openness		-0.216 (0.167)	-0.197 (0.151)	-0.233 (0.145)	-0.343** (0.173)
Control of corruption			- 0.227*** (0.056)	-0.224*** (0.054)	-0.224*** (0.053)
Inflation				0.048***	0.046***

Variables	Estimates using two-stage least squares (fixed effects)				
	<i>Dependent variable: education</i>				
	(1)	(2)	(3)	(4)	(5)
Population growth rate				(0.017)	(0.017)
Observations	195	195	195	195	195
Anderson, a star. LM stats.	60.831	57.495	57.660	56.487	57.694
Cragg-Donald Wald F-stat	163.982	121.925	121.746	109.666	118.532
Hansen-Sargan test (P-value)	0.7387	0.5726	0.7056	0.7628	0.8903

Note: Standard errors are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$,
Source: Authors

The robustness analysis presented in Table 5 further reinforces the validity of the initial findings. The inclusion of additional control variables, namely domestic investment and foreign direct investment, does not alter the sign of the mobile money coefficient. The coefficient remains positive and significant, confirming that mobile money can finance education in sub-Saharan Africa. This result shows that mobile money serves as a specific catalyst, facilitating direct household investment in human capital.

Table 5: Robustness analysis by adding additional control variables

Variables	Estimates using two-stage least squares (fixed effects)	
	<i>Dependent variable: education</i>	
	(1)	(2)
Mobile money	0.157*** (0.060)	0.158*** (0.060)
GDP per capita (log)	0.478** (0.187)	0.468** (0.189)
Trade openness	-0.298*** (0.081)	-0.308*** (0.084)
Control of corruption	0.014 (0.038)	0.016 (0.038)
Inflation	0.129*** (0.023)	0.130*** (0.024)
Population growth rate	-5.262* (2.977)	-5.321* (2.979)
Domestic investment	0.242** (0.114)	0.245** (0.115)
Foreign direct investment		0.104 (0.249)
Observations	259	259
Anderson cannon. LM stat.	195.647	195.652
Cragg-Donald Wald F-stat	602.760	600.178

Variables	Estimates using two-stage least squares (fixed effects)	
	Dependent variable: education	
	(1)	(2)
Hansen-Sargan test (P-value)	0.1865	0.1898

*Note: Standard errors are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$; * $p < 0.1$*

Source: Authors

5. Conclusion and economic policy implications

The aim of this research was to analyze the effects of mobile money on education in Sub-Saharan Africa, whilst exploring the role of financial institutions. Our results confirm that mobile money acts as a lever for the accumulation of human capital through education. The empirical analysis, adjusted for endogeneity biases using the double least squares method, shows that the adoption of mobile money improves education in Sub-Saharan Africa.

One of the major contributions of this work lies in highlighting a crucial synergy between mobile money and financial institutions. Our results indicate that the effects of mobile money on education are amplified by financial institutions. Thus, mobile money and financial institutions act as complementary mechanisms: banks provide the necessary structural depth and regulatory framework, whilst mobile money ensures the accessibility of financial inclusion. The robustness of our conclusions is confirmed by a series of robustness tests.

Our work confirms the strategic role of mobile money in financing education. It has important implications for sub-Saharan African countries. These findings argue in favor of an integrated strategy that promotes both the expansion of mobile money services and the capacity building of financial institutions to support education in sub-Saharan African countries. To maximize educational returns, policymakers must encourage the integration of mobile money services with the financial system, whilst ensuring a regulatory framework that protects household savings. The transformation of Sub-Saharan Africa into a knowledge-based economy requires leveraging the convergence of technological agility and institutional strength to ensure that every financial innovation translates into a tangible and sustainable improvement in human capital.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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Data availability statement

The data that support the findings of the study are available from the corresponding author upon reasonable request.

Ethical Approval Statement

This study is theoretical and empirical in nature and did not involve human participants, personal data, or animal subjects. Consequently, no ethical approval was required.

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Appendix

Table A.1: List of countries covered by the study

Countries	Countries	Countries	Countries	Countries
Angola	Congo, Dem, Rep	Guinea-Bissau	Mauritania	Senegal
Benin	Rep. Congo	Kenya	Mauritius	South Africa
Botswana	Ivory Coast	Lesotho	Mozambique	Tanzania
Burkina Faso	Eswatini	Liberia	Namibia	Togo
Cameroon	Gambia	Madagascar	Niger	Uganda
Central African Rep	Ghana	Malawi	Nigeria	Zambia
Chad	Guinea	Mali	Rwanda	

Source: Authors