THE IMPACT OF REMITTANCES ON POVERTY IN AFRICA: A CROSS-COUNTRY EMPIRICAL ANALYSIS

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Abstract

Remittances have become a recognized important element in the mix of finance for development, and potentially more important for poverty reduction. However, there are limited empirical studies on the impact of remittances on poverty in Africa. This study analyses the impact of remittances on poverty in a panel of 32 African countries. The study expands upon earlier work by testing with two measures of poverty and considering the effects of other foreign inflows as well—exports and Official Development Assistance (ODA). After accounting for observed heteroscedasticity and possible endogeneity, the regression results consistently show that remittances significantly reduce poverty, whereas exports and ODA are found to have an insignificant effect on poverty. The absence of a significant relationship between exports and ODA on poverty does not mean that these factors should be ignored but suggests that they work indirectly through economic growth whereas remittances provide an additional direct impact on poverty as a source of finance for development.

JEL Categories: F240, C230
Keywords: Remittances, Poverty, Africa, Panel Data Models

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1. Introduction

In the literature on development finance, remittances have increasingly become recognized as an important and growing element. A growing body of literature has evaluated the microeconomic effects of remittances, focusing on the impact of remittances for villages or specific countries in Africa (Adams, 1991; Adams and Cuecuecha, 2013). While such micro studies highlight the relationship between remittances and poverty, there remains more limited empirical evidence on the impact of remittances on poverty in Africa at the macro level. This study helps remove the existence of any micro-macro paradox, which is commonly found in the aid literature, by focussing on a broad panel of African countries. In evaluating the relationship between remittances and poverty, we build on the basic growth-poverty model suggested by Ravillion and Chen (1997). We expand upon previous work by testing for the significance of remittances on poverty relative to other foreign currency flows (exports and Official Development Assistance). Despite this rising importance of remittances, there has been limited empirical studies on the macroeconomic impact of remittances in Africa, which is the purpose of this study. This study analyses the impact of remittances on poverty in a panel of 32 African countries.

The upward trend of cross-border remittances to developing countries has led to a resurgence of focus on remittances owing to their role in development finance and poverty alleviation. Studies analysing the impact of cross-border remittances have predominantly focused on developing regions in East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and South Asia. Very limited empirical studies, however, exist on the developmental impact of cross-border remittances to Africa, most empirical studies examine the impact of domestic remittances at the household and community level. This study seeks to fill the gap in the literature by analysing the impact of cross-border remittances on poverty in Africa.

Cross-border remittances are the sum of two components in the balance of payments, personal transfers and compensation of employees. Personal transfers consist of current transfers between resident and non-resident households. Compensation of employees refers to the income of short-term seasonal workers employed in economies where they are non-residents, and the income of residents employed by non-resident entities (World Bank, 2015b).

Remittances to Africa have increased from US$11.45 billion in 2000 to US$50.11 billion in 2010 (World Bank, 2015a). They are an important source of foreign finance, accounting for over 15% of Gross Domestic Product (GDP) in countries such as Lesotho, Liberia, Gambia and Comoros. They are the largest source of external financial flows to Africa, exceeding both Foreign Direct Investment (FDI) and aid flows since 2010.

There are two distinguishing features of remittances. First, they are more stable relative to other foreign financial flows (Gupta, Pattillo & Wagh, 2009:105). Second, they tend to behave counter-cyclically. Quarterly and Blankson (2004) find that remittances to Ghana move counter-cyclically with respect to the economic cycle and are beneficial in smoothing household income and consumption over time. The counter-cyclical nature of remittances enables them to absorb external shocks that could negatively affect the economies of recipient countries.

Given the stable and counter-cyclical nature of remittances, it has become increasingly important to analyse their effects on development. Evidence from around the globe suggests that remittance-receiving households generally have higher levels of income and lower incidences of extreme poverty compared to households that do not receive remittances (Kamuleta, 2014: 18). Ratha (2013) argues that remittances can play a pivotal role in contributing towards poverty reduction, as they tend to increase the incomes of recipient households.

A number of studies have analysed the relationship between remittances and poverty. Adams (1991) looked at a sample of households in rural Egypt found that the number of poor households decreases by 9.8% when international remittances are included in household income. Similarly, Yang and Martinez (2006) analysed the impact of remittances on poverty using household surveys in the Philippines and found remittances to have a negative relationship with poverty.

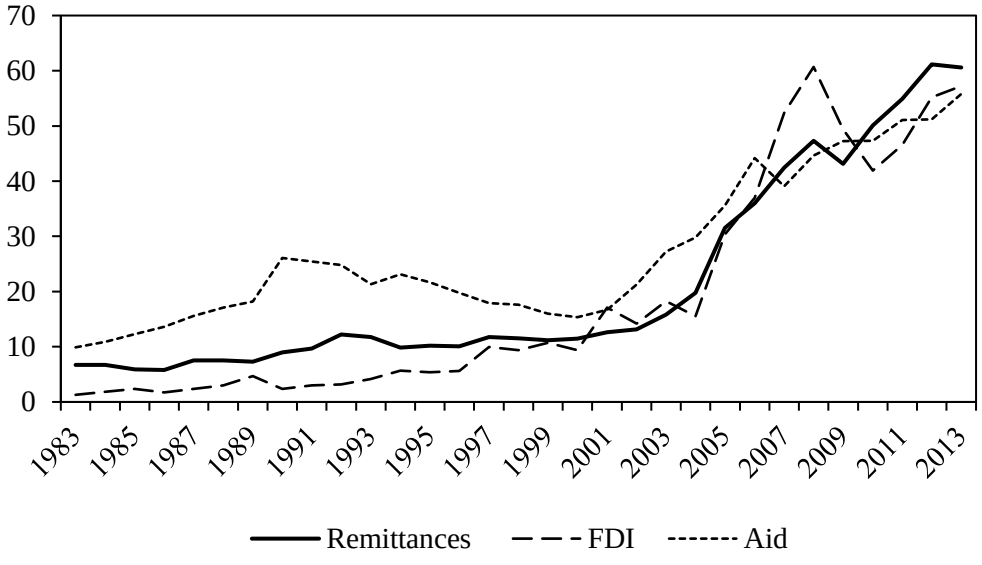
Despite the growing importance of remittances as a source of finance for development, the high cost of sending remittances to and within Africa limit their impact on development outcomes. In 2013, the average cost of sending remittances to and within Africa was 11.5%; this compared with a global average cost of 8.9% (World Bank, 2013). A report by the Overseas Development Institute (ODI) estimated a mid-range annual loss of $1.8 billion as a result of Africa's high remittance costs (Watkins & Quattri, 2014:20).

The G7 and the G20 have taken a number of steps to reduce the cost of sending remittances. In 2008, the G7 adopted a quantitative goal towards halving the global cost of sending remittances from 10% to 5% over five years (Watkins & Quattri, 2014:17). Although this commitment has been reaffirmed and taken up in a number of countries, the commitment has had no discernible effect on Africa's high remittance costs.

2. Remittances to Africa

Remittances to developing countries have grown rapidly over recent years, rising from around US$292 billion in 2010 to US$436 billion in 2014 (World Bank, 2015b). Africa has been part of the global surge in remittance flows. Remittances to the continent have increased substantially, rising from US$11.6 billion in 2000 to US$50.1 billion in 2010 or 331.9%. They are now the largest source of external financial flows to Africa, exceeding both FDI and aid flows since 2010 (Figure 1).

Figure 1. Financial inflows to Africa, 1983-2013 (billions of US dollars)



Source: World Bank (2015a)

Moreover, remittances are an extremely important source of finance for a number of African countries, which receive flows equivalent to about 20% of GDP (Table 1). Although remittances account for a comparatively smaller share of GDP in larger countries, they still comprise an average flow equivalent to about 2% of Sub-Sahara Africa's (SSA) GDP.

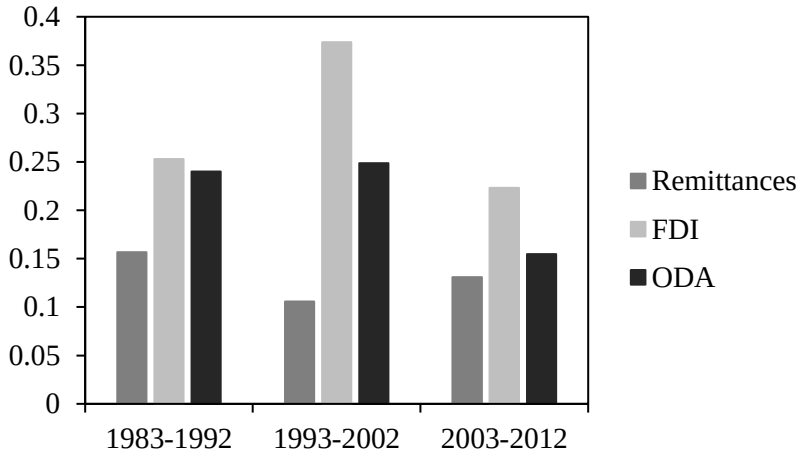
Table 1. Remittance flows to African countries (% of GDP), 2013

Country	% of GDP
Lesotho	20.9
The Gambia	20.0
Liberia	19.7
Comoros	19.4
Senegal	10.9
Cabo Verde	9.6
Togo	9.2
Sao Tome and Principe	8.7
Mali	8.2
Guinea-Bissau	6.7
Egypt	6.6
Morocco	6.4
Tunisia	4.9
Nigeria	4.0
Madagascar	4.0

Source: World Bank (2015b)

Additionally, remittances tend to be more stable relative to other external financial flows. Over the period 1983-2012, remittances to Africa were not only less volatile than ODA but they were also less volatile than FDI, which is often perceived as the most stable external financial flow (Figure 2) (Gupta, Patillo and Wagh, 2009:105). Remittances also tend to behave counter-cyclically and tend to increase in response to external shocks in recipient countries and decline when conditions are more favourable.

Figure 2. Volatility of external flows to Africa
Coefficient of variation of (financial flow/GDP)



Source: Author's calculations. Data are from World Bank (2015a).

2.1 Channels and Costs for Remittances in Africa

Recipients receive remittances through remittance service providers (RSPs), which include commercial banks, non-bank financial institutions such as micro-finance institutions or post offices, specialised money transfer operators (MTOs), and new innovative RSPs like mobile network operators. However, two MTOs, MoneyGram and Western Union together, account for over half of the total market share in 22 countries in Africa (Watkins & Quattri, 2014:17).

Informal remittance channels like Hawala are widespread in Africa, but have high transaction costs (Sander & Maimbo, 2003:27). In the basic Hawala mechanism "the remitter pays, often with a small fee, the first transfer person (in the sending country), who informs the second transfer person (in the recipient country), and the second transfer person releases funds to the recipient" (Kamuleta, 2014:34). Some analysts find that the fragmented nature of informal channels provides advantages, as they make services accessible to people living in areas with limited access to formal financial services (Hariharan, 2012; Rodima-Taylor et al., 2013). While others have taken the view that these channels support criminal activities (Looney, 2003), capital flight, tax evasion and smuggling (Maimbo and Passas, 2005).

Informal remittance channels also include transfers sent by unofficial courier companies, relatives or friends. Globally, studies show that the cost of remitting money through such informal channels is cheaper (Freund & Spatafora, 2005:357). However, remittances sent through informal channels are not recorded in the balance of payments, which then understates the total volume of recorded remittances. By affecting the way in which migrants remit money, transaction costs are a significant determinant of the volume of official recorded remittances.

In 2013, the average cost of sending money to and within Africa was 11.5%; while the average global cost was 8.9% (World Bank, 2013). The most expensive sending markets in Africa were Ghana, Tanzania and South Africa, which measured 26%, 20.2% and 19.3% respectively. Factors contributing to Africa's high remittance cost structure include: "limited competition, regulatory practices that limit market entry, and a lack of financial inclusion" (Watkins & Quattri, 2014: 25).

Exclusivity agreements between big MTOs and banks are the drivers of Africa's high remittance costs as they restrict competition (Watkins & Quattri, 2014:24). Exclusivity agreements with commercial banks allow MTOs to carry out transactions through designated commercial banks (Ratha, Mohapatra, & Scheja, 2011). A 2007 survey carried out in Nigeria found that 84% of commercial banks in the country had exclusivity agreements with either MoneyGram or Western Union (Watkins & Quattri, 2014:17). The virtual duopoly operated by MoneyGram and Western Union is stifling competition in the African market for remittances.

3. Defining and Measuring Poverty

The United Nations High Commission for Refugees (UNHCR) defines poverty as a human condition characterised by the sustained deprivation of resources, choices, capabilities, security and power necessary for adequate standard of living (UNHCR, 2004). Thus, poverty is a multidimensional condition of being without the necessities of daily living, often associated with hardship, need, and lack of resources across a wide range of circumstances. Economic deprivation is a standard feature of most definitions of poverty.

Development agencies often employ quantitative measures of poverty, such as those setting a threshold of one or two dollars a day, for practical comparative purposes. Poverty can also be measured by specific indicators relating to certain economic and social factors, such as infant mortality and literacy rates. Although quantitative poverty measures may fail to account for the multidimensional aspects of poverty, they provide a number of benefits like (Chambers, 2002:22): a comparison over time; a cross-sectional comparison of different households, communities or countries; and an estimation of poverty distributions within populations. All of which are effective at influencing policy-makers.

The poverty issue is always closely associated with the poverty line, which is the minimum threshold level of income, or consumption, below which one cannot afford to purchase all the resources one requires to live. Practically, different countries often use different poverty lines. However, in general, it is more common to use one poverty line in order to compare economic welfare levels across countries and regions.

In this respect, the purchasing power parity (PPP) exchange rates are used to ensure that poverty levels do not change with normal exchange rates (Makoka & Kaplan, 2005:6).

Although there are various methods used to measure poverty, this study makes use of the poverty headcount and the poverty gap indices.[2]

Poverty Headcount, P_0

The Poverty Headcount Index, denoted as P_0, measures the share of the population whose consumption, or income, is below the poverty line. This poverty measure quantifies the share of the population that cannot afford to buy a basket of goods.

The Poverty Headcount measure has the advantage of being easy to construct and understand. It also has the advantage of being an adequate measure of assessing the overall progress in reducing poverty. However, it does suffer from a number of limitations (Makoka & Kaplan, 2005:19). First, it does not account for differences in well-being between different households living below the poverty line, by assuming that the poor are all in the same situation. And second, it does not take the depth of poverty into account. For this reason, the Poverty Gap Index is also employed.

Poverty Gap, P_1

The Poverty Gap Index, P_1 measures the degree to which the mean income of the poor differs from the established poverty line. It is also called the Depth of Poverty Index. It measures the distance by which the average income of the poor deviates from the poverty line.

The advantage of the poverty gap measure is that it reflects the average shortfall of poor individuals, thereby giving a better understanding of the depth of poverty (Makoka & Kaplan, 2005:19). Another advantage of this measure is that it gives an indication how much would have to be transferred to the poor to bring their expenditure up to the poverty line. It is therefore easy to derive from the index, the minimum cost of eliminating poverty with transfers i.e. the cost of eliminating poverty by targeting the poor directly, with no additional targeting or distortion costs. However, the limitations of the poverty gap index are that it does not capture differences in the severity of poverty among the poor and it ignores inequality among the poor themselves (Makoka & Kaplan, 2005:20).

4. Literature Review for the Economics of Remittances

The literature generally explains the motivation for remittances (section 4.1) and focuses on the impact of remittances at the household level (section 4.2) and national level (section 4.3). This study is concerned with the relationship between remittances and inequality and poverty.

4.1 Motives and Determinants of Remittances

At the micro level, the literature concerning the motives for remitting has been influenced to a large extent by Lucas and Stark's (1985) paper, *Motivations to remit: Evidence from Botswana*. They postulate alternative motives for remitting money as: pure altruism; pure self-interest; and other intermediate motives.

In traditional neoclassical economics, migrant remittances would be thought of as motivated by self-interest. Migration itself would be done in the context of long-run income maximization. Migrants may send remittances with the aspiration to inherit, acquire assets back home or in preparation for their return home (Carling, 2008:584). In this respect, the 'brain drain' is usually motivated by self-interest.

[2] Also discussed in Appendix A.

Alternatively, migrants are considered to be altruistic if their utility is derived from their family's utility, which is assumed to depend on their family's consumption (Carling, 2008:584). If remittances are motivated by altruism, one can expect remittances to increase in response to adverse conditions back home.

A number of authors find that remittances are motivated by a combination of altruistic and self-interest motives, Lucas and Stark (1985), for example, suggest "tempered altruism" or "enlightened self-interest" to refer to a combination of altruistic and self-interest motives.

Lucas and Stark's analytical framework was a significant component in the development of the New Economics of Labour Migration (NELM). The NELM differs from the traditional neoclassical approach to labour migration, which posits that decisions about migration are made on an individual basis. The primary principles of the NELM are that decisions regarding remittances are related to decisions about migration and that these decisions must be understood at the household level (Carling, 2008:584). Migrant workers enter into contractual insurance agreements with household members back home and send remittances when households experience shocks. At the same time, households support migrants by, for example, paying the costs of migration or supporting the migrant during periods of unemployment (Carling, 2008:584). This co-insurance agreement between migrants and households reduces household risks for family members back home.

By contrast, macro level studies attribute remittance flows like to: economic conditions in a migrant's home and host countries; the stock of migrant workers in the host country, economic policies and institutions in the home country, transaction costs and opportunities for investment.

Economic conditions in a migrant's home country can determine the volume of remittances repatriated, as adverse shocks to output, wages and employment may reduce household income and increase the need for remittance inflows. Assuming migrants are motivated by altruism, this can encourage them to send more remittances home. In this event, remittances would be countercyclical. Economic conditions in a migrant's host country can also be a determinant of remittance flows. Favourable economic conditions in a migrant's host country increase a migrant's employment and earnings prospects, enabling migrants to send more money home. Using data from Latin American countries and the US, Vargas-Silva and Huang (2006) found that remittances are mostly driven by changes in the macroeconomic conditions of the host country. The stock of migrant workers in the host country is another significant determinant of remittances (Freund and Spatafora, 2008:356).

Economic policies and institutions in a migrant's host country can also affect the inflow of remittances. The presence of exchange rate restrictions, for instance, can discourage migrants from sending remittances through formal channels (El-Sakka & McNabb, 1999). Likewise, macroeconomic instability, such as real exchange rate overvaluation, can also discourage migrants from sending remittances through formal channels. Alternatively, financial sector development can encourage the flow of remittances through formal channels.

Risks in the home country, such as political instability, may discourage migrants from remitting, at least for investment purposes. A study by Wahba (1991) found that political instability and poor financial intermediation had a negative impact on the inflow of remittances.

Greater potential returns on assets in the host country can encourage migrants to invest their savings in the host country rather than remit money home, assuming the investment motive for remittances surpasses the altruistic motive.

Despite the many motivations for remittances, the stock of migrant workers in a host country appears to be the most significant determinant of gross remittances at the macro level (El-Sakka & Mcnabb, 1999; Chami, Fullenkamp & Jahjah., 2005; and Freund & Spatafora, 2005).

4.2 Impact of Remittances at the Household Level

There are generally four areas of direct impact at the household level, which are cited because of remittances.

Health

Although the empirical evidence on the impact of remittances on health outcomes in Africa is somewhat limited, household surveys conducted by the Africa Migration Project[3] indicate that remittance-receiving households in Africa, particularly households receiving remittances from outside the continent, spend on average 5-12% of total remittances on healthcare (Ratha et al., 2011:68). Birdsall and Chuhan (1986) found that remittance-receiving households in rural Mali increased demand for health services, particularly demand for private healthcare services. While using panel data for KwaZulu Natal, Nagarajan (2009) found that remittance-receiving households spend a larger share of their household budget on food and health expenditures.

Education

In Africa, household surveys by the Africa Migration Project indicate that expenditure on education is the second-highest use of international remittances in Nigeria and Uganda, the third highest in Burkina Faso and the fourth highest in Kenya (Ratha et al., 2011:66). With respect to domestic and intraregional remittances, remittance-receiving households in Kenya and Uganda, for example, typically spend 15% of domestic or intraregional remittances on education, while in Nigeria households typically spend 20% of domestic or intraregional remittances on education (Ratha et al., 2011:66).These figures indicate that a significant portion of remittances received in African countries are spent on education.

Adams, Cuecuecha and Page (2008) found that remittance-receiving households in Ghana invest more in education than households that do not receive remittances. And using data from six countries in Sub-Saharan Africa, Ratha (2013) found a strong positive relationship between remittances and the average number of household members with a secondary education. A study by Elbadawi and Roushdy (2010) found that in Egypt children living in remittance-receiving households are more likely to complete tertiary education than children living in households that do not receive remittances.

Physical capital and entrepreneurship

Remittances often contribute to financial asset formation; improve investment opportunities; and promote entrepreneurship (Orozco et al., 2005). In Africa, household surveys by the Africa Migration Project indicate that a significant share of remittances to Africa are spent on investments in property, farming, agricultural equipment, and investments in small businesses (Ratha et al., 2011:65). As a share of total remittances, investments in these items represent 57% in Nigeria, 55.3% in Kenya, 36.4% in Burkina Faso, 20.2% in Uganda, and 15.5% in Senegal (Ratha et al., 2011:65).

Insurance against external shocks

Migration enables remittance-receiving households to diversify their income sources, and by so doing reduces household vulnerability to external shocks. Remittances to Africa also function as a form of social insurance against external shocks (Block & Webb, 2001). In Botswana, Lucas and Stark (1985) found

[3] The Africa Migration Project is a joint project undertaken by the World Bank and the African Development Bank in order to understand migration and remittances in Africa, with the objective of formalising informed policy recommendations for policymakers (World Bank, 2015c).

that remittance-receiving households, which rely on crops for their sustenance, receive more remittances during unfavourable environmental conditions. Mohapatra, Joseph & Ratha (2009) found that remittance-receiving households in Ethiopia are less likely to sell their productive assets to cope with food shortages when faced with external shocks. While household surveys conducted in the Senegal River Valley found that remittances serve as an intra-household risk diversification strategy that supports household consumption against adverse external shocks (Azam and Gubert, 2005, 2006).

4.3 Impact of Remittances at the Macro Level

Given the underlying rational for remittances, above, the accumulated macro impact at the national level is usually found to be greater economic stability, higher fiscal revenues, more economic growth and less poverty and inequality.

Stability

Remittances have been shown to be more stable and sustainable sources of foreign currency for development relative to other financial flows like FDI and ODA (European Union, 2014). In SSA, where private capital flows have fluctuated considerably over the years, remittances have been consistently less volatile (Gupta, Pattillo & Wagh, 2009).

To the extent that they represent a stable and large source of foreign currency, remittances have been shown to "help sudden current account reversals during periods of economic instability, improve a country's credit rating, and facilitate the inflow of new investments" (Amuedo-Dorantes & Pozo, 2004). Moreover, they are likely to stem investor uncertainty when foreign reserves are declining or when external debt is rising (Gupta, Pattillo & Wagh, 2009).

Insofar as they are motivated by the altruism of migrant workers, remittances also tend to behave counter-cyclically. They tend to increase in response to external shocks in recipient countries and decline when conditions are more favourable. Singh et.al. (2010) found that for a panel of 36 African countries remittances behaved counter-cyclically, emphasizing their role as a shock absorber. The countercyclical nature of remittances is of particular importance in African countries, where variations in climatic conditions such as rainfall, floods and droughts have a marked bearing on economic growth. Quarterly and Blankson (2004) found that remittances to Ghana move counter cyclically with respect to the economic cycle and are beneficial in smoothing household consumption and welfare over time. Hence remittances behave differently to other private capital flows, which tend to be pro-cyclical. An important difference between remittances and other private capital flows is that remittances involve transactions between households and are less driven by profit seeking motives (Ratha, 2003; Frankel, 2010).

Fiscal Policy

Given that remittances enter recipient countries through household transfers, which are not taxed directly, they have an indirect impact on fiscal policy by expanding the indirect tax base by consumption-based taxation (Chami, Cosimano and Gapen, 2006). Chami, Csimano and Gapen (2006) found that remittances increased income and consumption, expanded the tax base and, by so doing, allowed governments to incur additional expenditures and carry more debt. Chami, Hakura and Montiel (2012), however, argue that by enabling governments to carry more debt, without clearly showing the full cost of government actions, remittances could damage the quality of government institutions in receiving countries. Similarly, Chami and Fullenkamp (2013) found that, by increasing government expenditure, remittances could enable governments to appropriate more resources and allocate them to those in power rather than invest in national development. Therefore, a moral hazard could arise because of the risk of government corruption.

Economic growth

A number of studies have analysed the impact of remittances on growth, but the results have not been conclusive. Singh et al. (2010) showed that remittances may have a negative sign in growth regressions but this may be related to their counter-cyclic behaviour. However, remittances may have a positive effect on growth if they increase investment. This result can be large insofar as remittances improve credit constraints faced by people living in areas with underdeveloped financial systems (Woodruff & Zenteno, 2004)..

Secondly, by increasing household income and easing budget constraints, remittances can potentially reduce labour supply or labour market participation of recipients (Lucas 1987; Azam & Gubert, 2006; Bussolo & Medvedev, 2007; Chami et al., 2008). This can potentially lead to a decrease in output growth. But there is little evidence that this phenomenon has had an impact on output in Africa, particularly in countries with high levels of unemployment (Kamuleta, 2014).

Singh et al. (2010:8) and some have argued that remittances can increase the prices of domestically produced goods and appreciate the real exchange rate, a process known as the 'Dutch Disease. This effect can be harmful to long-term growth, as an appreciation of the real exchange rate reduces the competitiveness of a country's tradable sectors and can cause an increase in the current account deficit (Kireyev, 2006). Amuedo-Dorantes and Pozo (2004) found that a doubling of remittances resulted in an appreciation of the real exchange rate in 13 Latin American and Caribbean (LAC). However, there is limited evidence of this effect occurring in African countries (Bourdet & Falck, 2006).

The complexity of the growth process make it challenging to determine the impact of remittances on growth. On average, empirical studies that include remittances in cross-country growth regressions provide mixed results (Barajas et al., 2009; Catrinescu et al., 2009; Singh, Haacker & Lee, 2009). The absence of a significant relationship between remittances and growth in regressions indicates either that their impact on growth can only be realised over the long-run or that official remittances data are of a poor quality.

Poverty impact

Overall, the literature provides evidence to support the hypothesis that remittances reduce poverty, as they are directly received by the poor (Ratha et al., 2011:60). Remittances directly impact poverty by augmenting the income and consumption of poor remittance-receiving households. They also indirectly affect poverty and welfare in recipient countries through their multiplier- and macroeconomic effects.

At the household level, Stahl (1982) and Adams (1991) pioneered efforts to collect data that could be used to analyse the welfare effects of remittances (Stahl, 1982). Adams (1991) found that the number of poor households in Egypt decreased by 9.8% when international remittances were included in household income. Evidence for African countries also points to the poverty-reducing impact of remittances. Using household survey data from 1994-1995, Lachaud (1999) found remittances to reduce rural poverty in Burkina Faso by 7.2% and urban poverty by 3.2%. While Adams and Cuecuecha (2013) found that, in Ghana, remittances reduce the likelihood of a household living in poverty by half.

Cross-country macroeconomic evidence on the impact of remittances on poverty was more limited until the pioneering works by Adams and Page (2005) led to the building of a database on remittances, poverty and inequality that enabled researchers to examine the remittances-poverty nexus in developing countries. Jongwanich (2007) and Gupta, Pattillo and Wagh (2009) have used this database on remittances, poverty and inequality to estimate the impact of remittances on poverty for countries in the Asian-Pacific and Sub-Saharan African regions. Similarly, Anyanwu and Erhijakpor (2010) analysed the relationship between remittances and poverty for a panel of 34 African countries. These studies have found an

estimated elasticity of remittances on poverty has varies between -.15 and -.35, as summarized in Table 2, below (and in Appendix A).

Table 2. Cross-country empirical evidence of poverty and remittances relationship

Study	Model Specification	Method	Period	Estimator	Instruments	Poverty Elasticity of Remittances
Adams and Page (2005)	$log(Pov_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 log(rem_{it}) + \beta_4 region_{ij} + \varepsilon_{it}$	Unbalanced Panel, 71 countries	1980-1998	OLS, IV	Distance, Education, Government stability	-0.35
Jongwanich (2007)	$log(Pov_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 log(rem_{it}) + \beta_4 X_{it} + \varepsilon_{it}$	Panel, Asia- Pacific countries	1993-2003	Fixed effects		-0.28
Gupta, Pattillo and Wagh (2009)	$log(Pov_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 log(rem_{it}) + \beta_4 region_{ij} + \varepsilon_{it}$ $log(rem_{it}) = \alpha_i + \beta_1 \log(Pov_{it}) + \beta_2 \log(trade_{it}) + \beta_3 log(educ_{it}) + \beta_4 (distance_{it}) + \beta_5 (dual_{it}) + \beta_6 (rem_{it-1}) + \varepsilon_{it}$	Unbalanced Panel,76 developing countries	1981-2003	OLS, 3SLS	Poverty, Trade openness, Education, Distance, Dual exchange rate dummy	-0.15
Anyanwu and Erhijakpor (2010)	$log(P_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 log(r_{it}) + \beta_4 X_{it} + \varepsilon_{it}$	Unbalanced Panel, 33 African countries	1990-2005	OLS, GMM-IV	First and second lags of remittances	-0.29

Source: Compiled by author.

Notes: See Appendix A for further details.

Inequality impact

The impact of remittances on income inequality is uncertain. A number of studies suggest that remittances increase income inequality (Oberai & Singh, 1980; Stahl, 1982; Barham & Boucher, 1998; and Taylor et al., 2005); whereas others suggest that they reduce it (Ahlburg, 1996). Barham and Boucher (1998) found that remittances increase income inequality in Nicaragua. Similarly, Oberai and Singh (1980) found that, in India, remittances increase inequality in rural areas. On the other hand, Ahlburg (1996) found that remittances reduce income inequality in Tonga.

The impact of remittances on inequality ultimately depends on where those who migrate or remit are situated in the distribution of income (Gonzalez-Konig & Wodon, 2005:2). If migration is more prevalent among individuals from poorer segments of the population, remittances are likely to be inequality decreasing as typically poorer families will receive the additional income. Alternatively, if migration is more prevalent among individuals from richer segments of the population, remittances are likely to increase income inequality as comparatively richer households will benefit from them.

5. Model, Methodology and Data

Following the empirical works of Adams and Page (2003) and Gupta, Pattillo and Wagh (2009), the basic Ravillion and Chen[4] growth-poverty model is extended to include income inequality and remittances:

$$\boldsymbol{log(P_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 log(r_{it}) + \varepsilon_{it}} \quad (1)$$

where P represents a measure of poverty in country i at time t, α_i captures fixed effects; β_1 is the growth elasticity of poverty with respect to income, y; β_2 is the elasticity of poverty with respect to income inequality, g; and β_3 is the elasticity of poverty with respect to remittances, r; ε is an error term capturing errors in the poverty measure used. The specific variable measures used in this study are shown in Table 3 below.

Equation (1) identifies the impact of remittances on poverty after controlling for income and inequality. However, aside from remittances, other foreign currency inflows might also impact poverty, so this study expands upon previous work by testing the effects of exports and Overseas Development Aid (ODA) as well.

Exports may have an impact on poverty through their impact on employment and wages (Winters et al. 2004). According to the Hechscher-Ohlin model, countries with an abundance of unskilled labour will have a comparative advantage in products that are labour intensive (Thelle, et al., 2015). Considering the view that most African countries have large unskilled labour forces relative to a shortage of capital, an increased demand for unskilled labour would increase employment prospects and wages. In theory, there should be an opportunity for a direct poverty reduction impact from exports.

The goal of donor aid (ODA) is to increase economic development in the poorest countries and reduce poverty (Dollar & Pritchett, 1998; Burnside & Dollar, 1998; Collier & Dollar, 2000), so we test for its impact on poverty.

By incorporating exports and ODA in our model, the study seeks to determine whether foreign currency flows in general have a significant effect on poverty or whether the effect of remittances is unique. This will help in informing policies for African countries' sources of financing for development.

In addition to ODA and exports, the model includes income group dummy variables to control for unobserved heterogeneity across countries. Countries that share similar characteristics often face similar challenges (Sy & Rakotondrazaka, 2015:4). Therefore, using the World Bank's income group classification, countries are classified into low-income, lower-middle- and upper-middle-income groups, based on their gross national income (GNI) per capita. GNI per capita is a useful income group measure as it reflects the average income levels of a country's citizens. Furthermore it is related to other indicators that measure the economic and social well-being of a country and its people.

Integrating the additional variables, our fully specified model is:

$$\boldsymbol{log(P_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 log(r_{it}) + \beta_4 log(x_{it}) + \beta_5 log(a_{it}) + \beta_6 D_1 + \beta_7 D_2 + \gamma t + \varepsilon_{it}} \quad (2)$$

where P, α_i , β_1 , β_2 , γ and ε are as previously defined; β_4 and β_5 are the coefficients for exports and ODA respectively; and β_6 and β_7 are the coefficients for the lower- and upper-middle-income group dummy variables (Table 2).[5] The model is expressed as a log-linear model. The appeal in using a log-linear model is that it enables the slope coefficients to be interpreted as elasticities (Gujarati,1995:180).

[4] Ravallion and Chen (1997) used data from 42 developing countries to estimate how absolute poverty levels have changed over time. They were one of the first to develop a model using cross-country aggregate data.
[5] Low-income countries are taken as the reference group.

The underlying control model assumes that poverty is reduced as per capita income rises (Gupta, Pattillo & Wagh, 2009), therefore β_1 is expected to be negative ($\beta_1 < 0$).

In theory, higher poverty levels are associated with greater income inequality (Gupta, Pattillo & Wagh, 2009), thus β_2 is expected to be positive ($\beta_2 > 0$).

Controlling for income and its distribution, we estimate the signs and magnitudes of the coefficients for remittances (β_3), exports (β_4) and ODA (β_5). A priori, we expect that a negative coefficient for remittances would indicate that remittances have a positive impact on poverty reduction. Given that low-income countries generally have higher poverty rates (Sumner, 2012:7), the coefficients of the lower- and upper-middle-income group dummy variables, β_6 and β_7, are expected to be negative ($\beta_6, \beta_7 < 0$).

5.1 Data

The dataset consists of 32 countries over the period 1983 to 2013, with a total of 130 observations.[6] The poverty and income inequality data are from the World Bank's PovcalNet database which releases estimates of global poverty from 1981 to 2012. The common international poverty line, currently set at $1.90 in 2011 Purchasing Power Parity (PPP) exchange rates, is used. The use of PPP exchange rates ensures that $1.90 is valued roughly the same in all countries. Data for all the other variables are from the World Bank's World Development Indicators, supplemented with data from the International Monetary Fund's (IMF) Balance of Payments Statistics. Given that the poverty estimates are based on household surveys that take place every few years, the analysis includes countries that have at least two nationally-representative household surveys.

The variable definitions are summarized below in Table 3 and explained in further detail in Appendix B. Summary Descriptive statistics for the regression variables are shown in Tables B-2 and B-3 in Appendix B.

[6] See Appendix A, Table A-1 for raw data.

Table 3. Summary of variables used in the study

Variable	Description	Source
Poverty headcount ratio (P_0)	Percentage of population living in households with income below the poverty line	PovcalNet database
Poverty gap ratio (P_1)	Distance by which the average income of the poor deviates from the poverty line (expressed as a percentage of the poverty line)	PovcalNet database
Gini coefficient (g)	Measures changes in the distribution of income	PovcalNet database
per capita GDP (y)	Income measure (in constant 2005 US dollars)	World Development Indicators (WDI)
Remittances (r)	Sum of personal transfers and compensation of employees (expressed as a percentage of GDP)	World Development Indicators (WDI) and Balance of Payments Statistics (BOPS)
Exports (x)	Value of goods and services provided to the rest of the world	World Development Indicators (WDI)
ODA (a)	Grants and loans made on concessional terms	World Development Indicators (WDI)
Income group dummy variables (D)	Countries classified into low-income, lower-middle-, and upper-middle-income groups based on per capita GNI	World Bank GNI per capita Operational Guidelines & Analytical Classifications database
Trade openness (t)	Sum of imports and exports (expressed as a percentage of GDP)	World Development Indicators (WDI)
Educational attainment (e)	Average schooling years among the over 25 population	Barro-Lee Educational Attainment database

Source: Compiled by author.

6. Empirical Results

Equation 2 models poverty based as a function of income, income inequality, remittances, exports and ODA, and income group dummy variables, using the variables in Table 3. We include the dummies to control for unobserved heterogeneity across countries. All economic variables are transformed by logs.

6.1 Estimation Methodology

We first estimate a standard Ordinary Least Squares (OLS) model for the poverty headcount and the poverty gap. Next we consider the possible violations of the Gauss-Markov assumptions of homoscedasticity and correct for it with Generalised Least Squares (GLS) estimation. Then we consider a violation of the exogeneity assumption and correct for it with two-stage-least-squares (2SLS) estimation (Table 4). We note that the OLS results remain robust across the different estimation procedures.

Generalized Least Squares (GLS)

OLS assumes that the errors are homoscedastic, with the same variance across countries and across time, which may be an overly restrictive assumption for this study. The estimated impact of remittances on poverty may be biased by unobservable country specific factors, which either cannot be measured or have not been accounted for. In other words, there could be latent heterogeneity present in the errors. Although

this will generally not interfere with consistent parameter estimation, failing to account for the presence of heterogeneity will yield inconsistent estimates of the standard errors of the estimated parameters and can invalidate statistical inferences (Driscoll & Kraay, 1998). In the presence of panel-level heteroscedasticity, GLS provides efficient estimates and would be preferred to OLS estimation (Arrelano, 2003: 20) The GLS estimator transforms the model equation into a new model by assigning weights to the errors. The variances of the errors in the transformed model are equal and constant, thus removing the problem of heteroscedasticity. A simple derivation of the GLS estimator is provided in Appendix B.

In Table 4 below, a likelihood ratio test confirms the presence of panel-level heteroscedasticity, which justifies the use of the GLS estimator.[7] As expected, the GLS coefficients are of the same sign and magnitude of OLS coefficients, however the standard errors are slightly smaller. The smaller standard errors under the GLS estimator point to the efficiency of the GLS estimation results over the OLS results.

Two Stage Least Squares (2SLS)

If the relationship between remittances and poverty is not be unidirectional, there is a possibility of reverse causality, which would make remittances endogenous to poverty. Endogenous variables are correlated with the disturbance term, which violates the Gauss-Markov assumption that the regressors and the error term are uncorrelated. To take account of the possible endogeneity between remittances and poverty the study adopts the 2SLS estimation technique. The 2SLS approach replaces the endogenous remittances variable (r) with predicted values of the variable ($\hat{r}$).

Table 4 also shows the results of the 2SLS estimation.[8] When instrumenting for remittances the results are consistent with the OLS estimation results, with some variation in the size of some coefficients.

In order to justify the use of the instrumented remittances variable, we test for endogeneity using the Durbin-Wu-Hausman (DWH) test. The DWH test estimates the first-stage regression model by regressing remittances against the exogenous variables and the instruments. This is followed by substituting the predicted values of the residuals ($\hat{u}$) from the first-stage regression into the poverty regression. The regressors are exogenous if the coefficient of the residuals is not significantly different from zero. Table C-3 in Appendix C presents the results of the DWH test. The DWH test statistic is not significantly different from zero, therefore we fail to reject the null hypothesis of exogeneity. Nonetheless, we show the results for comparison purposes.

Poverty headcount ratio

Table 4 displays the regression results for the poverty headcount ratio model. As expected, the coefficient for per capita GDP is negative and indicates that, on average, if income increases by 10%, ceteris paribus, the headcount ratio is expected to decrease by 6.5%.

The Gini coefficient carries a positive sign and is significant. This supports the hypothesis that greater inequality is associated with higher poverty.

The coefficient for remittances is significant and indicates that a 10% increase in the share of remittances in GDP is expected to lead to an approximate 1% decrease in the headcount poverty ratio, ceteris paribus. This outcome is similar to that found by Gupta, Pattillo and Wagh (2009) who found that a 10% increase in remittances is associated with an estimated 1% fall in the poverty headcount ratio. On the other hand, using a sample of 33 African countries, Anyanwu and Erhikakpor (2010) found that a 10% increase in the share of remittances in GDP reduces the headcount ratio by 2.7%. Their findings, however, were limited by a small sample size of only 51 observations.

[7] The results of the likelihood ratio test can be found in Appendix C, Table C-1.
[8] The estimation of the instruments is shown in Table C-2 in Appendix C.

As previously mentioned, the model includes income group dummy variables to control for unobserved heterogeneity across countries. Countries that share similar characteristics often face similar challenges (Sy & Rakotondrazaka, 2015:4). Using the World Bank's income group classification, countries are classified into low-income, lower-middle- and upper-middle-income groups, based on their gross national income (GNI) per capita. The dummy variable constants tell us that, keeping all else constant, the poverty headcount ratio is expected to be 58% lower in upper-middle-income countries and 47% lower in lower-middle-income countries than in low-income countries. This implies that low-income countries generally have higher rates of poverty and larger poverty gaps than middle-income countries for reason beyond simply income levels.

Exports are found to have an insignificant effect on poverty. This is unexpected given that one might expect exports to positively contribute towards poverty reduction beyond its effect on GDP. Nonetheless, this result is line with the outcome obtained by Thelle et al., (2015). Using a sample of 78 countries, over the period 1996 to 2010, they found that, on average, exports do not in themselves have a significant impact on poverty outcomes.

Equally surprising, ODA flows are found to have an insignificant impact on poverty. Arvin and Barillas (2010:2155) obtained the same result when testing for the causal link between ODA and poverty. Such donor aid is often used for political or commercial interests, or macroeconomic effects that do not necessarily directly impact on poverty beyond the indirect impact of GDP; consequently, the gains from ODA showed no direct impact on the poor.

Dollar and Pritchett (1998) have demonstrated that for ODA to be more effective in decreasing poverty it needs to be specifically targeted to developing countries with sound economic policies and management. In such a policy environment, financial assistance would promote economic growth which should translate to poverty reduction. Our model already captures the impact of economic growth but finds that ODA did not contribute additional poverty-reducing benefits.

Earlier cross-country evidence (Table 2) showed that remittances generally had a stronger impact on poverty. Jongwanich (2007) estimated the impact of remittances on poverty for developing Asian-Pacific countries and found that a 10% increase in remittances leads to a 2.8% decrease in poverty. Adams and Page (2005) estimated the impact of migration and remittances on poverty for 71 developing countries and found remittances to reduce poverty by 3.5%. Thus, remittances appear to have a smaller impact on poverty in Africa than in other continents across the world.

Table 4. Estimation Results for Poverty Headcount Model

Poverty headcount	OLS	GLS	2SLS
Per capita GDP (constant US$2005)	-0.65*** (-0.133)	-0.65*** (-0.128)	-0.67*** (-0.142)
Gini coefficient	3.10*** (-0.293)	3.10*** (-0.284)	3.48*** (-0.332)
Remittances (% of GDP)	-0.09*** (-0.034)	-0.09*** (-0.033)	-0.10*** (-0.044)
Exports (% of GDP)	0.08 (-0.137)	0.08 (-0.132)	
ODA (% of GDP)	0.02 (-0.058)	0.02 (-0.056)	
Lower-middle-income	-0.47*** (-0.187)	-0.47*** (-0.18)	-0.40* (-0.225)
Upper-middle-income	-0.58*** (-0.346)	-0.58* (-0.334)	-0.67* (-0.393)
Time	0.01* (-0.007)	0.01*** (-0.006)	0.01 (-0.008)
Constant	-4.26*** (-1.103)	-4.26*** (-1.064)	-5.28*** (-1.36)
Observations	130	130	83
Adjusted R^2	0.69	0.69	0.71
F-statistic	37.40***	...	...
Wald chi2	…	321.48	206.25

Note: ***, **, and * indicate significance at 1%, 5% and 10% level. Standard errors are reported in parentheses.
Source: Author's calculations.

Poverty gap ratio

Table 5 displays the regression results for the poverty gap ratio. As previously noted, the poverty gap ratio measures the distance by which the average income of the poor deviates from the poverty line (expressed as a percentage of the poverty line). Note that the regression results are broadly similar to those for the poverty headcount.

Income is found to have a negative relationship with poverty, and the coefficient is substantially more negative (-0.96 versus -0.65) suggesting that income has a larger impact on closing the mean income shortfall from the poverty line than it has on bringing people out of poverty.

Using the poverty gap ratio, the coefficient for remittances is not different to that of the poverty headcount ratio (-0.10 and -0.09 respectively).

The Gini coefficient remains positive and statistically significant; however the magnitude of the coefficient is larger.

Exports and ODA still have a statistically insignificant effect on the poverty gap.

In summary, both the regression results support the hypothesis that remittances have a positive and statistically significant effect on poverty reduction. Exports and ODA have no significant direct impact

on poverty, but their indirect contributions are likely to be captured by the per capita income term. Note that when exports and ODA are excluded from the regression, the coefficient for remittances remains about the same.

Table 5. Estimation Results for Poverty Gap Model

Poverty gap	**OLS**	**GLS**	**2SLS**
Per capita GDP (constant US$2005)	-0.96*** (-0.167)	-0.96*** (-0.161)	-0.93*** (-0.175)
Gini coefficient	4.52*** (-0.368)	4.52*** (-0.355)	4.96*** (-0.41)
Remittances (% of GDP)	-0.10** (-0.043)	-0.10*** (-0.041)	-0.11** (-0.055)
Exports (% of GDP)	0.2 (-0.171)	0.2 (-0.165)	
ODA (% of GDP)	0.01 (-0.073)	0.01 (-0.07)	
Lower-middle-income	-0.49** (-0.234)	-0.49** (-0.225)	(-0.37) -0.277
Upper-middle-income	-0.64 (-0.433)	-0.64 (-0.418)	(-0.72) -0.484
Time	0.01 (-0.008)	0.01 (-0.008)	-0.01 -0.01
Constant	-9.07*** (-1.38)	-9.07*** (-1.331)	-10.20*** -1.677
Observations	130	130	83
Adjusted R^2	0.72	0.72	0.75
F-statistic	42.40***	...	...
Wald chi2	…	364.4	241.09

Note: ***, **, and * indicate significance at 1%, 5% and 10% level. Standard errors are reported in parentheses.
Source: Author's calculations.

7. Conclusion and Recommendations

This study uses data on remittances, poverty and inequality from 32 countries across Africa to examine the impact of remittances on poverty in Africa. The study expands upon previous work by using two alternative measures of poverty and including two additional foreign currency flows in the standard poverty-remittance model, exports and ODA.

The basic model indicates that per capita income and income distribution (gini) remain the underlying determinates of poverty. A 10% increase in per capita income can reduce the poverty headcount by about 7% and the poverty gap by 9%. As we might expect, this indicates that a rise in income is more effective in eliminating the 'degree of poverty'. And a reduction in the gini coefficient by 0.1 can reduce the poverty headcount by 0.3 percent and by 0.5 percent for the poverty gap. Similarly, an improved income distribution has a bigger impact on the degree of poverty than on the amount of poverty. These results are

similar to Gupta, Pattillo and Wagh (2009) who found that a 10% increase in remittances is associated with an estimated 1% fall in the poverty headcount ratio.

We then find that a 10% increase in remittances reduced the poverty headcount by 0.9% and reduced the poverty gap by 1%. This is at the lower end of the elasticities that were found by other researchers for other groupings of developing countries, which ranged from -0.15 to -0.35 (Table 2). Although remittances appear to have a smaller impact on poverty in Africa than in other continents across the world, the impact was highly significant. This is a somewhat surprizing result, and may be due to the high cost of sending remittances to Africa relative to other continents. In any event, it deserves further study.

We also found that exports and donor aid (ODA) were not significant factors in directly reducing poverty in our model. This may appear strange at first, but seems to imply that there were no additional impacts from these factors beyond that of raising per capita income, which was already included in the model. This result does not indicate that ODA is irrelevant for poverty reduction, but simply lacks direct effects beyond that of income.

We tested our model for homoscedasticity and found that some heteroscedasticity existed, which we corrected using a GLS estimator. This did not change the parameter estimates but simply corrected for their standard errors. Our outcome is similar to Gupta, Pattillo and Wagh (2009) who find that a 10% increase in remittances is associated with an estimated 1.5% fall in the headcount ratio.

We also tested the model for the exogeneity of the explanatory but did not find evidence of endogeneity. Nevertheless, we ran the model with 2SLS and reported the results, which were similar to those of OLS and GLS in any case. This strengthens our belief in the robustness of the model and the parameter estimates.

We also found that dummy variable for different income groupings were significant, which suggests that other characteristics of development are not necessarily captured by the level of per capita GDP. This might relate to characteristics like infrastructure development and financial inclusion. We found that as countries rose in income level, these other factors reduced poverty.

In line with other researchers, we found that remittances were counter-cylic to income growth (negative correlation coefficient). We believe that this support the new economics of labour migration view that migration and remittances are likely to represent household decisions for income insurance, as opposed to the traditional neoclassical view that migration and remittances purely represent self-interest motivation.

In summary, the regression results support the hypothesis that remittances have a positive and statistically significant effect on poverty reduction. Exports and ODA have no impact on poverty, which suggests that the gains from exports and ODA fail to trickle down to the poor. Note that when exports and ODA are excluded from the regression, the coefficient for remittances remains about the same. Thus, remittances appear to be a major source of development finance to Africa.

The main limitation of the study was the limited availability of poverty and remittances data. Poverty data are based on household surveys that take place once every few years. Moreover, a number of African countries generally do not record or publish data on remittances. For those reasons, the analysis could only include countries that have at least two observations.

Recommendations

Despite the growing importance of remittances as a source of finance for development in Africa, their impact on poverty may be smaller than elsewhere owing to the high cost of remitting. The lower elasticity merits further study. A number of factors contribute to maintain Africa's high transaction cost structure,

including: “limited competition, regulatory practices that limit market entry, and a lack of financial inclusion in African countries” (Watkins & Quattri, 2014:24). Exclusivity agreements involving major MTOs and commercial banks are one of the drivers of Africa’s high remittance costs as they restrict competition (Watkins & Quattri, 2014: 24). These agreements have the effect of reducing competition, increasing the cost of market entry and creating highly segmented markets characterised by limited competition.

The G7 and the G20 have taken a number of steps to reduce the high transaction costs of remittances (Watkins & Quattri, 2014). In 2008, the G7 adopted a quantitative goal towards halving the average global cost of remittances, from 10% to 5% over five years (Watkins & Quattri, 2014). Although this commitment has been reaffirmed and taken up in a number of countries, the commitment has had no discernible effect on the high transaction costs in African countries.

Because high transaction costs limit the impact that remittances can have on development outcomes in African countries, efforts need to be taken to reduce the costs of remitting money to and within Africa. Regulatory authorities could to permit post offices and microfinance institutions to play a greater role in the market for remittances in Africa. Post offices and microfinance institutions offer more coverage, particularly in rural areas where formal financial services are often limited. Allowing more RSPs to operate in the remittance market and perform money transfers will bring about greater competition, with potential benefits for price and service quality (Watkins & Quattri, 2014:28). Similarly, regulatory authorities should vigorously assess the practices of MTOs in markets dominated by limited competition.

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Appendix A: Background of Previous Analytic Papers on Poverty and Remittances

Background to Table 2

Adams and Page (2005)

Adams and Page (2005) estimated the impact of migration and remittances on poverty for 71 developing countries over the period 1980 to 1998. Three measures of poverty were used: the poverty headcount, the poverty gap and the squared poverty gap ratios, which measure the depth, intensity and severity of poverty respectively. The poverty model was specified as:

$$log(Pov_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 log(rem_{it}) + \beta_4 region_{ij} + \varepsilon_{it} \quad (1)$$

where *P* is a measure of poverty in country *i* at time *t*; α_i captures fixed effects; β_1 is the growth elasticity of poverty with respect to income, y; β_2 is the elasticity of poverty with respect to income inequality, g; β_3 is the elasticity of poverty with respect to remittances, r; β_4 is a dummy variable capturing regional effects; and ε is an error term capturing errors in the poverty measure used.

The poverty elasticity of migration and remittances were estimated separately and both migration and remittances were found to reduce poverty.

The study used instrumental variables (IV) to deal with the possibility of reverse causality between migration, remittances and poverty. Three instruments were used for migration and remittances: the distance from the remittance-sending to the recipient countries; the level of educational attainment in the recipient countries; and government stability. Using the IV approach, equation (1) was estimated in two stages. The first stage involved regressing migration and remittances against the chosen instruments and including income, the Gini coefficient, and regional dummies as exogenous variables. The second stage involved taking the instrumented migration and remittance variables and including them in the poverty regression to estimate their poverty elasticity. Instrumenting for migration and remittances and controlling for income, inequality and regional effects, migration and remittances were still found to reduce poverty.

Jongwanich (2007)

Jongwanich (2007) estimated the impact of remittances on poverty for developing Asian-Pacific countries. The estimated poverty equation was of the form:

$$log(P_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 log(r_{it}) + \beta_4 X_{it} + \varepsilon_{it} \quad (2)$$

The study included additional control variables (within the vector X_{it}): human capital, inflation and openness. It was found that a 10% increase in remittances leads to a 2.8% decrease in poverty.

Jongwanich's (2007) results, however, must be accepted with a degree of caution as the study did not account for the possible reverse causality between remittances and poverty.

Gupta, Pattillo and Wagh (2009)

Gupta, Pattillo and Wagh (2009) used an updated database on remittances, poverty and inequality to estimate the poverty elasticity of remittances. The database consisted of 76 developing countries, with a focus on countries from the Sub-Saharan African region. The direct poverty elasticity of remittances was first estimated using equation (3) below. Subsequently, the Three Stage Least Square (3SLS) estimator, which allows for poverty and remittances to be determined simultaneously as a system of equations, was used. The system of equations was made of a poverty model and a model capturing the determinants of remittances:

$$log(Pov_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 log(rem_{it}) + \beta_4 region_{ij} + \varepsilon_{it} \quad (3)$$

$$log(rem_{it}) = \alpha_i + \beta_1 \log(Pov_{it}) + \beta_2 \log(trade_{it}) + \beta_3 log(educ_{it}) + \beta_4 (distance_{it}) + \beta_5 (dual_{it}) + \beta_6 (rem_{it-1}) + \varepsilon_{it} \quad (4)$$

where remittances (equation 4) are modelled as a function of poverty (Pov_{it}), trade openness ($trade_{it}$), educational attainment ($educ_{it}$), distance (in miles) from the host country to the recipient country ($distance_{it}$), a dual exchange rate dummy ($dual_{it}$), and lagged remittances (rem_{it-1}).

Two of the variables included in the remittance equation (4) were also included as instruments in the Adams and Page (2005) study.

Controlling for the possible reverse causality between remittances and poverty, the study found that, on average, a 10% increase in the share of remittances in GDP leads to a 1.5% decrease in the poverty headcount ratio.

Anyanwu and Erhijakpor (2010)

Anyanwu and Erhijakpor (2010) estimated the impact of remittances on poverty using a dataset of 33 African countries over the period 1990-2005. To control for the possible endogeneity between remittances and poverty, they used the two-stage Generalised Method of Moments Instrumental Variables (GMM-IV) estimator to instrument for remittances. The first stage of the GMM-IV estimator involved regressing the remittance variable (r_{it}) against its first and second lags and including income, the Gini index, the illiteracy rate, trade openness and inflation as exogenous variables. The second stage involved taking the instrumented remittances variable and including it in the poverty model to estimate the poverty elasticity of remittances. They found that a 10% increase in remittances (as a share of GDP) leads to a 2.9% decrease in the poverty headcount.

Anyanwu and Erhijakpor (2010) results, however, must also be accepted with a degree of caution as they had a small sample size of only 51 observations.

One of the common limitations of previous cross-country studies is that a number of them fail to account for the possible endogeneity between remittances and poverty. Endogenous variables are correlated with the disturbance term; this violates the Gauss-Markov assumption that the regressors and the error term are uncorrelated. Failing to account for endogeneity when endogeneity is present can bias the estimation results. An additional limitation of previous cross-country studies is that they do not account for unobservable country specific factors, meaning there could be latent heterogeneity present in the errors. Although heterogeneity will generally not interfere with consistent parameter estimation, failing to account for it will yield inconsistent estimates of the standard errors of the estimated parameters and can invalidate statistical inferences. This study accounts for the possible endogeneity and heteroscedasticity in the model by employing the Two-Stage Least Squares (2SLS) and Generalised Least Squares (GLS) estimation techniques.

Appendix B: Data for Regression Analysis

Variable Definitions

Poverty measures

Two poverty measures are used: the poverty headcount and the poverty gap ratios. The poverty headcount ratio measures the percentage of the population living in households with income or expenditures below the poverty line.

Mathematically, the poverty headcount ratio P_0 is defined as:

$$P_0 = \frac{1}{N}\sum_{i=1}^{N} I(y_i < z) = \frac{1}{N}\sum_{i=1}^{q} 1 = \frac{N_p}{N} \quad (1)$$

where:
N = total population
I(.) = an indicator function taking a value of 1 (below the poverty line) if the bracketed expression is true, and 0 otherwise.
y_i = welfare indicator, e.g. consumption per capita
z = poverty line
N_p = number of poor individuals in the population

The poverty gap ratio (P_1) measures the distance by which the average income of the poor deviates from the poverty line, expressed as a percentage of the poverty line. The gap ratio may be thought of as the minimum cost of eliminating poverty, as it indicates how much would have to be transferred to the poor to bring their incomes up to the poverty line (Haughton & Khandker, 2009:69).

Mathematically the Poverty Gap Index is defined as:

$$P_1 = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{z-y_i}{z}\right) I(z - y_i) = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{z-y_i}{z}\right) \quad (2)$$

where the variables are defined as in equation 1 above.

Per capita GDP

Per capita GDP is used as the income measure. Income, as measured by per capita GDP, comes from the national accounts and is in constant 2005 US dollars (World Bank, 2015b).

Income inequality

Changes in the distribution of income are measured using the Gini coefficient. The Gini coefficient provides a convenient summary measure of the degree of income inequality in a given country. A Gini coefficient of 0 signifies equal income for all persons; while a coefficient of 100 means that all income is concentrated in one person (World Bank, 2015d).

Remittances

Remittances are the sum of two components in the balance of payments, personal transfers and compensation of employees. Personal transfers consist of current transfers between resident and non-resident households, and compensation of employees refers to the income of short-term seasonal workers employed in economies where they are non-residents and the income of residents employed by non-resident entities (World Bank, 2015b). It is important to note that unofficial remittance flows account for a significant portion of total remittances, Aggarwal, Dermiguc-Kunt and Peria (2006) estimate that about

50-250% of total remittances are accounted for by unofficial remittance flows. Therefore recorded remittances are likely to be understated.

Exports

Exports refer to the value of goods and services provided to the rest of the world (World Bank, 2015b).

ODA

ODA is all financing that flows from developed country governments and multilateral agencies to the developing world (Dollar & Pritchett, 1998:6). ODA is primarily the official government-to-government transfer of financial and technical resources for the programs of social and economic development (Raheem & Ogebe, 2014). It consists of grants and loans made on concessional terms and given by; multilateral institutions, countries in the Development Assistance Committee (DAC) of the Organisation of Economic Corporation and Development (OECD), and by non-DAC countries to countries and territories in the DAC list of ODA recipients (World Bank, 2015b).

Income group dummy variables

The model includes income group dummy variables to control for unobserved heterogeneity across countries. Countries that share similar characteristics often face similar challenges (Sy & Rakotondrazaka, 2015:4). Therefore, using the World Bank's income group classification, countries are classified into low-income, lower-middle-, and upper-middle-income groups based on their per capita Gross National Income (GNI). Using 2014 GNI values, low-income countries are those with a per capita GNI of $1,045 or less; lower-middle-income countries are those with a per capita GNI of over $1,045 but less than $4,125; and upper-middle-income income economies are those with a per capita GNI of over $4,125 but less than $12,736 (World Bank, 2015e).

Appendix B: Data for Regression Analysis

Table B-1.Data for regression analysis

Country	Income group	Survey year	Poverty headcount ratio	Poverty gap ratio	Per capita GDP (2005 constant US$)	Gini coefficient	Remittances (millions US$)	Remittances (% of GDP)	Exports (% of GDP)	ODA (% of GDP)
Algeria	UM	1988	7.1	1.05	2579.94	40.19	379	0.64	15.51	0.29
Algeria	LM	1995	6.38	1.27	2339.66	35.33	1120	2.68	26.19	0.70
Benin	L	2003	48.85	16.25	535.95	38.58	55.36	1.56	20.98	8.43
Benin	L	2011	53.11	18.98	552.62	43.44	171.96	2.36	14.26	9.47
Botswana	LM	1986	42.56	17.87	2619.57	54.21	37.25	2.67	68.33	7.23
Botswana	LM	1993	34.82	13.49	3878.59	60.79	74.29	1.79	47.10	3.12
Botswana	UM	2003	29.75	11.41	5108.25	64.73	38.87	0.52	48.83	0.37
Botswana	UM	2009	18.24	5.78	5695.95	60.46	15.21	0.15	34.80	2.72
Burkina Faso	L	1994	83.06	48.44	279.12	48.07	80.35	4.24	14.20	22.83
Burkina Faso	L	1998	81.61	42.99	334.45	49.94	71.67	2.56	12.81	14.26
Burkina Faso	L	2003	57.26	23.71	380.33	43.25	53.75	1.28	8.71	12.86
Burkina Faso	L	2009	55.29	19.94	446.71	39.76	95.99	1.15	12.70	12.93
Cameroon	L	1996	48.08	15.29	806.46	44.45	13.41	0.14	23.38	4.21
Cameroon	L	2001	23.12	6.07	883.91	42.14	20.31	0.21	21.92	4.75
Cameroon	LM	2007	29.27	8.32	926.72	42.82	167.34	0.82	23.93	9.43
Cape Verde	LM	2002	21.02	6.05	1739.00	50.52	85.08	13.70	32.55	14.74
Cape Verde	LM	2007	13.72	3.18	2511.66	43.82	138.87	9.17	31.54	10.91
Cote I’voire	LM	1985	6.81	2.03	1264.38	45.53	24.04	0.34	46.77	1.68
Cote I’voire	LM	1986	3.1	0.63	1257.30	37.97	35.81	0.39	39.50	1.90
Cote I’voire	LM	1987	6.66	1.6	1208.04	40.51	42.92	0.43	33.43	2.38
Cote I’voire	LM	1988	10.68	2.53	1178.97	36.89	42.64	0.42	30.49	4.14
Cote I’voire	LM	1992	21.58	6.45	1040.98	39.39	49.52	0.44	31.91	6.78
Cote I’voire	L	1993	19.22	5.41	1004.13	39.35	57.56	0.52	29.44	6.91
Cote I’voire	L	1995	19.11	4.67	1016.30	40.56	151.06	1.37	41.76	11.02
Cote I’voire	L	1998	25.66	7.57	1091.51	38.96	142.57	1.13	41.40	7.67
Cote I’voire	L	2002	23.03	7.05	978.74	41.34	120.09	0.97	47.46	8.65
Cote I’voire	LM	2008	29.02	10.3	939.63	43.18	198.92	0.82	47.12	2.58
Egypt	L	1990	4.46	0.6	878.22	32	4283.5	9.93	20.05	14.04
Egypt	LM	1996	2.46	0.34	966.31	30.13	3107	4.59	20.75	3.24

Egypt	LM	2000	1.81	0.31	1103.44	32.76	2852	2.86	16.20	1.37
Egypt	LM	2004	2.26	0.43	1166.46	32.14	3340.7	4.24	28.23	1.97
Egypt	LM	2008	1.68	0.37	1392.25	30.75	8694	5.34	33.04	1.07
Ethiopia	L	1995	67.9	27.07	127.02	44.56	27.36	0.36	9.62	11.44
Ethiopia	L	1999	55.25	16.03	132.59	29.98	33.73	0.44	11.87	8.35
Ethiopia	L	2004	36.31	8.34	148.85	29.81	133.74	1.32	14.75	18.05
Ethiopia	L	2010	33.54	9.04	237.36	33.17	345.15	1.15	13.60	11.78
Ghana	L	1987	63.84	25.13	356.31	35.35	0.7	0.01	19.66	8.06
Ghana	L	1988	62.8	24.61	366.25	35.99	6	0.12	18.18	11.07
Ghana	L	1992	47.38	16.4	389.43	38.44	7.30	0.11	17.23	9.55
Ghana	L	1998	33.9	11.33	431.47	40.07	29.5	0.39	33.87	9.38
Ghana	L	2006	25.15	8.41	520.17	42.77	105.25	0.52	25.19	6.09
Guinea	L	1991	92.31	62.96	277.33	46.84	13.6	0.45	30.33	12.52
Guinea	L	1994	48.54	19.01	264.26	46.08	0.49	0.01	22.75	10.59
Guinea	L	2002	61.6	26.14	301.95	43	15.19	0.51	26.48	8.61
Guinea	L	2007	59.7	23.71	301.73	39.36	15.07	0.36	28.76	5.52
Guinea	L	2012	35.27	10.34	303.49	33.73	66.3	1.17	29.72	5.99
Guinea-Bissau	L	1993	64.02	28.37	485.82	43.61	1.5	0.63	8.87	39.91
Guinea-Bissau	L	2002	53.87	18.63	396.81	35.57	17.63	4.24	17.83	14.44
Guinea-Bissau	L	2010	67.08	30.53	422.17	50.66	45.89	5.41	19.98	14.80
Kenya	L	1992	23.08	7.93	523.46	57.46	114.84	1.40	26.26	10.76
Kenya	L	1994	18.84	6.38	507.16	43.86	137.28	1.92	37.04	9.47
Kenya	L	1997	21.5	5.59	511.16	46.3	351.78	2.68	22.69	3.42
Kenya	L	2005	33.6	11.7	530.08	48.51	424.99	2.67	28.51	4.05
Lesotho	L	1987	74.77	44.17	443.63	56.02	353.09	95.60	13.02	28.39
Lesotho	L	1994	69.56	44.79	573.68	63.24	319.65	42.34	24.48	15.31
Lesotho	L	2003	61.31	31.99	685.95	51.57	556.89	57.46	60.07	8.14
Lesotho	LM	2010	59.65	31.83	867.66	54.18	610.13	27.89	44.38	11.71
Madagascar	L	1993	69.36	30.35	290.31	45.26	13.54	0.40	15.32	10.72
Madagascar	L	1997	65.85	28.12	275.78	39.47	12.18	0.34	21.87	23.49
Madagascar	L	1999	64.13	27.71	281.63	38.61	11.62	0.31	24.47	9.63
Madagascar	L	2001	68.68	34.36	294.05	47.44	10.87	0.24	29.08	8.17
Madagascar	L	2005	74.06	31.7	275.52	38.88	115.17	2.29	28.21	18.12
Madagascar	L	2010	81.76	40.32	275.00	40.63	547.03	6.27	24.97	5.38
Mali	L	1994	84.88	51.88	304.17	50.44	103.19	5.85	23.01	24.94
Mali	L	2001	57.92	22.91	384.46	39.87	88.17	3.35	33.30	13.38

Mali	L	2006	50.58	17.46	432.79	38.93	211.84	3.46	30.77	14.14
Mali	L	2010	49.25	15.19	459.65	33.04	472.75	5.02	26.00	11.55
Mauritania	L	1987	40.05	17.35	681.87	43.94	6.70	0.74	49.09	21.31
Mauritania	L	1993	41.16	13.66	663.85	50.05	2.27	0.18	32.00	27.00
Mauritania	L	1996	20.62	6.13	685.14	37.75	4.37	0.30	49.41	18.85
Morocco		1984	10.95	2.31	1170.72	39.19	873.73	6.17	26.64	2.40
Morocco	LM	1990	2.81	0.4	1401.45	39.2	2006.35	6.96	25.69	4.30
Morocco	LM	1998	7.4	1.29	1600.02	39.46	2010.74	5.02	24.41	1.33
Morocco	LM	2001	6.18	1.28	1697.64	40.64	3260.92	8.64	29.41	1.28
Morocco	LM	2007	3.12	0.61	2092.82	40.72	6730.47	8.95	35.75	1.62
Mozambique	L	1996	85.36	47.28	196.80	44.41	61	1.88	14.79	27.32
Mozambique	L	2002	80.36	41.53	271.30	47.04	52.55	1.25	27.34	52.82
Mozambique	L	2009	68.74	31.41	357.11	45.58	111.13	1.04	29.05	18.78
Namibia	L	1994	52.87	27.77	2878.74	74.33	14.90	0.41	44.47	3.77
Namibia	L	2004	31.46	10.17	3536.23	63.32	15.24	0.23	39.81	2.62
Namibia	L	2010	22.6	6.65	4122.14	60.97	15.12	0.13	47.80	2.27
Niger	L	1993	78.19	34.12	261.42	36.1	15.87	0.99	15.64	21.07
Niger	L	1994	81.38	43.13	262.67	41.53	6.90	0.44	16.53	23.86
Niger	L	2005	74.93	35.5	252.50	44.43	66.37	1.95	16.59	15.33
Niger	L	2007	72.02	28.75	255.79	37.3	79.35	1.85	17.43	12.68
Niger	L	2011	50.34	13.91	264.53	31.45	165.93	2.59	20.90	10.13
Nigeria	L	1985	46.01	17.39	639.54	38.68	10	0.03	17.39	0.11
Nigeria	L	1992	57.06	27.37	559.82	44.98	56	0.19	37.51	0.88
Nigeria	L	1996	63.5	31.07	546.25	51.92	947	2.71	32.24	0.54
Nigeria	L	2004	53.46	21.92	797.68	40.06	2272.7	2.59	30.16	0.66
Nigeria	LM	2010	53.47	21.76	997.45	42.97	19817.84	5.37	25.26	0.56
Rwanda	L	1984	63.65	19.9	263.23	28.9	2.94	0.19	12.63	10.25
Rwanda	L	2000	76.97	37.93	224.90	48.55	6.63	0.38	6.32	18.53
Rwanda	L	2006	68	31.14	305.48	52.04	28.99	0.93	12.30	19.39
Rwanda	L	2011	60.25	23.7	393.02	51.34	174.26	2.72	14.43	19.73
Senegal	LM	1991	67.97	36.11	677.30	54.14	162.56	2.89	23.09	11.17
Senegal	L	1994	56.78	21	635.06	41.44	113.83	2.94	31.75	16.39
Senegal	L	2001	48.58	16.1	716.65	41.23	304.68	6.25	28.73	8.86
Senegal	L	2006	37.58	12.44	770.51	39.22	925.24	9.89	25.63	9.24
Senegal	LM	2011	37.98	12.79	792.11	40.28	1613.91	11.18	25.17	7.34
Sierra Leone	L	2003	58.59	21.76	315.46	40.17	25.89	1.89	14.07	24.58
Sierra Leone	L	2011	52.33	16.7	381.38	33.99	58.81	2.01	16.32	14.50
South Africa	UM	1993	31.91	11	4668.25	59.33	101.70	0.08	21.83	0.20
South Africa	UM	1995	34.94	13.84	4757.96	62.97	105.32	0.07	22.14	0.25

South Africa	LM	2001	35.2	13.28	4884.44	57.77	297.39	0.24	29.37	0.35
South Africa	UM	2006	23.13	7.23	5671.15	64.79	691.93	0.25	29.27	0.26
South Africa	UM	2009	15.07	4.16	5820.66	63.01	862.05	0.29	27.91	0.36
South Africa	UM	2011	16.56	4.9	6010.41	63.38	1158.42	0.28	30.44	0.34
Swaziland	LM	1995	81.66	51.04	2099.84	60.45	82.55	4.86	60.02	3.40
Swaziland	LM	2001	48.44	17.49	2191.33	53.11	52.88	3.92	85.44	2.16
Swaziland	LM	2009	42.03	16.64	2440.41	51.45	93.46	2.97	59.15	1.78
Tanzania	L	2000	84.74	44.54	361.66	37.3	8	0.08	13.36	10.45
Tanzania	L	2007	52.73	18.95	481.23	40.28	25.46	0.12	18.92	13.12
Tanzania	L	2012	46.6	14.35	556.06	37.78	67.38	0.17	21.29	7.30
Togo	L	2006	55.55	21.05	383.95	42.21	232.17	10.54	38.20	3.63
Togo	L	2011	54.18	23.21	395.72	46.02	244.13	6.50	39.43	14.45
Tunisia	LM	1985	13.93	3.47	1975.90	43.43	270.82	3.22	32.10	1.91
Tunisia	LM	1990	9.82	2.44	2033.42	40.24	551.04	4.48	43.65	3.19
Tunisia	LM	1995	10.86	2.54	2237.69	41.66	679.88	3.77	44.90	0.41
Tunisia	LM	2000	5.32	1.02	2758.46	40.81	795.95	3.71	39.55	1.03
Tunisia	LM	2005	3.09	0.65	3217.89	37.73	1392.67	4.32	44.93	1.12
Tunisia	UM	2010	1.99	0.4	3847.59	35.81	2063.29	4.64	50.05	1.24
Uganda	L	1999	52.13	19.19	274.43	43	232.60	3.88	12.25	10.09
Uganda	L	2002	62.21	24.47	293.98	45.17	422.58	6.84	11.21	11.74
Uganda	L	2005	53.18	19.4	321.44	42.94	321.81	3.57	14.18	13.23
Uganda	L	2009	41.46	13.16	393.62	44.2	781.10	4.60	19.81	10.50
Uganda	L	2012	33.24	10.13	429.40	42.37	910.32	3.84	19.91	6.98
Zambia	L	2003	49.44	17.45	635.32	42.06	36.30	0.74	25.68	15.80
Zambia	L	2005	56.69	27.26	691.81	54.29	52.87	0.63	30.61	14.07
Zambia	L	2006	60.46	30.1	726.11	54.62	57.68	0.45	32.59	11.50

Source: Poverty and gini coefficient data are from World Bank (2015d), and remittances, exports and ODA data are from World Bank (2015b), supplemented with data from IMF (2015).

Table B-2. Bivariate correlations of regression variables

	Poverty headcount	Poverty gap	Per capita GDP	Gini index	Remittances (% of GDP)	Exports (% of GDP)	ODA (% of GDP)
Poverty headcount	1.00						
Poverty gap	0.99***	1.00					
Per capita GDP	-0.58***	-0.55***	1.00				
Gini index	0.29***	0.35***	0.41***	1.00			
Remittances (% of GDP)	-0.16*	-0.15*	0.04	-0.07	1.00		
Exports (% of GDP)	-0.33***	-0.29***	0.64***	0.28***	0.16***	1.00	
ODA (% of GDP)	0.50***	0.48***	-0.67***	-0.17**	0.14***	-0.38***	1.00

Source: Author's calculations.

Table B-2 (Appendix B) presents the pairwise bivariate correlations of the regression variables. The pairwise correlations show a negative relationship between remittances and both poverty measures at the 10% level of significance, suggesting that poverty decreases as remittances increase. Exports are negatively correlated with poverty, while ODA is positively correlated with poverty.

Table B-3. Descriptive statistics for regression variables

	Observations	Mean	Std.	Min	Max
Poverty headcount	142	43.42	24.50	1.68	92.31
Poverty gap	142	18.30	13.86	0.31	62.96
per capita GDP	984	1131.59	1309.22	113.71	6930.85
Gini index	142	44.40	8.73	28.9	74.33
Remittances (% of GDP)	900	4.76	11.35	0.003	106.46
Exports (% of GDP)	979	27.87	14.82	2.52	100.95
ODA (% of GDP)	973	10.86	10.78	0.0004	94.44

Source: Author's calculations.

On average, 43.4% of households live below the $1.90 international poverty line. The poverty gap ratio indicates that the average income gap between households living below the poverty line and the actual poverty line is 18.3%. These ratios, however, differ significantly across countries and across time (). For example, in 2010 the headcount ratio for Madagascar is 81.8%, while the headcount ratio for Tunisia is only 2%.

Appendix C: Estimation Results

Table C-1.Results of the Likelihood ratio test for heteroscedasticity

	LR chi2(31)	Prob > chi2
Poverty headcount	249.00	0.0000
Poverty gap	92.52	0.0000

Note: The null hypothesis states that the variances of the errors are homoscedastic.

Source: Author's calculations.

2 Stage Least Squares

In the first-stage of the 2SLS estimation technique, the endogenous remittances variable (r) is regressed on the exogenous variables, per capita GDP (y_{it}) and the Gini coefficient(g_{it}), and a set of instruments. In applying 2SLS, the study uses instruments suggested by the literature that can impact remittance flows. The instruments used are lagged remittances, trade and educational attainment. Lagged remittances are included to capture the dynamic effect. Given the stable nature of remittance flows, the expectation is that lagged remittances are a significant predictor of current remittances. The second instrument used is trade openness. Trade openness, as measured by the trade to GDP ratio, represents how open an economy is. The final instrument used is educational attainment. Educational attainment represents the average years of schooling among the over 25 population. The outcome of this variable depends on whether migration is more prevalent among the more educated or less educated members of a population (Gupta, Pattillo and Wagh, 2009).

Once the-first stage regression is estimated, the predicted values of the endogenous remittances variable $(\hat{r})$ are substituted in the poverty regression:

$$log(P_{it}) = \alpha_i + \beta_1 \log(y_{it}) + \beta_2 \log(g_{it}) + \beta_3 \log(\hat{r}_{it}) + \gamma t + \beta_6 D_1 + \beta_7 D_2 + \gamma t + \varepsilon_{it} \qquad (3)$$

Table C-2.Results of First-stage regression for 2SLS estimation

	Remittances
Per capita GDP (constant US$ 2005)	-0.05 (0.091)
Gini coefficient	0.02 (0.195)
Lagged remittances (% of GDP)	0.96*** (0.027)
Educational attainment	-0.07 (0.076)
Trade openness	0.04 (0.113)
Lower-middle-income	0.05 (0.126)
Upper-middle-income	-0.06 (0.223)
Time	-0.00 (0.005)
Constant	0.20 (0.796)
Observations	83
Adjusted R^2	0.96
F(8, 74)	253.58

Note: ***, **, and * indicate significance at 1%, 5% and 10% level. Standard errors are reported in parentheses.
Source: Author's calculations based on World Bank (2015a).

Table C-3. Results of Durbin-Wu-Hausman test for endogeneity

	Durbin-Wu-Hausman	Prob F(1,78)
Poverty headcount	0.640308	0.4260
Poverty gap	0.928383	0.3383

Note: The null hypothesis states that the variables are exogenous.
Source: Author's calculations.