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Article

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Remittances and Household Investment Decisions: Evidence from sub-Saharan Africa

Abstract

The impact of remittances on households left behind by migration is ambiguous a priori due to competing income and substitution effects. We offer new evidence on the effect of remittances on household investment decisions. We enrich our analysis using microdata from five sub-Saharan African countries, different investment alternatives, and different remittance sources. We use a recursive bivariate probit model and imperfect instrumental variable approaches to account for endogeneity concerns. We find that remittances increase the likelihood of human, physical, and social capital investment in most of our sample countries. We also find that remittance sources have a notable influence on household investment decisions. Finally, we explore three potential mechanisms: income effect, substitution effect, and migration expectations. We find that the income effect of remittances mainly drives the positive effect on capital investment. However, we also find evidence of substitution effect by left-behind household members and migration expectations in some countries. We contribute to the ongoing debate on the effect of remittances on capital investments, and our results shed light on the heterogeneous effect of remittance in the literature.

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Keywords: remittances, investments, sub-Saharan Africa, physical capital, human capital, social capital

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1 Introduction

Globally, one in nine people receive remittances from a migrant family member, and these transfers make up about 60% of the receiving household's income (United Nations, 2019). The United Nations estimate that about three-quarters of remittances are spent on necessities, such as food and housing, while the rest is saved or invested in income-generating activities and coping with shocks (i.e., crop failure or family emergencies) (United Nations, 2019). Earlier studies on the uses of remittances focused on household consumption expenditure (i.e., durable and non-durable goods). However, more recently, an increasing number of studies are investigating households' use of remittances for investment purposes.

In principle, remittances can help boost the longer-term prospects of remittance-receiving households by facilitating investment in productive assets. It can also help to smoothen consumption for households affected by adverse economic shocks. However, despite the potential of remittances to stimulate capital accumulation and investment, the earning capacity of receiving households often stays unchanged even after years of receiving remittances. This observation suggests that remittance-receiving households often fail to accumulate capital and invest in income-generating activities, instead allocating remittances to immediate and conspicuous consumption (Chami et al., 2005; Kakhkharov and Ahunov, 2020; Simiyu, 2013). Additionally, dependence on remittances may reduce involvement in income-generating activities by the left-behind household members.

It is difficult to theoretically determine the net effect of remittances on investment decisions. Several empirical studies have investigated this question, but the findings are inconclusive (Démurger, 2015). Studies have found positive (Amuedo-Dorantes and Pozo, 2010; Jena, 2018), null (Acosta, 2011), and adverse effects (Simiyu, 2013) of remittances on household investment decisions. The bigger concern here is the reliability of the existing empirical studies, as these studies often suffer from selection bias and other endogeneity issues (Adams, 2011).

This study aims to examine the effect of remittances on households' investment decisions using data from five sub-Saharan Africa (SSA) countries. More specifically, we investigate two questions. First, are remittance-receiving households more likely to make investment expenditures than non-remittance-receiving households? Second, do the household investment decisions vary by the type of investment expenditure: human capital (i.e., education and health), physical capital, and social capital? In addition, we also explore the heterogeneous effect of remittance sources – internal, within-Africa, and out-of-Africa remittances. Finally, we examine three different channels – income effect, substitution effect, and migration expectations – through which remittances can affect household investment decisions.

SSA is an excellent context to study these questions as little is known about the relationship between remittances and household investment decisions in the region. To our knowledge, only a handful of studies have examined this question in the region. Moreover, most empirical studies on the subject are based on Latin American countries, with some focus on Asia (Acharya and Leon-Gonzalez, 2014) but largely ignoring SSA. The results from these regions may not be generalizable to SSA primarily due to differences in migration patterns. SSA migrants typically migrate to other African countries or outside the continent with no intention of returning, while Latin American and Asian migrants are typically temporary migrants who return to their country of origin (Ratha et al., 2011).

Our study utilizes the Migration and Remittances Household Surveys conducted by the World Bank between 2009 and 2010 as part of the Africa Migration Project (AMP). These cross-sectional household surveys provide comprehensive information about migration, remittances, housing conditions, household assets and expenditures, and other socioeconomic and demographic characteristics. The dataset also provides the opportunity to analyze remittance flows by sources, namely, internal remittances, within-Africa remittances, and out-of-Africa remittances. We use data on five predominantly remittance-receiving countries in the AMP: Uganda, Kenya, Nigeria, Burkina Faso, and Senegal. An important characteristic of the AMP surveys is that they are standardized across countries, which allows for easy aggregation and comparison. The AMP surveys enable us to provide country-specific results and explore the effect heterogeneity across countries in SSA.

We define investment expenditure as an outlay for which the household expects financial returns in the future. Human capital investments are broadly defined to have two components – expenditure on education and health. Education investments are households' expenditure on tuition payment, purchase of school uniforms, books, and other related expenditures. Health investments are households' expenditure on doctor fees, hospital fees, and cost of diagnostics tests and medicine. Physical capital investments are households' expenditure on setting up a business, opening a store, purchasing farming equipment such as tractors, and purchasing other productive assets. Finally, social capital investments are households' expenditure on festivals, weddings, and funerals. Households that spend on festivals, either as contributions to the village or in private celebrations, receive tangible returns in the form of higher social status, access to larger social networks to protect against adverse economic shocks, and access to credit markets (Rao, 2001).

To identify the effect of remittances on household investment decisions, we use a recursive bivariate probit model and instrumental variables (IV) approach. The recursive bivariate probit model simultaneously estimates remittance receipt and investment decisions while incorporating the remittance-receipt variable in the investment decision equation. The identification of the recursive bivariate probit model parameters requires at least one variable (i.e., instrumental variable) in the remittance-receipt equation that is excluded from the investment decision equation (Bhattacharya et al., 2006; Horrace and Oaxaca, 2006; Jena, 2018; Wooldridge, 2002). Our primary outcome variables are binary indicators that equal one if the household made an investment expenditure in the previous 6 months before the interview and zero otherwise. Similarly, our treatment variable is a binary indicator, which equals one if the household has received remittances in the previous 12 months before the interview and zero otherwise. Since the investment decision and remittance receipts are binary variables and remittance receipt is potentially endogenous, the regression analysis employs a recursive bivariate probit model. However, we also implement a two-stage least squares (2SLS) approach as a robustness check. In addition, we conduct intensive margin analysis using the actual amounts of investment expenditures and remittances.

We account for the potential endogeneity of remittances by using historical migration networks. This instrument has been used previously in the migration literature (see Acosta, 2011; Coon, 2016; McKenzie and Rapoport, 2011). We define historical migration networks as district-level historical migration rates. District-level historical migration rates are obtained

from Population and Housing censuses – Burkina Faso 1996, Kenya 1999, Nigeria 2006, Senegal 1988, and Uganda 2002. The identifying assumption is that historical migration networks predict current migration rates and the subsequent inflow of remittances but do not directly affect a household's current investment decisions except through migration and remittances.

We find that remittances positively affect human, physical, and social capital investment in most sample countries. Our findings are consistent with past studies that find positive effects of remittances on human capital (Amuedo-Dorantes and Pozo, 2010), physical capital (Jena, 2018), and social capital (Fransen, 2015). However, we find that remittances reduce health and social capital investment in Nigeria and physical capital investment in Burkina Faso.

We check the robustness of our main results by using different specifications, different definitions of our key explanatory and outcome variables, and relaxing the exclusion restriction assumption. First, we implement Nevo and Rosen (2012)'s imperfect instrumental variables (IIV) approach that relaxes the exogeneity assumption by allowing the instrument to be correlated with the regression error term. The key assumption here is that the correlation between the instrument and error term is weaker than the correlation between the instrument and endogenous variable. Our results are largely robust to relaxing the exclusion restriction. Next, we consider a continuous treatment variable – the amount of cash remittances received by the household – and our main result persists. Finally, we used a continuous treatment (i.e., the cash amount of remittances) and a continuous outcome variable (i.e., the cash amount of investment expenditure), and the results are qualitatively similar to our main results. This suggests that our results are robust to relaxing the exclusion restriction, using different model specifications, and different definitions of the treatment and outcome variables.

We also explore the heterogeneity of our results across three different dimensions. First, we investigated how households with migrants and households without migrants differ in their investment decisions. Our results show that there is some variation in investment decisions between the two groups. However, our main results are driven by households with migrants. Next, we consider the effect of remittance sources on a household's investment decisions. Heterogeneity by remittance sources is important because the remittance literature points out that remittance sources contain critical information such as the relative size of remittances, migrant's control over the household's use of remittances, and transfer of values and norms. We find interesting patterns in investment by remittance sources: internal remittances matter more for education investment, within-Africa remittances are more likely to increase health investment, and out-of-Africa remittances are more likely to increase physical and social capital investment.

We also explore the potential mechanisms through which remittances affect households' investment decisions. In particular, we examine the income effect, substitution effect, and migration expectations effect. We use consumption expenditure and asset ownership as proxies to measure the income effect. We find that the income effect of remittances mainly drives the positive effect on capital investment. We use the labor supply response of adult household members to capture the labor substitution effect, and we find evidence of lower labor supply only in Kenya and Senegal. Finally, we examine the migration expectations effect using the children's (i.e., aged 6–15 years) labor force participation and school attendance. Our results

show that children in remittance-receiving households do not disproportionately drop out of school to join the labor force in most sample countries.

Our study contributes to the existing literature in the following ways. First, we contribute to the limited but growing literature on the impact of remittances on household investment decisions by providing empirical evidence for the understudied sub-Saharan Africa region. Second, our study uses data for five SSA countries and disaggregates investment expenditure into three categories – human capital, physical capital, and social capital investment. Our analysis allows us to compare the effect of remittances across countries using a standardized dataset. Past studies only study one type of capital investment and one country at a time. For instance, Jena (2018) and Ajefu (2018) studied only physical capital investment in Kenya and Nigeria, respectively. In addition, addressing the multiplicity of the investment alternatives allows us to explore the heterogeneity among the investment types and check for substitutability. Third, we identify the heterogeneous effect of remittances from domestic, within-Africa, and out-of-Africa sources on receiving households' investment decisions; past studies mostly focus on only international remittances or only internal remittances, and a few explore internal and international remittances. Finally, we explore several mechanisms through which remittances affect investment decisions. Existing studies assume that the income effect is the main mechanism; however, they do not demonstrate this empirically.

Our study has important policy implications. First, we provide further evidence that remittances can contribute to economic development through productive investments. Thus policymakers in SSA can design policies aimed at reducing remittance transfer costs to harness remittances and foster local economic development. Our study is also relevant for the local and international organizations designing business models and financial instruments to maximize the impact of remittances on economic development. Understanding the heterogeneous effect of remittance sources will help these organizations design effective financial instruments to boost capital formation and income generation in the remittance-receiving communities. For instance, policymakers can imitate Kenya's M-PESA – a mobile banking service – to facilitate the transfer of internal remittances. This is important since internal remittances matter most for education investment in SSA.

The rest of the paper is organized as follows. In Section 2, we provide the conceptual framework that explains the linkage between remittances and capital investment. We describe the data and methodology in Sections 3 and 4, respectively. In Section 5, we discuss our main results. Next, we present the robustness checks in Section 6, heterogeneity analysis in Section 7, and effect mechanisms in Section 8. Finally, we conclude the paper in Section 9.

2 Conceptual Framework

In the literature, economic migration decisions have been explained by the role of remittances. In these decisions, households send migrants to urban centers, or out of the country, with a desire to increase household income level and to diversify income sources (Adams, 1998; Clemens and Ogden, 2020; Rosenzweig and Stark, 1989; Stark, 1991). Theoretical models present different motives for sending remittances: altruism, insurance contract, loan contract, and investment or inheritance motive (Lucas and Stark, 1985). The altruism model posits that

remittances are sent because migrants care about their left-behind family members (Lucas and Stark, 1985; Stark, 2009). The insurance contract model suggests that remittances result from an implicit contract between the households and migrants to protect the household against shocks (Cox, et al., 1998; Rosenzweig and Stark, 1989). The loan contract model argues that remittances are repayments for an informal loan taken out by the migrants from their families to enhance their human capital and finance the cost of migration (Poirine, 1997). The first three models – altruism, insurance contract, and loan contract – are silent about the investment use of remittances or assume that remittances are not invested. The investment or inheritance motive suggests that migrants send remittances because they aspire to inherit family property, intend to return home, and consider that left-behind family members are trustworthy agents to maintain assets on their behalf (Lucas and Stark, 1985; Taylor and Wyatt, 1996).

The migration literature further points out that the four remittance motives may not be mutually exclusive. It may be the case that remittances are sent for all the motives at the same time, with each motive comprising a share of it (Poirine, 1997). It could also be the case that one of these motives becomes dominant at different stages of migration. For instance, at the early stage of migration, remittances sent back are typically for loan repayments. However, regardless of the motive, remittances are expected to positively affect household income at home if migrants earn a substantially higher income in the destination country (Stark and Bloom, 1985).

Remittances affect household investment decisions through three main channels – income effect, substitution effect, and migration expectations (Amuedo-Dorantes, 2014). First, remittances help ease households' resource constraints; the income effect of remittances reduces the need for households to send their children to join the labor force and enable households to pay tuition and other education-related expenses. Several studies in the literature have found a positive effect of remittances on education investments and the education outcomes of children left behind (Alcaraz et al., 2012; Amuedo-Dorantes and Pozo, 2010; Cox-Edwards and Ureta, 2003). Similarly, higher resource availability leads to better health outcomes of the household members through investment in improved lifestyle and spending more on health care (Ambrosius and Cuezuecha, 2013; Berloff and Giunti, 2019; Hines and Simpson, 2018; Salas, 2014). Furthermore, the income effect of remittances positively affects physical capital investment through facilitating savings and improving access to the financial market (Amuedo-Dorantes and Pozo, 2014; Chiodi et al., 2012; Jena, 2018).

The income effect of remittances may also affect a household's spending on social events such as birthdays, wedding ceremonies, and funerals. In developing countries where social safety net programs are relatively weak and private insurance services are inaccessible, households rely on informal risk coping mechanisms to mitigate the impact of adverse economic shocks. Relying on relatives, friends, and community members is the most frequently used informal coping mechanism (Carter and Maluccio, 2003; Gerry and Li, 2010). Rao (2001) shows that spending on big social events generates tangible returns, such as paying a lower price for items in the local marketplace and achieving higher social status. A relatively stronger social network and social status signal the creditworthiness of the household and increase access to credit markets. Thus, investing in building social networks through spending on social events is a form of social capital as it not only hedges against future shocks but also generates

other economic returns. However, remittances can act as a risk mitigation strategy, which may reduce the need to rely on social networks to cope with economic shocks. Consequently, the effect of remittances on social capital investment is ambiguous and can only be determined empirically.

Second, remittances can have a substitution effect because they may raise the reservation wage – the lowest wage at which a person is willing to work – of the left-behind household members and reduce the opportunity cost of leisure. Assuming leisure is a normal good, the substitution effect provides left-behind household members with incentives to lower labor supply. This phenomenon is also related to a moral hazard problem whereby left-behind household members are less inclined to engage in income-generating activities, which eventually leads to dependency on remittances (Amuedo-Dorantes, 2014; Démurger, 2015). The lowering of labor supply in response to receiving remittances is well documented in the literature (Amuedo-Dorantes and Pozo, 2006; Binzel and Assaad, 2011; Mendola and Carletto, 2012). In addition, remittance dependence due to the substitution effect of remittances may reduce the likelihood of capital investments as some physical assets (e.g., tractors) need to be combined with labor to be productive.

Finally, remittances can affect households' investment decisions through migration expectations. Left-behind household members in a remittance-receiving household may have high expectations of migration and be reluctant to engage in income-generating activities. Moreover, migration expectations of left-behind household members can negatively affect human capital formation. Children may drop out of schools if they perceive lower returns to education in their destination country. For instance, McKenzie and Rapoport (2011) found that boys in migrant households in Mexico are less likely to complete junior secondary school due to migration expectations and lower returns of Mexican education in the US labor market, especially in the context of illegal migration.

Theoretically, it is difficult to unambiguously determine the effect of remittances on household investment decisions. Thus, we set out to empirically investigate this phenomenon. Focusing on three investment categories – human capital, physical capital, and social capital – also helps us understand whether household investment decisions vary by type of investment expenditure.

3 Data Description

We used data from the Migration and Remittances Household Surveys conducted by the World Bank between 2009 and 2010. These household surveys are part of the AMP and are designed to provide information about the volume, causes, and impacts of migration and remittances in sub-Saharan Africa (Plaza et al., 2011). An important feature of the surveys is that they are standardized across countries, which allows for easy aggregation and comparison. We use data on five predominantly remittance-receiving countries from the AMP, namely Burkina Faso, Kenya, Nigeria, Senegal, and Uganda. The surveys are cross-sectional and provide comprehensive information about migration, remittances, housing conditions, household assets and expenditures, and other socioeconomic and demographic characteristics. The surveys contain information about households with no migrants, internal (domestic) migrants, within-Africa migrants, and out-of-Africa migrants, which we use to create a variable representing the source

of remittances. The principal respondent to the survey was the household head or their representative, who reported information about the migrant(s).

We define investment expenditure as an outlay for which the individual or household expects financial returns in the future. Following Jena (2018), we define physical capital investment as households' expenditure on setting up a business, opening a store, purchasing farming equipment such as tractors, and purchasing other productive assets. Human capital investments are broadly defined to have two components – expenditure on education and health. Education expenditures include tuition payment, purchase of school uniforms, and books. In many SSA countries, the public education system is subsidized; for instance, Nigeria's Universal Basic Education (UBE) up to Junior High School. Such public programs imply that there is little need to spend on tuition fees. However, despite subsidized public education, households still incur educational expenses such as buying textbooks, uniforms, and after-school lessons. Health care expenditures include doctor fees, hospital fees, and cost of diagnostics tests and medicine. Like education, the public health system in many SSA countries is highly subsidized. Despite subsidized health systems, not all services are available in public facilities, and not all services are free. Out-of-pocket expenditures on diagnostic tests and medicine comprise a substantial share of health expenditure in most SSA countries. Finally, following Rao (2001), we define social capital investments as households' expenditure on festivals, weddings, and funerals.

Households report the investment expenditures made during the last 6 months before the interview date. At the extensive margin, we use dummy indicators capturing whether the household made an investment expenditure or not in the preceding 6 months. Along with this extensive margin analysis, we conduct an intensive margin analysis using the actual amount of investments.

The control variables are household head characteristics such as gender of household head, whether the household head is a paid employee, whether the household head is self-employed, whether the household head has secondary education, whether the household head has above secondary education, whether the household head is aged 45–60 years old, whether the household head is above 60 years old, and socioeconomic characteristics of the household, such as number of children, number of elderly, and location of the household. We also control for the overall resource availability to the household by including per capita income. Per capita income is proxied by per capita expenditure following the standard practice in the literature as income data often suffer from measurement errors (Deaton, 2018; Jena, 2018).

Table 1 presents summary statistics of the outcome and control variables for the countries analyzed. Considerable variation exists between remittance-receiving and non-remittance-receiving households across all the countries in our sample. The first noticeable factor in Table 1 is that remittance-receiving households, on average, are more likely to be female headed than non-remittance-receiving households. Another interesting observation is that household heads in remittance-receiving households are on average less likely to hold paid employment or self-employment compared to non-remittance-receiving households in all the countries in our sample. Furthermore, for all the investment categories considered, remittance-receiving households, on average, spend more than non-remittance-receiving households. Kenya, on average, receives the highest amount of remittances, followed by Senegal and then Nigeria. Conversely, Burkina Faso receives the smallest remittances on average. Table A1 in Appendix presents correlation coefficients between the treatment and outcome variables.

Table 1 Summary statistics

	Uganda			Kenya			Nigeria			Burkina Faso			Senegal		
	Received Remittances (= if yes)	Not Received Remittances (= if yes)	Received Remittances (= if yes)	Received Remittances (= if yes)	Not Received Remittances (= if yes)	Received Remittances (= if yes)	Received Remittances (= if yes)	Not Received Remittances (= if yes)	Received Remittances (= if yes)	Received Remittances (= if yes)	Not Received Remittances (= if yes)	Received Remittances (= if yes)	Received Remittances (= if yes)	Not Received Remittances (= if yes)	Received Remittances (= if yes)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)					
Female household head (=1 if yes)	0.375 (0.485)	0.282 (0.45)	0.425 (0.495)	0.221 (0.415)	0.167 (0.374)	0.074 (0.262)	0.089 (0.285)	0.051 (0.221)	0.431 (0.496)	0.186 (0.389)					
Head is paid employee (=1 if yes)	0.243 (0.43)	0.254 (0.435)	0.238 (0.426)	0.408 (0.492)	0.214 (0.41)	0.297 (0.457)	0.021 (0.143)	0.033 (0.178)	0.107 (0.31)	0.217 (0.413)					
Head is self-employed (=1 if yes)	0.546 (0.499)	0.631 (0.483)	0.381 (0.486)	0.383 (0.486)	0.576 (0.494)	0.626 (0.484)	0.904 (0.294)	0.935 (0.247)	0.485 (0.5)	0.533 (0.499)					
Head has secondary education (=1 if yes)	0.336 (0.473)	0.326 (0.469)	0.262 (0.44)	0.296 (0.457)	0.236 (0.425)	0.214 (0.41)	0.034 (0.181)	0.036 (0.187)	0.142 (0.349)	0.15 (0.357)					
Head has above secondary education (=1 if yes)	0.418 (0.494)	0.373 (0.484)	0.251 (0.434)	0.261 (0.439)	0.521 (0.5)	0.545 (0.498)	0.012 (0.108)	0.006 (0.078)	0.055 (0.228)	0.11 (0.313)					
Head's age 45–60 years (=1 if yes)	0.352 (0.478)	0.224 (0.417)	0.284 (0.451)	0.301 (0.459)	0.433 (0.496)	0.365 (0.482)	0.336 (0.473)	0.306 (0.461)	0.308 (0.462)	0.386 (0.487)					
Head's age >60 years (=1 if yes)	0.204 (0.404)	0.112 (0.315)	0.316 (0.465)	0.149 (0.356)	0.284 (0.451)	0.114 (0.318)	0.318 (0.466)	0.157 (0.364)	0.336 (0.473)	0.255 (0.436)					
Log household income	7.6 (1.091)	7.181 (1.09)	7.974 (1.102)	7.755 (1.253)	8.574 (0.902)	8.321 (0.876)	7.661 (0.787)	7.591 (0.852)	8.829 (0.731)	8.612 (0.813)					

(Continued)

Table 1 Continued

	Uganda		Kenya		Nigeria		Burkina Faso		Senegal	
	Received Remittances (= if yes)	Not Received Remittances (= if yes)	Received Remittances (= if yes)	Not Received Remittances (= if yes)	Received Remittances (= if yes)	Not Received Remittances (= if yes)	Received Remittances (= if yes)	Not Received Remittances (= if yes)	Received Remittances (= if yes)	Not Received Remittances (= if yes)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Number of children in the household	2.299 (1.998)	2.045 (1.929)	1.432 (1.54)	1.47 (1.614)	6.057 (3.183)	6.039 (3.436)	1.529 (1.545)	1.492 (1.417)	4.277 (3.631)	3.18 (2.934)
Number of elderly in household	0.332 (0.584)	0.175 (0.433)	0.583 (0.747)	0.344 (0.637)	0.504 (0.722)	0.253 (0.562)	0.67 (0.847)	0.416 (0.675)	0.703 (0.753)	0.515 (0.709)
Household is in urban area (=1 if yes)	0.51 (0.501)	0.487 (0.5)	0.423 (0.494)	0.54 (0.499)	0.456 (0.498)	0.513 (0.5)	0.067 (0.25)	0.058 (0.235)	0.631 (0.483)	0.692 (0.462)
Remittances amount (in USD)	776.47 (2,391.68)	0 (0)	2,170.59 (10,769.82)	0 (0)	1,847.85 (6,819.30)	0 (0)	181.86 (427.82)	0 (0)	1,890.90 (2,752.23)	0 (0)
Domestic migration network (%)	-1.915 (7.992)	-2.849 (8.077)	0.106 (0.169)	0.152 (0.218)	0.129 (0.082)	0.108 (0.081)	0.109 (0.031)	0.103 (0.023)	3.486 (2.122)	3.67 (2.014)
International migration network (%)	- (-)	- (-)	0.037 (0.045)	0.045 (0.052)	- (-)	- (-)	0.356 (0.17)	0.329 (0.163)	0.101 (0.116)	0.128 (0.122)
Education investment (in USD)	481.154 (769.14)	269.02 (585.13)	464.76 (965.26)	375.07 (911.61)	607.35 (944.09)	360.37 (709.12)	71.07 (134.21)	50.86 (109.27)	143.80 (209.14)	106.97 (190.90)
Health investment (in USD)	89.89 (131.07)	48.15 (83.14)	181.44 (420.75)	128.95 (363.64)	157.03 (236.93)	100.82 (177.72)	81.46 (116.24)	74.74 (111.63)	203.65 (299.5)	145.53 (244.77)
Physical capital investment (in USD)	91.94 (437.17)	28.83 (232.32)	142.41 (745.31)	56.58 (384.57)	211.58 (821.46)	123.18 (591.59)	19.33 (70.58)	14.077 (51.69)	34.77 (134.67)	18.77 (92.35)
Social capital investment (in USD)	30.01 (72.08)	17.19 (53.70)	100.34 (411.34)	67.70 (327.98)	186.17 (603.84)	112.51 (432.07)	52.20 (92.62)	57.22 (95.56)	269.08 (412.80)	217.64 (346.22)
Number of observations	304	1,299	789	1,032	842	1,188	764	1,131	839	866

Notes: This table presents the mean and standard deviation of the key variables.

Standard deviations are presented in parentheses.

4 Empirical Methodology

We model households' investment decisions as a function of their remittance-receipt status and a vector of other explanatory variables. Adams (2011) and many others have noted that empirical analyses of migration and remittances have failed to provide needed insights because of various econometric issues. One such issue is endogeneity, which can arise from selection bias and simultaneity. First, migrants are a self-selected group as migration and remittance transfers are not random events. Remittance-receiving households might differ systematically from non-remittance-receiving households in unobservable characteristics, such as migration aspirations, entrepreneurial ambitions, level of altruism, and household-specific norms. Given that these characteristics are unobservable, estimating a regression model without properly accounting for them may lead to the classic omitted variables bias. Next, simultaneity may arise from the reason for sending the remittances. For example, it could be the case that the migrant sends remittances to take advantage of a business opportunity in the home community. In this case, remittances did not lead to investment expenditures; instead, the migrant's desire to invest led to the transfer of remittances. Thus, researchers need to address endogeneity issues carefully to obtain unbiased estimates.

Since the investment decision and the remittance receipt are binary variables in our main estimation and the latter is likely to be endogenous, we employ a recursive bivariate probit model (Bhattacharya et al., 2006; Hoxby and Oaxaca, 2006; Jena, 2018; Wooldridge, 2002). The recursive bivariate probit model accounts for endogeneity by simultaneously estimating remittance receipt and investment decisions while incorporating the remittance-receipt variable in the investment decision equation. We estimate the following recursive bivariate probit model:

$$R_{it}^* = X_i' \beta_1 + \varepsilon_{it} \quad (1)$$

$$Y_{it}^* = R_{it} \delta_1 + Z_i' \beta_2 + \varepsilon_{it} \quad (2)$$

and $E[\varepsilon_{it} | X, Z] = E[\varepsilon_{it} | X, Z] = 0$.

$$Var[\varepsilon_{it} | X, Z] = Var[\varepsilon_{it} | X, Z] = 1$$

$$Cov[\varepsilon_{it}, \varepsilon_{it} | X, Z] = \rho$$

where R_{it}^* and Y_{it}^* are latent dependent variables that determine the propensity of remittance receipt and the propensity to make an investment expenditure by the household, respectively. X_i' and Z_i' are vectors of covariates, and ε_{it} and ε_{it} are unobservable error terms and are assumed to be correlated. The correlation between the remittance-receipt equation and investment decision equation is ρ . We let two observable indicator variables represent the latent variables R_{it}^* and Y_{it}^* such that:

$$R_{it} = \begin{cases} 1 & \text{if } R_{it}^* > 0 \\ 0 & \text{if } R_{it}^* \leq 0 \end{cases} \quad (3)$$

$$Y_{it} = \begin{cases} 1 & \text{if } Y_{it}^* > 0 \\ 0 & \text{if } Y_{it}^* \leq 0 \end{cases} \quad (4)$$

where R_{it} indicates the remittance-receipt status of the household, and Y_{it} captures the households' investment decision. This study aims to empirically obtain estimates for the parameter δ_1 in Eq. (2), the parameter corresponding to the endogenous variable, R_{it} .

Based on Eqs (3) and (4), the four basic probabilities of the bivariate probit model are:

$$Prob[R_{it} = 1, Y_{it} = 1] = F[X_i'\beta_1, Z_i'\beta_2 + \delta_1; \rho]$$

$$Prob[R_{it} = 1, Y_{it} = 0] = F[X_i'\beta_1, -Z_i'\beta_2 + \delta_1; -\rho]$$

$$Prob[R_{it} = 0, Y_{it} = 1] = F[-X_i'\beta_1, Z_i'\beta_2; -\rho]$$

$$Prob[R_{it} = 0, Y_{it} = 0] = F[-X_i'\beta_1, -Z_i'\beta_2; \rho]$$

where $F[\cdot]$ indicates the distribution function of the bivariate normal distribution with correlation parameter ρ .

The identification of the recursive bivariate probit model parameters requires at least one variable (i.e., instrumental variable) in the remittance-receipt equation (i.e., Eq. (1)) that is excluded from the investment decision equation (i.e., Eq. (2)). A credible instrument should be strongly correlated with the endogenous regressor of interest (i.e., receipt of remittances in our case) but uncorrelated with the outcome of interest (i.e., investment decisions). While the first condition can be easily tested, the second condition is practically untestable. Consequently, it is difficult to find credible instruments, and only a few instruments are generally acceptable in the migration literature. We use historical migration networks as an instrument for remittances as they are one of the generally acceptable instruments that have been widely used in the migration literature (Acosta, 2011; Alcaraz et al., 2012; Calero et al., 2009; Coon, 2016; Hildebrandt et al., 2005; McKenzie and Rapoport, 2011).

The argument for using historical migration networks as an instrument is that such networks can reduce the cost of migration and induce current migration by providing access to information and facilitating services at the destination (i.e., assistance with accommodation and employment opportunities). The identifying assumption is that historical migration networks predict current migration rates and the subsequent inflow of remittances but do not directly affect a household's current investment decisions except through migration and remittances. Households with more extensive migration networks are expected to have lower migration costs, which increases their likelihood of having a migrant member and receiving remittances (Coon, 2016).

We define historical migration networks as district-level historical migration rates. District-level historical migration rates are obtained from Population and Housing censuses – Burkina Faso 1996, Kenya 1999, Nigeria 2006, Senegal 1988, and Uganda 2002.¹ We created domestic and international migration networks at the district level based on data availability. Domestic migration networks are defined as the proportion of the total population of a district that migrated to another district within the same country. Similarly, international migration networks are defined as the proportion of the total population of a district that migrated out

¹ Data source: Minnesota Population Center. Integrated Public Use Microdata Series, International: Version 7.3 [dataset]. Minneapolis, MN: IPUMS, 2020. <https://doi.org/10.18128/D020.V7.2>

of the country. For Uganda, we only have census data on net migration, which is total out-migration minus total in-migration in a district, and we use this variable as our instrument.

We define a district as a second-tier administrative unit within a country. This refers to a district in Uganda and Kenya, local government in Nigeria, and department in Burkina Faso and Senegal. Districts cover large geographic areas and populations, making it difficult for households to affect the migration networks in any significant way. The domestic migration network is about 0.1% in Kenya, Nigeria, and Burkina Faso, which suggests that, on average, one in 1,000 households have a domestic migrant (see Table 1). The domestic migration network in Uganda is negative, which suggests that, on average, districts experience more in-migration than out-migration. We have international migration network data for Kenya, Burkina Faso, and Senegal. Of these countries, Burkina Faso has the highest international migration network – about three in 1,000 households. In our estimation, we use both domestic and international migration networks in Kenya and Burkina Faso. However, because data is unavailable elsewhere, we use only domestic migration networks in Uganda and Nigeria and only international migration networks in Senegal. We argue that either historical domestic or international migration rates capture the overall migration network in the district.

The first stage regression shows that the migration network is statistically significant at less than 5% significance level (see Table 2). The F -statistic in the first stage is higher than 10 for all the countries under review except Uganda. However, it is close to 10 for Uganda. We check for overidentifying restrictions on our instruments using the Hansen's J -statistic. The joint null hypothesis states that the instruments are valid, and rejecting the null hypothesis implies that at least one of the instruments is not valid. In our case, we cannot reject the null hypothesis for any of the countries because the p -values are higher than the traditional significance levels.

A potential threat to identification using district-level historical migration networks as an instrument is that previous remittance flows, return migration, and the transfer of knowledge via migration may be correlated with district-level factors such as education facilities, health facilities, and a better investment climate. Consequently, historical migration networks could be correlated with the current level of infrastructure in a district. One way to account for this violation of the exclusion restriction is to control for district-level variation in infrastructure. However, it is difficult to find data on infrastructure at the district level in SSA. Consequently, we implement the IIV approach introduced by Nevo and Rosen (2012) as a robustness check. Nevo and Rosen (2012)'s IIV approach relaxes the exogeneity assumption by allowing the instrument to be correlated with the regression error term. The key assumption here is that the correlation between the instrument and error term is weaker than the correlation between the instrument and endogenous variable. The IIV approach produces bound estimates of the endogenous parameter of interest rather than a point estimate.

5 Main Results

We present our main estimation results in Table 3. The treatment variable is “received remittances,” which is an indicator variable that takes one if a household received remittances in the 12 months before the survey, and zero otherwise. The outcome variables are investment decision indicators that equal one if a household made a capital investment in the 6 months before the survey and zero otherwise. Columns 1–4 show the naïve probit estimates, while columns

Table 2 First stage regression estimates

	Uganda	Kenya	Nigeria	Burkina Faso	Senegal
	(1)	(2)	(3)	(4)	(5)
Domestic migration network	0.004*** (0.001)	−0.445*** (0.090)	0.646*** (0.130)	2.411*** (0.436)	– –
International migration network	– –	0.632* (0.356)	– –	0.312*** (0.068)	−0.535*** (0.113)
Household head is female (=1 if yes)	0.082*** (0.023)	0.230*** (0.025)	0.172*** (0.034)	0.151*** (0.047)	0.288*** (0.026)
Head paid employee (=1 if yes)	−0.078** (0.040)	−0.143*** (0.032)	−0.200*** (0.039)	−0.227*** (0.082)	−0.118*** (0.041)
Head self-employed (=1 if yes)	−0.096*** (0.034)	−0.085*** (0.029)	−0.137*** (0.034)	−0.078 (0.055)	−0.078*** (0.030)
Head has secondary education (=1 if yes)	0.061** (0.024)	0.014 (0.027)	0.039 (0.031)	0.058 (0.064)	0.046 (0.035)
Head has above secondary education (=1 if yes)	0.076** (0.030)	0.040 (0.032)	0.018 (0.030)	0.177 (0.131)	−0.022 (0.048)
Head's age 45–60 (=1 if yes)	0.111*** (0.026)	0.022 (0.026)	0.123*** (0.024)	0.114*** (0.025)	−0.065** (0.026)
Head's age is >60 (=1 if yes)	0.073 (0.060)	0.125*** (0.045)	0.212*** (0.044)	0.212*** (0.037)	−0.017 (0.038)
Log household income (in USD)	0.057*** (0.010)	0.071*** (0.011)	0.085*** (0.013)	0.024* (0.014)	0.099*** (0.017)
Number of children in household	0.010* (0.005)	−0.001 (0.007)	−0.004 (0.003)	0.015* (0.008)	0.017*** (0.004)
Number of elderly in household	0.080* (0.041)	0.036 (0.026)	0.026 (0.024)	0.039** (0.018)	0.060*** (0.022)
Household is in urban area (=1 if yes)	−0.002 (0.024)	−0.070*** (0.025)	−0.066*** (0.023)	−0.075 (0.052)	−0.077*** (0.027)
Constant	−0.285*** (0.072)	−0.109 (0.082)	−0.324*** (0.108)	−0.201 (0.137)	−0.364** (0.135)
Observations	1,603	1,821	2,029	1,895	1,705
F-statistics (test of excluded instrument)	7.24	16.11	24.68	20.58	22.45
SW Chi-squared statistics (underidentification test)	7.3	32.47	24.84	41.47	22.62
SW F-statistics (weak identification test)	7.24	16.11	24.67	20.58	22.45
Cragg-Donald Wald F-statistic (weak identification test)	7.78	14.68	24.44	20.06	23.19
Hansen's J-statistic (overidentification test of instruments)	–	0.382	–	2.87	–

Notes: This table presents the first stage estimates of our instrumental variable estimation. Robust standard errors are presented in parentheses. The SW F-statistics is a test of weak identification with a null hypothesis that the endogenous regressor is weakly identified. The Hansen's J-statistics are the test statistics from the Sargan–Hansen test of overidentifying restrictions. The joint null hypothesis is that the instruments are the valid instruments. The outcome variable in all columns is an indicator that equals one if a household received remittances.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

SW, Sanderson–Windmeijer.

Table 3 Effect of remittances on household investment decision

	Probit				Recursive biprobit			
	Human capital		Physical capital (=1 if yes)	Social capital (=1 if yes)	Human capital		Physical capital (=1 if yes)	Social capital (=1 if yes)
	Education (=1 if yes)	Health (=1 if yes)			Education (=1 if yes)	Health (=1 if yes)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-A: Uganda								
Received remittances (=1 if yes)	0.049* (0.028)	−0.016 (0.027)	0.025 (0.020)	0.051* (0.028)	0.021 (0.023)	0.002 (0.054)	0.017* (0.009)	0.030* (0.017)
Mean of the outcome variable	0.684	0.792	0.119	0.299	0.684	0.792	0.119	0.299
Observations	1,603				1,603			
Panel-B: Kenya								
Received remittances (=1 if yes)	0.021 (0.022)	0.014 (0.022)	0.053*** (0.016)	0.015 (0.024)	0.174*** (0.014)	0.182*** (0.007)	0.106*** (0.028)	0.169*** (0.011)
Mean of the outcome variable	0.594	0.676	0.141	0.418	0.594	0.676	0.141	0.418
Observations	1,821				1,821			
Panel-C: Nigeria								
Received remittances (=1 if yes)	0.052** (0.020)	0.021 (0.020)	0.047*** (0.018)	0.042* (0.022)	0.170*** (0.017)	−0.059** (0.025)	0.113*** (0.022)	−0.172*** (0.005)
Mean of the outcome variable	0.729	0.764	0.185	0.374	0.729	0.764	0.185	0.374
Observations	2,029				2,029			
Panel-D: Burkina Faso								
Received remittances (=1 if yes)	0.096*** (0.022)	0.016 (0.016)	0.000 (0.020)	0.011 (0.023)	0.157*** (0.024)	0.186*** (0.017)	−0.180*** (0.020)	0.148*** (0.019)
Mean of the outcome variable	0.645	0.875	0.231	0.649	0.645	0.875	0.231	0.649
Observations	1,895				1,895			
Panel-E: Senegal								
Received remittances (=1 if yes)	0.086*** (0.023)	−0.002 (0.020)	0.031** (0.015)	−0.048** (0.023)	0.189*** (0.051)	0.033 (0.056)	0.016 (0.055)	0.209*** (0.013)
Mean of the outcome variable	0.672	0.825	0.096	0.734	0.672	0.825	0.096	0.734
Observations	1,705				1,705			

Notes: This table reports the average marginal effects from the probit and recursive bivariate probit models. Robust standard errors are presented in parentheses. The variable of interest, received remittances, is an indicator that takes one if a household received remittances, and zero otherwise. Outcome variables are also indicator variables that equal one if a household made capital investment, and zero otherwise. Control variables are female household head, head is a paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is above 60 years, log household income, number of children in the household, number of elderly in the household, and location is urban.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

5–8 show the recursive bivariate probit estimates. Panels A–E present the results for Uganda, Kenya, Nigeria, Burkina Faso, and Senegal, respectively. All columns of Table 3 include control variables.

We present the average marginal effects from the probit and the recursive bivariate probit models in Table 3 and the estimated coefficients in Table A3 in Appendix. In addition, we present the robust standard errors in parentheses. Abadie et al. (2017) argue that when the treatment assignment is at the participant level, there is no need to cluster standard errors. From an experimental design perspective, our treatment assignment and our unit of analysis are at the household level, and so, we do not cluster our standard errors; rather, we present robust standard errors. Comparing the results of naïve probit and recursive bivariate probit estimates, we see that the naïve probit estimates are biased downwards. Downward bias in the probit estimation implies the presence of endogeneity due to reverse causality. Consequently, we focus on interpreting the recursive bivariate probit estimates.

5.1 Effect on education investment

Column 5 (Table 3) shows the effect of remittance receipt on education investment. We see positive marginal effects on the received remittance variable in all the countries, which indicates that remittance-receiving households are more likely to invest in education, compared to non-remittance-receiving households. The marginal effects are statistically significant in all the countries except Uganda. The marginal effects show that remittance-receiving households are about 15–19% more likely to invest in education in Kenya, Nigeria, Burkina Faso, and Senegal. This finding is consistent with the literature (Acharya and Leon-Gonzalez, 2014; Alcaraz et al., 2012; Amuedo-Dorantes and Pozo, 2010).

As argued in the remittance literature, remittances may reduce human capital investment by raising the opportunity cost of education and lowering the incentive to study (Amuedo-Dorantes and Pozo, 2006; Antman, 2012). In our sample countries, we do not see such negative effects. However, this negative effect may counteract the positive effect and lead to a null result. The insignificant and relatively small (i.e., 2%) marginal effect of remittance receipt in Uganda may be a consequence of children dropping out of school due to migration expectations or making up for the migrant worker in home production.

5.2 Effect on health investment

Remittances can improve a household's living standard by stabilizing the household's income and easing budget constraints (Amuedo-Dorantes, 2014; Yang and Choi, 2007). The positive income effect of remittance can also improve access to electricity, better sanitary facilities, and acquisition of durable goods such as refrigerators and gas stoves, which significantly improves the health outcomes of household members. Similarly, remittances can significantly improve human capital through increased access to quality healthcare and health care expenditure. We test the hypothesis that remittances positively affect households' health expenditure and present the results in column 6 (Table 3).

We find significant positive marginal effects for received remittances in Kenya and Burkina Faso. Remittance-receiving households in Kenya and Burkina Faso are about 18% more likely

to spend on health than non-remittance-receiving households. This result is consistent with previous findings in the literature (Ambrosius and Cuecuecha, 2013; Berloff and Giunti, 2019; Hines and Simpson, 2018; Salas, 2014). However, our results also show that remittance-receiving households in Nigeria are about 6% less likely to spend on health care than non-remittance-receiving households. Kakhkharov et al. (2021) find a similar result in Uzbekistan. They argue that the reduction in health expenditure arises from allocating a large proportion of a household's budget to other expenditures.

5.3 Effect on physical capital investment

The positive income effect of remittances can facilitate savings and asset accumulation by easing households' credit constraints and improving access to the financial market. Dealing with remittances may also increase the financial literacy of the household members (Aggarwal et al., 2011). Higher financial literacy, bigger savings, and improved access to the financial market may facilitate physical capital investments such as establishing a business, purchasing farming equipment, and other productive assets.

Since most physical capital needs to be combined with some labor to be productive, we may not see the positive effect of remittance on physical capital investment if households face a substitution effect of remittances. Remittance, being non-labor income, has a substitution effect that creates incentives to cut back labor supply to continue receiving remittances (Amuedo-Dorantes, 2014; Killingsworth, 1983) – a moral hazard problem. Therefore, the observed effect of remittances on physical capital is the net effect of the income and substitution effects. We present our result on the effect of remittances on physical capital investment in column 7 of Table 3.

Similar to health investment, we see a mixed result for physical capital investment – a significant positive effect in Uganda, Kenya, and Nigeria, and a significant negative effect in Burkina Faso. More precisely, remittance-receiving households in Uganda, Kenya, and Nigeria are, respectively, 1.7%, 10.6%, and 11.3% more likely to invest in physical capital. In contrast, remittance-receiving households in Burkina Faso are 18% less likely to invest in physical capital compared to non-remittance-receiving households. This result suggests that the income effect of remittances dominates the substitution effect in Uganda, Kenya, and Nigeria, whereas it is not true in Burkina Faso. Our findings of positive effect on physical capital are consistent with the literature; for instance, Jena (2018) in Kenya, Osili (2004), and Ajefu (2018) in Nigeria all found similar results. On the other hand, we find null effects in Senegal, which could be due to the competing influence of the income and substitution effects. Other studies also found null effects, such as De and Ratha (2012) in Sri Lanka. The negative association between remittances and physical capital investment in Burkina Faso could be due to the relatively small size of remittance inflows. This is important in the context of the initial cash outlay that physical capital investment requires.

5.4 Effect on social capital investment

In developing countries with less well-established credit markets and social protection systems, households adopt informal risk coping mechanisms such as relying on family and social networks. These networks can be developed or maintained by contributing towards ceremonies

such as festivals, weddings, and funerals. Remittance-receiving households with positive income effects have more resources to spend on these ceremonies, thus building larger social capital than non-remittance-receiving households. On the contrary, as the migration literature points out, remittances, being an income diversification strategy, work as a risk coping mechanism. Therefore, if remittances work as an effective coping mechanism, it will reduce households' incentive to spend on building social capital.

In column 8 of Table 3, we present the effect of remittances on social capital investment. We find a significant positive effect in all the countries under review except Nigeria. Remittance-receiving households in Uganda, Kenya, Burkina Faso, and Senegal are about 3%, 17%, 15%, and 21%, respectively, more likely to invest in social capital than non-remittance-receiving households. Our findings support previous results in the literature, for instance, Gerber and Torosya (2013) in Georgia, and Rao (2001) in rural India. On the contrary, we find that remittances reduce the likelihood of investment in social capital by 17% in Nigeria. Other studies such as Fransen (2015) also find a negative effect of remittance on social capital in Burundi. This finding supports the notion that remittances can act as a risk coping mechanism and reduce the need for remittance-receiving households to invest in social capital.

To sum up our results, we find that remittances increase the likelihood of human, physical, and social capital investments in most of the countries studied. Based on the conceptual framework, we suggest that the positive income effect of remittances likely drives the positive effect of remittances on capital investment. Conversely, we find a negative effect of remittances on health and social capital in Nigeria, and on physical capital in Burkina Faso.

6 Robustness Checks

6.1 Relaxing the exclusion restriction assumption

We tested the robustness of our results using alternative estimation techniques and different specifications of our model. As mentioned in the methodology section, a potential threat to identification using historical migration networks is that previous remittance flows, return migration, and the transfer of knowledge via migration may be correlated with district-level factors such as education facilities, health facilities, and a better investment environment. This can lead to a violation of the exclusion restriction. We estimate a model using the IIV approach to address this potential violation of the exclusion restriction. We also present ordinary least squares (OLS) and two-stage least squares (2SLS) regression estimates to compare with the IIV estimates. The result of this analysis is presented in Table 4. Columns 1–4 present the OLS estimates, columns 5–8 present the 2SLS estimates, and columns 9–12 present the IIV estimates. The IIV estimation coefficient bounds are presented in brackets, and the corresponding 95% confidence intervals are presented in parentheses. The coefficients are statistically significant at the 5% significance level if the 95% confidence intervals do not contain zero.

In Table 4, we see the OLS coefficients are severely biased downward toward zero. The 2SLS coefficients in Table 4 and the bivariate results in Table 3 are qualitatively similar – they have the same sign of the coefficients. However, there are a few differences. First, in Uganda, the coefficient of education expenditure becomes significant while the coefficient of physical

Table 4 Alternative estimates of the effect of remittances on household investment decision

	OLS				2SLS				Imperfect IV			
	Human capital		Physical capital	Social capital	Human capital		Physical capital	Social capital	Human capital		Physical capital	Social capital
	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
Panel-A: Uganda												
Received remittances (=1 if yes)	0.051** (0.025)	-0.017 (0.026)	0.028 (0.022)	0.053* (0.031)	1.673** (0.684)	0.656 (0.468)	0.102 (0.262)	1.317** (0.619)	[0.051, 1.673] (0.002, 3.014)	[0.035, 0.102] (-0.029, 0.616)	[0.180, 1.317] (0.082, 2.530)	
Observations	1,603				1,603				1,603			
Panel-B: Kenya												
Received remittances (=1 if yes)	0.029 (0.022)	0.016 (0.022)	0.056*** (0.017)	0.015 (0.024)	0.694*** (0.219)	0.649*** (0.232)	0.471*** (0.129)	1.192*** (0.270)	(0.722, 0.842) (0.211, 1.792)	(0.853, 1.754) (0.293, 3.281)	(0.499, 0.625) (0.185, 1.246)	(1.436, 2.520) (0.705, 4.498)
Observations	1,821				1,821				1,821			
Panel-C: Nigeria												
Received remittances (=1 if yes)	0.051** (0.020)	0.020 (0.020)	0.049*** (0.019)	0.042* (0.023)	0.791*** (0.232)	-0.387** (0.195)	0.708*** (0.226)	-0.872*** (0.277)	(0.051, 0.791) (0.012, 1.246)	(-0.387, 0.020) (-0.786, 0.060)	(0.049, 0.708) (0.013, 1.150)	(-0.872, 0.042) (-1.415, 0.087)
Observations					2,029							

(Continued)

Table 4 Continued

	OLS				2SLS				Imperfect IV			
	Human capital		Physical capital	Social capital	Human capital		Physical capital	Social capital	Human capital		Physical capital	Social capital
	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel-D: Burkina Faso												
Received remittances (=1 if yes)	0.097*** (0.022)	0.017 (0.016)	-0.001 (0.020)	0.012 (0.023)	0.530*** (0.160)	0.501*** (0.131)	-0.415*** (0.144)	1.145*** (0.233)	0.361, 0.777 (0.049, 1.441)	0.256, 0.858 (-0.018, 1.470)	(-1.338, -1.078) (-2.485, -0.101)	(0.012, 0.675) (-0.033, 1.352)
Observations	1,895				1,895				1,895			
Panel-E: Senegal												
Received remittances (=1 if yes)	0.087*** (0.023)	0.004 (0.020)	0.028* (0.016)	-0.047** (0.023)	0.161 (0.192)	0.203 (0.172)	-0.164 (0.119)	0.196 (0.206)	0.087, 0.161 (0.041, 0.538)	0.018, 0.203 (-0.040, 0.539)	(-0.164, 0.028) (-0.398, 0.058)	(-0.047, 0.196) (-0.091, 0.600)
Observations	1,705				1,705				1,705			

Notes: This table reports the estimates of OLS, 2SLS, and IV estimation. Robust standard errors are presented in parentheses. IV estimation bounds are reported in square brackets and corresponding confidence intervals are reported in parentheses. The variable of interest, received remittances, is an indicator that takes one if a household received remittances, and zero otherwise. Outcome variables are also indicator variables that equal one if a household made capital investment, and zero otherwise. Control variables are female household head, head is paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is >60 years, log household income, number of children in the household, number of elderly in the household, and location is urban.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

IV, imperfect instrumental variable; IV, instrumental variables; OLS, ordinary linear regression.

capital becomes insignificant, compared to the biprobit estimations in Table 3. Another difference is that, in Senegal, the coefficients of education and social capital lose their statistical significance, compared to Table 3. These results suggest that the 2SLS estimates are less precise than the biprobit estimates.

Column 9 (Table 4) presents the IIV estimates for education investment. The first point to notice is that all the IIV coefficient bounds are positive, suggesting that the remittance-receiving households are more likely to invest in education than non-remittance-receiving households. Second, we find that the OLS coefficients are either the lower bound or below the coefficient bounds, indicating that OLS estimates are biased downward. Finally, we find that the 2SLS coefficients are mostly either inside the IIV coefficient bounds or the upper bounds. These results suggest that our main results for education investment are robust to relaxing the validity assumption of the IV estimation approach.

Column 10 (Table 4) presents the IIV estimates for health investment. The IIV coefficient bounds are positive in Uganda, Kenya, Burkina Faso, and Senegal. The results show that the OLS coefficients are mostly below the coefficient bound, and 2SLS coefficients are inside the bound. However, the IIV coefficient bounds are statistically significant only in Kenya. In Nigeria, the coefficient bound is not strictly negative, whereas biprobit and 2SLS results are significant and negative. This result suggests that the IV estimation coefficient for health investment in Nigeria is not robust to relaxing the exclusion restriction assumption of the IV estimation approach. However, this finding does not nullify our main estimation result for health investment in Nigeria. Instead, it suggests that the exclusion restriction of the instrument we argued in the method section is critical and must be satisfied.

We present the IIV estimates for physical capital in column 11 of Table 4. Similar to our main estimation in Table 3, the IIV coefficient bounds are positive in Uganda, Kenya, and Nigeria and negative in Burkina Faso. In addition, the results show that the OLS coefficients are mostly below the coefficient bound, and 2SLS coefficients are inside the bound. These results suggest that our main results of physical capital investment are robust to relaxing the validity assumption of the IV estimation approach.

Finally, column 12 (Table 4) shows the IIV estimates for social capital. The IIV coefficient bounds are positive in Uganda, Kenya, and Senegal. The results show that the OLS coefficients are mostly below the coefficient bounds and 2SLS coefficients are inside the bounds. In Nigeria, the coefficient bound is not strictly negative, whereas biprobit and 2SLS results are significant and negative. This result suggests that the IV estimation coefficient for social capital investment in Nigeria is not robust to relaxing the exclusion restriction assumption of the IV estimation approach. However, as discussed above, this finding does not nullify our main estimation result of social capital investment in Nigeria; instead, it suggests that the exclusion restriction of the instrument is critical and must be satisfied.

To sum up the results from this robustness check, we find that the 2SLS estimates are qualitatively similar to the biprobit estimates, and except in a few cases, the 2SLS estimates are relatively less precise (i.e., have larger standard errors). The IIV estimation shows that most of our biprobit estimates are robust to relaxing the exclusion restriction. However, health and social capital investments in Nigeria appear to be sensitive to the relaxation of the exclusion restriction.

6.2 Continuous treatment variable

In our main estimation, we find the treatment effect of remittances by comparing remittance-receiving and non-remittance-receiving households. Here, we use remittance amount (in log scale) as the treatment variable. Outcome variables are still dummy indicators for investment decisions. This exercise allows us to address the concern that the indicator variable (i.e., received remittances) in our main estimation might be picking up the effect of unobserved differences between remittance-receiving and non-receiving households instead of the effect of remittances. The results for this exercise are presented in Table 5. Columns 1–4 present the average marginal effects of naïve probit estimates, while columns 5–8 present the average marginal effects of IV-probit estimates.

Once again, we observe that the naïve probit estimates are biased downward toward zero. Consequently, we focus on the IV-probit estimates. Column 5 (Table 5) presents the results for education investment, which shows that the coefficients are positive for all countries and statistically significant in Uganda, Kenya, Nigeria, and Burkina Faso. Similarly, we find a significant positive effect of remittance amount on health investment in Uganda, Kenya, and Burkina Faso. However, we find a significant negative effect in Nigeria, which is consistent with our main result. In column 7 (Table 5), consistent with our main results, we find that the remittance amount has a statistically significant positive effect on physical capital in Kenya and Nigeria but a significant negative effect in Burkina Faso. However, the remittance coefficient becomes insignificant in Uganda compared to our main result.

Finally, in column 8, we find that remittance amount has a statistically significant positive effect on social capital investment in Uganda, Kenya, and Burkina Faso but a significant negative effect in Nigeria. These findings are qualitatively similar to our main result from the biprobit estimation in Table 3. Thus, we can argue that our main results are robust to using a continuous treatment variable.

6.3 Continuous treatment and outcome variables

So far, we have examined investment decisions at an extensive margin, i.e., whether an investment expenditure was made or not. However, we are also interested in the amount of money spent on investments, i.e., the intensity of investment expenditure. Consequently, we examine the effect of remittances on investment decisions using a log scale of the actual amounts of investment expenditure. The result of this exercise is presented in Table 6. Columns 1–4 reports the OLS estimates, while columns 5–8 reports the 2SLS estimates. Since both the key explanatory variable and the outcome variables are in log scales, we can interpret the estimated coefficients as elasticities.

Column 5 (Table 6) reports the intensive margin estimates for education expenditure and shows that remittances increase education expenditure in all the countries examined except Senegal. Although we do not find a significant extensive margin effect of remittances received in Uganda, the intensive margin result shows that remittances significantly increase education expenditure. Specifically, a 10% increase in remittances leads to a 14.7% increase in education expenditure in Uganda. On the contrary, the extensive margin effect of remittances received on education investment was significant in Senegal, but we find no significant effect on the

Table 5 Effect of cash remittances on household investment decision

	Probit				IV-probit			
	Human capital		Physical capital (=1 if yes)	Social capital (=1 if yes)	Human capital		Physical capital (=1 if yes)	Social capital (=1 if yes)
	Education (=1 if yes)	Health (=1 if yes)			Education (=1 if yes)	Health (=1 if yes)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-A: Uganda								
Log (Cash remittances)	0.008 (0.005)	−0.003 (0.005)	0.004 (0.003)	0.009* (0.005)	0.137*** (0.015)	0.102** (0.046)	0.019 (0.049)	0.120*** (0.015)
Mean of the outcome variable	0.684	0.792	0.119	0.299	0.684	0.792	0.119	0.299
Observations	1,603				1,603			
Panel-B: Kenya								
Log (Cash remittances)	0.000 (0.003)	0.002 (0.004)	0.006** (0.002)	−0.000 (0.004)	0.072*** (0.010)	0.079*** (0.011)	0.072*** (0.008)	0.085*** (0.002)
Mean of the outcome variable	0.594	0.676	0.141	0.418	0.594	0.676	0.141	0.418
Observations	1,821				1,821			
Panel-C: Nigeria								
Log (Cash remittances)	0.008** (0.003)	0.002 (0.003)	0.006** (0.003)	0.003 (0.004)	0.073*** (0.010)	−0.044** (0.017)	0.066*** (0.009)	−0.073*** (0.009)
Mean of the outcome variable	0.729	0.764	0.185	0.374	0.729	0.764	0.185	0.374
Observations	2,029				2,029			
Panel-D: Burkina Faso								
Log (Cash remittances)	0.020*** (0.005)	0.005 (0.004)	−0.001 (0.004)	−0.001 (0.005)	0.099*** (0.015)	0.113*** (0.011)	−0.096*** (0.019)	0.119*** (0.003)
Mean of the outcome variable	0.645	0.875	0.231	0.649	0.645	0.875	0.231	0.649
Observations	1,895				1,895			
Panel-E: Senegal								
Log (Cash remittances)	0.012*** (0.003)	0.001 (0.003)	0.005** (0.002)	−0.010*** (0.003)	0.022 (0.024)	0.024 (0.021)	−0.021 (0.020)	0.021 (0.024)
Mean of the outcome variable	0.672	0.825	0.096	0.734	0.672	0.825	0.096	0.734
Observations	1,705				1,705			

Notes: This table reports the average marginal effects for probit and IV-probit models. Robust standard errors are presented in parentheses. The variable of interest is the amount of cash remittances received (in log scale) in the last 12 months. Outcome variables are also indicator variables that equal one if a household made capital investment, and zero otherwise. Control variables are female household head, head is paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is >60 years, log household income, number of children in the household, number of elderly in the household, and location is urban.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

IV, instrumental variables.

Table 6 Effect of remittances amount on household investment expenditure

	OLS				2SLS			
	Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)	Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)
	Log (Education expenditure)	Log (Health expenditure)			Log (Education expenditure)	Log (Health expenditure)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-A: Uganda								
Log (Cash remittances)	0.053* (0.029)	0.028 (0.023)	0.035 (0.022)	0.041* (0.024)	1.469** (0.638)	0.779* (0.401)	0.093 (0.242)	0.759* (0.388)
Mean of the outcome variable	3.408	2.791	0.466	0.981	3.408	2.791	0.466	0.981
Observations	1,603				1,603			
Panel-B: Kenya								
Log (Cash remittances)	0.023 (0.022)	0.025 (0.018)	0.044*** (0.015)	0.002 (0.017)	0.686*** (0.253)	0.188 (0.183)	0.540*** (0.153)	0.624*** (0.204)
Mean of the outcome variable	3.115	2.742	0.680	1.556	3.115	2.742	0.680	1.556
Observations	1,821				1,821			
Panel-C: Nigeria								
Log (Cash remittances)	0.070*** (0.019)	0.032* (0.017)	0.042** (0.017)	0.025 (0.019)	0.633*** (0.162)	-0.498*** (0.144)	0.504*** (0.151)	-0.522*** (0.162)
Mean of the outcome variable	3.989	3.312	0.976	1.763	3.989	3.312	0.976	1.763
Observations	2,029				2,029			
	(Continued)							

(Continued)

Table 6 Continued

	OLS				2SLS			
	Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)	Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)
	Log (Education expenditure)	Log (Health expenditure)			Log (Education expenditure)	Log (Health expenditure)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-D: Burkina Faso								
Log (Cash remittances)	0.087*** (0.020)	0.033** (0.016)	0.007 (0.018)	-0.037* (0.021)	0.500*** (0.159)	0.508*** (0.147)	-0.275** (0.127)	0.428** (0.169)
Mean of the outcome variable	2.361	3.376	0.820	2.454	2.361	3.376	0.820	2.454
Observations	1,895				1,895			
Panel-E: Senegal								
Log (Cash remittances)	0.071*** (0.017)	0.023 (0.015)	0.025** (0.012)	-0.039** (0.019)	-0.232 (0.149)	0.192 (0.122)	-0.111 (0.082)	-0.037 (0.150)
Mean of the outcome variable	3.112	3.867	0.484	3.790	3.112	3.867	0.484	3.790
Observations	1,705				1,705			

Notes: This table reports OLS and 2SLS estimates. Robust standard errors are presented in parentheses. Outcome variables are capital investment expenditure in US dollars (in log scale) in the past 12 months. The variable of interest is the amount of cash remittances received in US dollars (in log scale) in last 12 months. Outcome variables are also indicator variables that equal one if a household made capital investment, and zero otherwise. Control variables are female household head, head is a paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is >60 years, log household income, number of children in the household, number of elderly in the household, and location is urban.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

OLS, ordinary linear regression.

intensive margin. For other countries, we find that a 10% increase in remittances leads to a 5–7% increase in education expenditure in Kenya, Nigeria, and Burkina Faso.

Column 6 (Table 6) shows the intensive margin estimates for health expenditure. We find a significant positive effect of remittances on health expenditure in Uganda and Burkina Faso. Specifically, a 10% increase in remittances leads to a 5–8% increase in health expenditure in Uganda and Burkina Faso. Although the extensive margin effect of remittances received on health investment was significant in Kenya, we find no significant effect on the intensive margin. Consistent with the extensive margin effect of remittances received, we find a significant negative effect of remittances on health expenditure in Nigeria. Specifically, a 10% increase in remittances leads to a 5% reduction in health expenditure in Nigeria.

Column 7 (Table 6) presents the intensive margin results for physical capital expenditure. Again, consistent with our main estimation, we find a significant positive effect of remittances on physical capital expenditure in Kenya and Nigeria and a significant negative effect in Burkina Faso. Specifically, a 10% increase in remittances leads to a 5% increase in physical capital expenditure in Kenya and Nigeria and a 2.75% decrease in Burkina Faso.

Finally, column 8 (Table 6) presents the intensive margin results for social capital expenditure. We find a significant positive effect of remittances on social capital expenditure in Uganda, Kenya, and Burkina Faso and a significant negative effect in Nigeria. Specifically, a 10% increase in remittances leads to a 4–8% increase in social capital expenditure in Uganda, Kenya, and Nigeria, and a 5% decrease in Nigeria. Although the extensive margin effect of remittances received on social capital investment was significant in Senegal, we find no significant effect on the intensive margin.

Further extending the intensive margin analysis, we check for the non-linear effect of remittances on household investment expenditures. We explore the non-linearity of remittances with two different specifications. First, we add a quadratic term (i.e., squared remittance) in our main estimation equation. We expect the quadratic term to capture non-linearity in the effect of remittance on investment expenditures. Second, we add two additional terms in our main specification – high remittances and interaction of high remittances with remittance amount. High remittances is an indicator variable that equals one if the household received above district average remittances, and zero otherwise. This exercise will highlight whether a high amount of remittances received leads to any differential effect of remittances on household investment expenditures. We found little evidence of any non-linear effect of remittances on household investment expenditures. The results of these exercises are presented in Table A4 in Appendix.

7 Heterogeneity

7.1 Household with and without migrants

In this section, we explore the heterogeneity of the effect of remittances on capital investments. In the first heterogeneity analysis, we study how households with migrants and households without migrants differ in their investment decisions. In most cases, migration is a pre-condition for receiving remittances, but receiving remittances from non-household members (i.e., brothers, sons-in-law, and uncles) is not uncommon in SSA. Studying households with and without

migrants is important because the migration of adult household members may alter the labor supply mix of the household – children and other household members may need to work to make up for the migrant workers in home production or the domestic labor market. The result of this exercise using a recursive biprobit model is presented in Table 7. The treatment variable

Table 7 Effect of remittances on household investment decision conditional on having a migrant

	Household with a migrant				Household with no migrant			
	Human Capital		Physical Capital (=1 if yes)	Social Capital (=1 if yes)	Human Capital		Physical Capital (=1 if yes)	Social Capital (=1 if yes)
	Education (=1 if yes)	Health (=1 if yes)			Educa- tion (=1 if yes)	Health (=1 if yes)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-A: Uganda								
Received remit- tances (=1 if yes)	0.143*** (0.014)	0.113* (0.064)	0.044** (0.018)	0.096*** (0.017)	0.010 (0.011)	−0.014*** (0.002)	−0.010 (0.006)	−0.005*** (0.001)
Mean of the out- come variable	0.736	0.798	0.131	0.327	0.641	0.786	0.108	0.276
Mean received remittances	0.356				0.054			
Observations	719				884			
Panel-B: Kenya								
Received remit- tances (=1 if yes)	0.246*** (0.052)	0.269*** (0.025)	0.232*** (0.089)	0.311*** (0.013)	−0.014*** (0.002)	0.008 (0.051)	0.013* (0.007)	0.013 (0.034)
Mean of the out- come variable	0.610	0.692	0.153	0.436	0.566	0.649	0.119	0.389
Mean received remittances	0.622				0.104			
Observations	1,158				1,158			
Panel-C: Nigeria								
Received remit- tances (=1 if yes)	0.163** (0.067)	−0.125*** (0.048)	0.242*** (0.050)	−0.247*** (0.040)	0.047* (0.025)	−0.010*** (0.003)	0.022*** (0.005)	−0.036*** (0.005)
Mean of the out- come variable	0.773	0.756	0.191	0.347	0.659	0.777	0.177	0.418
Mean received remittances	0.579				0.151			
Observations	1,253				776			
Panel-D: Burkina Faso								
Received remit- tances (=1 if yes)	0.206*** (0.048)	0.253*** (0.015)	−0.216*** (0.056)	0.242*** (0.027)	0.053** (0.027)	0.056 (0.046)	−0.062* (0.034)	0.057*** (0.011)
Mean of the out- come variable	0.696	0.878	0.231	0.654	0.568	0.871	0.229	0.641
Mean received remittances	0.542				0.193			
Observations	1,142				753			

(Continued)

Table 7 Continued

	Household with a migrant				Household with no migrant			
	Human Capital		Physical Capital (=1 if yes)	Social Capital (=1 if yes)	Human Capital		Physical Capital (=1 if yes)	Social Capital (=1 if yes)
	Education (=1 if yes)	Health (=1 if yes)			Educa- tion (=1 if yes)	Health (=1 if yes)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-E: Senegal								
Received remittances (=1 if yes)	-0.006 (0.145)	0.069 (0.147)	0.184 (0.123)	0.318*** (0.052)	-0.012 (0.011)	0.032*** (0.012)	0.007 (0.006)	-0.014 (0.009)
Mean of the outcome variable	0.727	0.838	0.109	0.738	0.581	0.803	0.073	0.728
Mean received remittances	0.745				0.072			
Observations		1,065				640		

Notes: This table reports the average marginal effects for recursive bivariate probit models. Columns 1–4 show estimates for households with a migrant household member and columns 5–8 show estimates for households with no migrant household member. Robust standard errors are presented in parentheses. The variable of interest, received remittances, is an indicator that takes one if a household received remittances, and zero otherwise. Outcome variables are also indicator variables that equal one if a household made capital investment, and zero otherwise. Control variables are female household head, head is a paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is >60 years, log household income, number of children in the household, number of elderly in the household, and location is urban.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

is an indicator of remittances received, and the outcome variables are investment decision indicators. Columns 1–4 present the results for households with migrants, and columns 5–8 present those without migrants.

The results presented in Table 7 show sizeable heterogeneity in investment decisions between the households with and without migrants. The result for households with migrants almost completely mirrors our main findings except for a few differences. We find that remittance-receiving households in almost all the countries under review are more likely to invest in education than non-remittance-receiving households. We also find mixed effects for the other capital types and across countries. For example, remittances have positive effects on health expenditure in Uganda, Kenya, and Burkina Faso but a negative effect in Nigeria. Similarly, remittances have positive effects on physical capital investment in Uganda, Kenya, and Nigeria but a negative effect in Burkina Faso. Finally, remittances have positive effects on social capital in all the countries except Nigeria, where the effect is negative. This suggests that the effects found in the main results are driven by households with migrants.

The results for households without migrants are slightly different from those for households with migrants. For instance, column 5 (Table 7) shows that remittance has a negative effect on education expenditure in Kenya. This finding contradicts our main results and results from households with migrants. It suggests that remittances create disincentives for investing in education for a household without migrants. We find a positive effect on education for Nigeria and Burkina Faso, which is similar to our main results. Column 6 (Table 7) presents

results for health investment in households without migrants. We find negative effects in Uganda and Nigeria but positive effects in Senegal. The results in Uganda and Senegal are different from those for households with migrants. There is no difference in physical capital investment for the two groups in Kenya, Nigeria, and Burkina Faso. Finally, for social capital, there is no difference between the two groups for Nigeria and Burkina Faso. However, the coefficient for Uganda is negative and significant compared to the positive effect in households with migrants.

Overall, we find important heterogeneity between the two groups, which varies substantially across countries. This heterogeneity analysis suggests that the main results are driven mainly by households with migrants. This could be due to the altruism of migrants or an implicit contract between migrants and their left-behind family members. For households without migrants, some results were similar to those with migrants but mostly different. It is possible that the absence of an implicit contract between the migrant and left-behind household members affects the size, frequency, and utilization of remittances.

7.2 Remittance sources

We explore the second source of heterogeneity by remittance sources – internal (domestic), within-Africa, and out-of-Africa. Heterogeneity by remittance sources is important because the remittance literature points out that remittance sources contain critical information such as the relative size of remittances, migrant's control over the household's use of remittances, and transfer of values and norms. For example, compared to domestic remittances, out-of-Africa remittances are generally bigger in size (Table A2 in Appendix), but the migrant, being far away from the household, may have limited control over the use of remittances. Similarly, out-of-Africa migrants may transfer a vastly different set of values and norms learned at the destination countries to the household compared to domestic or within-Africa migrants. However, since we are constrained by our data, it is difficult for us to identify exactly which information the remittance source contains. Consequently, we explore the overall effect of remittance sources. Table 8 presents the effects of remittances conditional on the remittance sources. Columns 1–4 present the results for internal remittance, columns 5–8 present the results for within-Africa remittances, and columns 9–12 present the results for out-of-Africa remittances.

To understand the heterogeneity of the effect of remittances on education investment, we compare columns 1, 5, and 9 (Table 8). In Uganda, internal and African remittances have no significant effect on education. However, we find a significant negative effect of out-of-Africa remittances on education. In Kenya and Burkina Faso, we find that remittances from internal and within-Africa sources significantly increase the likelihood of investment in education, but it is insignificant for out-of-Africa remittances. We find a different result in Nigeria – internal and out-of-Africa sources have a significant positive effect on education investment, and African remittances have a significant negative effect. Finally, in Senegal, only remittances from internal sources have a statistically significant effect. These findings suggest that the remittance sources differentially affect education investment decisions in different countries. Overall, the result indicates that internal remittances increase the likelihood of investment in education, whereas African and out-of-Africa remittances have a mixed effect. This pattern in

Table 8 Effect of remittances on household investment decision by remittance source

	Internal remittances				Within-Africa remittances				Out-of-Africa remittances			
	Human capital		Physical capital	Social capital	Human capital		Physical capital	Social capital	Human capital		Physical capital	Social capital
	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
Panel-A: Uganda												
Received remittances (=1 if yes)	0.011 (0.011)	-0.013* (0.008)	-0.025 (0.044)	0.009 (0.018)	0.006 (0.007)	0.009 (0.020)	0.002 (0.001)	-0.002*** (0.000)	-0.006*** (0.002)	-0.002 (0.009)	0.004*** (0.001)	0.010*** (0.002)
Mean of the outcome variable	0.677	0.790	0.115	0.291	0.661	0.791	0.111	0.285	0.661	0.788	0.114	0.290
Observations	1,482				1,343				1,365			
Panel-B: Kenya												
Received remittances (=1 if yes)	0.083*** (0.009)	0.095*** (0.014)	0.061** (0.030)	0.073*** (0.007)	0.021*** (0.006)	0.028*** (0.009)	0.005*** (0.002)	0.016*** (0.003)	0.038 (0.038)	0.066 (0.048)	0.021*** (0.006)	0.009 (0.082)
Mean of the outcome variable	0.581	0.654	0.137	0.409	0.572	0.648	0.112	0.393	0.573	0.657	0.114	0.381
Observations	1,363				1,114				1,259			
Panel-C: Nigeria												
Received remittances (=1 if yes)	0.127*** (0.006)	0.073 (0.317)	0.071*** (0.014)	-0.084*** (0.006)	-0.003** (0.001)	0.002*** (0.000)	0.001 (0.001)	0.002 (0.002)	0.037** (0.018)	0.015 (0.025)	0.004 (0.021)	0.013 (0.022)
Mean of the outcome variable	0.722	0.759	0.184	0.385	0.706	0.750	0.159	0.346	0.715	0.753	0.167	0.343
Observations	1,646				1,224				1,355			
(Continued)												

(Continued)

Table 8 Continued

	Internal remittances				Within-Africa remittances				Out-of-Africa remittances			
	Human capital		Physical capital	Social capital	Human capital		Physical capital	Social capital	Human capital		Physical capital	Social capital
	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)	Education (=1 if yes)	Health (=1 if yes)	(=1 if yes)	(=1 if yes)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
Panel-D: Burkina Faso												
Received remittances (=1 if yes)	0.082*** (0.018)	0.122*** (0.009)	-0.095*** (0.013)	0.053*** (0.002)	0.081*** (0.022)	0.114*** (0.009)	-0.041*** (0.005)	0.051*** (0.004)	0.002 (0.005)	0.002*** (0.001)	0.000** (0.000)	0.002 (0.019)
Mean of the outcome variable	0.619	0.875	0.228	0.642	0.624	0.867	0.226	0.640	0.602	0.867	0.227	0.643
Observations	1,445				1,458				1,142			
Panel-E: Senegal												
Received remittances (=1 if yes)	0.052** (0.025)	-0.006 (0.022)	-0.033 (0.049)	0.003 (0.037)	0.014 (0.022)	-0.001 (0.018)	-0.039* (0.024)	0.027 (0.035)	-0.017 (0.037)	0.067 (0.056)	0.003 (0.073)	0.121*** (0.006)
Mean of the outcome variable	0.636	0.813	0.083	0.740	0.622	0.810	0.091	0.736	0.648	0.815	0.092	0.732
Observations	1,144				1,018				1,234			

Notes: This table reports the average marginal effects for recursive bivariate probit models. Robust standard errors are presented in parentheses. The variable of interest, received remittances, is an indicator that takes one if a household received remittances, and zero otherwise. Outcome variables are also indicator variables that equal one if a household made capital investment, and zero otherwise. Control variables are female household head, head is a paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is >60 years, log household income, number of children in the household, number of elderly in the household, and location is urban.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

education investment from internal remittance is likely due to lower migration expectations and greater control of the migrant over household investment decisions.

Unlike investment in education, health investment decisions does not have any substantive variation by remittance sources. Apart from the small, marginally significant effect of internal remittances on health expenditure in Uganda, we found no significant effect on health investment regardless of remittance sources in Uganda and Senegal. Conversely, in Kenya and Burkina Faso, remittances have a positive effect on health investment regardless of remittance sources. Finally, in Nigeria, we find that within-Africa sources have a significant, positive effect on health investment but domestic and out-of-Africa sources are insignificant.

Comparing columns 3, 7, and 11 (Table 8), we see variations in physical capital investment across sources. In Uganda, only remittances from out-of-Africa sources significantly increase the likelihood of investment in physical capital. Meanwhile, only internal remittances have a significant positive effect on physical capital investment in Nigeria. In Kenya, remittances from all sources significantly increase the likelihood of physical capital investment. On the contrary, in Burkina Faso, we find that both internal and within-Africa remittances have significant negative effects on physical capital investment and out-of-Africa remittances have significant but modest positive effects. Overall, our results suggest that out-of-Africa remittances increase the likelihood of physical capital investment, even in Bukina Faso, where internal and African remittances negatively affect physical capital investment. This result is due to the relatively strong income effect generated from larger out-of-Africa remittances.

Finally, we observe substantial heterogeneity of social capital investment across remittance sources by comparing columns 4, 8, and 12 (Table 8). In Uganda, we find that within-Africa remittances have a significant negative effect on social capital investment while out-of-Africa remittances have significant positive effects. In Kenya and Burkina Faso, only internal and within-Africa sources have significant positive effects on social capital investment. In Nigeria, internal remittances significantly reduce the likelihood of social capital investment, while in Senegal, out-of-Africa remittances significantly increase the likelihood of social capital investment.

Overall, we find substantial heterogeneity in household investment decisions by remittance sources. Moreover, the effect of remittance sources also varies across countries, making it difficult to distinguish patterns. However, a few patterns emerge: internal remittances are more likely to increase education investment, within-Africa remittances are more likely to increase health investment, and out-of-Africa remittances are more likely to increase physical and social capital investment.

7.3 Substitutability

Our final heterogeneity analysis explores the substitutability in investment decisions, which is the likelihood of investing in one capital type conditional on already investing in other capital types. This exercise relaxes the implicit assumption about the independence of the investment choices and allows us to explore potential substitutability among investment alternatives. The result of this exercise is presented in Table 9. In addition, this exercise allows us to examine whether conditioning on investment in other types of capital takes away the statistical significance or alters the sign of the effect, which will indicate strong substitutability between different types of capital investments.

Columns 1 and 2 (Table 9) present the likelihood of investing in human capital (i.e., education and health) conditional on investing in physical or social capital. In Kenya and Senegal, we find that remittances no longer significantly affect human capital investment if households invest in physical or social capital. Compared to our main result in Table 3, there is strong substitutability between human capital and other capital types in Kenya. However, we do not see such substitutability in Uganda, Nigeria, and Burkina Faso; households' likelihood of human capital investment is unaffected by the investment in other capitals. This result suggests a substantial variation in substitutability among human capital and other investment choices across countries.

Table 9 column 3 presents how remittances affect the likelihood of physical capital investment conditional on investment in either human or social capital. Compared to Table 3, we find that investment in human and social capital does not affect physical capital investment. This result suggests that there is no substantive substitutability between physical capital and other investment alternatives in any of the countries. We find a similar conclusion for social capital investment (column 4, Table 9); there is no sizeable substitutability between social capital and other investment alternatives. Since we find substitutability only in human capital and only in two countries, our implicit assumption of independence between the investment alternatives is benign. Consequently, relaxing the assumption will not substantively change our results.

8 Mechanisms

8.1 Income effect

This section explores the potential mechanism through which remittances affect a household's investment decisions. The first mechanism we study is the income effect. Remittances, through easing a household's budget constraint, may affect investment decisions. We use consumption expenditure and asset ownership as proxies to measure the income effect. More specifically, we use an indicator variable that takes one if a household spends above the district-level median consumption expenditure, and zero otherwise. Similarly, we use dummy indicators for ownership of radio and mobile phones.

Column 1 (Table 10) shows that remittance-receiving households in Uganda, Kenya, Nigeria, and Senegal are more likely to engage in above-median consumption than non-remittance-receiving households. However, we find that remittance-receiving households in Burkina Faso are less likely to engage in above-median consumption expenditure. This result suggests that remittance-receiving households in Burkina Faso are less likely to allocate a large proportion of their budget on consumption. Nevertheless, we still find some evidence of income effect in Burkina Faso as remittances increase the likelihood of asset ownership (see columns 2, 3, Table 10). Similarly, we find that remittances increase the likelihood of asset ownership in Kenya, Nigeria, and Senegal. These results indicate that remittances have a substantial income effect and are consistent with the literature. For instance, Simiyu (2013) finds a similar result in Kenya and Kakhkharov, and Ahunov (2020) in Uzbekistan.

Table 9 Substitutability of investments

	Invested on physical capital or social capital		Invested on human capital or social capital	Invested on human capital or physical capital
	Human capital		Physical capital (=1 if yes)	Social capital (=1 if yes)
	Education (=1 if yes)	Health (=1 if yes)		
	(1)	(2)	(3)	(4)
Panel-A: Uganda				
Received remittances (=1 if yes)	0.022 (0.036)	0.074 (0.066)	0.018** (0.008)	0.032 (0.021)
Mean of the outcome variable	0.769	0.872	0.124	0.314
Observations	576	576	1,480	1,468
Panel-B: Kenya				
Received remittances (=1 if yes)	0.064 (0.068)	0.022 (0.115)	0.108*** (0.026)	0.177*** (0.016)
Mean of the outcome variable	0.672	0.811	0.152	0.470
Observations	882	882	1,545	1,516
Panel-C: Nigeria				
Received remittances (=1 if yes)	0.177*** (0.033)	-0.049* (0.027)	0.131*** (0.024)	-0.179*** (0.005)
Mean of the outcome variable	0.758	0.844	0.184	0.391
Observations	986	986	1,874	1,884
Panel-D: Burkina Faso				
Received remittances (=1 if yes)	0.155*** (0.029)	0.197*** (0.018)	-0.181*** (0.018)	0.147*** (0.017)
Mean of the outcome variable	0.672	0.901	0.235	0.661
Observations	1,331	1,331	1,834	1,800
Panel-E: Senegal				
Received remittances (=1 if yes)	0.011 (0.066)	-0.006 (0.052)	0.018 (0.058)	0.208*** (0.023)
Mean of the outcome variable	0.678	0.853	0.099	0.748
Observations	1,282	1,282	1,651	1,584

Notes: This table reports the average marginal effects for recursive bivariate probit models. Robust standard errors are presented in parentheses. The variable of interest, received remittances, is an indicator that takes one if a household received remittances, and zero otherwise. Outcome variables are also indicator variables that equal one if a household made capital investment, and zero otherwise. Control variables are female household head, head is a paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is >60 years, log household income, number of children in the household, number of elderly in the household, and location is urban. Estimates of columns 1 and 2 are conditional on households investing on physical or social capital. Similarly, estimates of column 3 are conditional on households investing on human or social capital. Finally, column 4 is conditional human or physical capital investment.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 10 Mechanisms of the effect

	Income effect			Labor substitution	Migration expectation	
	Above median consumption expenditure (=1 if yes)	Own radio (=1 if yes)	Own mobile phone (=1 if yes)	Proportion of adult household member working	Proportion of children aged 6–15 working	Proportion of children aged 6–15 in school
	(1)	(2)	(3)	(4)	(5)	(6)
Panel-A: Uganda						
Received remittances (=1 if yes)	0.045*** (0.003)	−0.013 (0.021)	0.006 (0.020)	−0.234 (0.266)	−0.094 (0.237)	0.305 (0.464)
Mean of the outcome variable	0.303	0.778	0.569	0.676	0.080	0.871
Observations	1,603	1,603	1,603	1,603	963	963
Panel-B: Kenya						
Received remittances (=1 if yes)	0.154*** (0.011)	0.136*** (0.051)	0.001 (0.069)	−0.298*** (0.105)	0.058 (0.039)	0.308 (0.930)
Mean of the outcome variable	0.253	0.848	0.801	0.541	0.004	0.832
Observations	1,821	1,821	1,821	1,821	901	901
Panel-C: Nigeria						
Received remittances (=1 if yes)	0.070*** (0.024)	0.196*** (0.016)	0.171*** (0.011)	0.665*** (0.172)	−0.073 (0.057)	0.984*** (0.274)
Mean of the outcome variable	0.339	0.876	0.5783	0.595	0.031	0.705
Observations	2,030	2,030	2,030	2,030	1,245	1,245
Panel-D: Burkina Faso						
Received remittances (=1 if yes)	−0.132** (0.062)	0.149*** (0.044)	0.104*** (0.030)	0.278*** (0.094)	−1.001*** (0.221)	0.802*** (0.205)
Mean of the outcome variable	0.322	0.062	0.403	0.764	0.412	0.452
Observations	1,895	1,895	1,895	1,895	1,633	1,633
Panel-E: Senegal						
Received remittances (=1 if yes)	0.179*** (0.009)	0.110** (0.045)	0.117* (0.064)	−0.205* (0.117)	0.342 (0.247)	−0.606* (0.353)
Mean of the outcome variable	0.678	0.823	0.850	0.541	0.294	0.684
Observations	1,705	1,705	1,705	1,705	1,296	1,296

Notes: Columns 1–3 report the average marginal effects for recursive bivariate probit models and columns 4–6 report the estimates of 2SLS regression. Robust standard errors are presented in parentheses. The variable of interest, received remittances, is an indicator that takes one if a household received remittances, and zero otherwise. Control variables are female household head, head is a paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is >60 years, log household income, number of children in the household, number of elderly in the household, and location is urban.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

8.2 Substitution effect

The second mechanism we study is the substitution effect of remittances. Remittance, being non-labor income, has a substitution effect that creates incentives for left-behind household members to cut back labor supply and continue receiving remittances. The result of this exercise is presented in column 4 (Table 10). The outcome variable is the proportion of adult household members working. If substantial substitution exists, we expect to find a negative relationship between received remittances and the proportion of adult household members working.

The effect of received remittances is significant and negative in Kenya and Senegal. This result indicates that adult members in remittance-receiving households are less likely to join the labor force than their counterparts in non-remittance-receiving households in Kenya and Senegal. This finding is consistent with the literature (Amuedo-Dorantes and Pozo, 2006; Binzel and Assaad, 2011). On the contrary, we find a significant positive effect of remittances on adult household members' labor supply in Nigeria and Burkina Faso. This result is similar to those derived by Vadean et al. (2017), who found that remittances increase the likelihood of employment in Tajikistan. Overall, we only find evidence of the substitution effect of remittances in Kenya and Senegal.

8.3 Migration expectations

The final mechanism we explore is the migration expectations. Remittance may reduce human capital investment by raising the opportunity cost of education and lowering the incentive to study (Amuedo-Dorantes and Pozo, 2006; Antman, 2012; McKenzie and Rapoport, 2011). We explore two outcome variables to measure migration expectations – children's labor force participation (i.e., the proportion of children aged 6–15 working) and children's schooling (i.e., the proportion of children aged 6–15 in school). The result of this exercise is presented in columns 5, 6 (Table 10).

In column 5, we do not find significant positive coefficients of received remittances, which indicates that migration expectations do not significantly increase the labor force participation of the children (aged between 6 years and 15 years) in remittance-receiving households. On the contrary, we find that remittances significantly decrease children's labor force participation in Burkina Faso, which corresponds with the findings of Bargain and Boutin (2015).

We find a similar positive effect of received remittances (column 6, Table 10) on children's schooling in all the countries except Senegal. This result suggests that children in remittance-receiving households are more likely to continue school in Uganda, Kenya, Nigeria, and Burkina Faso. However, in Senegal, we find the opposite effect, suggesting that children in remittance-receiving households are less likely to continue school. Consequently, we can argue that the migration expectation channel is in effect only in Senegal but plays no significant role in explaining household investment decisions in other sample countries.

To summarize, we empirically explore three mechanisms and find that the income effect is the main channel through which remittances affect households' investment decisions. In addition, we find evidence of the substitution effect of remittances in Kenya and Senegal. Finally, we find evidence of the migration expectation channel only in Senegal.

9 Conclusion

Remittances can stimulate investment in income-generating activities by relaxing liquidity constraints in receiving households. However, remittance dependence and other unintended consequences can reduce investment in income-generating activities. In the context of SSA, we study whether the remittance-receiving households make any investment expenditures, and if they do, what kind of investments they make. With a few exceptions, we find that remittances increase investment in human, physical, and social capital in our sample countries. The income effect of remittances mainly drives this positive effect on investment. We do not find evidence of a strong income effect in Burkina Faso, and it is only in this country that we find remittances reduce the likelihood and amount of physical capital investment. This finding is not surprising as the average remittances received by the households in Burkina Faso are the lowest in our sample countries. Furthermore, we find evidence of substitution effect by the left-behind household members in Kenya and Senegal, but the effect is strong enough to influence investment decisions only in Senegal. Similarly, we find evidence of migration expectations only in Senegal, and remittances do not increase human capital expenditure there.

We also explore the heterogeneous effect of remittance sources on households' investment decisions. We find some interesting patterns: internal remittances matter more for education investment, within-Africa remittances are more likely to increase health investment, and out-of-Africa remittances are more likely to increase physical and social capital investment. We argue that internal remittances are more likely to increase education investment because they create relatively lower migration expectations than within-Africa and out-of-Africa remittances. Similarly, out-of-Africa remittances are more likely to increase physical and social capital investment due to the relatively strong income effect generated from the larger remittances.

Our study has important policy implications for SSA's economic development. First, we provide further evidence that remittances can contribute to economic development through productive investments. Given that migrants send about 15% of their total income as remittances, there is great potential to harness remittances by devising policies to reduce remittance transfer costs. This also coincides with the Sustainable Development Goal (SDG) 10.7.C (United Nations, 2015), which aims to reduce the cost of sending remittances to SSA to less than 3% by 2030 from the current 9% (World Bank, 2018). Our study is also relevant for the local and international organizations designing business models and financial instruments to maximize the impact of remittances on economic development. Understanding the heterogeneous effect of remittance sources will help these organizations to design effective financial instruments to boost capital formation and income generation in the remittance-receiving communities.

Furthermore, our study highlights the importance of social capital investment, which suggests that researchers and policymakers should devote more attention to this investment type. Policymakers seeking to boost human and physical capital investments should also focus on social capital investment decisions.

Although highly complementary to the existing literature, our findings must be evaluated against the fact that our analysis is not free from limitations. We use cross-sectional data, which makes us unable to follow the same household over time. Given the rising importance of remittances, a multi-country longitudinal study is required to generate deeper knowledge for policy action.

Declarations

Availability of Data and Material

The datasets used for this study are publicly available at the World Bank Microdata library <https://microdata.worldbank.org/index.php/home>

Competing Interests

The authors declare that they have no competing interests.

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Author's Contribution

SH and AS conceptualised the idea. AS organised and gathered the data while SH carried out the empirical analysis. AS wrote the introduction and data section, while SH wrote the methodology and conclusion. Both SH and AS wrote results, edited, reviewed and approved the final draft. AS submitted to the journal.

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Appendix

Table A1 Correlation of treatment and outcome variables

	Received remittances (=1 if yes)	Log (cash remittances)	Education (=1 if yes)	Health (=1 if yes)	Physical capital (=1 if yes)	Social capital (=1 if yes)	Log (education expenditure)	Log (health expenditure)	Log (physical capital expenditure)	Log (social capital expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel-A: Uganda										
Received remittances (=1 if yes)	1									
Log (cash remittances)	0.943	1								
Education (=1 if yes)	0.120	0.108	1							
Health (=1 if yes)	0.017	0.015	0.120	1						
Physical capital (=1 if yes)	0.049	0.047	0.088	0.050	1					
Social capital (=1 if yes)	0.074	0.068	0.113	0.167	0.153	1				
Log (education expenditure)	0.161	0.171	0.865	0.141	0.082	0.129	1			
Log (health expenditure)	0.112	0.122	0.175	0.797	0.085	0.188	0.282	1		
Log (physical capital expenditure)	0.087	0.094	0.091	0.039	0.878	0.131	0.123	0.120	1	
Log (social capital expenditure)	0.102	0.114	0.143	0.142	0.175	0.887	0.206	0.232	0.190	1

(Continued)

Table A1 Continued

	Received remittances (=1 if yes)	Log (cash remittances)	Education (=1 if yes)	Health (=1 if yes)	Physical capital (=1 if yes)	Social capital (=1 if yes)	Log (education expenditure)	Log (health expenditure)	Log (physical capital expenditure)	Log (social capital expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel-B: Kenya										
Received remittances (=1 if yes)	1									
Log (cash remittances)	0.937	1								
Education (=1 if yes)	0.056	0.047	1							
Health (=1 if yes)	0.08	0.078	0.225	1						
Physical capital (=1 if yes)	0.099	0.09	0.106	0.054	1					
Social capital (=1 if yes)	0.065	0.044	0.138	0.297	0.093	1				
Log (education expenditure)	0.072	0.101	0.881	0.204	0.06	0.106	1			
Log (health expenditure)	0.114	0.158	0.203	0.812	0.047	0.229	0.266	1		
Log (physical capital expenditure)	0.098	0.114	0.095	0.048	0.918	0.07	0.078	0.064	1	
Log (social capital expenditure)	0.076	0.085	0.147	0.273	0.08	0.865	0.158	0.304	0.082	1

(Continued)

Table A1 Continued

	Received remittances (=1 if yes)	Log (cash remittances)	Education (=1 if yes)	Health (=1 if yes)	Physical capital (=1 if yes)	Social capital (=1 if yes)	Log (education expenditure)	Log (health expenditure)	Log (physical capital expenditure)	Log (social capital expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel-C: Nigeria										
Received remittances (=1 if yes)	1									
Log (cash remittances)	0.941	1								
Education (=1 if yes)	0.066	0.085	1							
Health (=1 if yes)	0.031	0.019	0.126	1						
Physical capital (=1 if yes)	0.076	0.068	-0.011	0.002	1					
Social capital (=1 if yes)	0.056	0.031	0.076	0.266	0.021	1				
Log (education expenditure)	0.129	0.183	0.875	0.081	0.006	0.035	1			
Log (health expenditure)	0.102	0.118	0.122	0.845	0.031	0.272	0.157	1		
Log (physical capital expenditure)	0.081	0.09	0.001	0.014	0.923	0.038	0.044	0.056	1	
Log (social capital expenditure)	0.074	0.069	0.051	0.225	0.044	0.92	0.055	0.274	0.074	1

(Continued)

Table A1 Continued

	Received remittances (=1 if yes)	Log (cash remittances)	Education (=1 if yes)	Health (=1 if yes)	Physical capital (=1 if yes)	Social capital (=1 if yes)	Log (education expenditure)	Log (health expenditure)	Log (physical capital expenditure)	Log (social capital expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel-D: Burkina Faso										
Received remittances (=1 if yes)	1									
Log (cash remittances)	0.928	1								
Education (=1 if yes)	0.117	0.123	1							
Health (=1 if yes)	0.03	0.048	0.088	1						
Physical capital (=1 if yes)	0.012	0.009	0.026	0.047	1					
Social capital (=1 if yes)	0.021	0.015	0.098	0.128	0.137	1				
Log (education expenditure)	0.126	0.154	0.861	0.105	0.053	0.085	1			
Log (health expenditure)	0.038	0.091	0.116	0.76	0.059	0.135	0.202	1		
Log (physical capital expenditure)	0.028	0.033	0.055	0.062	0.939	0.134	0.096	0.106	1	
Log (social capital expenditure)	-0.019	0.002	0.135	0.131	0.158	0.877	0.166	0.225	0.182	1

(Continued)

Table A1 Continued

	Received remittances (=1 if yes)	Log (cash remittances)	Education (=1 if yes)	Health (=1 if yes)	Physical capital (=1 if yes)	Social capital (=1 if yes)	Log (education expenditure)	Log (health expenditure)	Log (physical capital expenditure)	Log (social capital expenditure)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel-E: Senegal										
Received remittances (=1 if yes)	1									
Log (cash remittances)	0.961	1								
Education (=1 if yes)	0.148	0.154	1							
Health (=1 if yes)	0.058	0.075	0.096	1						
Physical capital (=1 if yes)	0.047	0.045	-0.002	0.029	1					
Social capital (=1 if yes)	-0.003	-0.016	0.027	0.115	0.06	1				
Log (education expenditure)	0.157	0.178	0.92	0.082	0.005	0.008	1			
Log (health expenditure)	0.106	0.145	0.114	0.86	0.015	0.096	0.146	1		
Log (physical capital expenditure)	0.056	0.058	0.004	0.028	0.971	0.056	0.018	0.023	1	
Log (social capital expenditure)	0.031	0.038	0.074	0.156	0.033	0.916	0.087	0.196	0.035	1

Notes: Number of observations in Panel-A, 1,603; in Panel-B, 1,821; in Panel-C, 2,030; in Panel-D, 1,895; and in Panel-E, 1,705.

Table A2 Descriptive statistics by sources of remittances

	Uganda			Kenya			Nigeria			Burkina Faso			Senegal		
	Internal	African	Out-of-Africa	Internal	African	Out-of-Africa	Internal	African	Out-of-Africa	Internal	African	Out-of-Africa	Internal	African	Out-of-Africa
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Log (cash remittances)	4.621 (1.402)	5.534 (1.624)	6.686 (1.407)	5.097 (1.457)	6.232 (1.682)	7.013 (1.428)	5.458 (1.586)	6.262 (1.11)	7.069 (1.441)	3.844 (1.218)	4.427 (1.255)	5.51 (1.435)	6.13 (1.208)	6.293 (1.33)	7.295 (1.319)
Log (education expenditure)	4.187 (2.393)	4.525 (2.616)	4.469 (3.011)	3.003 (2.745)	3.078 (3.02)	3.511 (3.18)	4.153 (2.73)	4.128 (2.611)	5.152 (2.861)	2.545 (2.049)	2.587 (1.933)	3.738 (1.667)	3.202 (2.095)	3.221 (2.184)	3.793 (2.38)
Log (health expenditure)	3.116 (1.88)	3.405 (1.813)	3.361 (2.197)	2.465 (2.03)	2.845 (2.243)	3.442 (2.621)	3.433 (2.155)	3.128 (2.476)	3.795 (2.435)	3.479 (1.582)	3.329 (1.673)	4.057 (2.177)	3.851 (1.968)	3.825 (1.935)	4.328 (2.129)
Log (physical capital expenditure)	0.675 (1.856)	0.406 (1.27)	0.898 (2.188)	0.994 (2.1)	0.745 (2.077)	0.701 (1.904)	1.259 (2.409)	0.677 (1.958)	1.291 (2.61)	0.876 (1.677)	0.785 (1.547)	1.129 (2.027)	0.402 (1.369)	0.722 (1.804)	0.639 (1.82)
Log (social capital expenditure)	1.184 (1.768)	1.326 (1.943)	1.812 (2.239)	1.571 (1.952)	1.643 (2.252)	1.416 (2.227)	2.154 (2.516)	0.952 (2.238)	1.528 (2.534)	2.329 (1.991)	2.329 (2.045)	4.046 (2.051)	3.762 (2.401)	3.675 (2.395)	4.023 (2.664)
Observations	183	44	66	331	82	227	459	37	168	314	327	11	278	152	368

Notes: This table presents the mean and standard deviation of the key variables. Standard deviations are presented in parentheses.

Table A3 Effect of remittances on household investment decision

	Probit				Recursive biprobit			
	Human capital		Physical capital (=1 if yes)	Social capital (=1 if yes)	Human capital		Physical capital (=1 if yes)	Social capital (=1 if yes)
	Education (=1 if yes)	Health (=1 if yes)			Education (=1 if yes)	Health (=1 if yes)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-A: Uganda								
Received remittances (=1 if yes)	0.198* (0.114)	−0.058 (0.097)	0.137 (0.106)	0.157* (0.088)	0.478 (0.489)	0.047 (1.021)	0.730 (0.881)	0.572 (0.452)
Mean of the outcome variable	0.684	0.792	0.119	0.299	0.684	0.792	0.119	0.299
Observations	1,603				1,603			
Panel-B: Kenya								
Received remittances (=1 if yes)	0.067 (0.070)	0.043 (0.068)	0.259*** (0.080)	0.041 (0.065)	1.311*** (0.125)	1.414*** (0.102)	1.447*** (0.251)	1.332*** (0.095)
Mean of the outcome variable	0.594	0.676	0.141	0.418	0.594	0.676	0.141	0.418
Observations	1,821				1,821			
Panel-C: Nigeria								
Received remittances (=1 if yes)	0.174** (0.068)	0.070 (0.068)	0.186*** (0.070)	0.116* (0.062)	1.205*** (0.137)	−0.632* (0.337)	1.416*** (0.183)	−1.251*** (0.073)
Mean of the outcome variable	0.729	0.764	0.185	0.374	0.729	0.764	0.185	0.374
Observations	2,029				2,029			
Panel-D: Burkina Faso								
Received remittances (=1 if yes)	0.282*** (0.065)	0.080 (0.080)	0.000 (0.067)	0.032 (0.063)	1.149*** (0.221)	1.316*** (0.125)	−1.178*** (0.207)	1.401*** (0.055)
Mean of the outcome variable	0.645	0.875	0.231	0.649	0.645	0.875	0.231	0.649
Observations	1,895				1,895			
Panel-E: Senegal								
Received remittances (=1 if yes)	0.262*** (0.071)	−0.008 (0.081)	0.192** (0.094)	−0.150** (0.071)	1.204*** (0.383)	0.270 (0.417)	0.198 (0.760)	1.202*** (0.140)
Mean of the outcome variable	0.672	0.825	0.096	0.734	0.672	0.825	0.096	0.734
Observations	1,705				1,705			

Notes: This table reports the coefficients of our probit and recursive bivariate probit models. Robust standard errors are presented in parentheses. The variable of interest, received remittances, is an indicator that takes one if a household received remittances, and zero otherwise. Outcome variables are also indicator variables that equal one if a household made capital investment, and zero otherwise. Control variables are female household head, head is a paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is >60 years, log household income, number of children in the household, number of elderly in the household, and location is urban.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A4 Non-linear effect of remittances amount on household investment expenditure

	2SLS				2SLS			
	Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)	Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)
	Log (Education expenditure)	Log (Health expenditure)			Log (Education expenditure)	Log (Health expenditure)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-A: Uganda								
Log (Cash remittances)	6.938 (4.588)	0.530 (2.355)	-3.109 (2.093)	-3.317 (3.466)	3.916 (2.970)	2.155 (1.729)	0.177 (0.699)	1.956 (1.604)
Log (Cash remittances) squared	-0.986 (0.809)	0.045 (0.408)	0.577 (0.366)	0.735 (0.620)				
Log (Cash remittances) \times High remittance					-2.933 (2.719)	-1.214 (1.656)	0.205 (0.824)	-1.627 (1.560)
Observations							1,603	
Panel-B: Kenya								
Log (Cash remittances)	0.867 (1.595)	1.584 (1.356)	0.904 (1.005)	3.852* (2.028)	0.996* (0.527)	-0.057 (0.315)	0.507* (0.262)	0.311 (0.283)
Log (Cash remittances) squared	-0.032 (0.281)	-0.248 (0.240)	-0.065 (0.177)	-0.573 (0.358)				
Log (Cash remittances) \times High remittance					-0.931 (0.584)	0.001 (0.416)	0.470 (0.466)	-0.707* (0.426)
Observations							1,821	

(Continued)

Table A4 Continued

2SLS				2SLS			
Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)	Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)
Log (Education expenditure)	Log (Health expenditure)			Log (Education expenditure)	Log (Health expenditure)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-C: Nigeria							
Log (Cash remittances)	6.736 (4.127)	0.171 (1.493)	6.679* (4.012)	4.603 (2.884)	0.787*** (0.203)	-0.579*** (0.178)	0.517*** (0.181)
Log (Cash remittances) squared	-0.821 (0.540)	-0.090 (0.197)	-0.831 (0.525)	-0.689* (0.383)			
Log (Cash remittances) × High remittance				-0.162 (1.672)	-1.911 (2.561)	3.061 (3.495)	-2.348 (2.895)
Observations	2,029			2,029			
Panel-D: Burkina Faso							
Log (Cash remittances)	-1.690 (2.917)	-3.570 (4.115)	2.952 (3.347)	3.977 (3.135)	0.588*** (0.212)	0.517*** (0.182)	0.573*** (0.215)
Log (Cash remittances) squared	0.463 (0.614)	0.863 (0.863)	-0.682 (0.704)	-0.751 (0.662)			
Log (Cash remittances) × High remittance				2.096 (2.325)	0.060 (1.659)	0.565 (1.551)	0.300 (1.624)
Observations	1,895			1,895			
(Continued)							

Table A4 Continued

	2SLS				2SLS			
	Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)	Human capital		Log (Physical capital expenditure)	Log (Social capital expenditure)
	Log (Education expenditure)	Log (Health expenditure)			Log (Education expenditure)	Log (Health expenditure)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel-E: Senegal								
Log (Cash remittances)	2.999 (2.592)	-1.285 (1.823)	-5.129 (3.366)	-7.571 (4.902)	-0.753 (0.525)	0.428 (0.335)	-0.293 (0.239)	-0.112 (0.369)
Log (Cash remittances) squared	-0.415 (0.348)	0.190 (0.244)	0.645 (0.448)	0.969 (0.655)				
Log (Cash remittances) \times High remittance					8.061 (6.029)	-3.989 (3.602)	2.626 (2.747)	1.752 (4.266)
Observations							1,705	

Notes: This table reports 2SLS estimates. Robust standard errors are presented in parentheses. Outcome variables are capital investment expenditure in US dollar (in log scale) in past 12 months. The variable of interest is amount of cash remittances received in US dollar (in log scale) in last 12 months. Columns 1–4 includes amount of cash remittances received in US dollar (in log scale) squared. Columns 5–8 includes an indicator of high remittance (above district-level average remittances) and an interaction between cash remittances received (in log scale) and high remittances. Control variables are female household head, head is paid employee, head is self-employed, head has secondary education, head has above secondary education, head's age is 45–60 years, head's age is >60 years, log household income, number of children in the household, number of elderly in the household, and location is urban.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.