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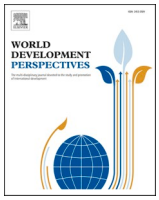

Mobile phones, leadership and gender in rural business groups

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ABSTRACT

Digital information and communication technologies are recognized as vital tools for empowering marginalized groups such as women in low income developing countries through reducing the costs of communication and connectivity. This study aimed at assessing the gender difference in mobile phone ownership among youth business group members, and how it affects election into leadership and group board positions in rural youth business groups in northern Ethiopia. We used instrumental variable methods on survey data on 1125 youths in 119 youth business groups where 32% of the members were female. Our results indicated that 37% of the females and 70% of the males owned mobile phones. Male members were twice as likely to become board members and five times as likely to become group leaders. Mobile phones had become instrumental for male members to become group leaders and board members while this was not the case for female members. Male members without mobile phone were not significantly more likely to become board members or group leaders than female members without and with mobile phones. The gender digital divide is thus a question of both ownership and the use of mobile phones for business and for getting positions that can empower women in business. Further research should investigate whether provision of mobile phones and training of female business members in use of mobile phones for business can lead to female empowerment and thereby eliminate or reduce the observed digital gender discrimination.

1. Introduction

We live in an era of intense transformation in the way information is transferred, and communication is undertaken throughout the global economy (Castells, 1996, 2010) owing to the continuous advancement in digital information and communication technologies. Digital technologies are widely recognized as important tools for empowering people in low income developing countries and achieving development goals (Qiang, Clarke, & Halewood, 2006; Unwin, 2009; Walsham & Sahay, 2006). Digital information and communication technologies lower the costs of information and connectivity and hence positively contribute in improving employment opportunities, enhancing access to cost effective health care, financial, skill training, marketing, agricultural extension, and educational services and thereby help achieve sustainable development goals, including empowering of marginalized groups such as women (Huyer & Carr, 2002; Hafkin & Huyer, 2006; Muto & Yamano, 2009; Hilbert, 2011; Antonio & Tuffley, 2014; Tadesse & Bahiigwa, 2015; Kansiime et al., 2019; Adegbite & Machethe, 2020; Hoang, 2020). This has been recognized in the United Nation's Sustainable Development Goal 5b, which aims to "achieve gender equality and empower all women and girls with emphasis on providing women decent work and representation in economic decision-making processes" (United Nations, 2017).

There is a great need for studies to help us understand these transformations in the way information is transferred and communication is undertaken and their implications in highly diverse societies in terms of their impacts on economic and social development and the need for policies to enhance their role in promoting sustainable development. While empirical findings and facts may rapidly be outdated, such findings may still be important for the understanding of later developments. The lack of studies creates missing links in the understanding of development processes.

This is a study in the periphery of this digital world, which captures the early effects of the introduction and adoption of simple mobile phones among rural youth organized in formal business groups. The groups have been formed to provide new livelihood opportunities for

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unemployed youth. High youth unemployment rates represent a growing challenge, particularly in many developing countries where population growth rates remain high. Economic transformation of over-populated communities that live on traditional livelihoods is necessary to achieve economic development and decent living to prevent migration caused by desperation.

We assess whether a gender digital divide plays out and reinforces gender differences in business management. Kularski and Moller (2012) define the digital divide as "*the gap between those that have access to vital information technology resources and those that do not have access to those resources*". The divide may be caused by the lack of technical skill and inadequate access to the technology. A gender digital divide may be due to traditional systems of inequality between the genders. The divide may lead to unequal opportunities in doing business, in establishing and maintaining social networks, accessing vital information, and achieving educational goals.

Antonio and Tuffley (2014) assess the digital gender divide in developing countries. The divide is not simply an issue of access, but also of problems to the use of digital ICTs (Kennedy, Wellman, & Klement, 2003). High costs of mobile phone services and lack of skills/knowledge constrain farmers' adoption of ICT in developing countries and female farmers are lagging behind male farmers in the use of mobile phones (Hoang, 2020) for example for agricultural advisory services (Kansiime et al., 2019). Kularski and Moller (2012) emphasize that the skill gap and the access gap come together as it is difficult to develop the skills without access and the technology cannot be used without the basic skills.

In this study we assess the ownership of simple mobile phones among male and female youth business group members, whether there is a gender divide in the ownership of mobile phones and how this may influence the position of youth business group members in the boards and leadership positions in the youth business groups. We study newly formed youth business groups established as primary cooperatives in rural areas in northern Ethiopia. This is an area where simple mobile phones have become common tools for communication over the last 10–15 years.

Despite that fact that the country was able to introduce telecommunication services some 125 years ago, the development of the sector was for one century almost stagnant. In 2010 only 7.7% of the population had access to mobile cellular phones even though mobile phone service was introduced in the country in 1999 (Dubale, 2010). However, there has been an encouraging expansion of the service including in rural areas of the country since then. According to the Agency (2021) World Fact Book, in terms of mobile cellular phone subscription in Ethiopia, the total number of subscriptions reached 38.15 million in 2019, which was about 36.2 subscriptions per 100 inhabitants. The total number of internet users in the country reached 19.12 million in 2018 and this accounts for 18.6% of the population.

Ethiopian culture is patriarchal, and men have traditionally been household heads and taken up almost all leadership positions in the society. Recent legal reforms in the country have strengthened women's land rights (Holden, Deininger, & Ghebru, 2011; Holden & Tilahun, 2020). Less is known about the position of women in business. They are supposed to have equal rights to men as members of the primary cooperative businesses that we study.

The recent developments in the expansion of vital Information and Communication Technology (ICT) tools in the country has changed the way people communicate, and how they organize their economic and social relations. However, there exists a dearth of information on to what degree women in business are benefiting equally from the developments in the ICT sector. Geldof (2011) assessed the relationship between gender and ICTs from the viewpoint of low-literate youth in Ethiopia and Malawi. She found women to face more challenges in accessing and using these technologies than men and concluded that the gender digital divide is fundamentally socially constructed. In this study, we aim to answer the following research questions:

a) Is there a gender difference in possession of mobile phones among youth business group members?
b) Is the gender difference in ownership of mobile phones explained by systematic variation in education, other personal and family characteristics?
c) Is having a mobile phone important for business group members being elected into board and leadership positions in youth business groups?

Our hypotheses for testing are that there is a gender digital divide that contributes to strengthen the gender gap in obtaining leadership positions. If our hypotheses cannot be rejected, an important policy implication can be to target the gender digital gap through allocation of mobile phones and training of female business group members in the use of such tools.

In our study of 1161 members in 119 youth business groups in northern Ethiopia, we find that women are outnumbered by men in such business groups (32% of the members are women), are less likely to be board members (only 22% of the female group members against 41% of male members are board members) and are much less likely to be group leaders/vice group leaders (only 4% of females and 20% of males are in such positions). Female group members are also less likely to own mobile phones (37% of female against 70% of male members). Mobile phones are instrumental in doing business, such as for marketing, organization of groups, and contacting authorities. We find that mobile phone ownership is instrumental to becoming business group board members and leaders and especially so for male members. The ownership of mobile phones contributes to enhance the gender gap as only males seem able to utilize mobile phone ownership to increase the likelihood of becoming board members and leaders. In order to empower young women in business it is therefore not sufficient just to provide mobile phones to women members but also to train them on how to use mobile phones for business.

2. Literature review

The introduction of telecommunication services into Ethiopia dates to the early decades after the invention of telephone by Alexander Graham Bell in 1874. The service was introduced in Ethiopia in 1894 during the period of Emperor Menelik II (Tsigie & Feyissa, 1999). During the second half of the 20th century, humanity has seen an amazing investment and advancement in science and technology. This continued effort has brought social, economic, political, and cultural transformations, which are highly dependent on global communication infrastructure that includes innovations like the internet, mobile telephony, and social networking applications (Hilbert, 2011). Since the beginning of the 21st century, the world has rapidly been adopting these information and communication technology tools, which have changed forever the way people communicate and organize social and economic activities and interactions (Negroponte, 1995; Webster, 1995; Castells, 2010; Freeman & Louçã, 2001; Hilbert, 2011). Aker and Mbiti (2010) identified five mechanisms through which mobile phones can facilitate economic development in Africa. These include increasing market efficiency through reducing search costs and improving coordination among market agents, improving firms' productive efficiency through better management of their supply chains, creating new jobs to address demand for mobile related services, facilitating communication among social networks in response to shocks and managing risks, and through facilitating the delivery of services like financial, health, educational, and agricultural services. Batista and Vicente (2013, 2018) argue that the introduction of mobile phones in rural Mozambique has facilitated financial services, improved consumption smoothing and reduced rural households' vulnerability to shocks and has facilitated out-migration by reducing transaction costs related with migrant remittances and thereby improving insurance possibilities. Mobile money can enhance financial inclusion thereby facilitating urbanization and structural change in

Africa while improving the welfare of people in rural areas (Batista & Vicente, 2020). The development of infrastructure in general and information and communication technologies are important in facilitating technology adoption by farmers in developing countries. Suri (2011) argues that high cost of acquiring agricultural technologies due to poor infrastructure constrain farmers in developing countries to have low rates of adoption of technologies like hybrid maize that could increase farm profits substantially. Nevertheless, at the core of the information communication technology (ICT) revolution is the issue of access to ICT tools, and who is empowered and who is informationally marginalized by use of these tools (Hilbert, 2011).

In this regard, the term "digital divide" has been used in the literature often to conceptualize "the gap between those that have access to vital information technology (ICT) resources and those that do not have access to those resources" (Kularski & Moller, 2012; DiMaggio, Hargittai, Celeste, & Shafer, 2004). Kularski and Moller (2012) further argue that the gap is established through the dearth of technical skill and through a physical constraint on access to vital ICT resources, with the two gaps reinforcing one another. With no access to vital ICT resource, it is problematic to develop the technical skill whereas at the same time it will be redundant to have access to the technology before having the skill to use it.

The literature on digital divide, as pointed out by Zhao, Collier, and Deng (2014), usually examines two broad dimensions, with the first focusing on the digital divide between countries (international digital divide) while the second is the divide between individuals or groups of individuals within a country (domestic digital divide). In the case of the international digital divide, there is a significant gap between developing and developed countries, and this is explained in terms of differences in socioeconomic factors, mainly income and educational attainment (Fuchs & Horak, 2008; Zhao et al., 2014; Pick & Nishida, 2015; Hilbert, 2016). Regarding the domestic digital divide, existing literature tends to emphasize specific groups of people within a country who appear particularly disadvantaged by the digital divide. These include people in the lower stratum of society in terms of income, education and/or literacy and people in remote or rural areas, the elderly, and women and girls (Zhao et al., 2014; Nishijima, Ivanauskas, & Sarti, 2017). The rural–urban divide is also associated with limited infrastructure and network services in rural areas. The digital divide is triggered by and may strengthen traditional systems of inequality in terms of, for example, race, socioeconomic status, gender (Kularski & Moller, 2012), and the gap in total factor productivity between male and female owned business firms (Essers, Megersa, & Sanfilippo, 2021).

The debate about women's access to and use of digital ICT in developing countries has been one of the focuses of the literature on the digital divide. Digital technologies could, potentially, enable women to overcome longstanding inequalities, which are more prevalent in developing countries, by providing employment opportunities and chances to increase income, in addition to improving access to cost-effective health care and education (Hilbert, 2011; Antonio & Tuffley, 2014). Understanding the causes of gender digital divide that have has implications for how women in society could benefit from the digital revolution. The factors behind the gender digital divide were the focus of studies by many scholars. Most argued that the ICT sector is dominated by men and the main cause of male dominance in the ICT sector is culture-based (Allen, Armstrong, Riemenschneider, & Reid, 2006; Horrigan, 2007; Wilson, 2003; Mumporeze & Prieler, 2017). Based on empirical analysis, Hilbert (2011) indicated that the reason why fewer women access and use ICT in Africa and Latin America is their unfavorable conditions with respect to employment, education, and income. In a study by Mumporeze and Prieler (2017), the barriers for women's access to ICTs in Rwanda were found in social, economic, and cultural factors, which include feelings of lack of self-worth, low confidence, limited education, and heavy domestic responsibilities. Geldof (2011) assessed the relationship between gender and ICTs from the viewpoint of low-literate youth in Ethiopia and Malawi. The study argues that the gender digital divide is mainly socially constructed in these countries. Regarding the constraints that women face in accessing and using ICTs, Geldof (2011) identified domestic responsibilities, time constraints, limited mobility, and sociocultural norms as important factors.

This paper contributes to the of empirical evidence regarding the gender digital divide in developing countries with this study of youth business groups in Ethiopia. The gender gap in ownership of simple mobile phones among male and female youth business group members may be important at the early stages of the ICT revolution in a country (Ono & Zavodny, 2007). Although such ownership may expand rapidly, there may still be long-standing effects on the gender gaps in participation in business leadership and management.

3. Context

Landless youth within the local communities in the study area may register to become members of youth business groups (Holden & Tilahun, 2018). Local leaders and experts have identified natural resources such as rehabilitated communal lands and mineral resources that the communities are willing to allocate to youth groups formed by youth from their own communities. Each group is allocated a demarcated land area or mineral resource that they must take responsibility for. Groups may be formed through self-selection into groups or based on decisions by local administrations. The groups establish themselves as primary cooperatives based on cooperative law. They have to elect a board consisting of five members including leader, vice leader, secretary, accountant, and treasurer. The local authorities decide on a type of business the group can run based on the type of resource they have been allocated. The group must establish its own bylaw for self-organization and make a business plan that has to be accepted by the local authorities. The groups are also subject to auditing by the local authorities.

The groups allocated mineral resources are only given a temporary right to extract a specific mineral resource to build a starting capital for establishing another type of business. These groups graduate when a certain capital level is reached, and the mineral resource may be reallocated to another group. Groups allocated a rehabilitated land resource are given a more permanent land right, if they manage the land in a sustainable way. They are required to protect their land area and establish a business activity that does not deplete the resource base.

4. Data and methods

4.1. Data

We have a sample of 1161 youth business group members from 119 youth business groups from five districts in Tigray Region of Ethiopia. The dataset is available and can be accessed (in the reference list, see the link to Holden & Tilahun, 2021). The 119 groups were sampled based on a census in 2016 finding 742 such business groups in these districts (Holden & Tilahun, 2018). The census found that the average youth business group size was 19.5 members. In the survey of members, which took place in July–August 2016, up to 12 randomly sampled group members were interviewed among those that were available.

4.2. Estimation strategy

We assess ownership of mobile phones as a technology adoption decision. We do not attempt to separate the knowledge of this technology from the access/ownership of the technology. We assume that private individual ownership is the rule although family members and friends may help each other with mobile phone services in cases of urgency and need. For business purposes, individual possession and ownership of mobile phones may be instrumental.

We assume that ownership of mobile phones (and knowledge of their use) are functions of the level of education of the youth group members, their gender, and family background. Their education is itself endoge-

nous and a function of their personal ability, gender (cultural norms), and family characteristics. More wealthy families may have been able to provide more education to their children. Parents with more education are also likely to provide more education to their children although the mechanisms of this effect could be diverse (genetic, social, economic) and hard to separate. Observable and unobservable individual and family characteristics may play a role and we will attempt to control for these. We combine instrumental variable techniques with controls for observable and unobservable factors. We start with parsimonious models for ownership of mobile phones and add controls to assess the robustness of the basic findings. We estimate the following basic model:

$$M_{ig} = \alpha_0 + \alpha_1 G_{ig} + \alpha_2 E^*_{ig} + \alpha_3 I_{ig} + \alpha_4 F_{ig} + c_g + \varepsilon_{ig} \quad (1)$$

M_{ig} is a dummy variable = 1 if individual group member i in group g owns a mobile phone, G_{ig} is a dummy variable for the group member being male (=1), E^*_{ig} is education level of the group member (years of completed education). I_{ig} is a vector of other individual controls including risk tolerance (obtained from an incentivized investment game), number of brothers, number of sisters, birth rank, and number of siblings being members of the same youth group. F_{ig} is a vector of (parent) family characteristics of the youth group member, including farm size of parents' farm, gender of household head for parents' household, education of head of parent household (years completed), a dummy for whether the parents have a radio, and number of oxen owned. c_g represents a vector of observable and/or unobservable group and community characteristics. We use random effects and fixed effects specifications to control for these. In the models with group random effects, we use district fixed effects and main production activity fixed effects while the models with group fixed effects implicitly control also for district and main activity differences across groups.

The challenge with the above model is that education is potentially endogenous, and we may get biased and inconsistent estimates unless we control for this endogeneity. We use instrumental variable estimation to assess the importance of endogeneity bias.

$$E^*_{ig} = \beta_0 + \beta_1 G_{ig} + \beta_2 Z_{ig} + \beta_3 I_{ig} + \beta_4 F_{ig} + c_g + \omega_{ig} \quad (2)$$

This requires the identification of instruments (Z_{ig}), that are correlated with education, but not with the outcome mobile phone ownership. Based on our knowledge of the local context we have identified two potentially suitable instruments. These are the age of the member and whether parents have a radio. Age is used as an instrument as the education system has improved over the years in the study region such that older members are likely to have fewer years of education. The second instrument, whether the parents have a radio or not, is also an indication of an influence towards children having more education based on the situation at their parents' home. We also argue that these variables do not have a direct effect on mobile phone ownership, and we inspect whether that is the case through an overidentification test and by inspecting the results when these variables are directly included (Table 4). We test whether these instruments are statistically valid (overidentification test) by inspecting their significance in the first stage instrumentation model, and their strength by assessing their correlation with mobile phone ownership (F-test).

Next, we assess factors associated with group members becoming group board members and group leaders/vice leaders. We estimated the following models:

$$\begin{aligned} B_{ig} &= \gamma_0 + \gamma_1 G_{ig} + \gamma_2 E^*_{ig} + \gamma_3 M^*_{ig} + \gamma_4 I_{ig} + \gamma_5 F_{ig} + c_g + \upsilon_{ig} \\ L_{ig} &= \delta_0 + \delta_1 G_{ig} + \delta_2 E^*_{ig} + \delta_3 M^*_{ig} + \delta_4 I_{ig} + \delta_5 F_{ig} + c_g + \nu_{ig} \end{aligned} \quad (3)$$

where B_{ig} is a dummy variable equal to one if group member i in group g is a board member and likewise L_{ig} is a dummy variable for the group member being group leader or vice leader. Group leaders are, by definition, also board members and the models are therefore not independent from each other. The other variables are as explained earlier. We are interested in how gender, education and mobile phone ownership are influencing or being correlated with such board membership and leadership in the groups which themselves select their board members and leaders. The challenge in these estimations is that both education and mobile phone ownership are potentially endogenous and using these variables as explanatory variables to explain board membership and leadership can give biased and inconsistent parameter estimates. To test and control for such endogeneity bias we estimated models without and with the endogenous variables with group random effects and fixed effects specifications combined with other controls to assess the significance and parameter values for the gender, education, and mobile phone variables. In addition, we used a control function approach and included the error terms from the specified mobile phone and education models as additional controls in the board membership and leadership models. This also rests on the identification of suitable instruments that affect education and mobile phone ownership but not election into becoming board members or group leaders. Such control function models also require correction of standard errors and we used bootstrapping for this.

We have used education and sex of head of parent household as instruments for education in the leadership and board membership models. It is likely, from a theoretical perspective, that the gender and education of a subject's parents affect her/his level of education, but it is not likely that these variables have any direct effect on the election processes within the youth business groups. We expect a positive effect of the education of parent household heads on the education of children and that female heads are more education oriented while males are more farming oriented based on cultural norms in the area. The validity of the instruments was assessed with Sargan's chi-squares test and could not be rejected in either model. The strength of instruments was assessed with a joint F-test in the first stage regression and the test results showed that the instruments were very strong. Exogeneity of education was assessed with Wu-Hausman test and exogeneity of education was rejected in the models for leadership and board membership. We also proposed and tested individual risk tolerance and the parents having a radio as instruments for the prediction of mobile phone ownership. The theoretical validity of these instruments is based on the assumption that buying a mobile phone is seen as a risky investment and outward oriented parents (having radio) may also mean that their children are more oriented towards owning modern technology like mobile phones. These instruments are not likely to directly affect the business group election processes for board and leadership positions. Although risk tolerance was strongly correlated with mobile phone ownership, and not significantly correlated with leadership and board membership in the models, we failed to reject exogeneity of mobile phone ownership. We therefore treat it as an exogenous variable.

Based on the finding that mobile phone ownership was statistically exogenous, we also assessed the interaction effect between the gender and mobile phone ownership dummy variables. This allowed us to assess whether there exists a specific gender discrimination effect associated with mobile phone ownership. For further details on the dataset and methods used, the authors have made the dataset in STATA file together with do file containing the estimation methods available (in the reference list, see the link to Holden & Tilahun, 2021).

5. Descriptive statistics

Table 1 presents the distribution of mobile phones by gender among the youth group members in our sample. We see that 70.2% of the male members and 37.0% of female members have mobile phones.

Table 2 compares the characteristics of mobile phone owners versus non-owners among the youth business group members. We see highly significant differences in their gender, risk tolerance, education, education of parents, and parents' ownership of radio and oxen. Oxen are used for land cultivation in this rural setting dominated by agriculture and can be considered as an indicator of farming ability. Risk tolerance

Table 1
Distribution of mobile phones by gender within youth business groups.

Having a mobile phone?	Females	Males	Total
No, frequency	237	234	471
% within gender group	63.0	29.8	40.6
Yes, frequency	139	551	690
% within gender group	**37.0**	**70.2**	**59.4**
Total	376	785	1161
% of sample	32.4	67.6	100.0

Note: Test for difference: Pearson chi2(1) = 116.4, Pr = 0.000

Table 2
Comparing mobile phone owners with non-owners.

	Mobile phone owner			
	No (n = 471)	Yes (n = 690)	t-value	P-value
Male dummy	0.497	0.799	860.100	0.0000
Risk tolerance	0.398	0.475	5.352	0.0000
Age, years	29.130	28.974	0.255	0.7990
Education, years	3.862	6.274	10.661	0.0000
Number of brothers	2.677	2.749	0.736	0.4621
Number of sisters	2.295	2.417	1.359	0.1746
Birth rank	2.983	3.170	1.564	0.1183
No. of siblings in group	0.155	0.246	2.986	0.0029
Farm size of parents	2.421	2.242	1.387	0.1659
Education of parent hhh[1]	2.085	3.936	9.314	0.0000
Gender of parent hhh	0.875	0.879	0.235	0.8143
Parent hh has radio	0.412	0.532	4.053	0.0001
No of oxen of parent hh	0.841	1.049	5.233	0.0000

Note: [1]hhh = household head, hh = household.

was measured with the Gneezy, Leonard, and List (2009) investment game and shows that owners of mobile phones are also more willing to take risk. As one could expect, mobile phone owners have on average more education than non-owners, 6.3 years versus 3.9 years. This illustrates the low level of education among the youth group members. The average level of education of their parents (head of household) is even lower, 3.9 for mobile phone owners' parents versus 2.1 years for non-owners' parents.

We may assume that female youth represent about 50% of the youth population. We find that they are less likely to join youth business groups than males as they represent only about 32.4% of the youth group members in our sample of youth groups and youth group members. But how well represented are female members in the board and key positions of the groups? Fig. 1 gives the distribution for our sample of group members from the 119 groups.

We see that female youth group members are strongly underrepresented in the youth group boards also in relative terms. About

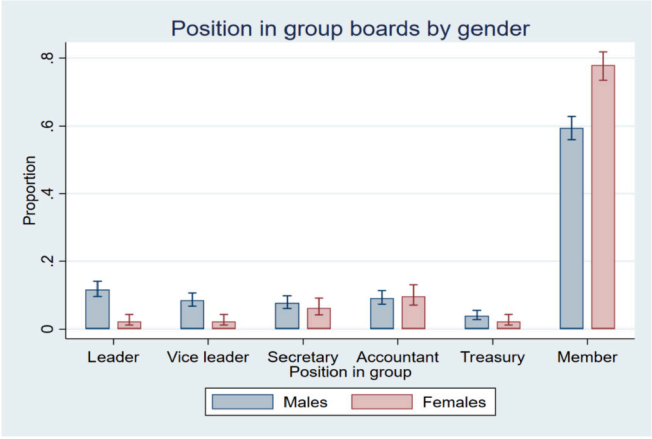

Fig. 1. Distribution of sample members in group board positions, by gender.

78% of them were ordinary members against 59% of the males. The gender difference was even stronger for the leadership position as only 4% of the females were leader or vice leader of their group against 20% of the males. Only in the position of accountant, females were equally likely as males to hold the position.

Table 3 compares the characteristics of youth business group board members with other group members and youth group leaders with other members. We first look at the board members versus non-board members. We see they are highly significantly ($p < 0.001$) different in terms of their mobile phone ownership, gender, age, education, parents' farm size, education, and ownership of radio. Members are also significantly more risk tolerant ($p < 0.05$). Board members are on average 30.5 years old against 28.3 years for the others and have 6.0 against 4.9 years of education.

For group leaders the highly significant characteristics are quite similar to those for board members. 86.7% of leaders versus 54.7% of the others own mobile phones. Leaders are on average 32.3 years against 28.5 years for the others. The difference in education is less significant, 5.9 years for leaders versus 5.2 years for the others ($p < 0.05$), while the difference in education for parents was larger and more significant, 4.3 years against 2.0 years ($p < 0.0000$). The difference in risk tolerance is small and barely significant ($p < 0.1$).

6. Results and discussion

6.1. Factors associated with mobile phone ownership

Table 4 presents the results for the mobile phone models. The first model is a parsimonious model including only the gender (male) dummy variable, which is highly significant, and showing that male-headed households are 33.2 percentage points more likely to own a mobile phone. The OLS model shows that the gender variable alone explains 10% of the variation in mobile phone ownership.

The second model includes other basic individual characteristics; risk tolerance, age, education, number of brothers, number of sisters, birth rank, and number of siblings in the youth group. Risk tolerance and education are highly significant and with positive signs, but the gender dummy remains highly significant as well and the coefficient on the male dummy variable is only slightly reduced. The gender difference is therefore only to a very small extent explained by gender differences in education and risk tolerance. Jointly, the individual characteristics explain about 20% of the variation in mobile phone ownership.

The third model adds more controls including district fixed effects and main production activity fixed effects. The male dummy, risk tolerance and education remain highly significant. Three variables for parent households, education, sex of household head and oxen ownership, are also significant.

A problem with the first three models is that education may be endogenous, and this can lead to biased and inconsistent parameter estimates. We, therefore, instrument for education. The fourth model in Table 4 is the instrumentation model for education with district and main activity fixed effects and the two last models in the table are two variants of the second stage IV models, one with district and main activity fixed effects and one with group fixed effects. We see that the instruments, age, and a dummy for parents having a radio, are highly significant in the first stage, while they were insignificant in model 3, indicating that they are strong instruments (as shown by their joint F-values in the first stage) and their statistical validity cannot be rejected. The second stage results at the bottom in the last two models show that the Sargan's overidentification test is ok. However, the endogeneity test (Wooldridge's robust score) tells us that we cannot reject exogeneity. In other words, we have no problem due to endogeneity of education in these models. The results are also for that reason not very different from the results from the models that did not control for endogeneity of education. We may treat education as an exogenous variable.

Male members are 31 percentage points more likely to have a mobile

Table 3
A comparison of the characteristics of youth group board members and leaders versus other group members.

	Board member				Group leader			
	No (n = 760)	Yes (n = 401)	t-value	P-value	No (n = 988)	Yes (n = 173)	t-value	P-value
Mobile owner, dummy	0.501	0.771	9.695	0.0000	0.547	0.867	10.559	0.0000
Male dummy	0.614	0.793	6.643	0.0000	0.636	0.908	10.114	0.0000
Risk tolerance	0.431	0.468	2.321	0.0206	0.438	0.479	1.899	0.0588
Age, years	28.271	30.489	3.851	0.0001	28.478	32.231	5.036	0.0000
Education, years	4.929	5.990	4.453	0.0000	5.195	5.867	2.165	0.0313
Number of brothers	2.700	2.758	0.585	0.5585	2.737	2.624	0.851	0.3958
Number of sisters	2.336	2.429	1.045	0.2964	2.362	2.399	0.306	0.7597
Birth rank	3.054	3.170	0.939	0.3478	3.093	3.098	0.031	0.9751
No. of siblings in group	0.205	0.217	0.354	0.7238	0.206	0.225	0.394	0.6937
Farm size of parents	2.488	1.985	4.058	0.0001	2.385	1.914	3.058	0.0025
Education of parent hhh[1]	2.664	4.175	6.745	0.0000	2.983	4.347	4.309	0.0000
Gender of parent hhh	0.870	0.892	1.138	0.2555	0.873	0.901	1.073	0.2845
Parent hh has radio	0.446	0.554	3.502	0.0005	0.472	0.549	1.884	0.0609
No of oxen of parent hh	0.955	0.983	0.700	0.4843	0.956	1.012	1.002	0.3174

Note: [1]hhh = household head, hh = household.

Table 4
Factors associated with youth business group members possessing mobile phones.

	OLS	OLS	GRE	First Stage	IVREG	IV-GFE
	mobile1	mobile2	mobile3	Education	mobile4	mobile5
Male, dummy	0.332***	0.311***	0.306***	0.374	0.310***	0.313***
	(0.0292)	(0.0286)	(0.0284)	(0.2355)	(0.0294)	(0.0293)
Risk tolerance		0.182***	0.167***	0.258	0.178***	0.131**
		(0.0522)	(0.0503)	(0.3421)	(0.0490)	(0.0503)
Education, years		0.0384***	0.0322***		0.0334***	0.0315***
		(0.0035)	(0.0047)		(0.0081)	(0.0087)
Instruments						
Age		0.00233	0.000305	−0.181***		
		(0.0015)	(0.0017)	(0.0112)		
Parents have radio			0.0263	0.766***		
			(0.0253)	(0.1850)		
Other controls						
Farm size of parents			−0.0126	0.237***	−0.0166*	−0.00667
			(0.0072)	(0.0448)	(0.0070)	(0.0070)
No. of brothers		−0.00246	0.00318	−0.072	0.0045	0.00418
		(0.0084)	(0.0090)	(0.0565)	(0.0081)	(0.0079)
No of sisters		−0.00229	−0.00843	0.107	−0.00423	−0.0126
		(0.0094)	(0.0088)	(0.0613)	(0.0091)	(0.0090)
Birth rank		0.0119	0.0118	−0.113*	0.0118	0.0123
		(0.0071)	(0.0070)	(0.0457)	(0.0070)	(0.0069)
No of siblings in group		0.0500*	0.024	0.134	0.037	−0.00957
		(0.0241)	(0.0217)	(0.1632)	(0.0227)	(0.0246)
Education of parents			0.0156***	0.443***	0.0148**	0.0160**
			(0.0042)	(0.0279)	(0.0053)	(0.0052)
Sex of head of parent hh			−0.121**	−0.668*	−0.128**	−0.0992*
			(0.0407)	(0.2980)	(0.0411)	(0.0393)
No. of oxen of parent hh			0.120***	0.100	0.115***	0.145***
			(0.0302)	(0.1653)	(0.0268)	(0.0335)
District FE	No	No	Yes	Yes	Yes	–
Main activity FE	No	No	Yes	Yes	Yes	–
Group Effects	No	No	RE	No	No	FE
Constant	0.370***	−0.00274	0.193*	3.403***	0.182**	0.158
	(0.0240)	(0.0678)	(0.0805)	(0.9341)	(0.0653)	(0.1380)
Observations	1161	1161	1125	1148	1148	1125
R-squares	0.1000	0.2060	0.2599	0.5850	0.2630	0.3720
Wooldridge's robust score (p-value)					0.9629	0.9447
Sargan's chi-sq. test (p-value)					0.3024	0.3144
First stage F-value					184.948	150.192

Note: Cluster robust standard errors in parentheses, clustering on business groups. Significance levels: * 0.05 ** 0.01 *** 0.001.

phone than female members, after we have controlled for education, individual, parent and group characteristics. This is very strong evidence of a gender digital divide in terms of mobile phone ownership. Next, we will assess the gender and mobile phone ownership effect on election into group boards and leadership positions.

6.2. Factors affecting group board membership and leadership

Table 5 presents models for factors related to youth group business members being leader or vice leader in their group. We are interested in how gender, education and mobile phone ownership affects selection into leadership positions. We first assess how gender affects leadership in the first three models in the table with stepwise addition of additional

Table 5
Factors associated with youth group members becoming group leader/vice leader.

	Leader1	Leader2	Leader3	Leader4	Leader5 IV-GFE	Leader6 IV-GFE
Male, dummy	0.144***	0.156***	0.162***	0.116***	0.119***	0.029
	(0.0155)	(0.0160)	(0.0188)	(0.0204)	(0.0216)	(0.0252)
Age	0.00350**	0.00453***	0.00682***	0.00878***	0.0116***	0.011***
	(0.0011)	(0.0011)	(0.0015)	(0.0015)	(0.0020)	(0.0020)
Education, years				0.0069	0.0233**	0.022**
				(0.0036)	(0.0080)	(0.0079)
Mobile phone, dummy				0.136***	0.115***	−0.004
				(0.0217)	(0.0261)	(0.0317)
Mobile*Male interaction						0.183***
						(0.0362)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Parent househ. controls	No	Yes	Yes	Yes	Yes	Yes
Main activity FE	No	Yes	–	–	–	–
District FE	No	Yes	–	–	–	–
Youth group effects	RE	RE	FE	FE	FE	FE
Constant	−0.0633	−0.0825	−0.195**	−0.301***	−0.352***	−0.311***
	(0.0409)	(0.0555)	(0.0652)	(0.0696)	(0.0801)	(0.0780)
N	1138	1125	1125	1125	1125	1125
R-sq, overall	0.0567	0.0919	0.0970	0.1270	0.1590	0.1718
Wooldridge's robust score (p-value)					0.0526	0.0694
Wu-Hausman (p-value)						
Sargan's chi-sq. test (p-value)					0.6569	0.8760
First stage F-value					106.064	105.856

Note: Linear models with group random effects (RE) or fixed effects (FE). Models with cluster robust standard errors (Leader1-4 models, models with robust standard errors (IV-FGE models). Significance levels: * 0.05 ** 0.01 *** 0.001. Instruments in Leader5-6 (IV) models: Parents' hhh education and sex of head of parent household. Endogenous variable: Education of member. Exogeneity could not be rejected for mobile phone ownership.

exogenous controls, while leaving out the endogenous mobile phone ownership variable. We see that males are 14.4 to 16.3 percentage points more likely to be selected into leadership positions than females and the variable is highly significant. Leadership position is also significantly and positively associated with age. One-year higher age increases the likelihood of being group leader by 0.35 to 0.57 percentage points according to the three first models.

Inclusion of the potentially endogenous education and mobile phone variables leads to a slight decrease in the coefficient on the male gender dummy while the age variable remains highly significant. The education variable is significant with a positive coefficient, and one-year extra education is associated with 0.7 to 0.9 percentage points higher probability of being in a leadership position ($p < 0.05$). The mobile phone dummy is indicating a strong effect and mobile phone owners are associated with 12.0 to 13.7 percentage points higher probability of being in a group leadership position than non-owners, similar in size to the effect of the gender dummy. This gives equal chances to a female member with a mobile phone as a male member without a mobile phone, *ceteris paribus*. However, we should be careful as these estimates may suffer from endogeneity bias, and here could be an interaction effect that these models do not investigate.

We tested instrumental variable models with education of parent household head, sex of head of parent household, birth rank and risk tolerance as instruments for education and mobile phone ownership. The instruments satisfied the validity requirements of being strongly correlated with the potentially endogenous variables with F-values above 10, and not being significantly correlated with the outcome equation error term, but we failed to reject exogeneity for the mobile phone ownership variable[1].

The linear 2SLS Leader5 (IV-GFE) model therefore instruments only for the education variable. We see that the education variable became highly significant, and that one-year additional education increases the probability of becoming a group leader by 2.4 percentage points, while one-year additional age increases the probability of becoming a leader by 1.2 percentage points. Having a mobile phone is associated with an 11.7 percentage points higher probability of being a group leader. This is an effect that is of similar size as the gender effect as male members have 11.9 percentage points higher probability of becoming group leader than female members. The endogeneity bias therefore caused the education and age effects to be downward biased while the gender and mobile phone coefficients appear not to have been affected much by this bias.

In the Leader6 (IVFGE) model we add an interaction between mobile phone ownership and gender to assess whether the mobile phone effect is systematically different for males and females, and indeed it is! Mobile phone ownership does not enhance the chance of females to become group leaders, but it is strongly enhancing the chance of males of becoming group leaders. A male member with a mobile phone has 18.3 percentage points higher probability of becoming a group leader than a male member without a mobile phone. A male member without a mobile phone does not have a significantly higher probability of becoming a group leader than a female member. The results for the key variables from the Leader6 (IV-GFE) model are shown in Fig. 2.

Having done this analysis for the leadership models, we proceed with the same approach for board membership in the youth business groups.

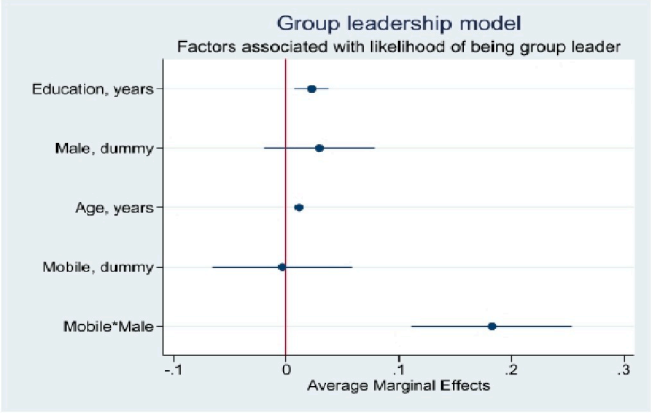

Fig. 2. Factors affecting group members becoming group leaders.

[1] The results are available from the authors upon request.

The group leaders are also part of the board, but the selection of other board members may be based on other criteria than that of leaders. The results are presented in Table 6 where models with an increasing number of controls are presented.

The last two models are linear instrumental variable 2SLS models with business group fixed effects and with education as endogenous variable. Education of parent household head and sex of parent household head were used as instruments, like in the leadership models. Exogeneity was rejected at 1% level of significance in both models, see the Wooldridge's robust scores in Table 5. These parent household characteristics are not likely to have any direct effect on the leader election process in the business groups. The statistical validity of the instruments could not be rejected as shown by Sargan's chi-squares test result and the instruments were found to be very strong as shown by the F-values in the first stage regressions.

Table 6 demonstrates a strong gender effect although its size was reduced when including education and mobile phone ownership. The size of the gender effect is not sensitive to controlling for endogeneity of education. However, the inclusion of the mobile phone and gender interaction variable demonstrates, like in the leadership model, that mobile phones are instrumental for males to dominate also as group board members. When this interaction effect is not taken into account, male group members are 10.5 percentage points more likely to be elected into group boards, *ceteris paribus*. With the inclusion of the interaction effect, male members without mobile phones are not significantly more likely to become board members than female members, while males with mobile phones are 18.3 percentage points more likely to be board members than male members without a mobile phone. On the other hand, females with a mobile phone are not more likely to become board members than females without a mobile phone. This demonstrates a strong gender digital divide.

Age is also highly significant, and one-year higher age is associated with 1.6 percentage point higher likelihood of becoming a board member. Controlling for endogeneity of education resulted in a stronger age effect. The effect of controlling for endogeneity is even stronger on the effect of education itself. One extra year of education is associated with 4.5 percentage points higher likelihood of members becoming board members.

Finally, we see that the control for endogeneity resulted in a reduction in the parameter on the mobile phone variable from 21.2 to 17.4 percent before controlling for interactions between gender and mobile. This is still a very strong effect and demonstrates the power of having a mobile phone. This effect is higher than the gender effect. But it is only in the hands of male members that mobile phone ownership is enhancing the likelihood of becoming a board member. The effects of the key variables in the Boardmember5 (IV-GFE) model in Table 6 are also illustrated in Fig. 3.

7. Conclusions

We find a strong gender gap in ownership of mobile phones among youth business group members as male members were about 31 percentage points more likely to possess a mobile phone. Furthermore, we found that having a mobile phone also had a strong effect on group male members becoming group leaders and group board members while for females having a mobile phone had no significant effect on their likelihood of becoming business group board members or group leaders. When we also take into account that male group members on average are older than female group members and there being a significant age effect, these together also contribute to the male dominance in group boards and leadership positions. While education also had positive

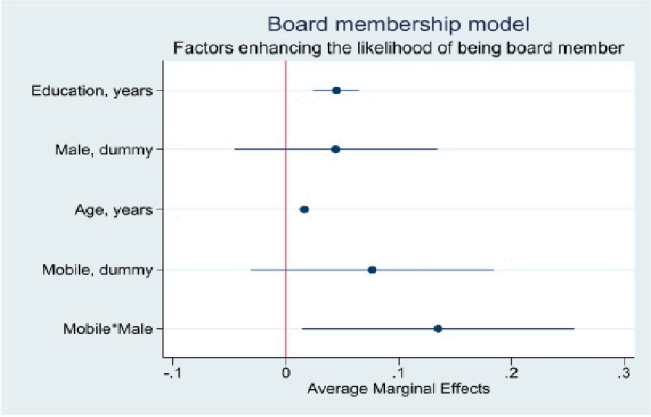

Fig. 3. Marginal effects of age, education, gender, and mobile phone ownership on youth business group board membership.

Table 6
Factors associated with group members being in the youth group board.

	Boardmem1	Boardmem2	Boardmem3	Boardmem4	Boardmem5 IV-GFE	Boardmem6 IV-GFE
Male, dummy	0.162***	0.179***	0.181***	0.108**	0.110***	0.044
	(0.0314)	(0.0298)	(0.0354)	(0.0384)	(0.0338)	(0.0422)
Age	0.0039*	0.0052***	0.00755***	0.0099***	0.0164***	0.0162***
	(0.0017)	(0.0016)	(0.0021)	(0.00221)	(0.00265)	(0.0025)
Education, years				0.0088	0.0453***	0.0446***
				(0.0049)	(0.0102)	(0.0102)
Mobile phone, dummy				0.214***	0.165***	0.077
				(0.0302)	(0.0373)	(0.0551)
Mobile*Male interaction						0.135*
						(0.0577)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Parent househ. controls	No	Yes	Yes	Yes	Yes	Yes
Main activity FE	No	Yes	–	–	–	–
District FE	No	Yes	–	–	–	–
Youth group effects	RE	RE	FE	FE	FE	FE
Constant	0.0359	−0.0430	−0.0669	−0.221*	−0.352*	−0.322
	(0.0612)	(0.0866)	(0.0953)	(0.1024)	(0.1458)	(0.177)
N	1138	1125	1125	1125	1125	
R-sq, overall	0.0427	0.1003	0.0793	0.1107	0.190	0.195
Wooldridge's robust score (p-value)					0.0010	0.0012
Sargan's chi-sq. test (p-value)					0.6932	0.8098
First stage F-value					106.06.35	105.86

Note: Linear models with group random effects (RE) or fixed effects (FE). Significance levels: * 0.05 ** 0.01 *** 0.001. Instruments in Boardmem5 and Boardmem6 (IV-GFE) models: Parents' household head education and sex of head of parent household. Endogenous variable: Education of member.

effects on members being in board membership and leadership positions, this did not contribute to a larger gender gap in such positions as female members did not have less education than male members. The gender gap in mobile phone ownership and the interaction effect between gender and mobile phone ownership were much more important in explaining why male members dominated group boards and leadership positions. The policy implication for empowerment of women in business is therefore that training campaigns for female group members should not only stimulate mobile phone ownership but such ownership also has to be accompanied with training in the use of mobile phones for business.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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