A G D I   Working Paper

WP/24/009

Fighting female unemployment: the role of female ownership of bank accounts in complementing female inclusive education

Forthcoming: Journal of Entrepreneurship and Public Policy

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Abstract

The purpose of the study is to assess if a policy of female inclusive education should be complemented with a policy of female ownership of bank accounts to fight female unemployment. The study therefore examines how female ownership of bank accounts moderates the incidence of female education on female unemployment. The focus is on 44 Sub-Saharan African (SSA) countries for the period 2004 to 2018 and the empirical evidence is based on interactive quantile regressions. The interactions are tailored such that female ownership of bank accounts influence the effect of female inclusive education on female unemployment. From the empirical findings, it is evident that female ownership of bank accounts does not effectively moderate female education in order to reduce female unemployment unless complementary policies are considered. The complementary policies should be in view of boosting the interaction between female education and female bank account ownership in increasing employment opportunities for the female gender and by extension, reducing female unemployment. The invalidity of the moderating effect is robust to the inclusion of more elements in the conditioning information set as well as accounting for other dimensions of endogeneity such as simultaneity and the unobserved heterogeneity. Policy implications are discussed. This study contributes to the extant literature by assessing how female ownership of bank accounts complement female inclusive education to reduce female unemployment.

1. Introduction

The positioning of this study on nexuses between female unemployment, female ownership of bank accounts and inclusive female education is motivated along three main fundamental elements in the scholarly and policy literature, notably: (i) the prevailing high levels of female unemployment in Sub-Saharan African (SSA); (ii) the importance of female bank account ownership and inclusive education in inclusive economic participation and (iii) gaps in the attendant literature on the subject. These motivational insights are expanded in the same chronology as highlighted[1].

First, with respect to the comparatively high rate of female unemployment in Africa, whereas some progress has been made towards gender equality in the global markets owing, *inter alia*, to social and economic progress, the corresponding advancement has been limited in the African continent due to more gender exclusion and high poverty levels (Woldemichael, 2020; Asongu & Odhiambo, 2021; Tchamyou *et al.*, 2022). In accordance with the attendant literature, when incomes are low as it is the case with most African countries, most women are obliged to work in households for domestic chores or at the family farm. However, with economic development, household income increases and correspondingly compensates for women's home production such as elderly and child care. Moreover, when women are excluded from formal agriculture, manufacturing and manual jobs owing to discrimination and stigma, such also contributes towards female exclusion in the formal economic sector. In accordance with the narrative, with more financial access and female education, *inter alia*, female unemployment issues in the formal economic sector can be addressed.

Second, the importance of female bank account ownership and female inclusive development are respectively, financial access and human capability development channels by which more female unemployment can be reduced (Woldemichael, 2020; Ncube *et al.*, 2021; Naguib, 2024; Metu & Nwogwugwu, 2024). It follows that business reforms and policies aimed at addressing issues surrounding female unemployment, (*inter alia*, good governance and infrastructure), also embody the two main independent variables of interest employed in this study (i.e., bank account ownership by females and female inclusive education).

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[1] It is important to note that female education represents enrolment of high school females (% of gross), female bank account ownership denotes the ability of women to open bank accounts like men while female unemployment is the total female unemployment as a percentage of the female labour force.

In the light of the above, the main focus of the present study is to assess whether policies designed to promote female inclusive education should be complemented with policies tailored to enhance female ownership of bank accounts in order to fight female unemployment. It is premised on the foundational elements that both skills and financial knowledge are imperative for promoting female employment or reducing female unemployment. Moreover, in the long term, such policies enhance female managerial confidence as well as female opportunities of finding white collar jobs (Ojong *et al*., 2021; Moyo & Sibindi, 2022; Tibaingana et al., 2024). The positioning of the study also builds on an identified gap in the extant scholarly literature on the subject.

Third, extant studies on gender inclusion have largely focused on among others, the importance of building on innovations in mobile money to tackle issues related to inequality (Awel & Yitbarek, 2022); the importance of microfinance institutions and banking mechanisms in enhancing the participation of females in the formal economic sector, especially as it is related to innovations in mobile phones for payment purposes (Ngono, 2021); how women can be more politically-involved for better economic development (Bezinna *et al*., 2021); the nexus between financial access and innovations in mobile money (Kim, 2022); linkages between information technology, mobile money and financial access (Asongu & Odhiambo, 2018; Osabuohien & Karakara, 2018) and insights into gender gaps linked to female gender inclusion (Mndolwa & Alhassan, 2020).

In the light of the above, in terms of originality and value, the study contributes to the extant literature by examining how female ownership of bank accounts complement female inclusive education to reduce female unemployment. From the empirical findings, it is evident that female ownership of bank accounts does not effectively moderate female education in order to reduce female unemployment unless complementary policies are considered. The complementary policies should be in view of boosting the interaction between female education and female bank account ownership in increasing employment opportunities for the female gender and by extension, reducing female unemployment. The invalidity of the moderating effect is robust to the inclusion of more elements in the conditioning information set as well as accounting for other dimensions of endogeneity such as simultaneity and the unobserved heterogeneity.

The remainder of the study is structured in the following manner. The theoretical underpinnings are covered in Section 2 while Section 3 discusses the data and relevant methodology. The empirical findings and corresponding discussion are covered in Section 4 while Section 5 concludes with policy implications and future research directions.

2. Theoretical underpinnings and testable hypothesis

The intuition and theoretical underpinnings for the study exclusively rest on postulating and establishing that gender inclusive education is a means by which female unemployment can be reduced. By extension, it is also a channel that can be moderated/complemented with the opening of female bank accounts and such moderation/complementarity can engender externalities in terms of reducing unemployment. The two main theoretical postulations underlying the present exposition are understood in terms of: (i) the relevance of inclusive education in reducing female unemployment and (ii) the "job search theory" in which, more emphasis is placed on characteristics that are conducive to employment avenues (Ama, 2008; Maitino et al., 2024).

The two underlying theoretical premises are emphasized in more detail in what follows.

With respect to the first theoretical strand, students, regardless of their disciplines acknowledge the perspective that their main objective of studying is to find a job and/or be employed once they have graduated with a diploma from school. Accordingly, majority of students anticipate prospects of employment even before they graduate from schools. In essence, this strand of literature is in accordance with the extant studies on the motivation for pursuing training and education for potential employment prospects (McMahon, 1987; Ama, 2008; Sahu et al., 2024; Asongu *et al.*, 2021b). This corresponding literature is thus, in line with the perspective that the main purpose of being educated is to get employed and earn a salary for a livelihood.

In relation to the second strand or with emphasis on the "job search theory" (McMahon, 1987), it is posited that the concern of students getting into the labor market after graduation substantially depends on the anticipated salary and/or wage that the corresponding job would provide them in order for them to be able to sustain a living. In essence, the expected utility is contingent on a comparison of the living standard while at school with the living standard once a job is obtained upon graduation. As articulated in the corresponding theory, anticipations from students in regard to the expected salary could lead the attendant students being self-employed by means of entrepreneurial opportunities or getting employed in private and public

organization which offer them the anticipated/relevant salary. It is also worthwhile to emphasize that the expected benefits are consistent with insights from the extant literature on the subject (Psacharopoulos, 1982; McMahon, 1987; Teichler, 2000; Ama, 2008; Asongu *et al.*, 2019; Adejumo *et al.*, 2021). Moreover, from the intuition the anticipated benefits both in terms of employment and living standards can improve if students are provided with financial access instruments such as bank accounts.

Borrowing from the underlying, it is apparent that the linkages being assessed in this study are consistent with both intuition and theoretical underpinnings. Theoretical underpinnings on the front that one of the main aims of education is to get employed upon graduation from school and by extension, gender inclusive education policies are designed to promote female employment upon graduation, as considered within the remit of this study. On the intuitive front, educational policies can be combined with complementary policies that are favorable for gender economic participation such as female ownership of bank accounts. When the theoretical and intuitive fronts converge, the problem statement being examined in this study is apparent, notably: an assessment of how bank accounts ownership by females can moderate the incidence female education on female unemployment. This theoretical base is further boosted on the premise that, the outcome variable as well as the two independent variables of interest (education and bank accounts) are all skewed towards the female gender in their conceptions and measurements.

The above theoretical exposition is consistent with the extant literature on the relevance of literacy in employment avenues (Babajide *et al.*, 2021; Dvouletý, 2024; Quagrainie, 2024), especially when such employment prospects are moderated/complemented with appealing characteristics for female employment such as female ownership of bank accounts. The above theoretical narrative as well as its contextualization with the problem statement being considered in this study, leads to the following testable hypothesis that is sound and simple to follow.

Hypothesis 1: female inclusive education is complemented with female ownership of bank accounts in order to reduce female unemployment.

It is also relevant to substantiate the attendant hypothesis with the corresponding literature focusing on female inclusive education as well as provide further insights into the interactions that are tailored in order to examine the corresponding hypothesis being investigated.

Accordingly, female inclusive education which is understood within the remit of female school enrolment is consistent with the extant literature on gender inclusive education, especially as it pertains to female with higher levels of education being more susceptible to be employed compared to females with lower levels of education (Kouladoum, 2023; Asongu et al., 2023). Moreover, the tested hypothesis is tailored such that female bank accounts do not directly affect female unemployment, but moderate the incidence of female inclusive education on unemployment. This is consistent studies which have established that female bank account ownership affects female unemployment either directly or indirectly (Ngono, 2021; Asongu & Odhiambo, 2023). Building on the attendant literature (Ngono, 2021; Asongu & Odhiambo, 2023), it is also important to emphasize that the perspective that bank account ownership enhances female employment opportunities is consistent with the intuition that the ownership of a bank account increase possibilities of both formal and informal transactions that are linked to economic activities, including employment avenues. This is also in line with the view that holding an account in a formal banking institution can entail emancipation and by extension, employment opportunities.

3. Data and methodology

3.1 Data

The focus of the present study is on 44 countries in sub-Saharan Africa (SSA) using data for the period 2004-2018. The dataset is from Ngono (2021) which has focused on linkages between banking, microfinancial institutions and female self-employment while the present study is concerned with linkages between female inclusive education, female access to bank accounts and female unemployment. The choice of the periodicity and sampled countries is therefore consistent with the motivations of Ngono (2021) on data availability constraints. The data are originally from two main sources: (i) World Development Indicators of the World Bank (2020a) and (ii) the Gender and Parity Statistics for Men and Women of the World Bank (2020b).

The main outcome variable is female unemployment (% of female labor force) while the two independent variables of interest are: (i) inclusive education in terms of female high school enrollment (% gross) and (ii) bank account ownership which is a dummy variable which takes the value of 1 if women can open bank accounts like men, 0 otherwise. Inclusive education is the main channel while bank accounts represent the moderating variable. These variables are documented in Ngono (2021). It is important to clarify that the choice of high school enrolment and not university enrolment is consistent with the narrative in the extant literature that citizens

with average levels of education are more likely to contribute to economic development and growth compared to citizens with higher levels of education when economies are at the initial levels of industrialization (Asiedu, 2014).

In order to account for variable omission bias, the following variables are involved in the conditioning information set, namely: female self-employment, female fertility, trade openness, the cost it takes for a woman to set up a business, the time for a woman to set up a business and the procedures a woman has to go through to start a business. As concerns the expected signs, female self-employment and trade openness are expected to reduce female unemployment while the other variables are anticipated to engender the opposite effect. For instance, according to Ngono (2021), female fertility increases female unemployment. Moreover the three adopted doing business indicators are negative doing business signals or doing business constraints and hence, positive effects are anticipated. The choice of the control variables is consistent with extant gender inclusive development literature, notably: Duflo (2012), Tchamyou (2017), Tchamyou *et al*. (~~2019a,~~ 2019b), ~~Asongu and Odhiambo (2020),~~ Ngono (2021) and Ofori *et al*. (2021) ~~and Nchofoung *et al*. (2021)~~.

It is also worthwhile to mention that the anticipated signs highlighted above can be subject to different signs in the light of the concerns surrounding multicollinearity that are apparent in interactive regressions. It is for this reason that, in the light of Brambor *et al*. (2006) on the pitfalls of interactive regressions, net effects and/or thresholds are computed because the issue of multicollinearity is overlooked. In essence, in accordance with contemporary interactive regressions literature, thresholds and/or net effects that are computed involve both the unconditional and conditional or interactive effects (Tchamyou, 2019).

The full definitions of the indicators and attendant sources are provided in Appendix 1 whereas the corresponding summary statistics is disclosed in Appendix 2. Appendix 2 is used to calculate net effects of female education on the outcome variable because mean values of the moderating bank account variables are employed. The attendant correlation matrix is provided in Appendix 3.

3.2 Methodology

As stated in the abstract, introduction and revisited in some sections of the study, the study contributes to the extant literature by examining how female ownership of bank accounts complement female inclusive education to reduce female unemployment. In the assessment of the objective, interactive quantile regressions are employed partly because interactive

regressions are consistent with the problem statement of complementarity and partly because the study aims to depart in terms of methodology from extant studies. Contrary to the extant gender economic promotion literature that assesses the linkages at the mean value of gender economic inclusion outcome variables (Ngono, 2021; Asongu & Odhiambo, 2021), the present study departs from the attendant literature by assessing the considered linkages throughout the conditional distribution of the outcome variable. The conditionality in this assessment is motivated by the premise that examining the considered linkages throughout the conditional distribution of the outcome variable enables emphasis to be placed on low, intermediate and high initial values of the outcome variable. In other words, the methodological choice is partly motivated by the fact that blanket policies that are based on an assessment on mean values of the outcome variable, are unlikely to succeed unless such an assessment is contingent on initial levels of the gender economic inclusion variable and thus, tailored differently across countries with varying levels of gender economic inclusion.

In the light of the above, contingent on the extant literature that is based on assessing determinants throughout the conditional distribution of the outcome variables (Billger & Goel, 2009), the present exposition adopts the Quantile regressions (QR) strategy, not least, because it enables an assessment of linkages throughout the conditional distribution of the outcome variable, in line with the motivation and arguments of the previous paragraph.

It is also imperative to emphasize that compared to the ordinary least squares (OLS) strategy that is based on a hypothesis of error terms that are normally distributed, with the QR approach, such an assumption is not necessary, especially as it pertains to assessing the examined nexuses throughout the conditional distribution of the outcome variable, and thus, putting emphasis on low, intermediate and high initial values of the outcome variable (Koenker & Bassett, 1978; Keonker & Hallock, 2001; Matekenya & Moyo, 2022; Sahni et al., 2021).

Still in accordance with the attendant literature highlighted in the previous paragraph, the empirical strategy is tailored such that the θth quantile estimator related to female unemployment is obtained by tackling the optimisation disclosed in Equation (1), which is provided without subscripts in order to enable room for more flow and readability.

$$\min_{\beta \in R^k} \left[\sum_{i \in \{i: y_i \geq x_i'\beta\}} \theta |y_i - x_i'\beta| + \sum_{i \in \{i: y_i < x_i'\beta\}} (1-\theta) |y_i - x_i'\beta| \right],$$ (1)

where $\theta \in (0,1)$. Relative to the OLS technique that is fundamentally premised on minimising the total sum of squared residuals, when it comes to QR analytical strategy, the estimation process is tailored such to maximise the corresponding absolute deviations. The procedure entails maximising the corresponding absolute deviations of the relevant quantiles. For illustrative purposes, the 25th quantile (i.e., related to θ =0.25) is estimated by approximately weighing the residuals. The corresponding quantile of female unemployment or y_i given x_i is:

$$Q_y(\theta / x_i) = x_{i'}\beta_\theta \quad (2)$$

where the comparative θ th quantile parameters that are characterised by slopes that are unique, are estimated at the conditional distribution of female unemployment. The attendant estimation is orthogonal to $E(y / x) = x_{i'}\beta$ in the OLS slope and in which framework; parameters are evaluated exclusively at the conditional mean of the female unemployment outcome variable. With respect to the estimation process in Equation (2), the outcome variable y_i is the female unemployment rate while x_i contains a constant term, *secondary female high school enrollment rate, women ownership of bank accounts like men, female fertility rate, trade openness, the cost it takes for a woman to set up a business* or *the time for women to set up a business* and *the procedures a woman has to go through to start a business.*

4. Empirical results

4.1 Presentation of results

The empirical results are disclosed in this section in Table 1 which is divided into two main panels. While the first panel involves only three variables in the conditioning information set, the second panel entails three more control variables. Hence, taking the total number of control variables to six. The motivation for adding variables in the conditioning set is to assess whether the signs and significance of the estimated independent variables of interest withstand empirical scrutiny with changes/improvements in the elements in the conditioning information set. It is evident from the two panels that the estimated coefficients of interest are exclusively significant in the bottom quantiles of the conditional distribution of female unemployment. By bottom quantile, the context refers to the distribution from the 10th quantile to the median.

Moreover, when the OLS estimates are compared with the corresponding QR estimates, the justification for adopting the QR is worthwhile, not least, because the significant estimated coefficients of interest that are shown in the OLS are also evident in the QR estimation approach exclusively in the bottom quantiles of the conditional distribution of female unemployment.

Furthermore, within the bottom quantiles, the estimated coefficients of the conditional distribution vary in terms of significance and magnitude of estimated coefficients.

In order to assess the investigated/testable hypothesis and thus, the relevance of female ownership of bank accounts in modulating the incidence of female education on female unemployment, net effects are computed, in accordance with contemporary interactive regressions literature (Diop *et al.*, 2021; Bandura, 2022). For instance in the second column of Table 1 pertaining to the OLS regressions, the net effect on female unemployment is -0.0018 = ([-0.147 × 0.836] + [0.121]). In the corresponding computation, 0.121 is the unconditional impact of inclusive education on the outcome variable, 0.836 is the mean or average value of bank account ownership by females while -0.147 is the interactive or conditional effect of inclusive education. In summary, on the left-hand side, net of effects of 0.0295, -0.2289 and -0.2029 are shown respectively, in the 10th, 25th and 90th quantiles of the female unemployment distribution while in the corresponding right-hand side, net effects of 0.0242, 0.0748 and 0.0144 are also evident respectively, in the 10th, 25th and 50th quantiles of the female unemployment distribution.

In the light of the above, the validity of the tested hypothesis can be confirmed when there are negative net effects. There is also evidence of positive net effects when more control variables are involved. It follows that from an overall perspective, female bank accounts and female education can interact to reduce female unemployment, only when complementary policies are taken on board in order to boost the relevance of the underlying interaction in reducing female unemployment. Accordingly, the corresponding net effects are positive, implying that as more elements of the conditioning information set (i.e., control variables) are involved, complementary policies are needed to boost the relevance of female ownership of bank accounts in order for the overall effect of female education on female unemployment to remain negative. Moreover, most of the control variables are significant with the anticipated signs discussed in the data section.

It is also worthwhile to clarify that changes in the sign of net effects as more elements in the conditioning information set are taken into account does not necessarily reflect an instability of the models nor a concern of multicollinearity that is not addressed. This is essentially because on the one hand, net effect can change depending on the involvement of more elements in the conditioning information set. However, what is needed to maintain the stability of the models are consistent signs in the unconditional and unconditional effects which

are essential in the computation of net effects. On the other hand, consistent with Brambor *et al*. (2006), the concern of multicollinearity is overlooked in interactive regressions, especially as it pertains to the independent variable of interest because the computation of net effects involves both the conditional and the unconditional effects of the independent variable of interest.

The main findings in this study have shown that female unemployment cannot be effectively reduced contingent on complementing a policy designed to promote inclusive education with a policy oriented towards promoting the ownership of bank accounts by females. Accordingly, such attendant policies are needed to reduce the substantial representation of women in the informal economic sector. Accordingly, as posited in the relevant policy literature (Woldemichael, 2020), between 75% and 90% of employment that is non-agricultural is informal and consists of low-paid work characterized by conditions in which a female is thrice more likely to be employed as a family worker in a contributing capacity compared to a male counterpart. Hence, the corresponding implications from the stylized fact that females are often vulnerable for exploitation and unpaid work cannot be effectively addressed by complementing a policy of female inclusive education with a corresponding policy of female ownership of bank accounts. Such complementary policy priority can thus not effectively protect the female gender from exploitation both in the short and long terms.

To put the above into more perspective, in the light of the fact that about 90% of women in sub-Saharan Africa are involved in the informal economic sector (Woldemichael, 2020), the complementarity of female education and female ownership of bank accounts is not just fair but also good economics, not least, because such complementarity targets constraints that are largely felt by women in access to employment, notably: education and financial access.

Table 1: Female unemployment, education and bank accounts

	Dependent variable: Female Unemployment											
	First Set of Specifications						Second Set of Specifications					
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	20.729***	0.191	1.994	18.524***	37.212***	50.583***	16.814***	1.051	-2.293	16.533***	23.710***	35.472***
	(0.000)	(0.912)	(0.536)	(0.000)	(0.000)	(0.000)	(0.001)	(0.675)	(0.617)	(0.001)	(0.001)	(0.000)
SES	0.121***	0.165***	0.142***	0.101**	-0.004	-0.067	0.121***	0.153***	0.166***	0.093*	0.099	0.044
	(0.000)	(0.000)	(0.000)	(0.012)	(0.950)	(0.506)	(0.000)	(0.000)	(0.001)	(0.095)	(0.184)	(0.670)
BkAcct	7.673***	6.126***	4.959***	6.845***	6.058**	6.598**	7.878***	5.991***	5.584***	6.141***	8.486***	10.102***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.011)	(0.032)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
SES × BkAcct	-0.147***	-0.162***	-0.104***	-0.122***	-0.085	-0.043	-0.133***	-0.154***	-0.109**	-0.094*	-0.129*	-0.099
	(0.000)	(0.000)	(0.002)	(0.001)	(0.243)	(0.645)	(0.000)	(0.000)	(0.019)	(0.065)	(0.059)	(0.296)
FSEmp.	-0.389***	-0.168***	-0.169***	-0.364***	-0.457***	-0.521***	-0.375***	-0.171***	-0.159***	-0.341***	-0.426***	-0.490***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Fertility	2.561***	1.528***	1.392***	2.114***	1.777**	1.409	2.889***	1.544***	1.807***	2.394***	3.059***	2.442**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.027)	(0.175)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.024)
Trade	-0.012	0.045***	0.045***	0.024**	-0.022	-0.069***	-0.024	0.046***	0.038***	0.019	-0.031*	-0.077***
	(0.488)	(0.000)	(0.000)	(0.010)	(0.216)	(0.004)	(0.166)	(0.000)	(0.001)	(0.135)	(0.073)	(0.001)
CostBusiness	---	---	---	---	---	---	-0.008***	-0.002	-0.003	-0.004	-0.009**	-0.005
							(0.000)	(0.168)	(0.201)	(0.192)	(0.037)	(0.335)
TimeBusiness	---	---	---	---	---	---	0.050***	0.022***	0.033**	0.034**	0.061***	0.066**
							(0.000)	(0.002)	(0.011)	(0.019)	(0.002)	(0.013)
Startupprocd	---	---	---	---	---	---	0.075	-0.094	-0.008	-0.132	-0.018	0.170
							(0.591)	(0.185)	(0.946)	(0.355)	(0.924)	(0.520)
Net Effects	-0.0018	0.0295	-0.2289	-0.2029	na	na	0.0098	0.0242	0.0748	0.0144	na	na
R²/Pseudo R²	0.650	0.309	0.342	0.440	0.509	0.577	0.685	0.318	0.369	0.470	0.546	0.614
Fisher	98.45***						75.24***					
Observations	328	328	328	328	328	328	316	316	316	316	316	316

*,**,***: significance levels of 10%, 5% and 1% respectively. OLS: Ordinary Least Squares. R² for OLS and Pseudo R² for quantile regression. Lower quantiles (e.g., Q 0.1) signify nations where female unemployment is least. SES: Secondary female high school enrollment rate. Trade: trade openness. CostBusiness: The cost it takes for a woman to set up a business. TimeBusiness: The time of women to set up a business. Startupprocd: The procedures a woman has to go through to start a business. The mean value of bank accounts is 0.836. na: not applicable because at least one estimated coefficient needed for the computation of net effect is not significant.
Source: Author's own creation/work

4.2 Robustness checks and further discussion of results

In the order to assess the robustness of the findings in Table 1, more control for endogeneity is taken into account. It is worthwhile to articulate that, in accordance with extant studies, there are four main causes of endogeneity (Tchamyou et al., 2019; Tchamyou, 2019). These include: (i) variable omission bias; (ii) measurement errors; (iii) simultaneity or reverse causality and (iv) the unobserved heterogeneity. The attendant dimensions are first substantiated before a narrative of how this study accounts for more endogeneity for robustness checks. The highlighted four principal dimensions of endogeneity are expanded in the same chronology as presented.

First, following the corresponding literature that is focused on addressing variable omission bias as a dimension of endogeneity (Asongu, 2013), the issue of variable omission bias can be addressed by expanding the conditioning information set or involving more control variables. This is the case of the present study because there two main specifications in Tables 1-3. While the first set of specifications on the left-hand side are characterized by limited control variables, more control variables are involved in the second set of specification in the right-hand side in order to account for variable omission bias.

Second, given that the study uses secondary data, the issue of measurement errors cannot be objectively attributed to the authors, not least, because authors of the present study were not involved in the primary data collection process. The underlying justification is also a reason, it is difficult for an empirical exercise to exhaustively account for all four dimensions of endogeneity (Tchamyou, 2020; Solt, 2020).

Third, in accordance with the extant literature (Mlachila et al., 2017), the issue of reverse causality or simultaneity can be addressed by lagged the independent variables of interest and control variables of one period or year. This is the case with Tables 2-3 of the present study because the contemporary outcome variable is regressed on the non-contemporary independent variables of interest and control variables. Fourth, the concerns of unobserved heterogeneity can be accounted for by controlling for both country-specific and time effects (Lahouel et al., 2019; Bliese et al., 2020). For instance, while fixed effects regressions are tailored to account for country-specific effects, other empirical strategies such as the generalized method of moments that are not designed to account for country-specific effects, do account for the unobserved heterogeneity be controlling for time fixed effects (Tchamyou, 2020).

Given the above, the control for country-specific effects did not yield significant results that are worth reporting in the study. However, consistent with the underlying literature on the control of time effects to account for the unobserved heterogeneity, Table 3 is tailored account for both simultaneity and the observed heterogeneity dimensions of endogeneity, in addition to accounting for variable omission bias in the second set of specifications. It follows that, three of the four main dimensions of endogeneity are considered in the robustness checks exercise, with Table 2 accounting for simultaneity and variable omission bias and Table 3 further controlling for the unobserved heterogeneity within the remit of time fixed effects in addition of accounting for variable omission bias and simultaneity by means of non-contemporary independent variables of interest and control variables.

Table 2: Female unemployment, education and bank accounts (non-contemporary)

Dependent variable: Female Unemployment

	First Set of Specifications						Second Set of Specifications					
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	**20.504*****	-0.300	**1.422*****	**19.944*****	**37.097*****	**50.362*****	**16.387*****	1.542	-1.180	**17.343*****	**24.411*****	**33.730*****
	(0.000)	(0.865)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.593)	(0.771)	**(0.001)**	**(0.000)**	**(0.000)**
SES (-1)	**0.115*****	**0.167*****	**0.145*****	0.085	-0.014	-0.076	**0.116*****	**0.147*****	**0.157*****	0.088	0.089	0.057
	(0.000)	**(0.000)**	**(0.001)**	(0.139)	(0.846)	(0.495)	**(0.002)**	**(0.000)**	**(0.000)**	(0.126)	(0.237)	(0.577)
BkAcct (-1)	**7.758*****	**6.614*****	**5.090*****	**6.148*****	**6.101*****	**6.531***	**8.007*****	**6.021*****	**5.356*****	**6.120*****	**8.204*****	**12.505*****
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.009)**	**(0.052)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
SES×BkAcct (-1)	**-0.143*****	**-0.171*****	**-0.107*****	**-0.106****	-0.082	-0.045	**-0.129*****	**-0.155*****	**-0.104****	**-0.092***	**-0.136****	-0.152
	(0.000)	**(0.000)**	**(0.006)**	**(0.047)**	(0.247)	(0.664)	**(0.000)**	**(0.000)**	**(0.012)**	**(0.078)**	**(0.049)**	(0.104)
FSEmp.(-1)	**-0.386*****	**-0.174*****	**-0.171*****	**-0.365*****	**-0.443*****	**-0.518*****	**-0.372*****	**-0.169*****	**-0.155*****	**-0.346*****	**-0.425*****	**-0.505*****
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Fertility (-1)	**2.572*****	**1.622*****	**1.485*****	**2.062*****	**1.641****	1.475	**2.912*****	**1.460*****	**1.665*****	**2.416*****	**2.737*****	**2.818*****
	(0.000)	**(0.000)**	**(0.001)**	**(0.000)**	**(0.037)**	(0.195)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.008)**
Trade (-1)	-0.013	**0.048*****	**0.046*****	0.020	-0.024	**-0.072*****	-0.026	0.046***	0.035***	0.019	-0.022	-0.087***
	(0.440)	**(0.000)**	**(0.000)**	(0.122)	(0.168)	**(0.005)**	(0.134)	(0.000)	(0.001)	(0.152)	(0.205)	(0.000)
CostBusiness (-1)	---	---	---	---	---	---	**-0.008*****	**-0.003***	-0.003	-0.004	**-0.008***	-0.006
							(0.000)	**(0.087)**	(0.172)	(0.179)	**(0.054)**	(0.278)
TimeBusiness (-1)	---	---	---	---	---	---	**0.050*****	**0.032*****	**0.036*****	**0.041*****	**0.058*****	**0.072*****
							(0.000)	**(0.000)**	**(0.002)**	**(0.006)**	**(0.003)**	**(0.006)**
Startupprocd (-1)	---	---	---	---	---	---	0.085	-0.110	-0.033	-0.179	0.066	0.292
							(0.548)	(0.177)	(0.772)	(0.222)	(0.729)	(0.265)
Net Effects	-0.004	0.024	0.055	na	na	na	0.008	0.017	0.070	na	na	na
R²/Pseudo R²	0.642	0.326	0.347	0.441	0.510	0.562	0.679	0.340	0.377	0.467	0.545	0.604
Fisher	**97.47*****						**79.28*****					
Observations	328	328	328	328	328	328	316	316	316	316	316	316

*,**,***: significance levels of 10%, 5% and 1% respectively. OLS: Ordinary Least Squares. R² for OLS and Pseudo R² for quantile regression. Lower quantiles (e.g., Q 0.1) signify nations where female unemployment is least. SES: Secondary female high school enrollment rate. Trade: trade openness. CostBusiness: The cost it takes for a woman to set up a business. TimeBusiness: The time of women to set up a business. Startupprocd: The procedures a woman has to go through to start a business. The mean value of bank accounts is 0.836. na: not applicable because at least one estimated coefficient needed for the computation of net effect is not significant. (-1): one year lag.
Source: Author's own creation/work

Table 3: Female unemployment, education and bank accounts (non-contemporary and year effects)

Dependent variable: Female Unemployment

	First Set of Specifications						Second Set of Specifications					
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	-16.003	-7.143	19.906	59.457	298.248	123.12	-315.298	70.233	-40.764	-73.061	276.492	-368.271
	(0.920)	(0.895)	(0.872)	(0.721)	(0.185)	(0.708)	(0.159)	(0.531)	(0.799)	(0.720)	(0.272)	(0.282)
SES (-1)	**0.114*****	**0.166*****	**0.146*****	0.090	0.024	-0.060	**0.115*****	**0.147*****	**0.156*****	0.085	0.074	0.053
	(0.000)	**(0.000)**	**(0.001)**	(0.112)	(0.747)	(0.594)	**(0.002)**	**(0.000)**	**(0.001)**	(0.145)	(0.300)	(0.582)
BkAcct (-1)	**7.773*****	**6.635*****	**4.979*****	**6.207*****	**6.508*****	**6.578***	**8.454*****	**5.824*****	**5.462*****	**6.333*****	**7.933*****	**12.953*****
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.005)**	**(0.052)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
SES×BkAcct (-1)	**-0.144*****	**-0.172*****	**-0.104*****	-0.110**	-0.087	-0.046	**-0.136*****	**-0.152*****	**-0.105****	**-0.094***	**-0.120***	**-0.165***
	(0.000)	**(0.000)**	**(0.008)**	(0.038)	(0.220)	(0.655)	**(0.000)**	**(0.000)**	**(0.012)**	**(0.078)**	**(0.070)**	**(0.066)**
FSEmp.(-1)	**-0.387*****	**-0.175*****	**-0.171*****	**-0.359*****	**-0.434*****	**-0.513*****	**-0.386*****	**-0.164*****	**-0.159*****	**-0.353*****	**-0.406*****	**-0.530*****
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Fertility (-1)	**2.589*****	**1.618*****	**1.488*****	**2.001*****	**2.129*****	1.714	**3.046*****	**1.451*****	**1.669*****	**2.548*****	**2.451*****	**2.726*****
	(0.000)	**(0.000)**	**(0.001)**	**(0.001)**	**(0.007)**	(0.137)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.008)**
Trade (-1)	-0.013	**0.048*****	**0.046*****	0.021	-0.019	**-0.067*****	-0.026	**0.048*****	**0.033*****	0.018	-0.018	**-0.100*****
	(0.439)	**(0.000)**	**(0.000)**	(0.101)	(0.278)	**(0.009)**	(0.128)	**(0.000)**	**(0.002)**	(0.172)	(0.258)	**(0.000)**
CostBusiness (-1)	---	---	---	---	---	---	**-0.008*****	**-0.003***	-0.003	-0.004	**-0.008****	-0.006
							(0.000)	**(0.097)**	(0.166)	(0.169)	**(0.048)**	(0.271)
TimeBusiness (-1)	---	---	---	---	---	---	**0.054*****	**0.031*****	**0.037*****	**0.042*****	**0.058*****	**0.076*****
							(0.000)	**(0.000)**	**(0.002)**	**(0.006)**	**(0.002)**	**(0.003)**
Startupprocd (-1)	---	---	---	---	---	---	0.183	-0.129	-0.017	-0.168	-0.101	**0.462***
							(0.277)	(0.145)	(0.891)	(0.294)	(0.610)	**(0.087)**
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Net Effects	-0.006	0.022	0.059	na	na	na	0.130	0.019	0.068	na	na	na
R²/Pseudo R²	0.642	0.326	0.348	0.441	0.512	0.562	0.683	0.340	0.377	0.467	0.549	0.611
Fisher	**85.30*****						**73.85*****					
Observations	328	328	328	328	328	328	316	316	316	316	316	316

*,**,***: significance levels of 10%, 5% and 1% respectively. OLS: Ordinary Least Squares. R² for OLS and Pseudo R² for quantile regression. Lower quantiles (e.g., Q 0.1) signify nations where female unemployment is least. SES: Secondary female high school enrollment rate. Trade: trade openness. CostBusiness: The cost it takes for a woman to set up a business. TimeBusiness: The time of women to set up a business. Startupprocd: The procedures a woman has to go through to start a business. The mean value of bank accounts is 0.836. na: not applicable because at least one estimated coefficient needed for the computation of net effect is not significant. (-1): one year lag.
Source: Author's own creation/work

The process of assessing if the investigated hypothesis withstands empirical scrutiny for Tables 2-3, is consistent with the narrative in Table 1. As it stands, the investigated hypothesis is not validated because of positive net effects in spite of consistent negative conditional or interactive effects. Moreover, the invalidity of the tested hypothesis is visible for the most part, in the bottom quantiles of the conditional distribution of the outcome variable. It follows that the findings in Table 1 are robust to the control of simultaneity and the unobserved heterogeneity in Tables 2-3. In what follows, the established findings are discussed further in the light of extant literature.

The fact that the tested hypothesis is not valid for most part could call for innovative bank account technologies that are more related to employment opportunities. This is essentially because of the established evidence in the literature that bank account innovations, especially as it pertains to mobile money innovations and financial technologies (fintechs) are essential in fighting female unemployment (Freeman, 2005; Whittall *et al*., 2009; Osabuohien & Karakara, 2018; Mndolwa & Alhassan, 2020; Ngoni, 2021; Staples & Whittall, 2021; Hennebert *et al*., 2021; Geelan, 2021; Flanagan & Walker, 2021; Kim, 2022~~; Asongu & le Roux, 2023~~) and financial access (Lashitew *et al*., 2019; ~~Asongu *et al*., 2020;~~ Coffie *et al*., 2021; Koomson *et al*., 2021; Awel & Yitbarek, 2022; Serbeh *et al*., 2022) with positive inclusive development externalities.

The overall findings on the effect of female education on female unemployment is not consistent with a strand of literature on the importance of female education in fighting female unemployment, notably: Kamau (2021) who has shown that education aids women in getting employed and by extension, the underlying employment makes women financially and economically independent; Choi et al. (2019) on the significance of literacy in employment and Adejumo et al. (2021) with respect to the importance of human capital in long term employment opportunities.

Conversely, the fact that the tested hypothesis does not withstand empirical scrutiny in relation to education, *ceteris paribus*, can be understood from the position of Achuo et al. (2023) on the inability of educated persons to be employed owing to mismatches in the labour market between what employers need in terms of skills and what school graduates offer. Some authors have attributed the underlying mismatch to the type of education and management system (Stijepi, 2021; Shi & Wang, 2022), especially in the light technical education providing more employment opportunities compared to general education (Iqbal et al., 2020; Forster et al.,

2016). A caution in the understanding of this explanation of the results is that, the narrative should not be understood by making abstraction to the empirical premise which is interactive regressions. Hence, the isolated effects of bank accounts and education cannot be distinctly interpreted though, it is worthwhile to also engage extended strands of the literature when discussing the findings, at least, for informative purposes.

5. Concluding implications and future research directions

The present study complements that extant literature by attempting to answer the following question: should a policy of female inclusive education be complemented with a policy of female ownership of bank accounts to fight female unemployment? It follows that the purpose of the study is to examine how a policy of female ownership of bank accounts influences the effect of female inclusive education on female unemployment. In other words, the present research examines how female ownership of bank accounts moderates the incidence of female education on female unemployment. The focus is on 44 Sub-Saharan African (SSA) countries for the period 2004 to 2018 and the empirical evidence is based on interactive quantile regressions. From the empirical findings, it is evident that female ownership of bank accounts does not effectively moderate female education in order to reduce female unemployment unless complementary policies are considered. The complementary policies should be in view of boosting the interaction between female education and female bank account ownership in increasing employment opportunities for the female gender and by extension, reducing female unemployment. The invalidity of the moderating effect is robust to the inclusion of more elements in the conditioning information set (i.e., control variables) as well as accounting for other dimensions of endogeneity such as simultaneity and the unobserved heterogeneity. Other policy implications are discussed in what follows.

There are three main policy implications resulting from the findings, especially as it pertains to increasing female bank account ownership and reducing initial levels of female unemployment, contingent on complementary policies that boost the interaction of female education and ownership of bank account with the ultimate aim of reducing female unemployment. First, bank account ownership by females should be increased be specifically focusing on women that need such bank accounts for employment purposes compared to female who just need the corresponding bank accounts for subjective purposes. It follows that policies designed to promote female ownership of bank accounts should be preceded by surveys on the motivation

of owning such bank accounts and those seeking employment and/or self-employment opportunities should be given more priority, contingent on resources available for the promotion of the corresponding female ownership of bank accounts. Given that bank accounts have both bright and dark sides, considering both sides in policy formulation is relevant in understanding the importance of female ownership of bank accounts in fighting female unemployment.

Second, initial levels of female unemployment should be reduced in order to reap the benefits from the moderating role of female ownership of bank accounts. This is essentially because the estimations are exclusively significant in bottom quantiles of the conditional distribution of female unemployment. It is important to note that bottom quantiles of the conditional distribution of female unemployment are below-median levels of female unemployment, thus, representing countries in which female unemployment are below-median. Third, the effectiveness of education in engendering employment, is also contingent on the type of education, especially as it pertains to technical education versus general education. It follows that educational policies that are more tailored to the needs of employers in the job market can improve how educated females with bank accounts increase their chances of getting employed. Moreover, the underlying education policies should be tailored toward equipping females with the much-needed financial literacy training on the importance of bank accounts and how these can be used to improve employment opportunities.

The main limitation of the study is that quantile regressions provide findings with broader linkages on concepts being investigated. Hence, in order to tailor more country-specific policy implications, country-specific studies using the relevant robust country-specific empirical strategies are worthwhile. Furthermore, the findings in this study obviously leave more space for future research, especially as it relates to assessing how the findings in the study are relevant to other developing countries in Asia and Latin America. Moreover, going beyond SDG5 on gender equality and considering other SDGs is a worthwhile future research endeavour. Another caveat in the present study worth considering in future research is the adoption of education enrolment instead of education completion, owing to data availability constraints at the time of the study. It follows that further studies on the subject should consider school completion rates as the relevant data become available. It is also worthwhile to note that the study is focused on females and not males, as focusing exclusively on females in not uncommon in the extant literature. Hence, the corresponding findings are relevant exclusively to females

and their extension to males should be taken with caution unless substantiated with empirical evidence. Hence, male-centric studies should be considered as future research. Future studies should also consider comprehensive measures of bank account, not least, because bank accounts have both bright and dark sides.

Appendices
Appendix 1: Definitions and sources of variables

Variables	Definitions	Sources
Female Self-Employment	Self-employed, female (% of female employment)	WDI (World Bank)
Education	School enrollment, high, female (% gross)	WDI (World Bank)
Bank accounts	Dummy variable which takes the value 1 if women can open bank accounts like men, 0 otherwise.	Gender and parity statistics for men and women (2020)
Female Unemployment	Unemployment, female (% of female labor force)	WDI (World Bank)
Fertility	Fertility rate of women	WDI (World Bank)
Trade	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	WDI (World Bank)
Cost to start business	The cost it takes for a woman to set up a business.	Gender and parity statistics for men and women (2020)
Time to start business	The time it takes for a woman to set up a business.	Gender and parity statistics for men and women (2020)
Start up procedure	The procedures a woman has to go through to start a business	Gender and parity statistics for men and women (2020)

WDI: World Development Indicators. Source: Author's own creation/work

Appendix 2: Summary Statistics

	Mean	S.D	Min	Max	Obs
Female Self-Employment	76.840	22.988	11.816	99.081	645
Education	43.377	26.076	6.542	112.824	391
Bank accounts	0.836	0.370	0.000	1.000	660
Female Unemployment	9.206	8.512	0.218	38.265	645
Trade	74.769	34.486	19.100	225.023	604
Fertility	4.812	1.220	1.36	7.63	616
Time to start business	40.416	39.625	4.000	261	635
Cost to start business	108.518	140.472	0.200	1229.100	635
Start up procedure	9.468	3.089	3.000	18.000	635

SD: Standard Deviation. Min: Minimum. Max: Maximum. Source: Author's own creation/work

Appendix 3: correlation matrix (uniform sample size: 316)

	FUmpl	SES	Account	FSE	Fertility	Trade	Cost	Time	StartupP
FUmpl	1.000								
SES	0.580	1.000							
Account	0.312	0.305	1.000						
FSE	-0.767	-0.839	-0.302	1.000					
Fertility	-0.547	-0.879	-0.459	0.835	1.000				
Trade	0.270	0.340	0.046	-0.463	-0.424	1.000			
Cost	-0.322	-0.447	-0.458	0.385	0.504	-0.072	1.000		
Time	0.184	-0.010	-0.248	-0.081	0.051	0.214	0.369	1.000	
StartupP	-0.109	-0.254	-0.246	0.213	0.237	-0.005	0.454	0.588	1.000

FUmpl: Female Unemployment. SES: Secondary female high school enrollment rate. Account: dummy variable who takes the value 1 if women can open bank accounts like men, 0 otherwise. FSE: Female Self Employment. Fertility: Fertility rate of women. Trade: trade openness. Cost: The cost it takes for a woman to set up a business. Time: The time of women to set up a business. StartupP: The procedures a woman has to go through to start a business. Source: Author's own creation/work

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