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Female unemployment, mobile money innovations and doing business by females

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Abstract

The purpose of this study is to complement extant literature by examining how mobile money innovations can moderate the unfavorable incidence of female unemployment on female doing of business in 44 countries from sub-Saharan Africa for the period 2004 to 2018. The empirical evidence is based on interactive quantile regressions. The employed doing business constraints are the procedures a woman has to go through to start a business and the time for women to set up a business, while the engaged mobile money innovations are: (i) registered mobile money agents (registered mobile money agents per 1000 km^2 and registered mobile money agents per 100,000 adults) and (ii) active mobile money agents (active mobile money agents per 1000 km^2 and active mobile money agents per 100,000 adults). The hypothesis that mobile money innovation moderates the unfavorable incidence of female unemployment on business constraints is overwhelmingly invalid. The invalidity of the tested hypothesis is clarified, and the policy implications are discussed.

Keywords: Mobile phones, Financial inclusion, Women, Doing business, Sub-Saharan Africa

JEL classification: G20, O40, I10, I20, I32

Introduction

The study is motivated by four principal fundamentals in the extant policy and scholarly literature on the subject. Accordingly, an investigation into the nexuses between female unemployment, mobile money innovations and doing business by females is founded on the following four constructive lines, namely: (i) the policy syndrome of gender exclusion in sub-Saharan Africa (SSA); (ii) the importance of promoting inclusive development in view of achieving most poverty- and inequality-related sustainable development goals (SDGs); (iii) the established relevance of mobile money innovations in promoting inclusive development outcomes and (iv) gaps in the extant gender inclusion and doing business literature. The four highlighted fundamentals are expiated in the same chronology as highlighted.

First, the concern surrounding gender exclusion is well articulated in the United Nations' SDGs agenda, especially as it pertains to SDG5, which is focused on gender inclusion in all its forms. In essence, the present study falls within the remit of

promoting gender inclusion because two main gender exclusion variables are considered in the empirical exercise, notably: (i) the female unemployment rate is considered as a moderating variable (i.e., policy syndrome) while (ii) the doing of business by females is used as the proxy for the outcome variable. It is also worthwhile to emphasize that the importance of gender inclusion in the sub-region is also premised on sound stylized facts, not least because, according to the extant scholarly and policy literature (Asongu et al., 2021a; World Bank, 2018), about 160 USD trillion is lost on an annual basis in terms of gross domestic product (GDP) as a result of the absence of gender inclusion.

Gender exclusion is just part of the broader concerns of poverty and inequality that is apparent in SSA.

Second, beyond the concern of gender exclusion, it is documented in the extant contemporary literature on the subject (Asongu & Nwachukwu, 2016; Bicaba et al., 2017; Tchamyou, 2020), that unless the concern of income inequality (i.e. gender exclusion embodied) is addressed; most countries in the sub-region would not achieve most income inequality- and poverty-oriented SDGs targets of the United Nations. It is important to articulate that the prevailing high poverty and inequality levels in the sub-region are traceable to the fact that most governments in the attendant sub-region have failed to leverage the recent economic growth resurgence to improve equitable income distribution avenues (Tchamyou, 2019, 2020). In order to put this stance in more perspective, Nwani and Osuji (2020) have recently established that in 2019, SSA beat Asia to become the region in the world, hosting the highest number of people living in absolute poverty. Against this background, the channel of mobile money innovations used in this present exposition builds on the established evidence that they represent significant instruments in reducing poverty and income inequality gaps (Awel & Yitbarek, 2022; Kim, 2022; Ngono, 2021).

Third, this study is also motivated by the fact that mobile money innovations have been documented to be fundamental in promoting inclusive development as well as the doing of business in view of, *inter alia*, tailoring countries towards the achievement of SDGs as well as in addressing other policy syndromes like high unemployment which can, for the most part, be addressed by self-employment avenues such as the doing of business (Asongu & Odhiambo, 2018; Asong & Nting, 2022; Tchamyou, 2019; UNCDF, 2022). In essence, mobile money innovations offer, *inter alia*, financial inclusion opportunities that are worthwhile in the achievement of a plethora of inclusive development outcomes (Abdulqadir & Asongu, 2022; Achuo et al., 2021; Asongu & le Roux, 2019; Tchamyou et al., 2019a, 2019b; UNCDF, 2022). It is based on the underlying premise that the present study is concerned with addressing how mobile money innovations can be leveraged to promote the doing of business by the female gender, contingent on existing levels of doing business constraints and female unemployment because of an apparent gap in the extant literature on the subject.

Fourth, the extant literature on the subject can be summarized in three main streams, especially as it pertains to research on doing business**,** gender inclusion and mobile money innovations. These three streams of research are expanded in the same chronology as stated.

a. With regards to the first stream, the extant doing business literature has not been concerned about the problem being engaged in this study. Tchamyou (2017) has focused on how the knowledge economy influences doing business in Africa, Asongu and Odhiambo (2019a) have examined the challenges of doing business in Africa while Asongu and Tchamyou (2016) have been concerned with how the knowledge economy can be affected by doing business conditions. Eskor (2017) has considered mechanisms by which doing business can be promoted by means of strategies that are consistent with the phenomenon, whereas Kolo (2017) has focused on innovations that are linked to sustainability, especially as it pertains to promoting entrepreneurship. Chigunta (2017) assesses the importance of entrepreneurship in addressing issues related to youth unemployment, whereas Nagler and Naudé (2017) focus on issues surrounding the doing of business within the non-farming sector in SSA. Adom (2017) puts emphasis on the importance of financial institutions in the doing of business, contingent on an overwhelming informal economic sector, while Amankwah-Amoah (2018) provides insights from an emerging economy on the relevance of promoting doing business policies. Eshun (2018) focuses on how institutions can be reinvented in order to facilitate economic prosperity by means of entrepreneurship, whilst Juma et al. (2017) are concerned with how collaborative systems can be leveraged for the purpose of promoting sustainable doing of business.

b. Concerning the second stream, contemporary studies on innovations in mobile money have largely focused on, among others, nexuses among banking mechanisms, innovations in the use of mobile phones and the doing of business by the female gender (Ngono, 2021); Kim (2022) has focused on the incidence of financial access that is inclusive and innovations in mobile money while, Osabuohien and Karakara (2018), Asongu and Odhiambo (2018) and Mndolwa and Alhassan (2020) are interested in nexuses among access to finance, information technology, mobile phones and gender-inclusive financial development.

c. The third stream on mobile money innovations has largely been articulated along issues that are not captured in the present study, not least because: Koomson et al. (2021) have assessed how the adoption of mobile money responds to shocks that are idiosyncratic; Coffie et al. (2021) have assessed drivers of Fintech adoption in small and medium-sized enterprises; Awel and Yitbarek (2022) have been concerned with the importance of mobile phone improvements when it comes to paying utility bills; Lashitew et al. (2019) and Asongu et al. (2020, 2021b) have looked into factors that drive innovations in mobile money while Serbeh et al. (2022) have been concerned with the importance of inclusive financial avenues in sustainable development prospects in rural zones. There is also a category of authors that have predominantly focused on digital currencies (Biais et al., 2019, 2020; Chiu & Koeppl, 2019; Choi & Rocheteau, 2021; Eyal & Sirer, 2014; Easley et al., 2019; Huberman et al., 2021; Pagnotta, 2022; Saleh, 2021; Schilling & Uhlig, 2019).

Among the highlighted strands and streams of research on which the present exposition is underpinned, the closest study in the literature to the present research is Ngono (2021), which has assessed how female self-employment in SSA can be promoted through the following mechanisms: innovations in the use of mobile phones,

banks and microfinance institutions (MFIs). The authors have used data from 2004 to 2018 and employed the generalized method of moments (GMM) as an empirical strategy. The main similarity between Ngono (2021) and the present study is that both rely on the same dataset while investigating different problem statements. In this respect, the following two distinctive features are apparent in the light of the underlying study.

a. The outcome variable in the present study reflects female doing business indicators, while the outcome variable of Ngono (2021) is the female self-employment rate, which is used as a control variable in the present study. Moreover, while the problem statement in the underlying study is tailored such that there are direct linkages between the investigated channels and the outcome variable, in the present study, nexuses are indirect because the empirical analysis is framed as in interactive regression setting instead of being understood as in linear additive models. For instance, while money innovations in the underlying study are understood to influence female self-employment directly, in the present exposition, the incidence of mobile money innovations in the doing of business by females is contingent on existing levels of female unemployment as conceived within the remit of interactive or non-linear additive estimations.

b. On the methodological front, instead of assessing the nexuses at the mean value of the outcome variables as expressed in the GMM regressions, there is an assumption in the present study that the investigated nexuses are contingent on existing levels of the outcome variables, such that policies designed to influence female doing of business by means of mobile money innovations (and contingent on female unemployment) are unlikely to succeed unless such policies reflect initial levels of doing business constraints and hence, tailored differently across countries with low, intermediate and high initial levels of the considered doing business constraints. In order to take this modelling constraint into account, a quantile regressions estimation strategy is adopted because it enables the assessment of the nexuses throughout the conditional distribution of the outcome variables.

The rest of the study is organized in the following manner. Sect. "Theoretical underpinnings and testable hypothesis" discusses the extant theoretical underpinnings motivating the study while the data and methodology are covered in Sect. "Data and methodology". Sect. "Empirical results" presents and discusses the empirical results, while Sect. "Concluding implications and future research directions" concludes with implications and future research directions.

Theoretical underpinnings and testable hypothesis

This section on the theoretical exposition is engaged in three main strands, especially as it pertains to: (i) discussing the two main theoretical foundations underpinning the study; (ii) providing insights into how the theoretical foundations can be contextualized in relation to the problem statement being considered and (iii) formulating the corresponding testable hypothesis in the light of the two previous strands. These

underlying elements are discussed in detail in what follows using the same chronology as highlighted. However, in order to enhance readability and flow, the theoretical underpinnings are contextualized after presentation in respective strands.

First, within the remit of the strand on theoretical underpinnings, two main theoretical foundations can be employed to motivate the present exposition, notably: (i) technology acceptance theoretical views and (ii) the intensive and extensive margin theories underlying how financial access affects inclusive development outcomes such as gender economic inclusion.

In the first stream, consistent with recent Fintech (Ndoya & Asongu, 2022) and mobile phone adoption (Asongu et al., 2018; Cusick, 2014; Nikiforova, 2013; Yousafzai et al., 2010) literature for inclusive development outcomes, the following theories are relevant in the adoption of mobile phones for the inclusive development purposes, namely: the theory of reasoned action (TRA), the theory of planned behavior (TPB) and the technology acceptance model (TAM).

The TRA is based on the foundation that customers are rational, especially when acknowledging the consequences of their actions (Ajzen & Fishbein, 1980; Bagozzi, 1982; Fishbein & Ajzen, 1975). The TPB is an improved version of the TRA and according to Ajzen (1991), more articulation is placed on two main categories of customers: (i) customers who show conscious influence that is connected to their actions and (ii) customers who fail to show such conscious influence. With respect to the TAM, the hypothesis underlying the desire of a customer to adopt a given technology is contingent on the customer's voluntary decision to adopt and use that specific type of technology (Davis, 1989). In accordance with the extant literature, there exist three theories possessing two main common denominators that merit further articulation: (i) individual belief formation and (ii) composite constituents such as utilitarian, behavioral and psychological characteristics.

In terms of contextualization, the attendant customer-centric characteristics are consistent with the problem statement being examined in this study from three main perspectives (Ndoya & Asongu, 2022). (i) In relation to the utilitarian premise, digital technologies are adopted by customers because these users anticipate that the attendant technologies will enhance their well-being and standards of living, especially by means of doing business, as considered within the remit of the present study. (ii) From the behavioral angle, some customers can adopt digital technologies because they want to climb a social ladder and belong to a social order, especially as it pertains to joining a doing business club. (iii) Psychological and personal foundations that inspire the decision of whether a mobile technology should be adopted by a customer or not, are influenced by other tendencies, such as existing unemployment levels and the established relevance of such technologies in doing business. In summary, the attendant three factors motivating the decision by an individual to adopt a specific type of technology depend on a multitude of features that are both idiosyncratic and systematic.

With respect to the second stream in the first strand relating to the complementary theoretical underpinnings, the extensive and intensive margin theories apply to the context of the study because financial access is fundamental in the doing of business. According to the extant inclusive development literature (Tchamyou et al., 2019b): (i) the extensive margin theory applies when customers who were not previously using mobile

phones for financial access purposes are provided with the means by which to have access to finance for the purpose of doing business and (ii) the intensive margin theory is apparent when customers who had been previously enjoying financial access by means of mobile money innovations are provided with more opportunities of financial access by means of the same mobile money innovations.

Second, in terms of contextualizing the presented theoretical perspectives, it is imperative to put the attendant theoretical underpinnings in more contexts because financial access opportunities by means of mobile phones have inclusive development externalities, such as the doing of business by females. Moreover, the decision by a female to start a business because of more financial access from mobile phone externalities is also contingent on extant female doing of business constraints. The attendant contextualization is founded on documented challenges to doing business in Africa (Asongu & Odhiambo, 2019a) as well as the established nexus between doing business and inclusive development outcomes (Asongu & Odhiambo, 2019b).

Third, with regard to the theoretical underpinnings in the first strand and the corresponding contextualization of the theoretical view in the second strand, a testable hypothesis can thus be formulated. Accordingly, from the TRA, TPB and TAM, females can adopt mobile money innovations because they want to do business and such an adoption is contingent on whether they are unemployed or not. Moreover, financial access by means of mobile money innovations (through intensive and extensive margin theoretical channels) offers females with the prospect of doing business, *inter alia*, depending on existing levels of female doing business constraints. The underpinnings above lead to the following testable hypothesis.

Hypothesis 1: mobile money innovations promote the doing of business by females and existing doing business levels influence the relationship.

In the light of the above, the empirical analysis section of this study is tailored towards assessing if the data from the sampled countries is consistent with the theoretical underpinnings and related testable hypothesis. Accordingly, the nexus between mobile money innovations, female unemployment and doing business constraints is in terms of females that are unemployed using extant and new mobile money innovation opportunities to improve their doing business opportunities (i.e., the intensive and extensive margin theories). The favorable expectation or advantages of mobile money innovations are based on reasoned action, planned behavior and technology acceptance on the part of unemployed females (i.e., TRA, TPB and TAM).

Data and methodology

Data

This present exposition is focused on forty-four countries in SSA using data for the period 2004 to 2018 which are obtained from three main sources, notably: (i) the Financial Access Survey (IMF, 2020); (ii) the World Development Indicators of the World Bank (2020a) and (iii) the Gender and Parity Statistics for Men and Women of the World Bank (2020b). In accordance with the motivation of the study, especially as it pertains to the close positioning in relation to Ngono (2021), the study is based on the same dataset as that used by the underlying study. It follows that the same reasons for data availability constraints apply as in the underlying study.

Two main outcome variables are employed in the study, namely: (i) the procedures a woman has to go through to start a business and (ii) the time for women to set up a business. Following the motivation of the study and corresponding testable hypothesis, the main independent variables of interest are mobile money innovations employed as the moderating variables and the female unemployment rate (% of the female labor force) employed as the main channel or policy syndrome because, as motivated in the introduction and formulated in Sect. "Theoretical underpinnings and testable hypothesis", the ability of females to leverage mobile money innovations in view of doing business is contingent on existing mobile money innovation levels. In other words, female unemployment is moderated by the incidence of mobile money innovations in the ability of women to do business. Consistent with Ngono (2021), two types of mobile money adoption variables are employed in the present study: (i) registered mobile money agents (registered mobile money agents per 1000 km^2 and registered mobile money agents per 100,000 adults) and (ii) active mobile money agents (active mobile money agents per 1000 km^2 and active mobile money agents per 100,000 adults). It follows that while two types of mobile money innovation dynamics are adopted for the study, the additional employment of two types of mobile money dynamics in each category is to provide more room for policy implications as well as robustness insights.

Consistent with Ngono (2021), in order to control for variable omission bias and thus avoid estimations that are not robust, the empirical analysis is tailored to include 6 variables in the conditioning information set, namely: inclusive education, trade openness, female self-employment, the cost it takes for a woman to set up a business and bank account ownership by women. While these constitute five control variables, the sixth control variable is obtained complementarily from the outcome variables employed. For instance, when one outcome variable is employed in a given specification, the second outcome variable is employed as the sixth control variable and vice versa. The choice of these variables that are involved in the conditioning information set is consistent with contemporary gender inclusive and doing business literature (Asongu & Odhiambo, 2020; Asongu et al., 2021c; Cheah et al., 2021; Chen et al., 2021; Demirgüç-Kunt et al., 2018; Duflo, 2012; Nchofoung et al., 2021; Ngono, 2021; Ofori et al., 2021; Tchamyou et al., 2019a, 2019b). As concerns the expected signs from the control variables, the involved doing business constraints are expected to positively influence the outcomes variables given that they are proxied in terms of doing business constraints. However, trade, inclusive education, female self-employment and ownership of bank accounts are expected to have the opposite effects. Beyond these considerations on expected signs, it is also worthwhile to acknowledge that within the remit of interactive regressions, the expected signs cannot be established with certainty, not least because the concern of multicollinearity is not considered in interactive regressions (Brambor et al., 2006). It is for this reason that the net effects and/or thresholds are computed. These computations overlook the concern of multicollinearity by taking into account both the unconditional and conditional incidences of the main channel in the computation of net influences from the main channel on the outcome variable.

Appendix Table 5 discloses the definitions and corresponding sources of the variables employed in the study, while Appendix Table 6 provides summary statistics that are used to inform the study, especially as it pertains to the computation of net effects and/or

thresholds that are relevant in the assessment of the testable hypothesis. Accordingly, in order not to interpret the estimated coefficients as in linear additive models, as apparent in the empirical results of the study, such net effects and/or thresholds are computed in order to mitigate the pitfalls of interactive regression documented in Brambor et al. (2006). The appendix section is completed with a correlation matrix.

Methodology

In line with the motivation of the study of departing from Ngono (2021), who has adopted a GMM empirical strategy that assesses the investigated nexuses at the mean value of the gender-inclusive outcome variable, the present study adopts a quantile regressions strategy, which examines the concerned linkages throughout the conditional distribution of the outcome variable in order to increase space for policy implications as well as account for initial levels of the outcomes that are likely to influence the investigated nexuses and, by extension, corresponding policy implications. The motivation for the choice of the quantile regressions in order to avail space for more policy implications is consistent with the extant "quantile"-centric literature (Asongu, 2017; Billger & Goel, 2009; Boateng et al., 2018; Tchamyou & Asongu, 2017).

It is also worth articulating that, compared to the ordinary least squares (OLS) approach that is premised on the assumption that the error terms are normally distribution, such is not the case with the quantile regression strategy because the considered nexuses to be examined are investigated throughout the conditional distribution of the outcome variable. Moreover, unit roots tests and cointegration dispositions are not needed for the quantile regressions estimations because the estimations should be done in level series, not at an alternative level of integration. The narrative in this paragraph is supported by both contemporary and non-contemporary quantile-centric literature (Asongu, 2017; Keonker & Hallock, 2001; Koenker & Bassett, 1978).

Building on the suggested empirical approach, the θth quantile estimator of female doing of business is obtained by solving for the corresponding problem of optimization in Eq. (1), that is provided by overlooking subscripts in order to enhance readability and flow.

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

where $\theta \in (0,1)$. Compared to the OLS technique that is estimated by minimizing the sum of residuals that are squared, with the quantile regressions technique, it is instead the absolute deviations that are considered throughout the conditional distributions of the outcome variables (i.e. doing business constraints within the context of the study). As a case in point, the 75th quantile ($\theta = 0.75$) is minimised by weighing the residuals. The attendant conditional quantile of female doing of business or y_i given x_i is:

$$Q_y(\theta/x_i) = x_i'\beta\theta \quad (2)$$

where for the relative θth quantile that is investigated, parameters with unique slopes are estimated. The corresponding formulation is orthogonal to $E(y/x) = x_i'\beta$ in the OLS slope in which, parameters are exclusively investigated at the mean of the conditional

distribution of female doing business. For the model in Eq. (2), the dependent variable y_i is a female doing business constraint while x_i contains a constant term, *female unemployment, mobile money innovations, secondary female high school enrollment rate, trade openness, the cost it takes for a woman to set up a business, female self-employment and female ownership of bank accounts.*

Empirical results

Presentation of results

The empirical results are presented in this section in Tables 1, 2, 3, 4. More specifically: Table 1 is concerned with linkages between female unemployment, registered mobile money agents and the time to start a business by a female; Table 2 focuses on female unemployment, registered mobile money agents and the procedure to start a business by a female; Table 3 is concerned with female unemployment, active mobile money agents and the time to start a business by a female while Table 4 focuses on linkages between female unemployment, active mobile money agents and the procedure to start a business by a female. It follows that the first-two tables employ the mobile money innovation dynamic of registered mobile money agents, while the last-two use the mobile money innovation dynamic of active mobile money agents.

Each of the tables is divided into two main panels, respectively, reflecting each of the corresponding mobile money innovation dynamics within each category. It follows that the four tables correspond to the eight main regression categories. It is also worthwhile to clarify that when findings are compared across quantile and corresponding OLS regression outcomes, the motivation for the choice of the quantile regression approach is justified because the OLS and quantile estimates exhibit distinguishing features in terms of signs of estimated coefficients as well as in the magnitude of the estimated coefficients. This is thus an indication that initial levels of the doing business constraint outcome variables are relevant in understanding the investigated linkages.

In order to examine the validity of the tested hypothesis formulated in Sect. "Theoretical underpinnings and testable hypothesis", it is expected that female unemployment should increase female doing business constraints while mobile money innovations should moderate female unemployment in reducing the corresponding doing business constraint. In other words, given that the main channel is female unemployment, it is expected that the unconditional or non-interactive incidence of female unemployment on the outcome variable should be positive while the corresponding conditional or interactive incidence should be negative. On the basis of the significance of the attendant conditional and unconditional estimated coefficients, mobile money innovation thresholds at which the unconditional positive incidence of female unemployment on doing business constraints are completely dampened, are computed in accordance with contemporary interactive regressions literature (Nchofoung & Asongu, 2022a, 2022b; Nchofoung et al., 2022). Accordingly, the threshold values are critical levels of the mobile money innovations that should be attained in order for the effect of female unemployment to change the sign from positive to negative because the corresponding interactive effect is expected to have a negative significant sign.

It follows that the validity of the tested hypothesis is based on computing critical levels of mobile money innovations that should be reached in order for female unemployment

Table 1 Female unemployment, registered mobile money agents and time to start a business by a female

| | Dependent variable: Time to start a business by a female | | | | | | | | | | | |
| | Registered mobile money agents per 100 000 adults (Oae1) | | | | | | Registered mobile money agents per 1000 km2 (Oae2) | | | | | |
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	− 15.537	− 11.286**	− 10.904	− 1.895	− 0.059	16.442	− 14.233	− 7.239	− 9.493	3.787	0.225	28.512
	(0.269)	(0.023)	(0.146)	(0.912)	(0.998)	(0.713)	(0.320)	(0.202)	(0.202)	(0.823)	(0.993)	(0.529)
FUmpl	0.783***	0.641***	0.675***	0.837***	0.789**	0.113	0.784***	0.610***	0.654***	0.859***	0.765**	0.004
	(0.000)	(0.000)	(0.000)	(0.002)	(0.034)	(0.870)	(0.000)	(0.000)	(0.000)	(0.001)	(0.042)	(0.994)
Oae1	− 0.002	− 0.002	0.0007	− 0.00001	− 0.004	− 0.010	–	–	–	–	–	–
	(0.329)	(0.173)	(0.767)	(0.997)	(0.567)	(0.466)						
Oae2	–	–	–	–	–	–	− 0.001	− 0.004***	− 0.0004	− 0.001	− 0.00005	0.003
							(0.344)	(0.000)	(0.675)	(0.601)	(0.990)	(0.628)
FUmpl x Oae1	0.0002	0.0006***	0.0001	0.00009	− 0.000001	0.0004	–	–	–	–	–	–
	(0.550)	(0.006)	(0.700)	(0.909)	(0.999)	(0.850)						
FUmpl x Oae2	–	–	–	–	–	–	− 0.00002	0.001***	0.0005	0.0005	− 0.001	− 0.0001
							(0.962)	(0.006)	(0.370)	(0.713)	(0.542)	(0.976)
SES	0.233**	0.083***	0.085*	− 0.016	0.175	0.276	0.225**	0.060*	0.080*	− 0.028	0.179	0.185
	(0.029)	(0.008)	(0.069)	(0.876)	(0.238)	(0.326)	(0.036)	(0.091)	(0.083)	(0.786)	(0.275)	(0.513)
Trade	− 0.072	− 0.075***	− 0.065**	− 0.051	− 0.111	− 0.119	− 0.071*	− 0.092***	− 0.075***	− 0.103*	− 0.086	− 0.132
	(0.072)	(0.000)	(0.012)	(0.380)	(0.170)	(0.433)	(0.068)	(0.000)	(0.002)	(0.066)	(0.315)	(0.374)
FSEmp	0.020	0.073**	0.072	− 0.013	− 0.038	− 0.170	0.006	0.060	0.068	− 0.033	− 0.050	− 0.296
	(0.806)	(0.038)	(0.175)	(0.911)	(0.819)	(0.593)	(0.943)	(0.140)	(0.200)	(0.787)	(0.791)	(0.367)
CostBusiness	0.216***	0.016	0.047***	0.059	0.213***	0.319***	0.216***	0.009	0.044***	0.069*	0.212***	0.326***
	(0.002)	(0.130)	(0.004)	(0.111)	(0.000)	(0.001)	(0.000)	(0.448)	(0.005)	(0.056)	(0.000)	(0.001)
Startupprocd	2.456***	2.474***	2.317***	2.589***	2.097***	1.961	2.445***	2.413***	2.314***	2.427***	1.836***	2.126*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.105)	(0.000)	(0.000)	(0.000)	(0.000)	(0.008)	(0.074)
Bankaccount	− 7.165**	− 6.154***	− 6.458***	− 5.115	− 5.018	− 8.002	− 7.052**	− 5.819***	− 6.331***	− 4.230	− 4.503	− 5.966
	(0.028)	(0.000)	(0.000)	(0.126)	(0.276)	(0.358)	(0.031)	(0.000)	(0.000)	(0.193)	(0.370)	(0.491)

Table 1 (continued)

Dependent variable: Time to start a business by a female

| | Registered mobile money agents per 100 000 adults (Oae1) | | | | | | Registered mobile money agents per 1000 km2 (Oae2) | | | | | |
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Thresholds	na	nsa	na	na	na	na	na	nsa	na	na	na	na
R^2/Pseudo R^2	0.592	0.412	0.419	0.415	0.469	0.532	0.593	0.403	0.419	0.418	0.465	0.532
Fisher	**24.74*****						**23.59*****					
Observations	104	104	104	104	104	104	104	104	104	104	104	104

*, **, ***: significance levels of 10%, 5% and 1% respectively. OLS: Ordinary Least Squares. R^2 for OLS and Pseudo R^2 for quantile regression. Lower quantiles (e.g., Q 0.1) signify nations where the time to start a business by a female is least. FUmpl: Female Unemployment. Oae1: Number of registered mobile money agents per 100,000 adults. Oae2: Number of registered mobile money agents per 1000 km². SES: Secondary female high school enrollment rate. Trade: trade openness. CostBusiness: The cost it takes for a woman to set up a business. Startupprocd: The procedures a woman has to go through to start a business. Bankaccount: dummy variable if women can open bank accounts like men and 0, otherwise. na: not applicable because at least one estimated coefficient needed for the computation of the threshold is not significant. nsa: not specifically applicable because both the unconditional and conditional effects have the same signs. Bold values are significant estimated coefficients and the Fisher statistics

Table 2 Female unemployment, registered mobile money agents and procedure to start a business by a female

| | Registered mobile money agents per 100,000 adults (Oae1) | | | | | | Registered mobile money agents per 1000 km² (Oae2) | | | | | |
| | Dependent variable: procedure to start a business by a female | | | | | | | | | | | |
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	5.200* (0.064)	1.757 (0.471)	−5.123 (0.261)	1.899 (0.726)	2.933 (0.535)	6.832** (0.044)	5.708** (0.042)	0.246 (0.924)	−3.482 (0.388)	3.787 (0.823)	0.225 (0.993)	28.512 (0.529)
FUmpl	−0.072 (0.322)	−0.060 (0.133)	−0.007 (0.918)	−0.143 (0.106)	−0.043 (0.571)	−0.195*** (0.001)	−0.088 (0.195)	−0.075* (0.052)	−0.025 (0.675)	0.859*** (0.001)	0.765** (0.042)	0.004 (0.994)
Oae1	−0.0003 (0.736)	0.001* (0.098)	0.001 (0.419)	−0.0005 (0.768)	0.0003 (0.808)	0.00004 (0.967)	—	—	—	—	—	—
Oae2	—	—	—	—	—	—	0.00005 (0.873)	0.0008** (0.032)	0.0003 (0.588)	−0.001 (0.601)	−0.00005 (0.990)	−0.003 (0.628)
FUmpl × Oae1	−0.0001 (0.211)	−0.0002** (0.020)	−0.0001 (0.488)	−0.00007 (0.790)	−0.0002 (0.366)	−0.0002 (0.142)	—	—	—	—	—	—
FUmpl × Oae2	—	—	—	—	—	—	−0.0002 (0.161)	−0.0005** (0.012)	−0.00009 (0.782)	0.0005 (0.713)	−0.001 (0.542)	−0.0001 (0.976)
SES	−0.005 (0.753)	0.047*** (0.003)	0.057* (0.055)	0.007 (0.833)	−0.001 (0.960)	−0.023 (0.275)	−0.005 (0.744)	0.059*** (0.001)	0.049* (0.059)	−0.028 (0.786)	0.179 (0.275)	0.185 (0.513)
Trade	0.009 (0.349)	0.012 (0.147)	0.057*** (0.000)	0.032* (0.083)	0.005 (0.731)	0.010 (0.376)	0.007 (0.450)	0.018** (0.035)	0.050*** (0.000)	−0.103* (0.066)	−0.086 (0.315)	−0.132 (0.374)
FSEmp	−0.002 (0.877)	−0.001 (0.939)	0.055* (0.091)	0.015 (0.693)	0.010 (0.758)	−0.009 (0.682)	−0.007 (0.716)	0.0110 (0.557)	0.047 (0.111)	−0.033 (0.787)	−0.050 (0.791)	−0.296 (0.367)
CostBusiness	−0.001 (0.863)	0.018*** (0.005)	0.0005 (0.964)	−0.008 (0.562)	0.0002 (0.985)	−0.015* (0.072)	−0.001 (0.852)	0.016** (0.014)	−0.001 (0.867)	0.069* (0.056)	0.212*** (0.000)	0.326*** (0.001)
TimeBusiness	0.099*** (0.000)	0.051*** (0.000)	0.065*** (0.009)	0.145*** (0.000)	0.183*** (0.000)	0.304*** (0.000)	0.100*** (0.000)	0.051*** (0.000)	0.067*** (0.002)	2.427*** (0.000)	1.836*** (0.008)	2.126* (0.074)

Table 2 (continued)

	Dependent variable: procedure to start a business by a female											
	Registered mobile money agents per 100,000 adults (Oae1)						Registered mobile money agents per 1000 km^2 (Oae2)					
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Bankaccount	0.901	**−1.436*****	−1.412	0.537	**1.874****	0.862	0.894	**−1.472*****	**−1.346***	−4.230	−4.503	−5.966
	(0.131)	**(0.004)**	(0.121)	(0.619)	**(0.049)**	(0.200)	(0.134)	**(0.004)**	**(0.091)**	(0.193)	(0.370)	(0.491)
Thresholds	na	na	na	na	na	na	na	nsa	na	na	na	na
R^2/Pseudo R^2	0.515	0.315	0.292	0.250	0.341	0.410	0.370	0.314	0.295	0.418	0.465	0.532
Fisher	**3.58*****						**3.96*****					
Observations	104	104	104	104	104	104	104	104	104	104	104	104

*, **, ***: significance levels of 10%, 5% and 1% respectively. OLS: Ordinary Least Squares. R^2 for OLS and Pseudo R^2 for quantile regression. Lower quantiles (e.g., Q 0.1) signify nations where the procedure to start a business by a female is least. FUmpl: Female Unemployment. Oae1: Number of registered mobile money agents per 100,000 adults. Oae2: Number of registered mobile money agents per 1000 km^2. 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. Bankaccount: dummy variable if women can open bank accounts like men and 0, otherwise. na: not applicable because at least one estimated coefficient needed for the computation of the threshold is not significant. nsa: not specifically applicable because both the unconditional and conditional effects have the same signs. Bold values are significant estimated coefficients and the Fisher statistics

Table 3 Female unemployment, active mobile money agents and time to start a business by a female

| | Dependent variable: Time to start a business by a female | | | | | | Active mobile money agents per 1000 km² (Oaa2) | | | | | |
| | Active mobile money agents per 100 000 adults (Oaa1) | | | | | | | | | | | |
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	−19.875* (0.089)	−11.260** (0.016)	−12.266* (0.068)	−10.329 (0.331)	−11.812 (0.656)	40.648*** (0.000)	−15.552 (0.158)	−10.497** (0.024)	−13.872** (0.029)	−10.465 (0.324)	−9.000 (0.737)	36.872*** (0.000)
FUmpl	1.329*** (0.000)	0.925*** (0.000)	1.004*** (0.000)	0.995*** (0.000)	1.006** (0.024)	0.707*** (0.000)	1.158*** (0.000)	0.914*** (0.000)	1.016*** (0.000)	0.993*** (0.000)	0.947** (0.012)	0.708*** (0.000)
Oaa1	0.0060 (0.157)	0.003* (0.057)	0.002 (0.303)	−0.0007 (0.873)	−0.001 (0.885)	−0.001 (0.439)	—	—	—	—	—	—
Oaa2	—	—	—	—	—	—	0.001 (0.324)	−0.0003 (0.687)	0.0005 (0.685)	−0.0008 (0.704)	0.001 (0.852)	−0.0007 (0.214)
FUmpl × Oaa1	−0.001* (0.059)	0.0001 (0.640)	−0.0002 (0.622)	0.0002 (0.793)	−0.0007 (0.716)	−0.0002 (0.490)	—	—	—	—	—	—
FUmpl × Oaa2	—	—	—	—	—	—	−0.001 (0.337)	0.001* (0.053)	0.0003 (0.640)	0.0006 (0.638)	−0.001 (0.581)	−0.001*** (0.002)
SES	0.157** (0.040)	−0.013 (0.626)	0.006 (0.867)	0.034 (0.602)	0.279* (0.090)	0.245*** (0.000)	0.171** (0.035)	−0.015 (0.575)	0.011 (0.758)	0.033 (0.612)	0.267 (0.108)	0.250*** (0.000)
Trade	0.077 (0.271)	0.041* (0.072)	0.044 (0.179)	0.020 (0.690)	0.009 (0.944)	−0.088*** (0.001)	0.035 (0.515)	0.029 (0.150)	0.045 (0.105)	0.018 (0.690)	−0.0009 (0.994)	−0.073*** (0.000)
FSEmp	0.124 (0.133)	0.085** (0.010)	0.106** (0.026)	0.116 (0.122)	0.098 (0.599)	−0.051 (0.166)	0.095 (0.264)	0.091*** (0.006)	0.124*** (0.006)	0.118 (0.117)	0.072 (0.704)	−0.052** (0.016)
CostBusiness	0.189*** (0.001)	−0.004 (0.644)	0.036** (0.020)	0.055** (0.028)	0.157** (0.013)	0.138*** (0.000)	0.187*** (0.000)	0.0008 (0.937)	0.038*** (0.008)	0.055** (0.025)	0.143** (0.022)	0.150*** (0.000)
Startupprocd	1.189*** (0.001)	2.120*** (0.000)	1.647*** (0.000)	1.220*** (0.003)	0.609 (0.534)	0.565*** (0.005)	1.345*** (0.000)	2.019*** (0.000)	1.619*** (0.000)	1.230*** (0.001)	0.724 (0.427)	0.670*** (0.000)

Table 3 (continued)

	Dependent variable: Time to start a business by a female											
	Active mobile money agents per 100 000 adults (Oaa1)						Active mobile money agents per 1000 km² (Oaa2)					
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Bankaccount	− 13.730***	− 8.752***	− 7.804***	− 6.510***	− 9.814**	− 39.115***	− 13.600***	− 8.191***	− 7.864***	− 6.453***	− 9.433**	− 37.143***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.043)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.047)	(0.000)
Thresholds	na	na	na	na	na	na	na	nsa	na	na	na	na
R²/Pseudo R²	0.776	0.577	0.598	0.591	0.599	0.736	0.769	0.588	0.600	0.593	0.601	0.744
Fisher	36.32***						47.02***					
Observations	69	69	69	69	69	69	69	69	69	69	69	69

*, **, ***: 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 the time to start a business by a female is least.FUmpl: Female Unemployment. OAA1: Number of active mobile money agents per 100,000 adults. OAA2: Number of active mobile money agents per 1000 km². SES: Secondary female high school enrollment rate. Trade: trade openness. CostBusiness: The cost it takes for a woman to set up a business. Startupprocd: The procedures a woman has to go through to start a business. Bankaccount: dummy variable which takes the value 1 if women can open bankaccounts like men, 0 otherwise. na: not applicable because at least one estimated coefficient needed for the computation of the threshold is not significant. nsa; not specifically applicable because both the unconditional and conditional effects have the same signs. Bold values are significant estimated coefficients and the Fisher statistics

Table 4 Female unemployment, active mobile money agents and procedure to start a business by a female

Dependent variable: procedure to start a business by a female												
	Active mobile money agents per 100 000 adults (Oaa1)						Active mobile money agents per 1000 km² (Oaa2)					
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Constant	0.194	−5.432**	−4.854	0.258	1.614	4.064***	1.031	−5.718*	−4.043	−3.170	5.426**	5.751**
	(0.940)	(0.038)	(0.185)	(0.957)	(0.538)	(0.006)	(0.671)	(0.063)	(0.277)	(0.550)	(0.044)	(0.018)
FUmpl	0.053	0.044	0.020	0.127	0.058	−0.036	0.009	−0.012	0.0007	0.038	0.042	0.007
	(0.341)	(0.392)	(0.786)	(0.195)	(0.277)	(0.217)	(0.853)	(0.803)	(0.990)	(0.669)	(0.352)	(0.859)
Oaa1	−0.00005	0.003***	0.001	−0.001	−0.0009	−0.0007	–	–	–	–	–	–
	(0.953)	(0.003)	(0.230)	(0.559)	(0.385)	(0.220)						
Oaa2	–	–	–	–	–	–	0.0004	0.001***	0.0006	−0.0001	−0.0009*	−0.001**
							(0.409)	(0.003)	(0.380)	(0.873)	(0.075)	(0.022)
FUmpl × Oaa1	−0.0004	−0.0006	−0.0002	−0.0005	−0.00008	−0.00009	–	–	–	–	–	–
	(0.054)	(0.002)	(0.384)	(0.196)	(0.685)	(0.393)						
FUmpl × Oaa2	–	–	–	–	–	–	−0.0003	−0.001***	−0.0002	0.0002	0.0001	0.00002
							(0.361)	(0.003)	(0.646)	(0.692)	(0.661)	(0.936)
SES	0.018	0.034**	0.061***	0.041	0.022	0.0001	0.022	0.037*	0.057**	0.063*	0.005	−0.005
	(0.314)	(0.035)	(0.008)	(0.165)	(0.177)	(0.986)	(0.193)	(0.054)	(0.015)	(0.057)	(0.732)	(0.721)
Trade	0.010	0.057***	0.050***	−0.014	−0.012	−0.013*	0.001	0.064***	0.047***	0.015	−0.027**	−0.023**
	(0.381)	(0.000)	(0.006)	(0.533)	(0.340)	(0.054)	(0.905)	(0.000)	(0.005)	(0.522)	(0.022)	(0.028)
FSEmp	0.035*	0.049***	0.052**	0.043	0.036**	0.022**	0.028	0.051**	0.048**	0.052	0.019	0.022
	(0.051)	(0.006)	(0.040)	(0.196)	(0.045)	(0.024)	(0.112)	(0.017)	(0.043)	(0.156)	(0.302)	(0.174)
CostBusiness	0.006	−0.005	0.008	0.017	0.010	−0.003	0.005	−0.013	0.006	0.015	0.007	−0.001
	(0.521)	(0.442)	(0.401)	(0.214)	(0.162)	(0.380)	(0.614)	(0.131)	(0.562)	(0.314)	(0.289)	(0.809)
TimeBusiness	0.072***	0.089***	0.050	0.036	0.068***	0.118***	0.086***	0.102***	0.055*	0.045	0.040*	0.052**
	(0.006)	(0.000)	(0.124)	(0.392)	(0.005)	(0.000)	(0.002)	(0.000)	(0.083)	(0.320)	(0.076)	(0.012)

Table 4 (continued)

	Dependent variable: procedure to start a business by a female											
	Active mobile money agents per 100 000 adults (Oaa1)						Active mobile money agents per 1000 km² (Oaa2)					
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Bankaccount	0.817	− 0.987*	− 1.624**	0.841	1.741***	2.597***	0.746	− 0.522	− 1.454*	− 0.383	1.638***	2.411***
	(0.116)	(0.081)	(0.043)	(0.419)	(0.003)	(0.000)	(0.160)	(0.414)	(0.066)	(0.731)	(0.005)	(0.000)
Thresholds	na	na	na	na	na	na	na	na	na	na	na	na
R²/Pseudo R²	0.390	0.330	0.270	0.220	0.341	0.484	0.336	0.336	0.285	0.187	0.345	0.476
Fisher	6.94***						4.71***					
Observations	69	69	69	69	69	69	69	69	69	69	69	69

*, **, ***: significance levels of 10%, 5% and 1% respectively. OLS: Ordinary Least Squares. R^2 for OLS and Pseudo R^2 for quantile regression. Lower quantiles (e.g., Q 0.1) signify nations where the procedure to start a business by a female is least. FUmpl: Female Unemployment. OAA1: Number of active mobile money agents per 100 000 adults. OAA2: Number of active mobile money agents per 1000 km². 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. Bankaccount: dummy variable which takes the value of 1 if women can open bank accounts like men, 0 otherwise. na: not applicable because at least one estimated coefficient needed for the computation of the threshold is not significant. Bold values are significant estimated coefficients and the Fisher statistics

to no longer promote constraints in the doing of business. Otherwise, in accordance with the attendant interactive regression literature, positive and negative synergies can be apparent when both the unconditional and conditional estimated coefficients have the same signs. In a scenario of a synergy effect, the thresholds cannot be computed and thus, the validity of the tested hypothesis cannot be established. The sign 'na' (or not applicable) is employed when at least one estimated coefficient needed for the computation of the threshold is not significant, while 'nsa' (or not specifically applicable) is employed in a scenario of a synergy effect.

In order to put the underpinning computation for the validity of the testable hypothesis into more perspective, an illustrative example is worthwhile. In the light of the discussed information criteria for the validity of the tested hypothesis, the tested hypothesis is exclusively valid in the second and last columns of tables in regressions pertaining to, respectively, the OLS regressions and 90th of the right-hand side. In these corresponding regressions, it is apparent in the light of the discussed information criteria that the unconditional incidence of female unemployment on the outcome doing business constraint variable is positive while the corresponding conditional or interactive incidence associated with the mobile money innovation dynamic is negative. It follows that given the abstraction of the OLS findings that are exclusively used for informative purposes, in order to compare the estimations based on the mean value of the outcome variable with the corresponding estimations based on the conditional distribution of the outcome variables of all the regressions that are considered, the tested hypothesis is exclusively valid in the 90th quantile of the right-hand side of Table 3. In the attendant quantile 708 (0.708/0.001) active mobile money agents per 100,000 adults are required for female unemployment to no longer increase the time it takes for a female to start a business. In order for the computed thresholds to make economic sense and be policy-relevant, these computed thresholds are supposed to be within statistical range by being situated between the minimum and maximum values of the corresponding moderating or mobile money innovation dynamic, as disclosed in the summary statistics. This is the case because the computed threshold of 708 active mobile money agents per 100,000 adults is between the 0.000 (i.e., minimum) and 1046.332 (i.e., maximum) values disclosed in the summary statistics in Appendix Table 6.

In the light of the narrative above, it is apparent that the tested hypothesis is not overwhelmingly valid because thresholds are not computed in most of the quantiles in order to confirm the validity of the tested hypothesis. Moreover, most of the significant control variables have the expected signs in light of the discussion in the data section.

Further discussion of results and nexus with the extant literature

This section is designed to clarify the invalidity of the tested hypothesis in the light of the extant literature on the subject. Accordingly, whether the tested hypothesis is valid or invalid is subject to empirical analysis and should be clarified in the light of various strands of the literature on the subject. Hence, the invalidity of the tested hypothesis is consistent with a strand of literature documenting that mobile money innovations cannot bridge the gender financial inclusion gap, not least because, at times, these innovations instead worsen the attendant gender financial inclusion gap. This could be clarified by the fact that women could be less likely to adopt mobile money innovations and

fintech owing to associated cost and their attitudes towards not adopting specific mobile innovations because they want to remain in a scenario of status quo (Cheah et al., 2021; Chen et al., 2021).

For instance, Chen et al. (2021) have established that women, despite being more affected by poverty (Molinier & Quan, 2019), are less likely to use fintech resulting from mobile money innovations while Cheah et al. (2021) have shown that women prefer traditional modes of transactions such as cash payment methods and concluded that fintech development like mobile money innovations is detrimental to women especially as it pertains to financial inclusion and unlike men, women are less willing to use financial services that are innovative. Demirgüç-Kunt et al. (2018) have confirmed that women are less likely to be financially included by means of mobile money innovations and marital status also plays a role because single women are characterized by some features that discourage them from utilizing some innovations and even in situations of married women, according to Kofman and Payne (2021), there is some oversight and control from husbands.

The findings are thus not broadly consistent with a strand of the literature supporting the perspective that fintech and mobile phone innovations do promote gender financial inclusion (Yeyouomo & Asongu, 2022), *inter alia*, Suri and Jack (2016) on the relevance of fintech in alleviating poverty in households that are headed by females and Loko and Yang (2022), Moufakkir and Mohammed (2020), Sahay et al. (2020), Sioson and Kim (2019) and Yeyouomo and Asongu (2022) on fintech reducing the financial inclusion gap between males and females.

In terms of intuition and looking specifically at the findings and proxies considered, the invalidity of the tested hypothesis is apparent because females that are unemployed are not sufficiently leveraging innovations in mobile money to engage in business activities in the sampled countries. Policy suggestions on how the situation can be improved are discussed in the conclusion section. Moreover, the invalidity of the tested hypothesis shows that more policy action is needed in order for the data to be consistent with the discussed theoretical underpinning, especially as it pertains to: (i) unemployed females using new mobile money innovation technologies for financial access in order to improve their business opportunities (i.e., the extensive margin theory) as well as unemployed females leveraging existing mobile money technologies for enhanced financial access in the doing of business (i.e., the intensive margin theory). (ii) Moreover, reasoned action, planned behavior and technological acceptance theories that motivate unemployed females to leverage extant and new mobile money innovations to do business could still be clouded by concerns of information asymmetry and the business environment, which need to be improved in order for unemployed females to effectively leverage innovations in mobile money for business activities.

Concluding implications and future research directions

The purpose of this study is to complement extant literature by examining how mobile money innovations can moderate the unfavorable incidence of female unemployment on female doing of business in 44 countries from sub-Saharan Africa for the period 2004 to 2018. The empirical evidence is based on interactive quantile regressions. The employed doing business constraints are the procedures a woman has to go through to start a

business and the time for women to set up a business, while the engaged mobile money innovations are: (i) registered mobile money agents (registered mobile money agents per 1000 km^2 and registered mobile money agents per 100,000 adults) and (ii) active mobile money agents (active mobile money agents per 1000 km^2 and active mobile money agents per 100,000 adults). The hypothesis that mobile money innovation moderates the unfavorable incidence of female unemployment on business constraints is overwhelmingly invalid. The invalidity of the tested hypothesis has been clarified and in what follows, informative policy implications are discussed.

The first policy implication is related to dealing with female unemployment because the corresponding high levels could unfavorably affect the incidence of mobile money innovations on females doing business. This is essentially because very high levels of female unemployment could discourage females from leveraging mobile money innovations to do business owing to concerns such as information asymmetry on the comparatively less successful nature of women in doing business. Second, improving female literacy, especially as it pertains to the relevance of fintech in driving female doing of business is important in order to better inform the female gender on the relevance of using fintech and/or mobile money innovations opportunities for the doing of business. Third, improving initial conditions for doing business by females is imperative because less doing business constraints will always encourage more females to seize existing and potential business opportunities.

These policy implications are informative as they do not directly result from the findings owing to the premise that the tested hypothesis is overwhelmingly invalid. Moreover, reporting findings in which the tested hypothesis is not valid also contributes to the growing literature on fighting publication bias which is associated with the preference for strong, significant and expected results over weak, insignificant and unexpected results that are consigned to the file drawer (Asongu, 2015; Boateng et al., 2018).

The findings in the study obviously leave avenues for future research, especially as it pertains to considering other policy or moderating variables by which the incidence of the policy syndrome of female unemployment on constraints in the doing of business by the female gender can be mitigated. Among possible policy variables that can be considered are good governance dynamics and female-centric policy variables such as female entrepreneurial training opportunities. Moreover, beyond the remit of SDG5 on gender economic inclusion, which is the specific focus of the present study, future studies should critically engage other United Nations' SDGs. Future studies can also leverage on more updated data which is a caveat of this study, especially in the light of engaging the existence of unexplained variations that are apparent in the significance of the constant term in the present study.

Appendix
See Tables 5, 6, 7.

Table 5 Definitions and sources of variables

Variables	Definitions	Sources
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)
Female self-employment	Self-employed, female (% of female employment)	WDI (World Bank)
Female unemployment	Unemployment, female (% of female labor force)	WDI (World Bank)
Education	School enrollment, high, female (% gross)	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)
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)
Registered agents 1	Number of registered mobile money agents per 100,000 adults	Financial Access Survey (2020)
Registered agents 2	Number of registered mobile money agents per 1000 km^2	Financial Access Survey (2020)
Active agents 1	Number of active mobile money agents per 100,000 adults	Financial Access Survey (2020)
Active agents 2	Number of active mobile money agents per 1000 km^2	Financial Access Survey (2020)

WDI world development indicators

Table 6 Summary statistics

	Mean	S.D	Min	Max	Obs
Time to start business	40.416	39.625	4.000	261	635
Start-up procedure	9.468	3.089	3.000	18.000	635
Female self-employment	76.840	22.988	11.816	99.081	645
Female unemployment	9.206	8.512	0.218	38.265	645
Education	43.377	26.076	6.542	112.824	391
Trade	74.769	34.486	19.100	225.023	604
Cost to start business	108.518	140.472	0.200	1229.100	635
Bank accounts	0.836	0.370	0.000	1.000	660
Registered agents 1	237.012	314.561	0.115	2160.727	199
Registered agents 2	168.559	475.494	0.004	4372.031	199
Active agents 1	171.339	227.829	0.000	1046.332	125
Active agents 2	144.217	425.719	0.000	3141.954	125

SD standard deviation, *Min* minimum, *Max* maximum

Table 7 Correlation matrix (uniform sample size: 69)

	Time	StartP	FSE	FUmpl	SES	Trade	Cost	BankA	Oae1	Oae2	Oaa1	Oaa2
Time	1.000											
StartP	0.523	1.000										
FSE	− 0.262	0.005	1.000									
FUmpl	0.508	0.174	− 0.757	1.000								
SES	0.098	− 0.023	− 0.844	0.566	1.000							
Trade	0.041	− 0.096	− 0.521	0.235	0.411	1.000						
Cost	0.330	0.282	0.507	− 0.368	− 0.654	− 0.199	1.000					
BankA	− 0.311	− 0.113	− 0.301	0.290	0.318	0.155	− 0.298	1.000				
Oae1	− 0.379	− 0.389	0.093	− 0.184	− 0.048	− 0.042	− 0.137	0.211	1.000			
Oae2	− 0.279	− 0.172	0.014	− 0.206	− 0.028	− 0.135	− 0.059	0.174	0.730	1.000		
Oaa1	− 0.377	− 0.346	0.090	− 0.190	− 0.023	− 0.055	− 0.135	0.266	0.966	0.787	1.000	
Oaa2	− 0.281	− 0.153	0.015	− 0.214	− 0.029	− 0.145	− 0.051	0.179	0.706	0.995	0.780	1.000

FSE: Female Self Employment. FUmpl: Female Unemployment. SES: Secondary female high school enrollment rate. Trade: trade openness. Cost: The cost it takes fora woman to set up a business. Time: The time of women to set up a business. StartP: The procedures a woman has to go through to start a business. BankA: dummy variable which takes the value 1 if women can open bankaccounts like men, 0 otherwise. Oae1: Number of registered mobile money agents per 100,000 adults. Oae2: Number of active mobile money agents per 100,000 adults. Oaa1: Number of registered mobile money agents per 1000 km2. Oaa2: Number of active mobile money agents per 1000 km^2

Declarations

Ethics approval and consent to participate

This article does not contain any studies with human participants or animals performed by the author.

Consent to publication

Not applicable.

Competing interests

The authors neither have financial nor non-financial competing interests.

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