

The Role of Gender in Firm Innovation Performance: Evidence from Eleven Sub-Saharan Africa Countries.

Abstract

Evidence from Sub-Saharan Africa (SSA) suggests that female entrepreneurs experience poorer access to financial and physical resources, markets, formal education and training, government and institutional support, and have less limited social capital than male entrepreneurs. Guided by Resource-based View theory, this paper investigated the relationship between human capital, financial capital and firm attributes and innovation performance with reference to the gender of ownership. We used data obtained from the World Bank's Enterprise Surveys for 11 SSA countries. The empirical analysis employed a two-phase process of ordered probit regressions to analyze the effects of explanatory variables as well as of gender of ownership on innovation. The findings indicated that midsized and large firms were more likely to engage in various innovative activities than small firms. Management experience was negatively associated with likelihood of innovating. Firm size was also moderated by gender with an upside down U on innovation. Female owned midsized firms were more likely to engage in non-technological innovations and overall innovations than male owned firms of similar size. However, female-owned large firms, despite having loads of resources did not innovate. Unlike prior studies that confirm female underperformance hypothesis, the finding that emerges from our work refutes the hypothesis and finds female entrepreneurs more innovative than male entrepreneurs in the context of Africa.

Keywords: Gender gaps, innovation, Sub-Sahara Africa, Resource-based view, entrepreneurship

Introduction

Evidence in Sub-Saharan Africa¹ (SSA) suggests that female entrepreneurs experience poorer access to financial and physical resources, markets, formal education and training, government and institutional support and have less limited social capital than male (ILO, 2003; Singh and Belwal, 2008; Tundui and Tundui, 2012). Amine and Staub (2009) document constraints female entrepreneurs face in this region. The issue of gender disparity in entrepreneurship has received considerable attention because problems faced by female during business start-up and growth periods can generate undesirable effects on overall performance of their enterprises (Carter 2000). A growing body of research indicates that female-led firms continue to lag behind male-led firms in entrepreneurial practices (Coleman and Robb 2009; Cirera and Qasim 2014; Gicheva and Link 2015). Several prior studies confirm that female-owned enterprises underperform male-owned firms in innovation (e.g. Tonoyan and Strohmeyer, 2006; Bardasi et al., 2011; Gicheva and Link, 2015).

Previous studies also sought to uncover underlying factors for gender-based gaps in entrepreneurial performance. The literature concludes that differential performance is explained by factors related to human capital, financial capital and firm characteristics, which to a greater extent, are more inclined towards males (Tonoyan and Strohmeyer, 2006; Khalife and Chalouhi, 2013).

Although there is much research on gender-based differences in entrepreneurial performance, such literature tends to focus on economic measures of entrepreneurial performance, with little to no attention given to innovation (another important but yet neglected dimension of entrepreneurial performance (Womenable 2010). Ljunggren et al. (2010) notes that many scholars consider innovation as a gender-neutral phenomenon and that studies on innovation and gender have laid more focus on male dominated industries and innovation activities. Coleman (2016) and Poggesi et al. (2015)'s current reviews of literature on gender, entrepreneurship and firm performance provide additional evidence

¹Sub-Saharan Africa is region that consists of 48 African countries lying south of the Sahara desert. The region has the highest rates of female participation in entrepreneurship and business closure respectively in the world (Global Entrepreneurship Monitor, 2016).

on the extent to which gender and innovation is an ignored area by researchers. A better understanding of the role of gender in innovation provides an excellent opportunity to advance our knowledge of gender in innovation performance. The addition of gender perspective to innovation can shed more light on how gender, as an individual characteristic can explain an innovator profile.

The research to date comparing entrepreneurial performance between male and female entrepreneurs tends to focus on developed countries; but such studies are almost non-existent in developing countries (Kobeissi 2010; Khalife and Chalouhi 2013) and in particular Sub-Saharan Africa (Amine and Staub 2009). It is difficult to generalize findings from these studies to developing countries because the systems and operating environment in these economies are different from that of developed countries. Therefore, this study focuses on gender and firm innovation in the context of developing countries.

The focus on gender and innovation in Sub-Saharan Africa stems from the fact that SSA region has the highest participation of females in entrepreneurship compared to other regions in the world, but the rates of female owned business closure is higher than males (Aterido and Hallward-Driemeier 2011; Global Entrepreneurship Monitor 2015). Reasons for short lifespan of female owned enterprises are related to cultural practices, which impose restrictions on female behaviour and gender stereotypes. These restrictions create inequalities in access to tangible and intangible assets, which in turn adversely affect levels of engagement in innovation and entrepreneurship in general. Coleman (2016) argues that entrepreneur's main role is to organize and effectively transform resources in order to gain competitive advantage.

In this paper, we use a dataset from World Bank Enterprise Surveys, which consists of firms from 11 Sub-Saharan Africa countries to examine the relationship between human capital, financial capital and firm attributes and innovation performance with reference to the gender of ownership. The study seeks to answer the following specific research questions:

- (i) How are firm size, training, management experience and access to finance associated with firm's innovative activities?

- (ii) How does gender of ownership affect firm innovative activities?

Therefore, this study makes a major contribution to research on gender and innovation by demonstrating that gender gaps exist in innovation. This paper has been organized in the following ways. The first part is introductory section, followed by review of literature that examines gender and innovation in the context of Resource-based View (RBV). The section provides theoretical and empirical evidence of gender gaps in innovation, resource endowment and capability that leads to the derivation of research hypotheses. The third section is concerned with methodology used in this research, which is followed by the presentation and discussion of findings of the completed research and closes with the conclusion and recommendations section.

Theoretical Perspectives

A better understanding of firm innovation performance can be drawn from a resource-based view theory which suggests that organizational resources are the main sources of competitive advantage and profitability growth (Barney 1991). RBV theory considers the firm as an accumulation of rare, valuable and imperfectly imitable tangible and intangible assets that an entrepreneur transforms to retain competitive advantage (Ayuso et al. 2006; Coleman, 2016). Firms with most effective development and transformation of resources tend to enjoy superior performance (Coleman, 2016).

Firm's outcomes of innovation depend on resource endowment and capacity to deploy such resources (Ayuso et al. 2006; Laosirihongthong et al. 2014). Typical resources most studied are financial capital and human capital (such as education, training). However, gender differences have been observed in endowment and deployment of each of the two groups of resources.

The causes of gender disparity in the two resource categories has been the subject of debate among researchers of female entrepreneurship. On the one hand, research evidence suggests that discrimination against females in accessing human and financial capital is a key challenge facing female entrepreneurs in both developed and developing countries (World Bank, 2012; UNCTAD, 2013). These discriminatory practices pose difficulties to female in

involvement in entrepreneurial activities and sometimes exclude them from male dominated sectors (Bardasi et al., 2011). However, Robb and Watson (2012) point out that in absence of discrimination, entrepreneurial performance of female entrepreneurs is the same as that of male counterparts. In contrast, a number of studies have reported that gender disparity in human and financial resources is a result of differences in motivation, behavior, preference, skills and expectation of rewards from the businesses between females and males (Bardasi, 2011; Robb and Watson, 2012).

Several prior studies indicate that females start new ventures with lower amount of initial capital, are risk averse and that place more value on non-financial and personal goals than males (Verheul and Thurik, 2001; Pelger, 2011). There is evidence (e.g. Sullivan and Meek, 2012; Muravyev et al., 2009) which suggests that female entrepreneurs face difficulties in accessing financial resources due weaker credit history and lack of ability to meet loan collaterals. Female entrepreneurs often cite lack of access to financial capital as one of the top obstacles to growth and innovation of the enterprises they own or manage (UNCTAD, 2013; ILO, 2003).

Human capital is another category in which gender differences typically exist. Several studies indicate that female entrepreneurs lack experience, technical & managerial skills, and competences, and have low level of education, (Stevenson and St-Onge, 2005; Tundui and Tundui, 2012). Low levels of human resources in female owned firms is linked to either discriminatory practices against female entrepreneurs (Ahl, 2006; Bardasi et al., 2011) or female preferences (Tonoyan and Strohmeier, 2006).

Because of these differences in human capital and financial capital, it is more likely to find female entrepreneurs running smaller and younger enterprises than male entrepreneurs or being concentrated in non-tech industries such as service and retail. As suggested by RBV innovation is intricately linked to firm's resource profile and empirical evidence provides support for this view (e.g. Hewitt-Dundas, 2006; Madrid-Guijarro et al., 2009; Coad et al., 2016). The theory posits that small and young firms are less likely to engage in innovation activities due to limited resource base, competencies and ability to reconfigure resources to enhance innovativeness (Hewitt-Dundas, 2006).

Gender specific entrepreneurial performance

Empirical evidence indicates that female-owned firms differ from male-owned firms in dimensions of entrepreneurial performance; such as export propensity and intensity (Orser et al., 2010; Margues, 2015), value added per worker (Buvinic' and Furst-Nichols, 2014); firm size, efficiency and growth (Loscocco et al., 1991; Bardasi et al., 2011); profit growth and business performance (Loscocco et al., 1991; Lee et al., 2010). The majority of these studies conclude that female owned firms are smaller, younger and underperform male owned firms in many traditional economic measures.

One fundamental question is whether gender gaps exist in innovation performance. Innovation is defined as a new combination of existing resources in a way that results in the production of new or significantly improved products or process, opening up new markets or introduction of new ways of doing things (Lee et al. 2010; Ljunggren et al., 2010). It is a multi-dimensional concept that emphasizes a more efficient use of resources by utilizing new ideas to create sustainable competitive advantages.

Literature on gender and innovation is not extensive and findings from the available limited research are inconclusive. For example, Global Entrepreneurship Monitor (2015)'s study indicates that rates of female entrepreneurs engaging in innovation activities is equal or higher than male entrepreneurs in nearly half of the countries surveyed. They also find that more female than male entrepreneurs are carrying out innovations particularly in efficiency-driven European economies. Availability of more educated female entrepreneurs than male is a driving factor of this pattern. However, GEM's findings do not reveal more information on types of innovation in which females are more engaged in than males do.

In contrast, Tonoyan and Strohmeier (2006) analyzing 1055 female- and 2207 male-owned businesses in Germany find that female owned firms perform poorly in product and process innovations than male owned firms. Poor performance was associated with females' lower commitment to innovations due to occupational sex segregation (as females prefer occupations which are not technically and technologically oriented) and fields of study and

vocational trainings which do not give them knowledge and know-how necessary for engaging in technological innovations (as females major in fields not strongly related to innovation such as management). Against this background, the probability of finding female entrepreneurs operating in innovative industries or having leadership positions in innovative firms is minimal (Coleman, 2016). Lee et al. (2010)'s study finds that female entrepreneurs were more likely to undertake non-technological innovations (such new management or marketing practices) and less likely to introduce technological innovations than male entrepreneurs did.

Furthermore, the effects of gender disparity on firm innovation performance can also be inferred from relationships that exist among different dimensions of entrepreneurial performance. For example, firm size is a predictor of innovation performance (Munier, 2006) while profitability, growth, export propensity and intensity, sales revenues and factor productivity are the outcomes of innovation (Varis and Littunen, 2010; Ar and Baki ,2011).

A growing body of empirical evidence consistently indicates that gender-based performance gaps exist in the predictors and outcomes of innovation performance. Female-owned firms are significantly smaller than male-owned firms in terms of number of workers and sales turnover (El-Hamidi et al., 2011) and underperform firms owned by male on innovation outcomes (Coleman, 2007; Bardasi et al., 2011; Khalife and Chalouhi, 2013). Tonoyan and Strohmeyer (2006) find that employment growth of female-owned firms is lower than male-owned firms because the former are less likely to engage in technology-based innovations than the latter. Similarly, Pelger (2011)'s study involving 34,234 German small and medium sized enterprises finds that female entrepreneurs are less growth-oriented and thus their investment goals are not aligned with R&D and introduction of new products.

Firm size

There is consensus among researchers that firm age and firm size predict innovation performance (Hansen 1992; Huergo and Jaumandreu, 2004; Munier, 2006). Empirical evidence suggests that large firms are more innovative than small firms due to possession of abundant resources. For example, Hansen (1992) used the data from the U.S. National

Science Foundation to investigate the effects of firm size on firms' innovation and the results showed that firm size was a significant determinant of product innovation. Small firms were found to produce more new products per dollar of sales than large firms did even when the firm age was controlled for (Hansen 1992). Hewitt-Dundas (2006) analyzed plant-level data from a longitudinal survey in Ireland and found that small firms were less likely to engage in innovation activity because they were facing higher levels of resource and capability constraints than large firms. Similarly, Munier (2006) found that an increase in firm size is associated with development of a variety of relational competences, which are important inputs for innovation.

In most cases, female-owned firms are smaller in terms of number of employees (Tonoyan and Strohmeier, 2006) than male-owned firms (OECD 2004; Orser et al. 2010), which might signal limited performance on innovation. Tonoyan and Strohmeier (2006) found that female owned firms were smaller and less likely to implement product and process innovations, due to less investment of time in their businesses. Lee et al. (2010) note that female entrepreneurs' preference to operate small firms represents an important mechanism to balance the roles of work and family life, while maintaining the desired level of business success. Based on the findings of review of literature, this study hypothesizes that:

Hypothesis 1a: *Innovation is positively associated with firm size*

Hypothesis 1b: *Firm size will be moderated by gender, so that at the same size of firms female owned enterprises are less likely to innovate than male owned enterprises.*

Human capital

Formal trainings

Trainings, do not only determine the quality and quantity of labour force supplied but also improve the entrepreneurs' managerial ability and employee capabilities to discover and exploit opportunities, thus resulting in high productivity (van der Sluis et al., 2005; Martínez-

Rosa and Orfila-Sintes, 2012). Previous studies report in-house and external trainings provided to firm owners, top managers and employees and are significant determinants of innovation and sales revenue (van der Sluis et al., 2005; El-Hamidi, 2011; Khalife and Chalouhi, 2013).

Innovation literature suggests that innovation is linked to skills of entrepreneur and employees because levels of skills and experience determine the rate at which new technology can be adopted and transferred with organizations (Csath, 2012). Trainings give employees an opportunity to acquire new skills and master new processes. The types of training determine entrepreneur's performance, as the skills acquired increase the possibility of engaging in knowledge-based production and innovation, and responding to changes in the business environment (Csath, 2012). Improvement in labour quality through continuous on-job trainings is crucial in introducing technology-based innovations (Jack et al., 2014.). The trainings, whether internally or externally organized have significant and positive effects on innovation decisions and degree of innovation (Martinez-Ros and Orfila-Sintes, 2012). However, some studies find that female entrepreneurs are less committed to innovations (Tonoyan and Strohmeyer, 2006), an implication for less devotion of resources to acquire skilled labour and develop employee skills. The above arguments lead to the development of the following hypotheses:

Hypothesis 2(a): *Training has a positive effect on firm innovation performance.*

Hypothesis 2(b): *Controlling for training, female owned firms are less likely to innovate than male owned firms.*

Management experience

Several lines of evidence suggest that indicates that management experience is an important predictor of firm innovation performance (Chirwa, 2008). However, the findings of previous research are contradictory. For example, Ayyagari et al. (2011) analyzed the data of 19,000 firms from 47 developing countries and found that firms with top managers of 4-10 years of experience are more innovative than firms managed by inexperienced managers. However, management experience of more than 10 years is associated with stagnation of innovation within firms. Similarly, Martinez-Ros and Orfila-Sintes (2012) found that

increases in management years of experience is associated with negative impact on innovation decision-making and degree. The impact of management experience on innovation is likely to be bigger in female owned firms than their male counterparts. Female entrepreneurs have less business experience and their social networks are less business oriented than male entrepreneurs (Bird and Sapp, 2004; Khalife and Chalouhi, 2013).

Problems faced by females during business start-up and growth periods could generate undesirable effects on entrepreneurial performance.

Carter (2000; pp.326) notes that:

" Gender differences which may act as constraints on both business start-up and growth are apparent in many aspects of women entrepreneurial activity and include women's pre-venture experience of the labour market, the financing of women owned firms, the use of networks in the management of firms and the overall under-performance of women owned firms".

Hypothesis 3(a):*Management experience has a negative relationship with firm innovation performance*

Hypothesis 3(b):*Controlling for management experience, female owned firms are less likely to innovate than male owned firms (relationship enhanced).*

Financial capital

Financial capital is a key element in the creation of new businesses and their subsequent growth (Amine and Staub, 2009). Ayyagari et al. (2011)'s investigation of the determinants of the rate at which the firms innovate in 47 developing countries revealed that access to bank loans and use of external financing is positively and significantly associated with firms' innovation performance. Lack of financial resources is a critical barrier that can block or reduce entrepreneur's abilities to engage in innovation activities (Coad et al., 2016; Madrid-Guijarro et al., 2009).

Literature on innovation indicates existence of gender gaps in accessing financial resources and start-up capital for innovation, creation of new ventures or expansion of the existing businesses. The findings of previous studies indicate that females are less likely than males to access bank loans and if they do, higher interest rates are levied against them (O' Riordan

et al., 1995; Sullivan and Meek, 2012; Muravyev et al., 2009). Similar findings are also reported by Coleman and Robb (2009) and Verheul and Thurik (2001) who find that females start their new ventures with lower amount of start-up capital and continue to raise significantly lower levels of debt and equity finance for subsequent years of their operations. Apart from having fewer financial resources than males when starting their ventures, females are also reluctant to take on large loans (Carter, 2000; Coleman and Robb, 2009; Bardasi et al., 2011).

Prior research has established that discrimination against females in accessing financial capital is a key challenge facing female entrepreneurs in both OECD and developing countries. For example, a field survey on female entrepreneurship and innovation conducted by UNCTAD (2013) in three developed countries (Sweden, Switzerland, the United States) and three developing countries (Brazil, Jordan and Uganda) revealed that lack of access to finance was one of the top obstacles to growth and innovation of female-owned firms in developed countries, topping other obstacles to innovation in United States of America and Sweden. Recent evidence from the United States also indicates that female-owned firms are less likely to access private investment to commercialize their developed technology than male-owned firms (Gicheva and Link, 2015). Bardasi et al. (2011) found that it was more difficult for females in Eastern Europe and Central Asia countries to get loans from banks than males who need the loans. However, financial constraints facing female-owned firms do not affect their firm efficiency (Bardasi et al., 2011). Explanations for financing gaps are related to differences in sector of activity, age and size of the female owned firms, preference, lack of managerial experience, risk aversion, weaker credit history.

In developing countries, for example Sub-Saharan Africa, access to credit by female entrepreneurs is much more difficult due to limited ability to meet loan collaterals as females are denied control over property by property laws or traditional customs, and bank officers normally doubt females' ability to repay their loans (Stevenson and St-Onge, 2005; Amine and Staub, 2009). The ILO (2003)'s study in the cities of Dar es Salaam, Arusha and Zanzibar in Tanzania on 128 female entrepreneurs reveals that lack of capital or finance is a single critical constraint to starting and growth of businesses.

As noted by Coleman and Robb (2009: pp.403-404) that:

“The fact that women small business owners start their firms with much smaller amounts of capital may have implications for their ability to hire employees, develop new products and services, grow, or even survive”.

Based on previous studies’ findings, we hypothesize that:

Hypothesis 4(a): *Access to finance has positive effects on firm innovation performance.*

Hypothesis 4(b): *Controlling for access to finance female owned firms are less likely to innovate male-owned firms.*

Methodology

Data and variables

The study uses data obtained from the World Bank’s Enterprise Surveys for 11 SSA countries² (2013 and 2014 enterprise surveys). The World Bank database provides firm-level information from different countries and across sectors. The sample consists of 7581 registered privately owned small firms, partnerships and limited shareholding corporations. The data is random and stratified into various manufacturing and service sectors and firm sizes (number of employees), thus they are representative of each country’s industrial structure. The World Bank surveys use standardized data collection instruments and sampling techniques across countries, which provide opportunity for cross-country comparisons and analyses at aggregate level. Bardasi et al. (2011) provide details of construction of a randomly stratified sampling used in the World Bank Enterprise Surveys in detail while Ayyagari et al. (2011) provide explanations of data collection procedures for the same surveys.

The database also provides information on percentages of female ownership. In construction of the sample for this study, all firms owned by the government were dropped because they are publicly traded firms (see Aterido and Hallward-Driemeier, 2011). Similarly, firms with mixed ownership were also dropped from the sample because it is difficult to tell who is responsible for firm’s strategic decisions like innovation in firms with mixed ownership between females and males. More often, females are not decision makers

²Countries in our sample included: Democratic Republic of Congo, Ghana, Kenya, Malawi, Namibia, Nigeria, South Sudan, Sudan, Tanzania, Uganda and Zambia.

in these firms despite having majority shareholding (Aterido and Hallward-Driemeier, 2011; Marques, 2015).

The database also provides comprehensive information on innovation activities of firms in each country. The World Bank's Enterprise Surveys capture information on firm innovation performance by asking firms to indicate whether they had undertaken any of the eight innovation activities for the past three years. These innovation activities include introduction of new or significantly improved product, method of manufacturing product or offering services, logistics & delivery, or distribution methods, management practices, organizational structure, marketing method. Other activities are expenditure on formal R&D activities and giving employees time to develop new ideas. The responses were either yes or no, and were coded as 1 for yes and 0 for no.

Following Ayyagari et al. (2011), three aggregate innovation indices were constructed by adding 1 if the firm's response is yes; meaning that it had undertaken one of the 8 innovation activities. Technological innovation index was formed from three innovation indicators which included: (i) introduction of new or significantly improved product, (ii) new or significantly improved method of manufacturing product or offering services, (iii) expenditure on formal R&D activities. Non-technological innovation index consisted of the following innovation indicators: (i) new or significantly improved logistics, delivery, or distribution methods, (ii) new or significantly improved management practices, (iii) new or significantly improved organizational structure, (iv) new or significantly improved marketing method, (v) give employees time to develop new idea. The overall innovation index was formed from addition of 8 indicators.

Description of Variables

Dependent variables

Independent variable consists of three innovation indices: technological innovation index, non-technological index and aggregate innovation index. The technological innovation index is constructed from three innovation indicators related to technological innovations, which include product innovation, process innovation and expenditure on R&D. The index is formed by adding 1 if the firm has undertaken 1 of the 3 indicators of innovation

activities. Non-technological innovation index is created by adding 1 if the firm has implemented one of the 5 innovation activities (i.e. logistics innovation, management practices, organizational structure, market innovation and new idea). Overall innovation index is formed by adding 1 if the firm has undertaken one of the 8 innovation activities. The values for technological innovation index, non-technological innovation index and overall innovation index range from 0-3, 0-5 and 0-8 respectively.

Independent Variables

Gender is the key variable in the model. We used dummy variable that takes value 1 if the firm's owner is a female and is the sole owner with 100% ownership of the firm and 0 if otherwise. Number of permanent, full-time employees measures firm size. The World Bank Enterprise Surveys classify firms in the following size categories based on the number of employees: (1) small firms (0-19 employees) (2) mid-sized firms (20-99 employees) and large firms (100 and above employees). Human capital is defined as stocks of knowledge, skills, experience and intelligence, which are used to generate resources (Khalife and Chalouhi, 2013). Human capital is measured in terms of management experience in the sector and availability of formal training programmes to permanent employees. Management experience is defined as the number of years the top manager has in the sector and takes the value 1 if the top manager has at least 5 years of experience and 0 if otherwise. Provision of formal training to permanent employees is a dummy variable = 1 if the firm has formal training programmes for its permanent employees and 0 if otherwise (Yes=1; No=0). Financial capital is measured in terms of access to finance or loan and is a dichotomous variable = 1 if the firm has obtained a credit or loan from financial institutions and 0 otherwise (Yes =1; No = 0)

Control variables

1. Country dummies
2. Sector dummies: 4 sectors (manufacturing, retail, wholesale and other services)

Estimation strategy

In this paper, we examined the role of gender on firm innovation performance in Sub-Saharan Africa enterprises. The estimation employed was based on ordered probit

regression models of innovation likelihood. We estimated multivariate models to control for determinants of innovation likelihood and then assessed the direct and indirect effects of gender of the owner on innovation performance. The framework for moderated ordered probit regression is:

$$Y = \alpha + \beta_1 X + \beta_2 Z + \beta_3 ZX + \varepsilon$$

Where Y is a dependent variable and can be either one of the three aggregate innovation indices (technological innovation index, non-technological innovation index or aggregate innovation index). X is the moderator variable depicting gender ownership. ZX is an interaction term of gender and other explanatory variables. Country and sector dummy variables were included in each regression to account for unobserved country and sector effects on innovations.

The empirical analysis employed a two-phase process of ordered probit regressions to analyze direct and indirect effects of gender on innovation (Orser et al., 2010). The first phase consisted of a base probit model which was estimated by including all control variables (country and sector fixed effects) and other hypothesized variables and gender except interaction terms of gender with other variables.

The second phase was an expansion of the base model by introducing interaction terms of gender and other hypothesized variables. Only significant variables in the base model were added to the expanded model, including gender interaction terms associated with those variables. Non-significant variables in the base model were dropped based on Orser et al. (2010)'s suggestions of evaluation of changes in the explanatory power of dropping the variable and changes in the estimated coefficients of the remaining terms. Tables 2 and 3 present findings of the base and expanded estimation models respectively.

Results

Table 1 provides information on firm owners' characteristics by gender. The chi-square tests show significant differences management experience. The average number of experienced top managers in male owned firms is higher than female owned firms. The majority of

female entrepreneurs own smaller sized firms than male entrepreneurs. However, more female entrepreneurs have access to finance and formal trainings to their permanent employees than their male counterparts.

Table 1: Profile of female and male business owners in SSA

	Female	Male	Test statistics χ^2
Firm size			
Small (0-19 employees)	69.2%	67.2%	$\chi^2=1.590$
Midsized (20-99 employees)	24.5%	25.5%	
Large (above 100 employees)	6.3%	7.3%	
Management experience			
< 5 years	22.6%	19.3%	$\chi^2=4.894^{**}$
5 years and above	77.4%	80.7%	
Training			
Yes	27.1%	26%	$\chi^2=0.445$
No	72.9%	74%	
Access to finance			
Yes	13.8%	13.1%	$\chi^2=0.298$
No	86.2%	86.97%	

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

Estimation Results

The findings from the base model probit estimations (Table 2) indicate significant factors that determine innovation performance of enterprises in SSA. Hypothesis 1(a) tested the relationship that firm size is positively associated with innovation. Findings indicate positive statistically significant relationship between firm size and innovation performance (three innovation indices). Midsized enterprises were more likely to undertake technological innovation ($p < 0.01$), non-technological innovation ($p < 0.01$) and overall innovation activities ($p < 0.01$) than small firms. Larger firms were also more likely to be innovative on the three innovation indices than small firms. Hence, hypothesis 1(a) was supported.

Hypothesis 2(a) considered a positive relationship between innovation performance and training. However, training was not a statistically significant predictor of innovation ($p\text{-value} > 0.1$). Similarly, the findings did not provide statistical evidence to support for access to credit as a predictor of innovation performance in SSA enterprises. Hence, hypotheses 2(a) and 4(a) were not supported. Hypothesis 3(a) predicted existence of negative relationship between management experience and innovation performance. There was a

significant negative relationship between management experience is and the three innovation indices. Management experience of greater than 4 years reduces the likelihood of introducing technological innovations (p-value < 0.1), on-technological innovation (p-value < 0.10) and overall innovations (p-value < 0.10). Thus, this finding provides support for hypothesis 3(a).

Table 2: Ordered Probit Estimations of Innovation Performance, Base Model

Variables	Technological innovation index	Non-technological innovation index	Overall innovation index
Gender (male)	-0.1130356 (0.043981)**	-0.0849443 (0.0423122)**	-0.1076951 (0.0409781)***
Firm size_midsized	0.2482346 (0.0325777)***	0.3092346 (0.0321336)***	0.2994355 (0.0315405)***
Firm size_large	0.5359547 (0.0551742)***	0.5469101 (0.0520138)***	0.5630555 (0.0514158)***
Access to finance	-0.0339936 (0.0412217)	-0.0107049 (0.0404198)	-0.0095911 (0.0387967)
Management experience	-0.0647137 (0.0345175)*	-0.0592293 (0.0340525)*	-0.0571427 (0.033398)*
Training	0.0108198 (0.0307265)	0.0159598 (0.0301737)	0.013186 (0.0293145)
Country effects	yes	Yes	Yes
Sector effects	yes	Yes	Yes
Wald chi2 (22)	409.91	541.31	
Observations	6,560	6,560	6,560
Prob>chi2	0.000	0.000	0.000
Pseudo R2	0.0236	0.0233	0.0188
Log pseudolikelihood	-8510.845	-11004.116	-13664.077

Note: ***, **, * denote statistical significance of estimated coefficients at 1, 5 and 10 percent respectively. Numbers in parentheses are standard errors.

The base model was re-estimated with introduction of interaction terms of gender with significant explanatory variables. Estimation of the probit regression model aimed at confirming the channel through which gender of ownership affects innovation performance. Non-significant variables in the base model were dropped at this stage of estimation. Firm size and management experience were the only statistically significant variables in the base model, hence their gender interaction terms were considered used in the expanded model. The gender interaction term for management experience was not statistically significant for the three innovation indices; hence refuting hypothesis 3(b). Table 3 below presents regression results for the interaction terms gender with firm size and management experience.

Hypothesis 1(b) considered moderation effects of gender on the relationship between firm size and innovation performance. Findings indicated that the gender interaction effects for midsized firms was positive and statistically significant for non-technological innovation index ($p\text{-value} < 0.05$) and overall innovation index ($p\text{-value} < 0.10$). Thus, hypothesis 1(b) is partly supported. Based on these findings, it is important to suggest that females who own midsized enterprises are more likely to be involved in non-technological and overall innovation activities than male entrepreneurs who own enterprises of similar size. The gender interaction term for the large size category was not statistically significant.

Table 3: Ordered Probit Estimations of Innovation Performance, Gender Interaction Effects

Variables	Technological innovation index	Non-technological index	Overall innovation index
Gender (male)	-0.1677763 (0.0930231)*	-0.0494979 (0.087736)	-0.1126984 (0.0842289)

Firm size_midsized	0.2481971 (0.0328433)***	0.2915552 (0.0324847)***	0.2880322 (0.031839)***
Firm size_large	0.5217224 (0.0559406)***	0.5534293 (0.0526649)***	0.5645652 (0.052559)
Management experience	-0.0600692 (0.0354251)*	-.0342708 (0.0352221)	-0.0413018 (0.0345612)
Gender x Firm size_midsized	0.0575033 (0.101304)	0.2223976 (0.0988238)**	0.1716086 (0.0951045)*
Gender x Firm size_large	0.2272381 (0.1695131)	0.0117298 (0.1659963)	0.0693046 (0.1581957)
Gender x management experience	0.0415979 (0.1020122)	-0.0964356 (0.0983761)	-0.0385354 (0.0938439)
Country effects	yes	Yes	Yes
Sector effects	yes	Yes	Yes
Wald chi2	441.55	592.05	586.94
Observations	7,069	7,069	7,069
Prob>chi2	0.000	0.000	0.000
Pseudo R2	0.0236	0.0239	0.0191
Log pseudolikelihood	-9174.6575	-11856.745	-14729.856

Note: ***, **, * denote statistical significance of estimated coefficients at 1, 5 and 10 percent respectively. Numbers in parentheses are standard errors.

Discussion of findings

This study set out with the aim of assessing the importance of firm size, training, management experience and access to finance on firm's innovative activities with reference to gender and ownership in the context of developing countries. Prior studies exploring gender and firm innovation performance are scarce and the available research findings are contradictory. On average, the majority of female-owned firms were less likely to be

involved in innovation activities than male-owned firms. The likelihood of engaging in innovation activities is related to firm size and management experience. Findings indicated that mid-sized and large enterprises were more likely to innovate compared to small firms. Based on tenets of RBV theory, firm size represents a collection of both tangible and intangible assets and innovation is a function of resource endowment and capabilities (Ayuso et al., 2006; Hewitt-Dundas, 2006). As a firm grows in size its ability to overcome resource and capability constraints increases (Hewitt-Dundas, 2006). Therefore, the findings of this study are consistent with previous studies that found positive relationship between firm size and innovation performance (Hansen, 1992; Munier, 2006).

In RBV framework, management experience also represents an important resource for innovative activities. Previous studies conclude that as management experience in the industry increases, the likelihood of engaging in different innovative activities increases or decreases. Consistent with empirical evidence (e.g. Ayyagari et al., 2011; Martinez-Ros and Orfila-Sintes, 2012), our findings indicate that firms run by more experienced managers are less likely to undertake any innovative activities. Possible explanations for this finding might be that experienced managers are hesitant to take the risks associated with innovation or suffer from management inflexibility or that there is a limited and restricted market for CEOs and innovation managers (Martinez-Ros and Orfila-Sintes, 2012).

Past research demonstrated that formal trainings could improve labour quality and impact new skills necessary for implementing various innovations (Jack et al., 2014; Martinez-Ros and Orfila-Sintes, 2012). However, our findings indicated that formal trainings do not contribute to innovation performance in SSA enterprises. These findings may suggest that firms in this region are less efficient in utilizing creative abilities or the skills possessed by their workforce or managers to carry out innovation. Additionally, trainings provided to employees may not be relevant or of the required quality to impart the skills needed for developing and implementing innovative ideas within organizations. A surprising finding is that access to finance is not associated with innovation. This finding contradicts previous studies which have suggested the positive impact of the access to financial resources on innovation (i.e. Ayyagari et al., 2011).

Another interesting finding is the existence of gender differences in non-technological innovation and overall innovation activities. Firm size appears to be moderated by gender with an upside down U curve on innovation in the context of Sub-Saharan Africa. Research evidence suggests that female entrepreneurs are more risk averse, generally not growth-oriented and that their investment decisions are not aligned with innovation (Pelger 2011; Orser et al. 2010). However, our findings indicated that female owned midsized firms were more likely to engage in non-technological innovation and overall innovation activities than male owned firms of similar size. This result may be explained by the fact that midsized firms are more likely to innovate because they have the resources and knowledge to do this and they need to grow to the large size because once they get past the small size, they have no choice but to grow or exit. This behavior is contrary to small firms' behavior which are trying to feed them and their family so they are less likely to try growth strategies and frankly do not have the resources to do anything but defend their space.

However, female-owned large firms, despite having loads of resources do not innovate. This result may be partly explained by the fact that firms endowed with resources are reluctant to explore new opportunities instead they concentrate on internal efficiency and are more comfortable using internal resources on things they are familiar with and where they expect a higher possibility of success (Keupp and Gassmann, 2013). Another possible explanation, however, may be that female owned large firms do not innovate due to "feminine" risk adversity as mentioned earlier. This may be a consequence of innovation being an inherently a risky undertaking. Females may therefore have less interest in committing resources and time to innovation activities because they are more risk averse than males.

This research has several practical and policy applications. Firstly, it points to role for gender in promoting innovation in midsized and large firms. This finding may encourage female entrepreneurs, who have been hesitant to engage in innovation activities due to anticipated gender related resource constraints, to start implementing innovative activities to improve growth and competitiveness of their enterprises. Second, our findings also raise practical and policy questions about why female owned midsized firms and large firms are not more or equally innovative than their male counterparts . Policy intervention may focus on overcoming size constraints to encourage females entrepreneurs owning mid and large

sized firms to innovate. Thirdly, as some factors such as training and credit access failed to explain the lack of innovation performance within female owned firms. It is important that training and education development programs be developed that focus rather, on improving technical and systematic knowledge that is geared towards improving innovation performance.

The current findings of this research add to a growing body of literature of gender and entrepreneurial performance. The results support the idea that innovation is a gendered phenomenon. These study findings are consistent with gender and entrepreneurship literature which suggests that gender gaps exist both in economic and non-economic dimensions of entrepreneurial performance (Tonoyan and Strohmeier, 2006; Lee et al., 2010; Orser et al. 2010; Bardasi et al., 2011). Unlike prior studies that confirmed female underperformance hypothesis, the finding that emerges from our work refutes this hypothesis, instead we find that female entrepreneurs are more innovative than male entrepreneurs.

Within the RBV framework, diversity of firm resources can be identified that enable an organization to implement useful strategies to improve competitive advantage. However, our study model captured only a few firm resources like firm size, experience, credit access and training their effects on innovation with reference to gender of ownership.

These few factors cannot comprehensively provide useful insight into the complex process of innovation within firms and especially when gender issues are taken into consideration. Future research may therefore; look into the possibility of extending the scope of coverage by either including more factors such as insight of individual managers, capabilities, organizational processes and institutional factors into the model.

Further research may also draw on other theoretical perspectives such as institutional theories to investigate further underlying factors responsible for gender gaps in innovation performance. Furthermore, qualitative research may also offer in-depth and useful descriptions of females' experiences of their engagement in innovation and entrepreneurial activities. Finally, our sample for the study is limited to firms in 11 SSA countries. Caution

must therefore be applied, as the findings might not be consistent with other regions. However, the results may still provide directions for future research.

Conclusion

The aim of the present research was to examine the linkages between innovation and organizational resources with reference to gender of ownership in SSA. This study complements the existing literature by focusing on the relationship of two important themes (gender and innovation) which are mostly neglected in past studies (ref). The findings are consistent with female entrepreneurship literature which suggests that gender gaps exist both in economic and non-economic dimensions of entrepreneurial performance. This study confirms previous findings and contributes additional evidence that suggests the existence of gender differences in innovation performance.

One of the more significant findings to emerge from this study is that female owned mid-sized firms were more likely to innovate than male owned firms of similar size. This finding challenges existing theoretical and empirical evidence which suggests that female entrepreneurs are less likely to innovate than their male counterparts due to limited access to both physical and intangible resources. While RBV theory suggests that firm innovation performance is a function of both resource endowment and capability, it is silent on the influence of gender of ownership on innovation. There is a need for future research to explore gender gaps in innovation by integrating multiple perspectives because a single theory cannot adequately explain gender gaps in organizational performance.

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