Gender diversity and productivity in manufacturing firms: evidence from six Sub-Saharan African (SSA) countries

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Abstract
We revisit predictions about the relationship between gender diversity and firm productivity using data on 1,082 manufacturing firms from six Sub-Saharan African countries: Ghana, the Democratic Republic of Congo, Tanzania, Uganda, Zambia and Kenya. Recent evidence suggests that a gender-diverse workforce opens up a firm to a vast range of talent, knowledge and perspectives critical to enhancing innovation and problem solving, and thereby, increasing firm productivity. Given the importance of manufacturing for employment and structural transformation in Africa, we test the gender diversity–productivity proposition by exploring structural differences (heterogeneity) across manufacturing firms using the Industry without Smokestacks (IWOSS) classification. We find that while gender diversity promotes firm productivity at lower levels, this effect is displaced with further increases. Our results did not show that IWOSS firms do any better in promoting the diversity–productivity link. Implications of this finding and areas for future studies are also discussed.

Key words: Africa; diversified firms; gender and diversity; knowledge and productivity spillovers

Introduction

Although considerable progress has been made to promote gender equality and empower women in various economic activities, the debate about the effects of gender diversity on firm productivity is still highly contested. One stream of the debate relies on the explanations of the knowledge-based and decision-making perspectives to suggest that a more diverse workforce enhances firm productivity because of the effects of multiple perspectives on firm decision-making (Darmadi, 2013; Mannix & Neale, 2005; Nguyen, Locke, & Reddy, 2015; Noland, Moran, & Kotschwar, 2016; Post & Byron, 2015; Solakoglu & Demir, 2016; Terjesen, Couto, & Francisco, 2016). Another stream of the debate focused on the social identity theory (SIT) as well as the similarity/attraction and homosociality perspectives to suggest a negative association through the inter-group conflict explanations offered by Dezso, Ross, and Uribe (2016); Coffman (2014); Chapple and Humphrey (2014); Richard, Murthi, and Ismail (2007).

Other studies have attempted to explore various competing explanations including possible nonlinear effects (Ali, Kulik, & Metz, 2011; Bae & Skaggs, 2019; Richard, Kochan, & McMillan-Capehart, 2002) and even the role of context (Hoobler, Masterson, Nkomo, & Michel, 2016; Joshi & Roh, 2009; Post & Byron, 2015; Richard, Murthi, & Ismail, 2007). Particularly for the studies exploring the context, the moderating effects of environment, industry and supportive culture have been investigated. Few studies have used cross-country data to show the results of spatial contexts (Dezsö & Ross, 2012; Marinova, Plantenga, & Remery, 2016; Terjesen, Couto, & Francisco, 2016; Zhang, 2020).

In this paper, we seek to provide evidence for Sub-Saharan Africa (SSA) by exploring structural differences in subsectors within the manufacturing sector. The main motivation for the paper is twofold. First, the paper is motivated by the changing dynamics in manufacturing activities. Recent evidence suggests that the transformation of manufacturing can be linked to factors such as talent, skillset and innovation (Giffi, Huelsman, Drew-Rodriguez, & McClelland, 2017). This dynamic implies that there is an opportunity for a more gender-diverse workforce to be employed by manufacturing firms, and there is a vast pool of talents in women that can be a critical resource for manufacturing transformation (Giffi et al., 2017). There has been a steady progress of women in terms of educational qualification, career and professional and managerial positions, and there is interest in how this relates to manufacturing productivity in Africa (Giffi et al., 2017). Second, the paper is motivated by the evolution of gender diversity in Africa, following the implementation of various affirmative action bills after decades of systematic exclusion at the workplace. Historically, women in Africa were heavily underrepresented at the workplace, even though they constitute a greater proportion of the population. UNIDO (2016) notes that women constitute less than 40% of the manufacturing workforce in Africa. This trend appears to be changing, as the continent continues to record increasing shares in women's labour force participation (Moodley et al., 2019). Unpaid family work, which used to be dominated by women, continues to witness a decline in the share of women's involvement (Moodley et al., 2019). Recent data also show that Africa has the highest share of female representation on company boards (Moodley et al., 2019). It is important to indicate, however, that the observed progress is not evenly distributed, as some countries still have a substantial proportion of women out of the labour force (Moodley et al., 2019).

The overall trends, nonetheless, reflect positively for Africa given the view that accelerating the progress that has been made towards increasing gender diversity could boost African economies by the equivalent of 10% of collective GDP by 2025 (Moodley et al., 2019). A variety of programmes have thus been implemented to enhance women's empowerment on the continent including the various initiatives that have sought to increase the share of women in Science, Technology, Engineering and Mathematics (Moodley et al., 2019). Despite all these developments, not much evidence exists to show the extent to which the progress being made is enhancing various economic indicators including firm productivity or what may constitute the best approach to empowering women. A revisit of predictions on the link between gender diversity and productivity is critical in reinforcing the various actions supporting women's empowerment.

This paper, therefore, revisits the issue of the link between gender diversity and firm productivity, with a focus on African manufacturing firms. We argue that with the growing importance of factors such as skillset, talents and innovation within manufacturing, women who used to be underrepresented will play a significant role in enhancing manufacturing productivity. One of the questions that we seek to answer is to find out in which of the manufacturing subsectors are these relationships more pronounced.

In carrying out our estimations, we explored possible heterogeneity in the relation by relying on firms that fall under what has come to be known as the Industry without Smokestacks (IWOSS) concept that has been popularized by Newfarmer, Page, and Tarp (2018). IWOSS are viewed as an alternative source of structural transformation in Africa, following the continent's several years of manufacturing deindustrialization. According to Newfarmer, Page, and Tarp (2018), IWOSS have some characteristics that make them useful for structural transformation in Africa and this includes high tradability, high productivity (relative to other economy-wide productivity levels), capacity to incorporate technological change and the evidence of scale/agglomeration economies. Some of the manufacturing subsectors described as IWOSS include agro-processing and horticulture, telecommunication and ICT-based products and business/trade services. Although existing data do not seem to capture its full range of activities, the evidence seems to suggest that these sectors are becoming important for transformation (Coulibaly & Page, 2021).

Our study makes use of data from the World Bank Enterprise and Innovation Follow-up Surveys for six SSA economies for our estimations: Ghana, the Democratic Republic of Congo,

Tanzania, Uganda, Zambia and Kenya. These are the only African countries with data in the World Bank Enterprise Surveys that was found to be useful in exploring the link between gender diversity and firm productivity. While the main Enterprise Survey contains general information about firms, the Innovation Follow-up surveys contain questions on innovations that are similar to the Organisation for Economic Co-operation and Development (OECD) technological innovation measures.

Following our analysis, we find evidence of a nonlinear relationship between gender diversity and productivity. Specifically, we find that an increase in the proportion of female-owned firms, as well as the proportion of full-time female employees, is initially associated with increases in firm productivity, but subsequently, some displacement effects are realized. In further exploring whether the heterogeneity in manufacturing according to the IWOSS concept matter for the diversity–productivity link, we find that its interaction with the proportion of full-time female employees is negative. This finding suggests that firms in non-IWOSS sectors seem to account for the positive association between gender diversity and firm productivity. These firms in non-IWOSS sectors are those engaged in traditional manufacturing activities.

Our main contribution to the literature stems from the finding that an exploration of heterogeneity in manufacturing activities reveals a more nuanced relationship between gender diversity and productivity. The implication for public policy is that a one-size-fits-all approach cannot continue to underscore gender-related interventions. Policies must be sector-specific and seek to provide a more relevant role for women in manufacturing.

The rest of the paper is structured as follows: the second section provides a conceptual background of the paper, while the third and fourth sections provide the method used for the estimation as well as discuss the main results, respectively. The last section provides some concluding remarks.

Conceptual background and hypothesis development

Conceptually, there are three main views about the nature of the relationship between gender diversity and firm productivity: namely, positive, negative and curvilinear. The first predicts a positive association between the two variables. The main explanation in support of this prediction is based on the 'knowledge-based research' and 'decision-making theory' which postulates that knowledge (or how to relate knowledge to the decision-making processes of a firm) is the primary problem facing firms (Mannix & Neale, 2005; Watson, Kumar, & Michaelsen, 1993). In responding to how this problem can be addressed, proponents of the theory postulated that diversity in knowledge actors introduces multiple perspectives and discourages the situation where only one particular knowledge dominates firm decision-making. Several channels for knowledge dissemination have been explored by this literature, and this includes socialization, interpersonal communications and collaboration in the form of pooling of group resources, which leads to success in decision-making (Nguyen, Locke, & Reddy, 2015; Noland, Moran, & Kotschwar, 2016; Post & Byron, 2015; Terjesen, Couto, & Francisco, 2016).

A corresponding explanation for the positive association between gender diversity and firm productivity is found in the resource-based view of a firm. In this view, it is suggested that intangible and socially complex resources, such as employee competence and experience, are the critical resources needed to sustain a firm's competitive advantage, relative to tangible resources such as the scale of operation (Barney, 2001). McMahan, Bell, and Virick (1998) have argued that intangible and socially complex resources, derived from gender diversity, in the form of market insight, creativity and innovation, and improved problem-solving, are critical in boosting firm productivity.

Another explanation for the positive relationship can be found in the upper-echelons theory about top management teams (TMT) (Finkelstein & Hambrick, 1996). This perspective applies mostly to females as managers/owners. The argument here is that a more diverse TMT can enhance the breadth of perspectives, cognitive resources and the overall problem-solving capacity

of the team (Bantel & Jackson, 1989; Hambrick, Cho, & Chen, 1996; Smith, Smith, Olian, Sims, O'Brannon, & Scully, 1994).

Empirically, numerous studies have confirmed this positive link. For instance, Terjesen, Couto, and Francisco (2016) in an assessment involving 3,876 public firms across 47 countries find that the presence of female directors is associated with high firm performance. Using a global sample of 21,980 firms across 91 countries, Noland, Moran, and Kotschwar (2016) also find that the presence of women in corporate leadership positions improves firm performance. They attributed this finding to skill diversity and suggested that policies that facilitated women rising through the corporate ranks are important. Similar findings were reported by Post and Byron (2015), Nguyen, Locke, and Reddy (2015) and Darmadi (2013) specifically for women in management roles (boardroom). Zhang (2020) used a longitudinal sample of 1,069 public firms in 35 countries to show that the more gender diversity is normatively accepted, the more it benefits a firm's market valuation and revenue. Other studies have found that firms with gender-diverse workforces innovate better and thus achieve higher output and better returns (Ali, Kulik, & Metz, 2011; Herring, 2009; Richard, Barnett, Dwyer, & Chadwick, 2004; Yang & Konrad, 2011).

A second view of the gender diversity–productivity link is the direct opposite to the view discussed above. In this perspective, gender diversity hurts firm productivity by lowering group commitment, organizational cohesion and increasing inter-group conflict. The explanation for this latter prediction is based on a combination of the social categorization theory (Tajfel, 1981), SIT (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) and the similarity-attraction paradigm (Byrne, 1971; Ibarra, 1992). The main thrust of the argument in this literature is that, in gender-diverse groups, individuals are more likely to make favourable associations with in-group members, rather than with out-group members. The resulting polarization can lead to conflict and stereotyping and hinder group solidarity and cooperation, thus reducing workplace efficiency and productivity (Chapple & Humphrey, 2014; Coffman, 2014; Dezso, Ross, & Uribe, 2016; DiTomaso, Post, & Parks-Yancy, 2007; Holgersson, 2013; Van Knippenberg & Schippers, 2007; Wellalage & Locke, 2012; Williams & O'Reilly, 1998). In relating gender diversity to the upper-echelons theory about TMT, Ancona and Caldwell (1992) and Murray (1989) suggest that a more diverse TMT can be costly to coordinate and control relative to a more homogenous team and that these added costs may impede performance.

Consistent with these views, Richard, Murthi, and Ismail (2007) and Ely and Thomas (2001) have shown that as gender diversity increases, the tendency is towards social comparison and categorization, with a rise in in-group/out-group formation as well as cognitive bias. Studies such as Matsa and Miller (2013); Ahern and Dittmar (2012); and Richard et al. (2004) also find evidence to suggest that gender diversity hampers productivity and reduces efficiency.

Beyond the assumption of linearity, other studies have emphasized that the gender diversity–productivity link is curvilinear, i.e., the existence of both the knowledge-based and resource-based theories as well as the social identity theories at various levels of gender diversity (Richard, Kochan, & McMillan-Capehart, 2002, 2007; Van Knippenberg, De Dreu, & Homan, 2004). In other words, different ranges of gender diversity are associated with different dynamics that can be explained by one or the other theory. This becomes the third and final view. Van Knippenberg, De Dreu, and Homan (2004), more explicitly, discussed this view within the categorization-elaboration model (CEM), where the role of information processing systems is explored in the diversity–performance link. The CEM incorporates the view that information/ decision-making and social categorization processes interact such that intergroup biases flowing from social categorization disrupt the elaboration (in-depth processing) of task-relevant information and perspectives, thus producing the offsetting relationships. Ali, Kulik, and Metz (2011) also explored this relation and suggested that at low to moderate levels of gender diversity, the group dynamics predicted by the knowledge-based and resource-based view of the firm are stronger than those predicted by self-categorization and social identity theories. At moderate to high levels of gender diversity, the group dynamics predicted by self-categorization and

social identity theories are stronger than those predicted by the resource-based view of the firm. Further support for the curvilinear hypothesis can be found in Bae and Skaggs (2019); Schneid, Isidor, Li, and Kabst (2015); Ali, Kulik, and Metz (2011); Richard, Murthi, and Ismail (2007); Palmer (2006); Richard et al. (2004); Earley and Mosakowski (2000); Knouse and Dansby (1999); Alexander, Nuchols, Bloom, and Lee (1995); and Blau (1977).

Also linked to the nonlinear hypothesis are studies that seek to predict the thresholds of gender diversity that is consistent with their argument. Although no consistent thresholds are established in these studies, Knouse and Dansby (1999) found that diversity levels of about 11–30% were optimal in the diversity and perceived group effectiveness relationship.

Other studies have also employed the contingency approach to explore the contextual nature of the gender diversity–productivity link (Neale, Northcraft, & Jehn, 1999; Richard & Johnson, 1999). Their findings do not deviate fundamentally from those discussed above. Additionally, they focus on various moderators in explaining the gender diversity–productivity link. The moderators explored include industry type (Ali, Kulik, & Metz, 2011; Joshi & Roh, 2009; Richard, Murthi, & Ismail, 2007), alliance networks (Bae & Skaggs, 2019), regulatory framework (Bae & Skaggs, 2019; Zhang, 2020) and organizational culture (Dwyer, Richard, & Chadwick, 2003; Richard, 2000).

Relating the different predictions on the gender diversity–productivity link to the context of SSA, we hypothesize that gender diversity may be positively associated with firm productivity. This hypothesis is based on the trajectory of the economic empowerment of women on the continent and the responsiveness of manufacturing, more generally. Although there are considerable variations in progress, Africa performs better ahead of other regions of the world in terms of women's labour-force participation at work (Moodley et al., 2019). The continent has the highest share of female representation on company boards of any region (25% vs. the global average of 17%), while women's participation in unpaid family work continues to fall. At the same time, manufacturing as a proportion of GDP appears to be following an upward trend, after several decades of continuous decline. We, therefore, argue that the progress made with a more diverse gender in the world of work should account for some of the variations in the upward trend.

Methodology

Data and sample construction

This study focuses on a sample of manufacturing firms across six SSA countries. The attention on manufacturing firms is because of their importance for employment and economic growth. Also, manufacturing firms tend to exhibit significant heterogeneities in productivity, which makes it unique in exploring a subject like the impact of gender diversity on firm productivity. We use data from the 2013 World Bank Enterprise and Innovation Follow-up Surveys which had an analytical sample of 1,082 firms.

Measurement of firm productivity

Firm productivity, in this study, is measured by the traditional (single factor) measure of labour productivity. Two variants of labour productivity are used: (1) one based on total sales revenue (2) and the other based on firm value-added. We calculate the ratio of total sales revenue by total full-time employees and take its logarithmic transformation as has been done in studies such as Bae and Skaggs (2019); Richard et al. (2004); Dwyer, Richard, and Chadwick (2003); and Richard (2000). The measure based on firm value-added is obtained by following an approach like that of sales revenue where we divide the differences between total sales revenue and the cost of intermediate inputs with the total number of full-time employees and take its logarithmic transformation. Liu, Wang, and Wei (2009) and Wu and Cheng (2016) have used this approach.

This variant of the productivity measure is less sensitive to the processes of substitution between materials/services and labour or the degree of vertical integration.

Measurement of independent variables

Gender diversity

We employ four measures of gender diversity which are consistent with the extant literature: (1) a dummy for female ownership, (2) a dummy for a female being in the top management, (3) the proportion of the firm owned by a female and (4) the proportion of female full-time employees. Tsou and Yang (2019) measured gender diversity using the share of female employees; Marinova, Plantenga, and Remery (2016) used the percentage of women on the management board as well as a dummy for the presence of at least one female on the board; Pfeifer and Wagner (2014) measured gender diversity using the share of female employees (i.e., the total number of females covered by social security over the total number of employees covered by social security). While Zhang (2020) and Bae and Skaggs (2019) use the popular Blau's index, they find it to be highly correlated with the measures we employ in this study.

Moderator variable

We relied on the IWOSS concept to define heterogeneity in manufacturing activities. Based on the classifications in the World Bank Enterprise Surveys questionnaire, we categorize the following sub-sectors as IWOSS based on the definitions of Newfarmer, Page, and Tarp (2018): (i) food, (ii) textiles, (iii) garments, (iv) leather, (v) wood, (vi) paper, (vii) publishing, printing and recorded media, (viii) furniture and (ix) recycling. Correspondingly, the non-IWOSS sectors are as follows: (i) chemicals, (ii) transport machines, (iii) plastics and rubber, (iv) basic metals, (v) nonmetallic products, (vi) fabricated metal products, (vii) machinery and equipment and (viii) electronics.

Control variables

We include control variables that may have a direct impact on firm productivity and are also consistent with the literature on gender diversity. These control variables include the proportion of the workforce with at least secondary education, age, innovation, firm size, training, exporting and foreign ownership. The proportion of the workforce with secondary education is used to capture the effects of human capital on firm productivity. Typically, firms with a more highly educated workforce are expected to be more productive than those with a small, educated workforce (Tsou & Yang, 2019). Firm age is included because newer firms have less formalized structures and may be able to promote creativity and innovation more easily, which can be beneficial to organizational performance (Bae & Skaggs, 2019). Alternatively, older firms can explore their economies of scale and scope to be more productive. The link between innovation and productivity has been widely explored in the literature (Crépon, Duguet, & Mairessec, 1998; Sauer & Vrolijk, 2019). The basic conclusion from this literature is that firms that tend to be more innovative also have a higher propensity to be productive. Firm size is included as a control because large firms have a greater capacity for profits due to economies of scale (Bae & Skaggs, 2019).

The inclusion of training is related to the effects of human capital on firm productivity. It captures on-the-job training that is offered to employees and is thus different from general education. Exporting is included to account for the role of the exports market in enhancing the productivity of local firms (Tsou & Yang, 2019). Given the standards and high-quality demands for engagement in the export market, it is expected that an unproductive firm that cannot meet these expectations is not likely to export. Further arguments can be made about the entry costs for participation in the exports market, which may also hinder entry for unproductive firms. Finally, foreign ownership is assumed to come with high-quality human capital and technology, both of which are positive correlates with firm productivity (Tsou & Yang, 2019).

Estimation strategy

The link between gender diversity and firm productivity has been explored using various specifications. The most common technique has assumed linearity between gender diversity and productivity. Others have relied on nonlinear models as a competing prediction (Ali, Kulik, & Metz, 2011; Bae & Skaggs, 2019; Richard, Kochan, & McMillan-Capehart, 2002). Both approaches are employed in this paper. A key innovation in our estimation is the introduction of an interaction between gender diversity and the IWOSS variable. This IWOSS variable is the main indicator variable that we introduce to account for heterogeneity between firms in the manufacturing sector.

Descriptive statistics

Tables 1–3 present some descriptive statistics of the variables used for the estimations. In Table 1, where we provide statistics on the sectoral distribution of the gender diversity variables used in the study, we find that the firms with the highest female ownership can be found in textiles (54%), garments (52%), paper (50%) and food (47%). These are typically firms in the IWOSS sector. Conversely, firms with the lowest proportion of female ownership include transport machines (13%), furniture (15%) and fabricated metal products (15%) (typically non-IWOSS). These distributions are not vastly different when we consider female top managers, the proportion of the firms owned by a female and the share of full-time female employees as indicators of gender diversity. In Table 2, where we present the sectoral distribution of labour productivity, we find that the highest shares are in nonmetallic mineral products, basic metals, plastics and rubber, publishing, printing and recorded media, and chemicals. We again find that the industries with the highest shares of female-to-male production workers are textiles, food, publishing, printing and recorded media, chemicals, and electronics.

In combining Tables 1 and 2, we find that in firms with the highest share, the gender diversity variables such as textiles and garments have low labour productivity values. These firms also have the lowest ratios of female to male production workers. A basic deduction from these results is that gender diversity may be negatively correlated with labour productivity since the most productive sectors also appear to have the lowest proportion of female workers. Further analysis will still be required to determine the true nature of the relationship, and this is done in subsequent sections of the paper.

We present, in Table 3, the descriptive statistics of all the variables in the analysis. We observe that about 32% of the firms have a female owner, and 13% have their top manager being a female. The average proportion of a firm owned by a female is 14%, and the average proportion of female full-time employees is 19%. We also observe for the control variables that about 59% of the workforce have at least secondary education, the average age of a firm is 17 and the average firm size is 64. While about 33% of the firms have undertaken some specific training, 27% are exporting firms and 16% are foreign-owned. In terms of the correlation coefficients, we find a positive association between labour productivity and all measures of gender diversity except for the proportion of the firm owned by a female. For the control variables, all are positively correlated with labour productivity with the highest being innovation. We do not find the explanatory variables to be strongly correlated in a way to be concerned about multicollinearity. We relied on the Tolerance Statistics to confirm it.

Empirical results

Table 4 reports the basic results of our estimations. In the linear specification (columns 1–4), which is estimated by ordinary least squares, we do not find any evidence of the gender diversity

Table 1. Sectoral distribution of gender diversity variables

	Sample	Female owner	Female top manager	Proportion of the firm owned by a female	Proportion of female full-time employees
IWOSS					
Textiles	66	.54	.26	.28	.34
Garments	89	.52	.45	.41	.47
Paper	8	.50	.13	.2	.14
Food	238	.47	.14	.19	.25
Publishing, printing and recorded media	75	.39	.18	.13	.27
Wood	54	.25	.09	.07	.10
Leather	12	.2	0	.08	.22
Furniture	143	.15	.04	.04	.07
Recycling	2	0	0	0	.12
Non-IWOSS					
Plastics and rubber	38	.32	.11	.15	.12
Machinery and equipment	35	.29	.09	.11	.12
Electronics	20	.25	0	.06	.15
Nonmetallic mineral products	56	.24	.09	.1	.12
Chemicals	71	.22	.07	.06	.23
Basic metals	23	.22	.09	.1	.11
Fabricated metal products	134	.15	.02	.05	.07
Transport machines	18	.13	0	.04	.10

variables having statistically significant effects on labour productivity. That notwithstanding, we find most of the control variables (proportion of the workforce with secondary education, innovation, firm size, training, exporting and foreign ownership) to be positively associated with labour productivity. Firm age was insignificant. In the nonlinear model (columns 5 and 6), where we include only the measures of gender diversity that are continuous (i.e., the proportion of the firm owned by a female and proportion of female full-time employees), we find evidence that suggests an inverted-U relationship between diversity and productivity. In this specification, gender diversity has an initial positive effect on labour productivity measured as sales revenue per employee ($[b = .015, p < .05]$ in Equation 5 and $[b = 2.324, p < .05]$ in Equation 6), but the square term is negatively correlated with sales per employee ($[b = -.0001, p < .05]$ in Equation 5 and $[b = -2.597, p < .05]$ in Equation 6). The results show that initial or lower levels of gender diversity (the proportion of the firm owned by a female or female full-time employee) are associated with productivity improvements. However, beyond a certain level of gender diversity, productivity declines. In other words, the results suggest that for some range of gender diversity, productivity is enhanced; however, beyond a certain threshold, gender diversity harms

Table 2. Sectoral distribution of labour productivity and the ratio of female to male production workers

	Sample	Sales revenue per employee	Female to male production workers
IWOSS			
Publishing, printing and recorded media	75	56,496.35	.40
Paper	8	48,787.89	.16
Food	238	23,593.13	.47
Wood	54	20,284.52	.12
Textiles	66	17,485.53	.80
Furniture	143	15,863.35	.09
Leather	12	15,095.14	.21
Garments	89	7,033.95	1.05
Recycling	2	3,570.23	.13
Non-IWOSS			
Nonmetallic mineral products	56	111,878.70	.13
Basic metals	23	66,877.27	.07
Plastics and rubber	38	60,530.95	.07
Chemicals	71	51,025.15	.25
Fabricated metal products	134	44,046.46	.06
Machinery and equipment	35	40,205.78	.12
Electronics	20	15,178.00	.25
Transport machines	18	6,957.56	.30

Table 3. Descriptive statistics of variables

	Mean	Standard deviation
1. Sales revenue per employee	34,232.38	175,261.30
2. Female owner	.32	.47
3. Proportion of the firm owned by a female	.14	.28
4. Female top manager	.13	.33
5. Proportion of full-time female employees	.19	.24
6. Proportion of workforce with secondary education	.59	.35
7. Age	17.32	15.03
8. Innovation index	.06	1.32
9. Full-time employees	63.91	292.45
10. Training	.33	.47
11. Export	.27	.44
12. Foreign ownership	.16	.36

Table 4. Base model (linear and nonlinear model)

Dep. var.: sales revenue/employee	Linear model				Nonlinear model	
	(1)	(2)	(3)	(4)	(5)	(6)
Gender diversity variables						
Female owner	.161					
	(.123)					
Female top manager		−.064				
		(.176)				
Prop. of the firm owned by a female			−.002		.015**	
			(.002)		(.007)	
Prop. of full-time female employees				.300		2.328***
				(.251)		(.664)
Prop. of the firm owned by a female sq.					−.000**	
					(.000)	
Prop. of female full-time employees sq.						−2.597***
						(.751)
Control variables						
Prop. of workforce with Sec. Edu.	.004***	.004***	.004***	.004**	.004***	.004**
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
Log of age	.058	.061	.060	.063	.056	.069
	(.063)	(.063)	(.063)	(.063)	(.063)	(.063)
Innovation index	.082*	.083*	.082*	.081*	.080*	.074
	(.049)	(.049)	(.049)	(.049)	(.049)	(.049)
Log of firm size	.144**	.139**	.136**	.146**	.138**	.127**
	(.063)	(.063)	(.063)	(.063)	(.064)	(.064)
Training	.326***	.329***	.334***	.318***	.325***	.322***
	(.120)	(.120)	(.120)	(.121)	(.120)	(.121)
Exporting	.450***	.465***	.470***	.455***	.464***	.450***
	(.147)	(.146)	(.146)	(.147)	(.146)	(.147)
Foreign ownership	.795***	.782***	.774***	.790***	.771***	.796***
	(.163)	(.163)	(.164)	(.162)	(.164)	(.163)
Constant	3.068***	3.150***	3.196***	3.049***	3.201***	2.931***
	(.269)	(.267)	(.276)	(.272)	(.274)	(.272)
R^2	.778	.778	.778	.778	.780	.780
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes

(*Continued*)

Table 4. (*Continued.*)

Dep. var.: sales revenue/employee	Linear model				Nonlinear model	
	(1)	(2)	(3)	(4)	(5)	(6)
Observations	1,082	1,082	1,082	1,082	1,082	1,082

Robust standard errors in parentheses.
***$p < .01$, **$p < .05$, *$p < .1$.

productivity. It will be recalled from the discussion on the descriptive statistics earlier, that an initial negative association was found.

As a robustness check, we assess whether the findings are consistent across the different measures of the dependent variable by using value-added per employee instead of sales per employee, as a measure of productivity. The results, which are presented in Table 5, are consistent with those observed in Table 4 in that the proportion of the firm owned by a female and the proportion of full-time female employees are positively associated with value-added per employee ($b = .017$, $p < .05$; $b = 2.087$, $p < .05$ respectively), and the square terms of these variables produce negative results ($b = -.0001$, $p < .05$; $b = -2.463$, $p < .05$ respectively). Similar to the results in Table 4, the rest of the control variables in Table 5 maintained their signs as before, indicating that the observed findings are robust.

In Table 6, we extend the base model in Table 4, by interacting the gender diversity variables with the IWOSS dummy. The interaction term allows us to explore heterogeneity in the gender diversity and firm productivity link by comparing IWOSS and non-IWOSS firms. The results show that only the interaction between the proportion of full-time female workers and the IWOSS dummy was significant ($b = -1.452$, $p < .05$). The negative and significant interaction term suggests that the positive association between the proportion of full-time female workers and labour productivity is relevant only for non-IWOSS firms. Interestingly, the IWOSS dummy on its own is consistently negative in all the specifications, suggesting IWOSS firms may be less productive. Like Table 5, we check for consistency in the results by relying on the value-added per employee as our dependent variable (see Table 7). The results remain unchanged as the interaction term remains negative ($b = -1.714$, $p < .05$).

Discussion

In this paper, we have analysed the effects of gender diversity on firm productivity using data on manufacturing firms from six SSA countries. We have also explored the potential moderating role of structural differences in manufacturing activities by identifying and controlling for IWOSS firms given their growing popularity as an alternative and emerging source of structural transformation in Africa (Newfarmer, Page, & Tarp, 2018) following the continent's several years of deindustrialization.

The main conclusion from our study is that the IWOSS firms do no better in explaining the positive association between gender diversity and firm productivity. This finding indicates that an increasing proportion of full-time females employed in IWOSS sectors do not contribute to increasing firm productivity. Rather, we find the evidence to be applicable to non-IWOSS firms (i.e., traditional manufacturers that rely on resources that Africans are most engaged). These results are consistent with the studies that have found a positive association between gender-diverse workforces and firm productivity (Ali, Kulik, & Metz, 2011; Herring, 2009; Richard et al., 2004; Yang & Konrad, 2011). That notwithstanding, our results are unique to the extent that in addition to controlling for common firm characteristics, we show that the relationship is peculiar to firms classified as non-IWOSS. A gender-diverse human capital provides

Table 5. Robustness check (linear and nonlinear model)

Dep. var.: value-added/employee	Linear model			Nonlinear model		
	1	2	3	4	5	6
Gender diversity variables						
Female owner	.210					
	(.136)					
Female top manager		−.103				
		(.197)				
Prop. of the firm owned by a female			−.002		.017**	
			(.002)		(.008)	
Prop. of full-time female employees				.158		2.087***
				(.286)		(.755)
Prop. of the firm owned by a female sq.					−.000**	
					(.000)	
Prop. of female full-time employees sq.						−2.463***
						(.861)
Control variables						
Prop. of workforce with Sec. Edu.	.003	.003	.003	.002	.003	.002
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
Log of age	.033	.036	.035	.037	.032	.045
	(.071)	(.071)	(.071)	(.071)	(.071)	(.071)
Innovation index	.096*	.096*	.096*	.096*	.094*	.089
	(.055)	(.054)	(.054)	(.055)	(.054)	(.054)
Log of firm size	.181***	.173**	.171**	.178***	.172**	.159**
	(.068)	(.068)	(.068)	(.068)	(.068)	(.068)
Training	.356***	.357***	.364***	.353**	.357***	.355***
	(.136)	(.135)	(.136)	(.137)	(.136)	(.137)
Exporting	.485***	.503***	.507***	.496***	.502***	.494***
	(.161)	(.161)	(.161)	(.161)	(.161)	(.161)
Foreign ownership	.823***	.808***	.803***	.816***	.798***	.823***
	(.176)	(.176)	(.177)	(.175)	(.176)	(.175)
Constant	2.655***	2.773***	2.812***	2.703***	2.804***	2.582***
	(.298)	(.297)	(.305)	(.302)	(.303)	(.303)
R^2	.753	.752	.752	.752	.754	.754
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes

(*Continued*)

Table 5. (*Continued.*)

Dep. var.: value-added/employee	Linear model			Nonlinear model		
	1	2	3	4	5	6
Observations	1,040	1,040	1,040	1,040	1,040	1,040

Robust standard errors in parentheses.
***$p < .01$, **$p < .05$, *$p < .1$.

Table 6. Base model: introducing an interaction term

Dep. var.: sales revenue/employee Gender diversity variables	(1)	(2)	(3)	(4)
Female owner	.091			
	(.212)			
Female top manager		−.024		
		(.489)		
Prop. of the firm owned by a female			.001	
			(.005)	
Prop. of full-time female employees				1.371**
				(.597)
Female owner × IWOSS	.087			
	(.262)			
Female top manager × IWOSS		−.111		
		(.522)		
Prop. of the firm owned by a female × IWOSS			−.004	
			(.005)	
Prop. of full-time female employees × IWOSS				−1.452**
				(.650)
IWOSS	−2.583**	−2.508**	−2.478**	−2.316*
	(1.132)	(1.129)	(1.135)	(1.209)
Control variables	Yes	Yes	Yes	Yes
Constant	5.743***	5.778***	5.808***	5.597***
	(1.157)	(1.156)	(1.161)	(1.231)
R^2	.781	.780	.781	.781
Sector dummies	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes
Observations	1,040	1,040	1,040	1,040

Robust standard errors in parentheses.
***$p < .01$, **$p < .05$, *$p < .1$.

access to a broader talent pool as well as varied perspectives and knowledge that feed into creativity, problem-solving and innovation in a firm. A gender-diverse human capital may also facilitate access to a wider variety of customers. Our results on the effect of diversity on sales per

Table 7. Robustness check: introducing an interaction term

Dep. var.: value-added/employee	(1)	(2)	(3)	(4)
Female owner	.200			
	(.225)			
Female top manager		.030		
		(.508)		
Prop. of the firm owned by a female			.003	
			(.005)	
Prop. of full-time female employees				1.574**
				(.634)
Female owner × IWOSS	.014			
	(.282)			
Female top manager × IWOSS		−.165		
		(.548)		
Prop. of the firm owned by a female × IWOSS			−.006	
			(.005)	
Prop. of full-time female employees × IWOSS				−1.714**
				(.697)
IWOSS	−2.917***	−2.834**	−2.798**	−2.603**
	(1.127)	(1.127)	(1.134)	(1.220)
Control variables	Yes	Yes	Yes	Yes
Constant	5.570***	5.613***	5.644***	5.412***
	(1.155)	(1.157)	(1.163)	(1.245)
Sector dummies	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes
Observations	1,040	1,040	1,040	1,040
R^2	.753	.752	.752	.753

Robust standard errors in parentheses.
***$p < .01$, **$p < .05$, *$p < .1$.

worker and value-added per worker suggest that this may be the case for the non-IWOSS firms in the study.

The observed findings may be the result of several efforts to reverse the African continent's deindustrialization by continuously enhancing the capital intensity of traditional African manufacturers manufacturing which is focused on the processing of primary resources and related activities. Not surprisingly, we find from our descriptive statistics that non-IWOSS firms, including firms that produce nonmetallic mineral products, basic metals as well as plastics and rubber, tend to have the highest average productivity values relative to the typical IWOSS sectors. It is to be noted that firms that are becoming more capital intensive tend to be more productive when compared to firms that are usually labour intensive (McMillan & Zeufack, 2022) and a gender-diverse human capital base provides access to talent, knowledge and perspectives required for increased productivity.

We again note from our results that males tend to dominate non-IWOSS firms which is possibly an outcome of a social construct about the gendered nature of manufacturing activities. Flecker, Meil, and Pollert (1998) showed how women steered away from male-dominated jobs (such as manufacturing) since they (and other minority groups) are the easy targets for redundancies or retrenchment when firms are restructuring or downsizing. We argue, based on our results, that with the evolving nature of the world of work, where firms are increasingly utilizing more innovative manufacturing processes and the increasing openness towards the engagement, the empowerment of women should provide ample motivation for women to get more involved at all levels in non-IWOSS firms. Public policy should be seen as explicitly supporting and encouraging this change given the evidence provided in our study of diversity enhancing productivity in African manufacturing firms.

Again, the knowledge-based research and decision-making theories have relevance in explaining our results. These theories posit that the primary problem confronting firms relates to knowledge and how it can enhance decision-making. They further emphasize that diversity in decision-making is critical in addressing the knowledge problems of firms. We, therefore, contend, based on our empirical findings, that gender diversity can be critical in addressing the challenges faced by African firms in efficiently exploiting their natural resources or sectors related to it. Given that most non-IWOSS sectors (or firms) tend to be characterized by the reliance on natural resources, it is therefore not surprising that such firms better explain the positive association between gender diversity and firm productivity.

Furthermore, the resource-based view of the firm, as emphasized by Barney (2001) and McMahan, Bell, and Virick (1998), can be useful in explaining the finding in as much as it posits that the intangible and socially complex characteristics of a more gender-diverse workforce are critical for enhancing firm productivity.

Research and theoretical contribution

This paper has explored the implication of gender diversity for productivity, considering the heterogeneous effects based on the classification of firms as IWOSS[1]. Our initial results showed that there is a nonlinear relationship between gender diversity and productivity. This means that while access to a larger pool of talent, knowledge, perspectives and a potentially wider variety of customers through an increased proportion of females employed may firstly be associated with increased productivity in the form of sales per employee and value-added per employee, continued expansion of gender diversity may be associated with productivity declines in manufacturing firms. This nonlinear relationship provides support for an integration of the knowledge-based, resource-based and social identity theories at various levels of gender diversity (Ali, Kulik, & Metz, 2011; Bae & Skaggs, 2019; Schneid et al., 2015). In the specific case of our study, the group dynamics predicted by the knowledge-based and resource-based view of the firm at low to moderate levels of gender diversity are stronger than those based on self-categorization and social identity theories. However, at moderate to high levels of gender diversity, the group dynamics predicted by the social identity theories are stronger and, therefore, adversely affect productivity.

Subsequently, where we introduce IWOSS firms as a moderator for gender diversity, we find a negative association between gender diversity and firm productivity for IWOSS firms. In other words, gender diversity is found to be productivity-enhancing in non-IWOSS or traditional manufacturing firms. This result for non-IWOSS firms is also consistent with the knowledge-based and resource-based theories (Mannix & Neale, 2005; Watson, Kumar, & Michaelsen, 1993). For a sector of manufacturing that has otherwise been on a path of decline, gender diversity offers a broad scope of employee competence and experience, market insight, creativity, innovation and problems solving critical to enhancing firm competitiveness (Barney, 2001;

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[1]A concept popularized by Newfarmer, Page, and Tarp (2018) as an alternative source of structural transformation in Africa.

McMahan, Bell, & Virick, 1998). We, therefore, argue that gender diversity may be critical in addressing the trend of decline in African manufacturing.

In sum, we observe a complexity of relations that require an integration of various theories in seeking to explain the impact of gender diversity on productivity, especially when we consider a unique form of heterogeneity among firms. Nonetheless, the overall results provide support for the affirmative action efforts being undertaken to enhance gender diversity on the African continent and more so at the workplace (Moodley et al., 2019; UNIDO, 2016). Our findings suggest that these efforts can yield favourable results, especially when they are properly targeted within the manufacturing sector. Our results also suggest that the advantages of manufacturing can be used as leverage towards enhancing affirmative action on the African continent (Moodley et al., 2019; UNIDO, 2016).

Practical implications

The study has brought to the fore the importance of diversification in recruitment by drawing from a broader talent base, particularly for traditional manufacturing in SSA. Increased gender diversity among employees of the firms will allow the firms to not only potentially access a wider variety of knowledge and perspectives for problem-solving and innovation but also reach out to a wider variety of customers (see Moodley et al., 2019; UNIDO, 2016). The result of increased gender diversity may be evidenced in the increased productivity not only in terms of sales revenue per employee but also in terms of value-added per employee as the evidence adduced in this study has shown.

The nonlinearity observed in the relationship between gender diversity and productivity within African firms suggests that managers need to be aware of the potential reversal in productivity with further expansions in gender diversity. Thus, for some ranges of gender diversity, various inter-group biases that arise from social categorization may produce the observed offsetting relationship (Richard, Kochan, & McMillan-Capehart, 2002; 2007; Van Knippenberg, De Dreu, & Homan, 2004). Finding the optimal proportion of females for increased productivity must engage the attention of managers beyond seeking to satisfy a regulatory requirement or affirmative action.

The trends observed with the introduction of IWOSS firms as a moderator in the effect of gender diversity on productivity in the results once again underscore the need to take into consideration peculiar heterogeneities among firms in the design of policy in Africa. While some firms may pursue gender diversity in response to regulatory requirements or affirmative action policy, there is the need to be minded that such laws or programmes while best-intentioned, do not necessarily have the same effect on the productivity of firms (Van Knippenberg, De Dreu, & Homan, 2004). As has been shown in this study, implementation of such policies may yield positive results on productivity in non-IWOSS firms and negative results in IWOSS firms.

Again, the differential impact based on the IWOSS classification suggests that identifying relevant heterogeneities can lead to the realization of a more nuanced relationship between gender diversity and firm productivity. The implication of this for public policy is that a one-size-fits-all approach cannot continue to underscore affirmative action interventions, particularly for those intended to enhance firm productivity. Some differential actions can be useful in realizing the positive association between diversity and productivity.

Limitations and future research

Overall, the findings of this study may be considered preliminary given that they are based on cross-sectional data from a limited number of countries in SSA – Ghana, the Democratic Republic of Congo, Tanzania, Uganda, Zambia and Kenya. Also, the nonavailability of micro-panel data that can be explored for causal inferences remains a challenge. In addition, our

study relies on the use of a single-factor measure of productivity as opposed to a multi-factor productivity measure that tends to be the preferred measure in the extant literature. Future studies may take advantage of a relevant micro-panel to explore the dynamic association between gender diversity and labour productivity. Also, extensions may include an attempt to isolate heterogeneity in the distribution of women that are relevant for manufacturing using age, skillset, the proportion of production and nonproduction workforce. Also, the moderating role of other variables such as innovation, education and various organizational variables can be explored.

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Appendix

Table A1. Definition of variables

Variable	Definition
Sales revenue per employee	Ratio of total sales revenue by total full-time employees
Value-added per employee	Ratio of value-added revenue by total full-time employees
Female owner	1, if a female owns the firm, 0 otherwise
Proportion of the firm owned by a female	The proportion of the firm owned by a female
Female top manager	1, if a top manager is female, 0 otherwise
Proportion of full-time female employees	The proportion of full-time female employees
Proportion of workforce with secondary education	The proportion of workforce with secondary education
Age	The age of the firm
Innovation index	An index for product, process, organizational and marketing innovation (obtained by summation)
Full-time employees	The total number of full-time employees
Training	1, if the firm undertook some form of training for its workers, 0 otherwise
Export	1, if the firm is an exporting firm, 0 otherwise
Foreign ownership	1, if the firm is foreign-owned, 0 otherwise

Table A2. Summary statistics

	Mean	Standard deviation
1. Sales revenue per employee	34,232.38	175,261.30
2. Female owner	.32	.47
3. Proportion of the firm owned by a female	.14	.28
4. Female top manager	.13	.33
5. Proportion of female full-time employees	.19	.24
6. Proportion of workforce with secondary education	.59	.35
7. Age	17.32	15.03
8. Innovation index	.06	1.32
9. Full-time employees	63.91	292.45
10. Training	.33	.47
11. Export	.27	.44
12. Foreign	.16	.36

Table A3. Descriptive statistics and correlations

	1	2	3	4	5	6	7	8	9	10	11	12
1. Sales revenue per employee	1.00											
2. Female owner	.01	1.00										
3. Proportion of the firm owned by a female	–.04	.74	1.00									
4. Female top manager	.04	.42	.63	1.00								
5. Proportion of female full-time employees	.01	.33	.45	.39	1.00							
6. Proportion of workforce with secondary education	.10	.05	–.01	.01	.11	1.00						
7. Age	.05	.10	–.02	–.03	–.03	.13	1.00					
8. Innovation index	.16	.01	–.06	–.03	.03	.16	.07	1.00				
9. Full-time employees	.01	–.01	–.02	–.05	.00	.04	.19	.10	1.00			
10. Training	.02	.06	.02	–.06	.10	.08	.19	.19	.12	1.00		
11. Export	.00	.11	.04	–.01	.07	.08	.29	.09	.11	.18	1.00	
12. Foreign	.15	–.05	–.09	–.06	–.03	.12	.07	.09	.12	.05	.18	1.00

Table A4. Distribution of gender diversity and productivity variables across IWOSS

Variable	Non-IWOS		IWOSS	
	Mean	Std. Dev.	Mean	Std. Dev.
Female owner	.21	.41	.38	.49
Female top manager	.06	.23	.16	.37
Proportion of the firm owned by a female	8.01	20.60	17.92	30.99
Proportion of female full-time employees	.12	.15	.24	.27
Sales revenue per employee	54,084.91	259,380.60	22,726.61	96,087.34
Female to male production workers	.13	.22	.46	.58

Observation: IWOSS = 397, non-IWOSS = 685.