

Female Ownership Participation and Product Innovation among Firms in Ghana: Does a Female Top Manager Strengthen the Relationship?

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DOI: <https://doi.org/10.47772/IJRISS.2026.1014MG0184>

Received: 07 September 2026; Accepted: 12 September 2026; Published: 23 September 2026

ABSTRACT

Women participate in firms as owners and top managers, but these roles may shape innovation in different ways. This study examined whether female ownership participation was associated with product innovation among formal firms in Ghana and whether having a female top manager strengthened that relationship. We analyzed the Ghana World Bank Enterprise Survey 2023. The dependent variable measured whether the establishment introduced a new or significantly improved product or service during the previous three years. We measured female ownership participation and the top manager's gender directly. After removing World Bank nonresponse codes and incomplete control variables, the analytical sample included 673 establishments; survey-weighted logistic regression controlled for logged firm age, employment size, realized industry, and region. We used hierarchical models, average predicted probabilities, alternative survey weights, unweighted estimation, alternative ownership measures, market-new innovation, additional R&D controls, influence diagnostics, and 1,000 stratified bootstrap replications. Weighted estimates indicated that 18.8% of firms reported product innovation, 33.9% had at least one female owner, and 20.5% had a female top manager. In the additive model, female ownership and female management were not independently significant. In the interaction model, female ownership was positively associated with product innovation when the top manager was male (adjusted odds ratio = 1.71, 95% confidence interval [1.03, 2.83], $p = .038$). The female-owner-by-female-manager interaction was negative and narrowly missed the conventional significance threshold, adjusted odds ratio = 0.27, 95% confidence interval [0.07, 1.01], $p = .052$. Adjusted innovation probabilities were 17.2% for firms with no female owner and a male manager, 25.4% for female-owned firms with a male manager, 28.7% for firms without female owners but with a female manager, and 16.2% for firms combining female ownership and female top management. However, the negative interaction was not stable under bootstrap, unweighted and influence analyses. The expected positive women-to-women moderation was therefore not supported. The findings suggest that ownership-management gender combinations may matter, but Ghanaian evidence does not justify a general claim that pairing female owners with female managers increases product innovation.

Keywords: female ownership, female top manager, product innovation, gender diversity, Ghana, Enterprise Survey

INTRODUCTION

Innovation is important for firm competitiveness and economic development. New or significantly improved products and services can help firms respond to customer needs, enter new markets, increase productivity and create employment. In developing economies, innovation often involves adaptation and incremental improvement rather than inventions that are new to the world. These forms of innovation still matter because they spread knowledge, improve local solutions and strengthen enterprise capability (Cirera & Muzi, 2020; Fu et al., 2018).

Women remain less represented than men in ownership and senior management in many business environments, including across African firms (Orkoh & Viviers, 2021). This difference is not only an equality concern. It may also affect which problems firms notice, which markets they serve, how they allocate resources, and whether

they pursue new ideas. Gendered educational, employment and financial experiences can shape access to technical knowledge, professional networks and capital. At the same time, women owners and managers may bring knowledge of underserved customers, diverse social ties and different approaches to risk, collaboration and employee involvement (Ritter-Hayashi et al., 2019; Strohmeyer et al., 2017).

Ghana provides a relevant context for this question. Women are active in entrepreneurship, trade and service activities, but they often face financing, skills, property and institutional constraints. Research on Ghana shows that women entrepreneurs innovate, particularly through marketing and non-technological changes, although the type and scale of innovation differ across formal and informal firms (Fu et al., 2020). Firm capabilities, networks, skills, and access to knowledge also shape Ghanaian innovation (Robson et al., 2009; Fu et al., 2018).

Ownership and top management are distinct organisational roles. Owners provide capital, bear risk, establish broad priorities and may influence governance. Top managers coordinate daily operations, allocate resources and translate strategic intentions into actions. A woman may own a firm without controlling it, and a female top manager may lead a firm whose owners are male. Treating female ownership and female management as interchangeable can therefore hide important relationships.

Recent international studies show mixed findings. Dohse et al. (2019) found that female ownership was more strongly associated with innovation than female management. Ritter-Hayashi et al. (2019) reported that gender diversity among owners and having a female top manager were positively related to innovation in developing countries. Tonoyan and Boudreaux (2023) found that gender diversity in ownership was associated with innovation partly through R&D and access to external capital. These studies support a broad diversity argument, but they do not establish that every female owner-manager combination performs in the same way.

Azeem et al. (2022) proposed a women-to-women mechanism. Using World Bank Enterprise Survey data from 16 developing countries, they found that combining female ownership with female top management promoted innovation breadth, which was related to productivity. They argued that shared gender experiences and female-to-female support may help firms overcome social and cultural barriers. This study was the principal benchmark for the present research design.

Other evidence points in a different direction. Machokoto et al. (2024) found that gender-diverse, rather than same-gender, owner-manager combinations were associated with greater innovation in emerging markets. In their analysis, female-owned firms led by male managers were the most innovative, while female-owned firms led by female managers were the least innovative. This heterophily argument suggests that different gender experiences may widen the knowledge and network resources available to a firm.

The competing findings make a Ghana-specific test valuable. National institutions, sectoral segregation, ownership concentration, managerial labour markets and cultural expectations may change how gender combinations operate. Cross-country averages can hide national patterns. The Ghana 2023 Enterprise Survey provides recent data on female ownership, the gender of the top manager, and product innovation, enabling a focused test with direct variables.

The study addresses two questions. First, is female ownership participation associated with product innovation among formal firms in Ghana? Second, does a female top manager strengthen the relationship? The study contributes by separating ownership and management roles, testing their interaction, reporting probability-scale effects and conducting extensive sensitivity analysis. The article follows the IMRaD format. The next section develops the theory and hypotheses, followed by Methods, Results, Discussion and Conclusion.

THEORETICAL BACKGROUND AND HYPOTHESES

Female Ownership Participation and Product Innovation

Upper-echelons theory proposes that organisational outcomes reflect the experiences, values and cognitive frames of powerful decision makers (Hambrick & Mason, 1984). Owners can influence strategic priorities, acceptable risk, and resource allocation. Even where an owner is not involved in daily operations, ownership

rights can provide access to governance discussions and major decisions. Female ownership may therefore affect whether a firm pursues new products, serves new customer groups or invests in experimentation.

Resource-based theory provides a related explanation. Firms innovate by combining knowledge, relationships, finance and organisational routines in ways that competitors cannot easily copy (Barney, 1991). Female owners may expand the firm's resource base through different professional and social networks, customer knowledge and experiences. They may identify needs that more homogeneous ownership groups overlook. Gender diversity can therefore increase the variety of information available for innovation.

Diversity does not guarantee better results. Benefits depend on participation, influence and communication. A woman may be recorded as an owner but hold a small share or play a nominal role. Gendered barriers may limit access to finance, technical training and market networks. Women-owned firms may also be concentrated in sectors with fewer opportunities for technological innovation. These constraints can reduce or reverse the expected relationship (Bastian et al., 2019; Strohmeier et al., 2017).

Empirical evidence is mixed but increasingly supports a context-dependent association. Dohse et al. (2019) found that female owners, more than female managers, were more likely to introduce innovations across many countries. Tonoyan and Boudreaux (2023) linked gender-diverse ownership with R&D, external capital and multiple forms of innovation in emerging economies. Research focused on Ghana suggests that women entrepreneurs are active innovators, although they may concentrate on marketing and non-technological innovation (Fu et al., 2020).

The present study uses a broad and direct measure: whether at least one woman is among the owners. This measure captures participation, not control. Female ownership participation is expected to add perspectives and resources that can support product innovation.

Hypothesis 1: Female ownership participation is positively associated with product innovation among formal firms in Ghana.

The Moderating Role of a Female Top Manager

Top managers translate strategic intentions into operational decisions. They allocate staff and finance, coordinate departments, interact with customers and suppliers, and decide whether ideas proceed to development. A female top manager may therefore help convert female owners' priorities and market knowledge into product innovation.

The women-to-women argument is based partly on shared experience and relational support. Female owners and female managers may understand similar institutional barriers and may find it easier to exchange information about gendered customers, employees and markets. Shared identity can build trust and reduce communication costs. Female managers may also act as role models and strengthen the voice of women at lower organisational levels (Azeem et al., 2022).

Upper-echelons theory suggests that executive characteristics matter when managers have discretion and when those characteristics are relevant to the strategic task (Hambrick, 2007). Innovation is uncertain and requires judgement. A female manager may bring a participative leadership style, diverse social information and greater attention to underrepresented customer needs. Female representation in top management has been associated with stronger performance where innovation is strategically important (Dezsö & Ross, 2012).

A positive interaction can also be understood as alignment. Female owners may support innovation but lack the time or operational authority to implement it. A female manager can provide the managerial channel through which ownership priorities become product-development decisions. The combination may therefore be more valuable than either role alone.

However, diversity theory offers a competing prediction. A mixed-gender owner-manager team may combine less overlapping networks and experiences than a same-gender team. Different perspectives can improve

problem solving when the firm manages disagreement constructively (Østergaard et al., 2011). Machokoto et al. (2024) found evidence that gender-diverse owner-manager combinations were more innovative than same-gender combinations in emerging markets. Board-diversity evidence similarly shows that cognitive differences can be as important as demographic similarity (Makkonen, 2022), while international firm evidence links gender-diverse boards to stronger corporate innovation (Griffin et al., 2021).

Tokenism and structural constraints may also weaken the positive interaction. A female manager in a female-owned firm may operate in a sector with limited resources or may face external discrimination from lenders, suppliers and customers. Shared gender does not ensure effective mentoring or cooperation. Azeem et al. (2022) explicitly noted that survey data cannot prove that female owners and managers interact closely. The proposed moderation must therefore be tested, not assumed.

Hypothesis 2: A female top manager positively moderates the relationship between female ownership participation and product innovation.

METHODS

Data Source and Survey Design

The study used the Ghana World Bank Enterprise Survey 2023. The survey collected establishment-level information between February 2023 and February 2024 from formal private businesses in eligible manufacturing and service sectors. The establishment was the unit of analysis. The full public-use file contained 713 establishments and 355 variables (World Bank Group, 2025).

The World Bank used stratified random sampling based on establishment size, industry, region and panel status. Survey weights account for unequal selection probabilities and eligibility assumptions. The primary analyses used the median-eligibility weight (wmedian). We used the weak-eligibility weight (wweak) for sensitivity analysis. Regression weights were divided by their analytical-sample mean so that relative weights were preserved without inflating residual degrees of freedom.

The World Bank recommends using the realised economic activity reported during the interview rather than relying only on the sampling-frame sector. The four-digit ISIC Revision 4 activity was therefore grouped into manufacturing, construction, wholesale and retail, transport and storage, accommodation and food services, and other eligible services for description. The main regression used three groups, manufacturing, wholesale and retail, and other sectors—to avoid excessive parameters. We also estimated a six-sector sensitivity model.

The survey response rate was 24.8%. Sampling weights address known design and eligibility differences, but they cannot remove all nonresponse bias. The cross-sectional design also means that the analysis identifies associations rather than causal effects.

Data Inspection and Analytical Sample

The data were inspected before modelling. We examined establishment identifiers, variable labels, response categories, ranges, and skip patterns. The 713 establishment identifiers were unique. We treated negative World Bank codes such as -9 for “do not know” as missing rather than numerical values.

Product innovation had 711 valid yes-or-no responses. Female ownership participation contained 708 valid responses, and top-manager gender contained 711 valid responses. The analysis also required valid firm age, employment, realised industry, region, top-manager sector experience, both survey weights and sampling stratum. Complete-case treatment produced 673 establishments, equal to 94.4% of the full survey.

We calculated firm age as interview year minus the year operations began. Permanent full-time employment was obtained from the previous fiscal year. Age and employment were strongly right-skewed, so we log-transformed them. We then centred the transformed variables on their survey-weighted means.

We checked the product-innovation outcome against the follow-up market-novelty question. A secondary variable identified innovations that were also new to the establishment's main market. We used this stricter outcome as a robustness test. We reviewed the survey wording and coding to ensure we coded firms without product innovation as zero rather than treating the skipped follow-up item as missing.

Female ownership percentage was also inspected. We assigned firms with a valid "no female owner" response a female ownership percentage of zero because the percentage question was skipped by design. We used percentage ownership and majority female ownership only in sensitivity models. The primary variable remained the direct participation question because it matched the proposed topic and benchmark literature.

Measures

Product innovation. The dependent variable was H1, which asked whether the establishment introduced a new or significantly improved product or service during the previous three years. Yes was coded as 1 and no as 0. The variable measures innovation that is new to the establishment and may include adaptation rather than world-first invention. This interpretation is consistent with the use of firm surveys in developing economies (Cirera & Muzi, 2020).

Female ownership participation. The independent variable was b4, which asked whether any woman was among the firm's owners. Yes was coded as 1 and no as 0. The measure records participation in ownership. It does not indicate decision authority, board membership or majority control. We examined the percentage owned by women separately in the robustness analysis.

Female top manager. The moderator was b7a, which asked whether the top manager was female. Yes was coded as 1 and no as 0. The top manager is the person with primary responsibility for running the establishment—the variable measures the senior manager's gender, not the gender composition of the wider management team.

Control variables. Logged firm age and logged permanent employment controlled for maturity and size. Realised industry controlled for sectoral opportunities and gender segregation. Region controlled for broad differences in markets, infrastructure and business support. The primary specification deliberately excluded R&D because it may be a mechanism through which ownership affects innovation. A sensitivity model added R&D and manager experience to show whether the focal pattern depended on their exclusion.

Statistical Analysis

We first calculated weighted descriptive statistics for innovation, ownership, management, firm characteristics, sector, and region. We then compared innovation rates across four groups: no female owner with a male manager, female ownership with a male manager, no female owner with a female manager, and female ownership with a female manager.

We used binary logistic regression because we coded product innovation as 0 or 1. Model 1 included controls. Model 2 added female ownership. Model 3 added female top management. Model 4 added the female-ownership-by-female-manager interaction. We reported heteroskedasticity-consistent HC1 standard errors (White, 1980). Odds ratios and 95% confidence intervals were used for interpretation.

Interaction coefficients in logistic regression do not equal interactions in predicted probabilities (Ai & Norton, 2003). We therefore calculated average predicted probabilities for the four gender combinations, averaging over observed controls. We generated confidence intervals from five thousand draws from the coefficient covariance matrix. We also reported conditional ownership and management contrasts and a probability-scale difference-in-differences.

Robustness tests used weak-eligibility weighting, an unweighted model, six realised sectors, female ownership percentage, majority female ownership, market-new product innovation, additional controls for R&D and manager experience, quadratic continuous controls, and influence exclusions. We resampled firms using a 1,000-replication stratified bootstrap within the World Bank sampling strata. Variance inflation factors assessed multicollinearity, while Cook's distance identified influential observations.

Ten-fold cross-validation assessed descriptive out-of-sample discrimination and calibration. These checks were not used to select a prediction tool. The model was designed for explanatory inference. All tests were two-sided, and $p < .05$ was treated as statistically significant.

Ethical and Data Management Considerations

The study used anonymised secondary establishment data under the World Bank Enterprise Surveys Data Access Protocol. No participant was contacted, and no attempt was made to identify a respondent or establishment. Results are presented only in aggregate form. The dataset was used for research purposes and was not redistributed.

RESULTS

Sample Characteristics

The analytical sample contained 673 establishments. One hundred and forty-six reported product innovation. The weighted product-innovation rate was 18.8%. 209 establishments reported female ownership participation, representing 33.9% of the weighted business population. 123 establishments reported a female top manager, corresponding to 20.5%.

The weighted mean female ownership share was 23.3% when firms without female owners were included as zero. The mean firm age was 14.11 years, the mean permanent employment was 26.33 years, and top managers had an average of 15.86 years of sector experience.

Women's participation varied by sector. Female ownership was most common in transport and storage and accommodation and food services, while female top managers were most common in accommodation and food services. Construction had no female top manager in the analytical sample and a very low product-innovation rate. These differences supported using industry-realised controls.

Table 1 Weighted Characteristics of the Analytical Sample

Characteristic	Unweighted n	Weighted % or M	Weighted SD
Product innovation, yes	146	18.8	
Female ownership participation, yes	209	33.9	
Female top manager, yes	123	20.5	
Female-owned share, per cent	673	23.31	37.25
Firm age, years	673	14.11	11.55
Permanent full-time employees	673	26.33	50.41
Top manager sector experience, years	673	15.86	9.84
Realised sector			
Manufacturing	220	15.6	
Construction	39	6.1	
Wholesale and retail	196	40.8	
Transport and storage	21	7.3	
Accommodation and food	152	17.5	
Other services	45	12.7	
Region			
Region 1	267	69.0	
Region 2	170	16.3	
Region 3	123	11.1	
Region 4	113	3.6	

Note. N = 673. Percentages and means use the World Bank median-eligibility weight. Female ownership participation means that at least one woman was among the owners.

Innovation across Ownership-Management Gender Combinations

The four groups showed a non-monotonic pattern. Firms without female owners and with male managers formed 63.3% of the weighted sample and had a weighted innovation rate of 16.8%. Female-owned firms with male managers formed 16.2% and had the highest directly observed rate, 28.5%.

Firms without female owners but with female top managers were uncommon, representing 2.8% of the weighted sample. Their weighted innovation rate was 23.4%, based on only four observed innovators. Female-owned firms with female managers formed 17.7% of the weighted sample and had an innovation rate of 16.1%. The descriptive findings therefore did not show the expected women-to-women advantage.

Table 2 Product Innovation by Female Ownership and Top-Manager Gender

Female owner	Female top manager	n	Innovation n	Unweighted innovation %	Weighted innovation %	Weighted sample %
No	No	442	92	20.8	16.8	63.3
No	Yes	22	4	18.2	23.4	2.8
Yes	No	108	29	26.9	28.5	16.2
Yes	Yes	101	21	20.8	16.1	17.7

Note. Weighted percentages use the median-eligibility survey weight. The group without female-owned establishments but with a female manager contains only 22 establishments and four product innovators.

Hierarchical Logistic Regression

Table 3 presents the hierarchical models. In Model 2, female ownership had an adjusted odds ratio of 1.24 (95% CI [0.83, 1.87]), $p = .291$. The additive association was positive but not significant. In Model 3, neither female ownership nor female management was statistically significant. Hypothesis 1 was therefore not supported as a general additive relationship.

Model 4 added the interaction and improved the deviance relative to Model 3, although the Akaike information criterion remained similar. Among firms with a male top manager, female ownership was associated with higher odds of product innovation, OR = 1.71, 95% CI [1.03, 2.83], $p = .038$. Among firms without female ownership, the female-manager coefficient was positive but uncertain, OR = 2.04, 95% CI [0.63, 6.60], $p = .234$.

The female-ownership-by-female-manager interaction was negative, OR = 0.27, 95% CI [0.07, 1.01], $p = .052$. This result did not support Hypothesis 2. The confidence interval narrowly included one, so the primary model did not provide conventional statistical evidence of a negative interaction either.

Table 3 Hierarchical Weighted Logistic Models Predicting Product Innovation

Predictor	Model 1 OR [95% CI]	Model 2 OR [95% CI]	Model 3 OR [95% CI]	Model 4 OR [95% CI]
Female ownership		1.24 [0.83, 1.87]	1.44 [0.86, 2.42]	1.71 [1.03, 2.83]*
Female top manager			0.72 [0.38, 1.37]	2.04 [0.63, 6.60]
Female ownership × female manager				0.27 [0.07, 1.01]
Logged firm age	2.16 [1.60, 2.92]***	2.13 [1.58, 2.86]***	2.11 [1.57, 2.84]***	2.15 [1.59, 2.90]***
Logged employment	1.24 [1.04, 1.48]*	1.24 [1.04, 1.48]*	1.23 [1.03, 1.47]*	1.23 [1.02, 1.47]*
AIC	623.65	624.63	625.51	623.99
Weighted AUC	0.683	0.682	0.686	0.694

Note. N = 673. Entries are adjusted odds ratios with HC1 robust 95% confidence intervals. All models include logged age, logged employment, three realised-industry groups and four regions. AIC = Akaike information criterion; AUC = area under the receiver operating characteristic curve. * $p < .05$. ** $p < .01$. *** $p < .001$.

Full Interaction Model

Table 4 Full Weighted Logistic Regression Model Predicting Product Innovation

Predictor	B	SE	Adjusted OR	95% CI	p
Female ownership	0.534	0.257	1.71	[1.03, 2.83]	.038
Female top manager	0.713	0.599	2.04	[0.63, 6.60]	.234
Female ownership × female manager	-1.319	0.679	0.27	[0.07, 1.01]	.052
Logged firm age	0.763	0.154	2.15	[1.59, 2.90]	< .001
Logged employment	0.206	0.093	1.23	[1.02, 1.47]	.028
Other sectors	-0.235	0.289	0.79	[0.45, 1.39]	.417
Wholesale and retail	-0.449	0.299	0.64	[0.35, 1.15]	.134
Region 2	-0.528	0.328	0.59	[0.31, 1.12]	.107
Region 3	-0.415	0.365	0.66	[0.32, 1.35]	.256
Region 4	0.124	0.553	1.13	[0.38, 3.34]	.823
Intercept	-1.305	0.265	0.27	[0.16, 0.46]	< .001

Note. N = 673. Manufacturing and Region 1 are reference groups. Continuous variables are centred. B = log-odds coefficient; SE = robust standard error; OR = odds ratio.

Predicted Probabilities and Conditional Relationships

Average predicted probabilities showed that female ownership was associated with an 8.3 percentage-point increase when the top manager was male, from 17.2% to 25.4%. The simulation interval was [0.3, 17.0] percentage points, $p = .042$. This conditional probability contrast supported the positive ownership relationship within male-managed firms.

When the top manager was female, female ownership was associated with a 13.1 percentage-point reduction, from 28.7% to 16.2%, but the interval was wide, [-37.5, 5.8], $p = .210$. A female manager was associated with a 12.3 percentage-point increase among firms without female owners and a 9.1 percentage-point reduction among female-owned firms. Neither simple managerial contrast was conventionally significant.

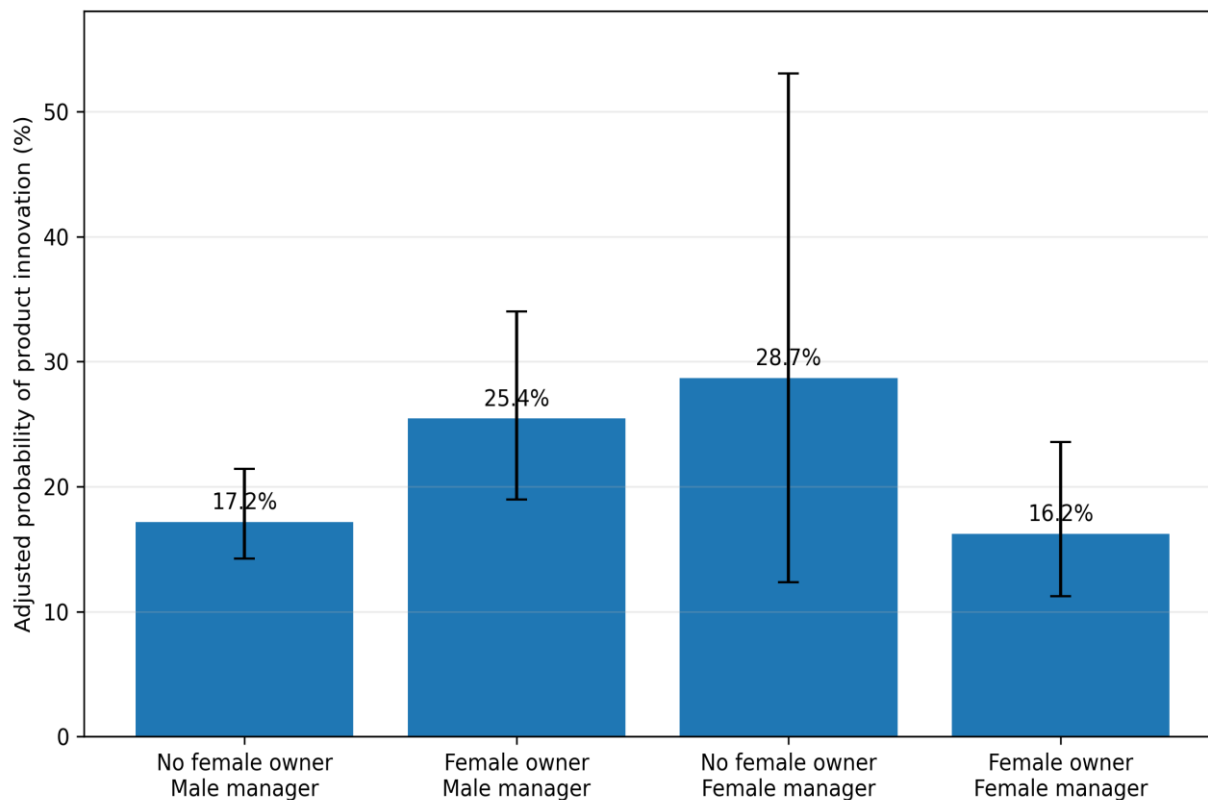
The probability-scale interaction was -21.4 percentage points, with a simulation interval from -47.0 to -0.7 percentage points. This interval excluded zero, but it was derived from the model-based covariance matrix and conflicted with the broader sensitivity evidence. We therefore report it as a model-specific pattern rather than a robust finding.

Table 5 Adjusted Product-Innovation Probabilities and Conditional Contrasts

Female owner	Female manager	Predicted innovation %	95% CI
No	No	17.2	[14.2, 21.4]
No	Yes	28.7	[12.3, 53.0]
Yes	No	25.4	[19.0, 34.0]
Yes	Yes	16.2	[11.2, 23.6]
Conditional contrast		Difference, pp	95% CI
Female ownership when top manager is male		8.3	[0.3, 17.0]
Female ownership when top manager is female		-13.1	[-37.5, 5.8]
Female manager when no female owner		12.3	[-5.8, 36.1]
Female manager when female ownership is present		-9.1	[-18.8, 0.9]
Probability-scale interaction (differen(in differences)		-21.4	[-47.0, -0.7]

Note. Predictions average over observed control variables. Confidence intervals use 5,000 coefficient simulations. The probability-scale interaction is the difference between the female-ownership contrast under female and male top managers. pp = percentage points.

Figure 1 Adjusted Probability of Product Innovation by Female Ownership and Top-Manager Gender



Note. Error bars show simulated 95% confidence intervals. The group without female ownership and with a female top manager has the widest interval because it contains only 22 establishments.

Diagnostics and Robustness Tests

Multicollinearity was manageable. Excluding the intercept, variance inflation factors ranged from 1.04 to 5.79. The largest value was for the interaction term, as expected, because it is constructed from the two gender indicators. The focal coefficients remained estimable with finite standard errors.

The weak-eligibility weight produced a positive ownership effect among male-managed firms and a negative interaction, but the interaction remained nonsignificant ($p = .080$). The unweighted model did not reproduce either relationship. A six-sector specification produced results close to the primary weighted model. Quadratic age and size controls did not materially change the conclusions.

Alternative ownership measures weakened the focal pattern. Female ownership percentage and majority female ownership were not significantly related to product innovation and did not interact significantly with top-manager gender. This finding suggests that the primary binary participation result should not be interpreted as evidence that higher female ownership shares always increase innovation.

The stricter market-new innovation outcome showed a positive female-ownership effect among male-managed firms, $OR = 2.62$, $p < .001$, but no interaction. Adding R&D engagement and manager experience reduced the female-ownership coefficient and left the interaction nonsignificant. R&D may partly explain the ownership relationship, but the cross-sectional data cannot establish mediation.

Influence analysis raised an important warning. Thirty-seven observations exceeded the heuristic $4/N$ Cook's distance threshold, and the maximum Cook's distance was .104. Removing the single most influential observation reversed the interaction sign and made it nonsignificant. Removing all observations above the threshold produced very unstable female-manager estimates. Because the observations were valid, we retained them, but we did not consider the interaction robust.

The stratified bootstrap completed all 1,000 replications. The bootstrap interval for the interaction odds ratio ranged from 0.05 to 9.52, and the two-sided bootstrap p-value was .554. The female-ownership bootstrap interval also crossed one. These results show that the apparent primary-model interaction is sensitive to sample composition and survey-weight variation.

Ten-fold cross-validation produced a weighted AUC of .585 and a Brier score of .155. The calibration slope was .365, and the intercept was negative. The model therefore had weak out-of-sample discrimination and overfitting. It should be used to understand average relationships rather than to predict whether a particular firm will innovate.

Table 6 Sensitivity of Focal Gender Relationships

Analysis	Female ownership OR	Female manager OR	Interaction OR	Interaction p
Primary median weight	1.71	2.04	0.27	.052
Weak eligibility weight	2.05	1.49	0.31	.080
Unweighted	1.41	0.84	0.89	.861
Six realised sectors	1.69	1.70	0.27	.064
Market-new product innovation	2.62	0.24	1.57	.799
Additional R&D and manager experience controls	1.40	2.17	0.40	.255
Quadratic controls	1.66	2.10	0.26	.051
Drop most influential observation	1.71	0.36	1.50	.727
Stratified bootstrap			0.51 [0.05, 9.52]	.554

Note. Primary and sensitivity entries are odds ratios. Bootstrap values are based on 1,000 within-stratum resamples. The interaction is not stable across methods.

DISCUSSION

Summary and Interpretation

This study examined female ownership participation, female top management and product innovation among formal firms in Ghana. The proposed positive women-to-women interaction was not supported. The primary weighted model instead suggested that female ownership was positively associated with innovation when the top manager was male. At the same time, the female-owner–female-manager combination had a lower predicted probability. However, this negative interaction was not stable across bootstrap, unweighted and influence analyses.

The results therefore support caution rather than a single universal gender-combination theory. Female ownership participation may matter in some governance arrangements, but the same binary label can describe very different firms. A woman may hold a small ownership share, share control with family members or own the entire firm. The female top manager may be the owner, a relative or a professional employee. The World Bank questions do not identify these relationships.

The additive models did not show a general advantage of female ownership. The significant conditional ownership coefficient appeared only after including the interaction. This means it should not be interpreted as evidence that all firms with female owners are more innovative. It applies specifically to the male-manager reference category in the primary weighted model.

The descriptive and predicted ordering resembles Machokoto et al. (2024), who reported that gender-diverse owner-manager combinations were more innovative than same-gender combinations in emerging markets. The highest observed Ghanaian innovation rate occurred among female-owned firms with male managers. The results do not match Azeem et al. (2022), whose cross-country study found a women-to-women innovation advantage.

This difference may reflect national context and how we define outcomes. Azeem et al. examined innovation breadth across selected sectors in multiple countries. The present study examined a binary product-innovation outcome across Ghana's eligible formal sectors. Ghanaian female entrepreneurs may be particularly active in marketing and organisational forms of innovation that are not captured by the product outcome (Fu et al., 2020).

The result may also reflect ownership concentration. Female-owned firms led by female managers had an average female ownership share above 90%, while female-owned firms led by male managers averaged about 44%. These are different governance structures. However, percentage and majority-ownership sensitivity models did not reproduce a clear interaction. The sample is therefore insufficient to determine whether concentration explains the pattern.

The small group of firms without female owners but with female managers also limits interpretation. Its adjusted probability was high, but the confidence interval was wide. A few observations strongly influenced the interaction. Larger national or multi-year samples are needed before strong conclusions are drawn about the four combinations.

Theoretical Implications

The findings qualify the women-to-women mechanism. Shared gender may create trust and mentoring, but it does not automatically increase product innovation. Organisational authority, resource access, and external institutions may matter more than similarity alone. Gender homophily can support communication, while gender heterophily can widen networks and knowledge. The relative value of each mechanism likely depends on context.

The study also supports a more precise use of upper-echelons theory. Top-manager gender should not be treated as a complete description of managerial cognition or leadership. The theory predicts that executive characteristics matter through experiences and interpretations. Future research should measure managerial education, technical background, risk orientation, networks and decision authority.

Resource-based explanations should also distinguish resource variety from resource control. Female participation can broaden the ownership group, but a minority owner may have little power to redirect finance toward innovation. Ownership percentage is an imperfect substitute for influence, and the Enterprise Survey does not record voting rights or board roles. Governance research needs direct measures of participation in strategic decisions.

The unstable interaction illustrates why country-level replication matters. Cross-country studies have statistical power and broad external validity, but national institutional arrangements can produce different patterns. A finding averaged across 16 or 39 emerging markets may not describe Ghana. Context-sensitive replication strengthens rather than weakens theory by identifying its boundaries.

Managerial Implications

Firms should avoid assuming that gender matching by itself will improve innovation. Owners should select and support managers based on relevant knowledge, leadership, market understanding, and the ability to build diverse teams. Gender inclusion remains important, but it should be paired with authority, resources, and professional development.

Female owners who appoint male managers should ensure that their market knowledge and strategic priorities are not lost. Clear governance meetings, innovation budgets and decision rights can help translate ownership perspectives into product-development activity. The positive conditional relationship in this study may reflect a successful combination of different networks, but the data cannot show the internal process.

Female-owned and female-managed firms should not be viewed as deficient because their average innovation probability was lower in this sample. The result may reflect sector, resource and institutional constraints or measurement limits. Managers can strengthen product innovation through R&D, customer research, supplier collaboration, employee idea systems and access to technical expertise.

All firms can benefit from gender-diverse innovation teams below the top level. Product development depends on employees, customers and partners as well as owners and managers. A single top-manager gender indicator cannot represent the range of ideas in the organisation. Firms should create processes that allow different employees to contribute safely and meaningfully.

Policy and Development Implications

Policy should support women's effective participation in ownership and management, not only their formal presence. Access to finance, property rights, procurement, technical training and professional networks can determine whether women have the resources and authority to influence innovation. Counting women owners without examining control may overstate inclusion.

Innovation programmes should recognise sectoral differences. Female ownership and management were concentrated in particular Ghanaian sectors, while product-innovation opportunities differed sharply. Support for hospitality, retail and services should include service and marketing innovation rather than focusing only on manufacturing technologies.

Mentoring programmes remain valuable, but they should not assume that only women-to-women relationships are beneficial. Both homophilic and gender-diverse mentoring can provide useful resources. Programmes can connect women entrepreneurs with female role models, male allies, technical experts, lenders and market partners. The goal should be wider and more effective networks.

Universities, business associations and development agencies can support innovation through product-testing facilities, customer research, digital design and R&D partnerships. Female-owned firms may need targeted help to convert market knowledge into scalable products. Such support should be evaluated using direct innovation outcomes rather than attendance alone.

The findings also underline the need for better gender-disaggregated business data in Ghana. Future establishment surveys should record ownership shares, decision rights, board composition, manager-owner relationships and the gender composition of innovation teams. Better measures would allow policy to distinguish symbolic inclusion from substantive influence.

Limitations and Future Research

The study is cross-sectional. It cannot establish that female ownership or female management causes innovation. Innovative firms may attract different owners and managers, while unobserved capabilities may influence both gender structure and innovation.

The ownership variable identifies whether any woman is an owner. It does not measure control, voting power, board participation or active involvement. Percentage female ownership was available but still did not show decision authority. Future studies should collect governance details.

The top-manager variable is binary and does not describe education, experience diversity, leadership style or the management team. A firm may have a female top manager but an otherwise all-male senior team. Team-level gender composition and functional expertise should be measured directly.

Product innovation is self-reported. Respondents may differ in their understanding of "new" or "significantly improved." The outcome does not measure commercial success, innovation count or radicalness. We examined a market-new outcome, but its event count was smaller, and estimates were imprecise.

The reference periods overlap imperfectly. Product innovation covered three years, while we measured ownership and management at the survey date. Ownership or management may have changed after the reported innovation. Longitudinal data are needed to establish sequence.

The group without female owners and with female managers was small. Influential observations and bootstrap instability suggest the interaction is imprecise. Pooling repeated Ghana surveys or using a carefully harmonised

multi-country design could improve power while preserving contextual analysis.

The overall survey response rate was 24.8%. World Bank weights address the sampling design and eligibility assumptions, but unobserved nonresponse bias remains possible. The weak out-of-sample calibration further shows that many determinants of innovation were not captured.

Future research should examine mechanisms. R&D engagement, external finance, employee creativity practices, digital technology, customer diversity and network breadth may connect gender structure to innovation. Qualitative case studies can show how female owners and managers interact and how they negotiate authority.

CONCLUSION

This study used the Ghana World Bank Enterprise Survey 2023 to examine female ownership, female top management and product innovation. The expected positive female-owner–female-manager interaction was not supported. Female ownership was positively associated with innovation only among male-managed firms in the primary weighted model, while the same-gender female combination had a lower predicted probability.

The interaction was not robust to bootstrap and influence tests. The responsible conclusion, therefore, is not that one gender combination is universally superior. Ownership influence, managerial capability, sector and resources matter. Ghanaian policy and management practice should promote meaningful gender inclusion while building the financial, technical and organisational capabilities required for innovation.

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APPENDIX A

Variable Coding and Reproducibility Summary

Construct	WBES variable	Coding or transformation
Product innovation	h1	1 = new or significantly improved product/service; 0 = no
Female ownership participation	b4	1 = at least one female owner; 0 = no female owner
Female top manager	b7a	1 = female; 0 = male
Female ownership percentage	b4a	0–100; skipped no-owner cases assigned zero for sensitivity
Market-new product innovation	h1 and h2	1 = product innovation also new to main market; 0 otherwise
Firm age	a14y and b5	Interview year minus start year; ln(age + 1), centred
Employment size	l1	Natural logarithm of permanent full-time employees, centred
Top-manager sector experience	b7	Years; additional-control sensitivity model
R&D engagement	h8	1 = formal R&D expenditure; 0 = no; sensitivity model
Realised industry	d1a2_v4	Three groups in primary model; six groups in sensitivity
Region	a2	Four World Bank Ghana survey regions
Primary weight	wmedian	Normalised median-eligibility weight
Alternative weight	wweak	Weak-eligibility sensitivity weight
Sampling stratum	strata	Used in 1,000-replication stratified bootstrap

Note. We treated World Bank negative response codes as missing. The analytical sample contained 673 establishments. The focal variables were direct survey measures, not proxy variables.