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Digital Technology Use, Market Scope and Expected Employment Growth among Women Entrepreneurs: Cross-Country Evidence from the Global Entrepreneurship Monitor

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ABSTRACT

Digital technologies are increasingly seen as a way to widen women entrepreneurs' market reach, yet evidence beyond digital access remains limited. Few studies examine how entrepreneurs' actual technology use relates to growth expectations and whether market scope explains this link. This study examines the association between digital technology use and expected employment growth among women entrepreneurs and tests market scope as a statistical mediator. Using 2022 Global Entrepreneurship Monitor data on 6,144 women in early-stage entrepreneurial activity across 46 economies, we estimated a linear regression with country fixed effects and country-clustered standard errors and a country-cluster bootstrap mediation model. Digital technology use was positively associated with expected employment growth ($B = 1.340$, $SE = 0.372$, $p < .001$) and market scope showed a positive indirect association ($B = 0.353$, 95% CI [0.233, 0.525], consistent with partial mediation. Significance varied across weighting specifications and the cross-sectional design precludes causal interpretation. The study contributes cross-national evidence linking technology use, market scope and growth expectations among women entrepreneurs.

1. Introduction

Digital technologies have increasingly reshaped how businesses operate, market their products and reach customers, creating new opportunities for women entrepreneurs to participate in and expand entrepreneurial activities. Digital platforms and technologies can facilitate access to information, customers and international markets, while potentially reducing some barriers associated with conventional business expansion (Pergelova et al., 2019; Hammad & El Naggar, 2023). For women entrepreneurs in particular,

digital technologies may provide alternative channels for accessing markets and resources that can support entrepreneurial activity and business development (Alhajri & Aloud, 2024; Bose et al., 2024).

However, a preliminary cross-country analysis conducted as part of this study's background investigation suggests that digital access alone may not adequately explain differences in women's entrepreneurial participation. Across 24 economies with available data for 2024, female internet usage averaged 81.2%, whereas women represented an average of 27.6% of business owners (World Bank, n.d.), with a very weak and statistically non-significant correlation between the two indicators ($r = -.089$, $p = .679$, $N = 24$). This divergence suggests that access to digital technology alone may not reliably translate into women's entrepreneurial participation.

This pattern raises an important question: if digital access alone does not adequately explain differences in women's entrepreneurial participation, what role does the actual use of digital technology play in shaping business outcomes? Rather than focusing only on access, this study examines how digital technology use may be associated with broader market access and expected business growth among women entrepreneurs. To examine this question, the present study draws on individual-level data from the Global Entrepreneurship Monitor (GEM) Adult Population Survey collected in 2022. This period provides a particularly relevant context for examining digital technology use because businesses were operating in the aftermath of substantial pandemic-related disruptions and adaptations in the use of digital technologies. Rather than treating internet access as a proxy for technology use, this study examines entrepreneurs' reported use and changes in digital technology and considers how such use relates to market access and business outcomes among women entrepreneurs.

Accordingly, this study examines the relationship between digital technology use and expected business growth among women entrepreneurs and investigates whether market access mediates this relationship. By doing so, the study contributes to the growing literature on digital entrepreneurship and women's economic participation and provides practical insights for policymakers and organizations seeking to support women-owned businesses.

2. Literature Review

2.1 Digital Technology Use and Expected Business Growth

Digital technologies can support business performance by improving marketing, communication and access to business information. However, their benefits depend on how technologies are integrated into business activities rather than on adoption alone. Research on women-owned SMEs suggests that ICT adoption does not automatically improve performance; digital literacy, business information strategies and effective utilization also matter (Omiunu, 2019; Eller et al., 2020). Other studies report positive associations between digital technology use and business outcomes among women entrepreneurs and SMEs (Anggraini et al., 2023; Feranita et al., 2023). Digital tools may also facilitate international expansion by improving access to market information and external customers (Pergelova et al., 2019). These findings support examining digital technology use as a potential correlate of expected business growth, without assuming an automatic or causal benefit.

Recent studies further highlight the importance of understanding digital technology use in relation to business practices and entrepreneurial context. Putit et al. (2025) examined the factors associated with continued social media marketing among small businesses (including micro enterprises) in emerging economies, emphasizing the role of perceived usefulness and compatibility with existing business practices. Pacho (2022) examined digital technology adoption by women entrepreneurs during the COVID-19 pandemic, while Bhagat et al. (2021) discussed digital marketing strategies adopted by women entrepreneurs and their relationship with business performance in micro and small enterprises. Together,

these studies provide additional context for examining how digital tools may relate to business outcomes, while recognizing that their effects depend on how the tools are adopted and used.

Although more than four years have passed since the onset of COVID-19, the pandemic remains relevant to this study for two reasons. First, it prompted many businesses to adopt or expand digital technologies for selling and customer engagement (Pacho, 2022) and the 2022 GEM survey captured entrepreneurs during this adjustment period. Second, the relationship examined here, between technology use and the geographic scope of the market, does not depend on the pandemic itself, although the pandemic-framed measure may reflect crisis-driven adoption and limits generalization to the present (see Limitations).

2.2 Digital Technology Use and Market Access

Digital platforms may help entrepreneurs communicate with customers and reach markets beyond their immediate geographical areas. By reducing some geographical barriers and improving access to market information, these technologies may support broader market engagement (Pergelova et al., 2019; Hammad & El Naggar, 2023). Research on women entrepreneurs in emerging economies also highlights the potential value of online platforms for business development (Bose et al., 2024). Market scope may therefore represent a relevant pathway linking digital technology use with expected business growth. In this study, market access specifically refers to the geographic scope of customers—local, national or international—rather than access to all business resources.

Kang (2022) examined women's engagement with online digital platforms, providing a complementary perspective on how entrepreneurs interact with digital environments. This platform-focused perspective supports distinguishing between the use of digital technologies and the geographic scope of the market's businesses serve. The present study therefore examines market scope as a potential statistical pathway linking digital technology use with expected employment growth.

2.3 Women Entrepreneurs and the Digital Context

Digital technology may be particularly relevant for women entrepreneurs facing resource or institutional constraints. Previous research highlights the potential of digital tools to support customer engagement, market knowledge and business development, while also showing that outcomes depend on effective technology use and the surrounding business context (Omiunu, 2019; Pergelova et al., 2019; Aracil-Jordá et al., 2023; Bose et al., 2024). Similarly, Fidelis and Adeyeye (2025) found that entrepreneurial engagement significantly strengthened rural women's economic inclusion and agency in resource-constrained settings, reinforcing the broader link between entrepreneurial activity and women's economic empowerment. Accordingly, the present study focuses on women already engaged in early-stage entrepreneurship and examines whether reported digital technology use is associated with expected employment growth and broader geographic market scope.

2.4 Research Gap

Existing research suggests that digital technologies can help women entrepreneurs access information, customers and broader markets. However, further evidence is needed on how digital technology use relates to expected business growth and whether market access helps explain this relationship. This study addresses this gap by examining the association between digital technology use and expected business growth among women entrepreneurs and testing the mediating role of market access.

2.5 Conceptual Framework

Based on the literature reviewed, this study proposes a conceptual framework (Figure 1) linking digital technology use (independent variable), market access (mediator) and expected business growth (dependent variable). Digital technology use may be associated with expected business growth directly and indirectly, by facilitating customer communication, information access, and engagement with markets beyond the entrepreneur's locality, which may broaden market access and, in turn, strengthen growth expectations.

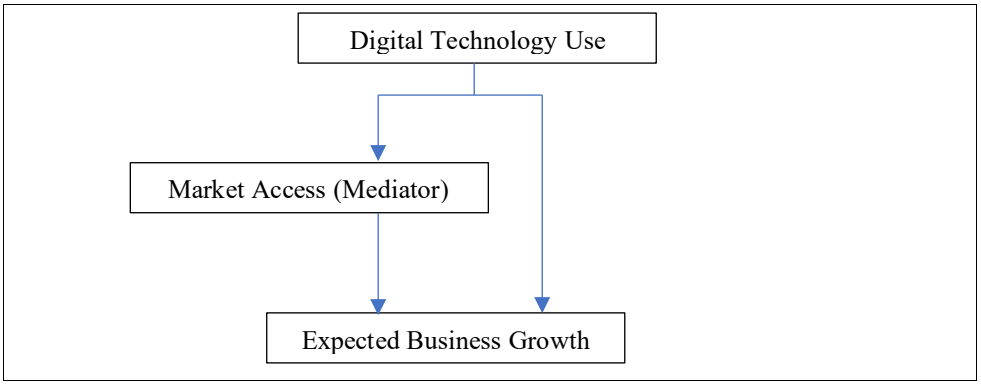


Figure 1. Proposed Conceptual Framework. The framework proposes a direct association between digital technology use and expected business growth and an indirect association through market access.

2.6 Hypothesis Development

Digital Technology Use and Expected Business Growth

Digital technology use may provide women entrepreneurs with opportunities to improve how they communicate with customers, access information, promote their products and services and reach broader markets. Previous research has highlighted the potential role of digital technologies in supporting women entrepreneurs' business activities and performance (Pergelova et al., 2019; Feranita et al., 2023; Bose et al., 2024). By facilitating access to customers and business resources, digital technology use may also strengthen entrepreneurs' expectations regarding future business expansion. Therefore, this study proposes that women entrepreneurs who use digital technologies are likely to report higher expected business growth.

H1: Digital technology use is positively associated with expected business growth among women entrepreneurs.

Market Access as a Mediating Mechanism

Digital platforms and online technologies can facilitate customer communication, information exchange and connections with geographically dispersed markets (Pergelova et al., 2019; Hammad & El Naggar, 2023). Broader market access may in turn create opportunities for expansion and strengthen expectations of future growth, suggesting that market access may be a mechanism linking digital technology use with expected business growth. Accordingly, the following hypothesis is proposed:

H2: Market access mediates the positive association between digital technology use and expected business growth among women entrepreneurs.

3. Research Method

3.1 Research Design

This study adopted a quantitative, cross-sectional research design using secondary data to examine the relationship between digital technology use and expected business growth among women entrepreneurs and to test whether market access mediates this relationship. The study relied on individual-level data from the Global Entrepreneurship Monitor (GEM) Adult Population Survey (APS). The use of an established, internationally harmonized dataset provides a large cross-national sample and standardized measures of entrepreneurial activity, enabling the study to examine the proposed relationships across different economic contexts.

A cross-sectional design was considered appropriate because the study examines associations among digital technology use, market access and expected business growth using data collected during the 2022 survey period. Because the data are observational and cross-sectional, the findings are interpreted as associations rather than causal effects.

3.2 Data Source

Data were obtained from the 2022 GEM Adult Population Survey (APS). The Global Entrepreneurship Monitor provides a standardized framework for collecting internationally comparable data on entrepreneurial activity and related individual- and business-level characteristics (Reynolds et al., 2005). The GEM APS collects standardized information on entrepreneurial attitudes, entrepreneurial activity and business characteristics among adults across participating economies.

The original dataset contained 171,768 respondents, including 85,478 female respondents. The 2022 dataset was particularly relevant to the present study because it includes specific questions concerning businesses' use of digital technologies in response to the COVID-19 pandemic, as well as expectations regarding future digital technology use

3.3 Sample

The study focused on women aged 18–64 who were involved in early-stage entrepreneurial activity, including nascent entrepreneurs and owner-managers of new businesses. The analytical sample was constructed by identifying respondents with valid information on the focal variables and the selected control variables. Cases with missing or non-substantive responses on the digital technology measure, market-scope measure, expected employment-growth outcome, age, education or household income were excluded from the primary complete-case analysis. The resulting analytical sample consisted of 6,144 women entrepreneurs across 46 economies.

The final sample should be interpreted in light of the survey's skip patterns and item nonresponse. The availability of some business-related questions depends on respondents' entrepreneurial status and their responses to preceding survey items. Consequently, the final analytical sample is smaller than the initial group of women involved in early-stage entrepreneurial activity. Because the analytical sample is based on complete cases, the findings may not generalize fully to all women entrepreneurs represented in the original survey. The potential implications of missing data are discussed in the limitations section.

3.4 Measures

Digital Technology Use

Digital technology use was operationalized using the GEM items measuring changes in businesses' use of digital technologies for selling products or services in response to the COVID-19 pandemic. Full variable definitions are provided in Appendix B (Table B1).

For nascent entrepreneurs, the relevant item was sucptech1, while the corresponding item for business owner-managers was omcrtech1. These items distinguish between businesses that adopted digital technologies, enhanced their existing digital technology plans, had already planned to use digital technologies before the pandemic and businesses that could function without digital technologies.

For the pooled sample, these responses were combined into a single indicator, digital_tech_use, coded as:

- 1 = Digital technology use
- 0 = No digital technology use
- Refused and Don't Know responses were treated as missing.

Responses indicating adoption, enhancement, or pre-existing plans to use digital technologies were classified as evidence of digital technology use, whereas respondents reporting that their business could function without digital technologies were classified as non-users.

The corresponding future-oriented item (sucptech2/omcrtech2), which asks whether the business expects to use more digital technologies during the following six months, was not combined with the current-use measure. This distinction was maintained because current technology use and future technology-use intention represent conceptually different constructs.

Market Access

Market access was operationalized using market scope, which indicates the geographic reach of a business's customer market. The harmonized measure distinguished among three substantive categories: local market only, national market and international market. These categories were coded in increasing order of geographic scope, with higher values indicating a broader market reach. Responses indicating an unknown market scope were treated as missing.

Although the study refers to this construct as market access for theoretical clarity, the observed measure specifically captures the geographic scope of the market. It does not directly measure all dimensions of market access, such as access to finance, suppliers, distribution networks, or individual customers. Accordingly, the interpretation focuses on the geographic breadth of the markets served by women entrepreneurs.

Expected Employment Growth

The dependent variable was expected net employment growth over the following five years (GEM variable TEAJOBGR). It was selected as a forward-looking indicator of growth aspirations, a recognized dimension of entrepreneurial growth; GEM uses expected job creation over a five-year horizon to characterize growth expectations and prior research links aspirations to subsequent firm growth, although the strength of this link depends on individual and contextual factors (Wiklund & Shepherd, 2003). The measure is therefore appropriate for examining whether digital technology use is associated with anticipated

employment expansion, but it should not be interpreted as realized job creation, sales growth, profitability, or overall business performance.

The raw outcome contained extreme values that could exert disproportionate influence on linear regression estimates, so it was capped at −100 and +100 for the primary analysis; negative values were retained because they represent expected employment decline. The cap was an analytical decision rather than an official GEM coding rule and alternative outcome specifications were examined as sensitivity analyses (Appendix A, Table A1).

Control Variables

The regression and mediation models controlled for several individual-level characteristics that may be associated with entrepreneurial outcomes. Age was measured using the respondent's current age in years (age). Educational attainment was measured using the GEM harmonized education variable (GEMEDUC). The original GEM categories were recoded into ordered educational levels rather than treating the original numerical codes as continuous values. Household income was measured using GEMHHINC, which categorizes respondents according to household income terciles: lowest, middle and upper third.

3.5 Data Preparation and Analysis

Data preparation and statistical analyses were conducted using Python. The original GEM SPSS dataset was inspected to identify relevant variables, value labels and non-substantive response codes. The focal variables were then recoded according to their substantive meanings. Refused, "Don't Know," unknown and other non-substantive responses were treated as missing where appropriate.

Descriptive statistics were calculated for the final analytical sample. Pearson correlations were used to describe bivariate associations among digital technology use, market scope and expected employment growth. Spearman rank-order correlations were also examined because market scope is an ordinal measure. Hypothesis 1 was examined using a multiple linear regression model in which capped expected employment growth was regressed on digital technology use, controlling for age, educational attainment and household income. Country fixed effects were included to account for differences in average outcome levels across economies and standard errors were clustered by country to allow for within-country dependence in the regression errors.

Hypothesis 2 was examined using a mediation model specifying digital technology use as the independent variable, market scope as the mediator and capped expected employment growth as the outcome. The analysis estimated the association between digital technology use and market scope (path a), the association between market scope and expected employment growth conditional on digital technology use (path b), the total association between digital technology use and the outcome (path c), the direct association after including market scope (path c′) and the indirect association (a × b). The indirect effect was assessed using a country-cluster bootstrap confidence interval. An indirect association was considered statistically distinguishable from zero when its 95% confidence interval did not include zero.

The mediation model was based on the primary unweighted specification (N = 6,144), with age, educational attainment, household income and country fixed effects as controls and standard errors clustered by country. Survey weights were used only in the weighting sensitivity analysis for H1 (Table 4) and were not applied to the mediation model reported in Table 5. The study also examined the sensitivity of the results to alternative outcome specifications and weighting procedures. The primary unweighted analysis was compared with weighted models using WEIGHT_L, both as supplied and after normalization within each country. The weighted analyses were restricted to respondents with valid, positive WEIGHT_L values. These analyses are presented as sensitivity checks rather than as evidence that any particular

weighting specification is necessarily more appropriate for the pooled cross-country estimand. The interpretation of the estimates takes into account that different weighting procedures may alter the relative contributions of countries and, consequently, the population represented by the pooled results.

As a country-level sensitivity analysis, the primary country fixed-effects specification was replaced with World Bank country income-group categories (WBINC_L). The individual-level controls and country-clustered standard errors were retained. This alternative specification was used to examine whether the estimated association differed when cross-country heterogeneity was represented by income groups rather than country-specific fixed effects (Appendix A, Table A1).

4. Findings and Discussion

4.1 Descriptive Findings

The final analytical sample comprised 6,144 women in early-stage entrepreneurial activity across 46 economies (62.2% nascent entrepreneurs; 37.8% owner-managers of new businesses; Table 1). Table 2 shows approximately two-thirds (65.5%) were classified as digital technology users, whereas nearly half (48.4%) served local markets only and 17.2% served international markets. Digital technology use and market scope are therefore related but distinct: reported technology use does not necessarily imply serving national or international markets.

Table 1. Sample Composition (N = 6,144)

Variable	Mean	SD	Min	Max
Age	37.285	11.211	18*	64*
Capped expected net employment growth	5.499	14.200	−100	100

Note. Range reflects the sample restriction to women aged 18–64.

Table 2. Categorical Variables

Variable	Category	n	%
Digital Technology Use	No	2,117	34.5%
	Yes	4,027	65.5%
Geographic market scope	Local	2,972	48.4%
	National	2,113	34.4%
	International	1,059	17.2%
Entrepreneurial stage	Nascent entrepreneur	3,821	62.2%
	Owner-manager of a new business	2,323	37.8%

Note. Expected net employment growth was capped at −100 and +100 for the primary analysis. Percentages may not sum to exactly 100 because of rounding.

4.2 Correlation Results

Pearson correlation analysis showed positive associations among the three focal variables. Digital technology use was positively associated with market scope ($r = .179$, $p < .001$) and capped expected

employment growth ($r = .061$, $p < .001$). Market scope was also positively associated with expected employment growth ($r = .112$, $p < .001$).

Spearman rank-order correlations produced a similar pattern. The correlation between digital technology use and market scope was positive ($r_s = .178$, $p < .001$). Digital technology use was also positively associated with expected employment growth ($r_s = .065$, $p < .001$), as was market scope ($r_s = .075$, $p < .001$). The coefficients were statistically significant but small, indicating modest bivariate associations that provide preliminary support for the multivariate analyses without establishing causal effects.

4.3 Hypothesis 1: Digital Technology Use and Expected Business Growth

Hypothesis 1 (H1) proposed a positive association between digital technology use and expected net employment growth. The hypothesis was tested using linear regression with country fixed effects and country-clustered standard errors, controlling for age, education and household-income tercile. The primary results are presented in Table 3.

Table 3. Primary Regression Results for Expected Net Employment Growth (H1)

Predictor	B	SE	95% Confidence Interval	p-value
Digital technology use	1.340	0.372	[0.591, 2.088]	< .001

Note. The dependent variable is expected net employment growth over five years, capped at −100 and +100. The coefficient represents an adjusted statistical association and should not be interpreted causally. Model information: N = 6,144; country fixed effects included; standard errors clustered by country; controls include age, education, and household-income tercile. Overall $R^2 = .0747$; within-country $R^2 = .0068$.

As reported in Table 3, digital technology use was positively associated with expected net employment growth ($B = 1.340$, $SE = 0.372$, $p < .001$). The 95% confidence interval did not include zero, providing statistical support for H1 under the primary model specification. The result indicates that digital technology users had a higher expected net employment-growth value, on average, after accounting for the included controls and country fixed effects. However, the finding concerns expected rather than realized employment growth and does not establish causation.

The positive association remained in several sensitivity analyses, although its statistical significance varied according to the weighting specification. Therefore, the primary unweighted result should be interpreted alongside the weighting sensitivity results discussed below.

Table 4. Weighting Sensitivity Analysis for H1

Model specification	N	B	SE	95% Confidence Interval	p-value
Unweighted, full analytical sample	6,144	1.340	0.372	[0.591, 2.088]	<.001
Unweighted, valid-weight subset	5,971	1.213	0.352	[0.505, 1.921]	.001
WEIGHT_L as supplied	5,971	0.938	0.511	[−0.092, 1.968]	.073
WEIGHT_L normalized within country	5,971	0.988	0.457	[0.068, 1.909]	.036

The weighting sensitivity analysis is presented in Table 4. The estimated association remained positive across the weighting specifications, but statistical significance varied. The supplied WEIGHT_L specification yielded a positive estimate that did not reach the conventional .05 significance level, whereas the within-country normalized weighting specification did. These differences indicate that the results should be interpreted with attention to the weighting approach. The unweighted full-sample model is retained as the primary specification, while the weighted models are treated as sensitivity analyses.

Sensitivity analyses using alternative specifications of expected employment growth are reported in Appendix A, Table A1. The estimated association remained positive when the outcome was capped at ±50 or ±20, transformed using the inverse hyperbolic sine, or operationalized as a binary indicator of positive growth or expected growth of at least six jobs. The estimate also remained positive when observations with absolute outcome values of 1,000 or more were excluded. However, the estimate using the uncapped outcome was sensitive to extreme values, indicating that the treatment of the outcome distribution affects statistical inference. These analyses support the importance of examining alternative outcome specifications rather than relying exclusively on the primary capped measure.

4.4 Hypothesis 2: The Mediating Role of Market Access

Hypothesis 2 (H2) proposed that geographic market scope would statistically mediate the association between digital technology use and expected net employment growth. The mediation analysis examined the association between digital technology use and market scope (Path a), the association between market scope and expected employment growth after accounting for digital technology use (Path b), the total effect (Path c), the direct effect after accounting for market scope (Path c′) and the indirect effect (a × b), as reported in Table 5.

Table 5. Mediation Analysis of Digital Technology Use, Market Scope, and Expected Employment Growth (H2)

Path	Estimate (B)	p-value	95% CI
a: Digital Tech → Market scope	0.215	< .001	[0.150, 0.280]
b: Market Scope → Expected employment growth	1.643	< .001	[1.021, 2.264]
c: Total association: digital technology use → Expected employment growth	1.340	< .001	[0.591, 2.088]
c′: Direct association controlling for market scop	0.987	.009	[0.257, 1.717]
a × b: Indirect association through market scope	0.353	—	[0.233, 0.525]

Note. N = 6,144 women in early-stage entrepreneurial activity (TEA), aged 18–64, in 46 countries. All paths are estimated with age, education, household income and country fixed effects. The model is unweighted. Standard errors are clustered by country; p-values and confidence intervals for paths a, b, c, and c′ use the t distribution with 45 degrees of freedom. The confidence interval for the indirect association (a × b) is a country-cluster percentile bootstrap interval (20,000 resamples) and excludes zero. Market scope accounts for about 26% of the total association (a × b / c). The analysis assesses statistical mediation in cross-sectional observational data and does not establish a causal mechanism.

The indirect association through market scope was positive (B = 0.353) and its 95% bootstrap confidence interval [0.233, 0.525] did not include zero. This provides statistical support for an indirect association through geographic market scope. The direct association also remained positive and statistically significant after accounting for market scope (B = 0.987, p = .009). Taken together, these findings are consistent with partial statistical mediation and provide support for H2 as a statistical hypothesis. However, the cross-sectional design does not establish temporal ordering or causality.

4.5 Discussion

The findings support a positive association between digital technology use and expected employment growth in the primary model and a positive indirect association through market scope. However, sensitivity to weighting specifications and the cross-sectional design require cautious interpretation.

First, digital technology use was positively associated with capped expected employment growth (B = 1.340, 95% CI [0.591, 2.088]), consistent with the argument that digital technologies may support entrepreneurial activity by facilitating customer communication, promotion and access to information. Because the outcome reflects growth expectations rather than realized performance, the association should not be read as evidence that technology use produces additional jobs.

Second, market scope statistically accounted for part of this association: technology use was positively associated with broader market scope, which in turn was positively associated with expected growth (indirect B = 0.353, bootstrap CI excluding zero), while the direct association remained significant after-market scope was included. This pattern is consistent with partial statistical mediation and with research emphasizing market-related mechanisms in digital entrepreneurship and the internationalization of women-led businesses (Pergelova et al., 2019; Bose et al., 2024). However, the measure captures geographic scope rather than all dimensions of market access, so it cannot identify which specific digital activities or market-development processes account for the association.

Third, statistical significance of the primary association depended on the weighting specification (Table 3): the estimate stayed positive throughout but was not significant with WEIGHT_L as supplied. The primary finding should therefore not be presented as fully robust to all weighting choices and the appropriate weighting approach depends on the intended estimand and the GEM survey design.

The model's overall R^2 was .0747, whereas its within-country R^2 was .0068, indicating that technology use and the controls explain only a limited share of within-country variation in growth expectations. Moreover, the coefficient (B = 1.340) equals about 0.09 SD of the outcome (1.340/14.200), a small practical magnitude. Other factors, such as business characteristics, sector, entrepreneurial experience, access to finance, and competitive conditions, may account for much of the remaining variation.

5. Conclusion

This study examined the association between digital technology use and expected employment growth among 6,144 women in early-stage entrepreneurial activity across 46 economies using GEM 2022 data. In the primary model, digital technology use was positively associated with capped expected net employment growth. The positive indirect association through market scope, together with the significant direct association, was consistent with partial statistical mediation.

However, the significance of the primary association varied across weighting specifications, the outcome reflects expected rather than realized growth and the cross-sectional design precludes causal conclusions. The study contributes cross-national evidence on how digital technology use, market scope and growth

expectations are related among women entrepreneurs and underscores the need to distinguish statistical mediation from causal mechanisms and to test the sensitivity of results to analytical decisions.

5.1 Theoretical Contribution

This study contributes to research on digital entrepreneurship and women's economic participation in three ways. First, it examines reported digital technology use at the entrepreneur and business level rather than relying solely on broad indicators of internet access. Second, it evaluates geographic market scope as a potential statistical pathway linking digital technology use with expected employment growth. The positive indirect association is consistent with the proposition that the geographic reach of a business may help explain part of the relationship between technology use and growth expectations. Third, the study highlights the importance of interpreting cross-sectional mediation results cautiously and of testing whether the principal findings are sensitive to weighting decisions. These contributions provide a basis for further research using longitudinal data and more detailed measures of digital technology use and market development.

5.2 Practical Implications

The findings may have implications for policymakers and organizations supporting women entrepreneurs. Digital skills and technology support programs could extend beyond basic access and consider how entrepreneurs use digital tools to communicate with customers, promote products and services and explore national or international markets. Training in digital marketing, e-commerce and online customer engagement may be useful areas for business-support initiatives to examine.

At the same time, the results do not establish that technology adoption or market expansion will necessarily cause employment growth. Support programs should therefore avoid treating digital technology as a standalone solution and should consider other constraints that may affect business development, including access to finance, management skills, infrastructure and market conditions. Future evaluations of such programs could use longitudinal or experimental designs to assess whether specific forms of support lead to measurable improvements in business outcomes.

5.3 Limitations

First, digital technology use was measured using a GEM item framed around businesses' use of digital technologies for selling products or services in the context of the COVID-19 pandemic. The resulting binary indicator does not measure the intensity, breadth, or sophistication of digital technology use and should not be interpreted as a comprehensive measure of digital maturity or digital transformation. Because the item is pandemic-framed, it may capture crisis-driven or temporary adoption rather than sustained integration, which may skew inferences about long-term digital adoption.

Second, market access was operationalized using geographic market scope, distinguishing local, national and international markets. This measure captures the geographic reach of the business's market but does not directly assess access to finance, suppliers, distribution networks, or other dimensions of market access.

Third, the outcome was expected, not realized, net employment growth over five years, capped at −100 and +100 to limit the influence of extreme values; the primary coefficient therefore depends on this outcome definition (Appendix A, Table A1).

Fourth, the primary complete-case sample may differ systematically from respondents excluded because of missing analytical variables. In the available comparison, women with a valid outcome who were excluded from the final analytical sample had a lower mean capped expected-growth value than those

retained in the analytical sample (3.914 compared with 5.499). The prevalence of any expected growth was also lower among the excluded respondents (0.490 compared with 0.678). This difference indicates that complete-case selection may limit the generalizability of the findings. The analysis does not establish that missingness is random.

Fifth, the significance of the primary association varied across weighting specifications (not significant with WEIGHT_L as supplied; significant when normalized within country), so conclusions about the strength of evidence for H1 should be made cautiously; the appropriate weighting depends on the target estimand and survey design. Finally, the cross-sectional design limits causal inference: reverse direction and unmeasured confounding cannot be ruled out and the mediation analysis does not establish temporal ordering.

5.4 Directions for Future Research

Future research could use longitudinal or panel data to examine whether changes in digital technology use precede changes in market scope and employment growth. Studies could also employ more comprehensive measures of digital technology use that distinguish between types of digital tools, frequency of use and the extent to which technologies are integrated into business operations.

Further work could examine additional pathways, including digital financial management, operational efficiency, customer relationship management and access to business networks. Research using alternative missing-data strategies and survey-design-appropriate weighting procedures could also assess the robustness and generalizability of cross-country findings. Finally, qualitative research could provide additional insight into how women entrepreneurs use digital technologies to navigate market opportunities and constraints across different economic and institutional contexts.

Data Availability Statement

The data used in this study were obtained from the Global Entrepreneurship Monitor (GEM) Adult Population Survey, 2022 wave. Access to GEM microdata is subject to the data access and terms-of-use conditions established by the GEM Consortium. The analysis was conducted using the relevant GEM microdata and author-developed data-cleaning and analysis procedures.

Funding Information

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Ethics Approval

Ethics approval was not applicable to this study because the research used secondary, anonymized survey data and did not involve direct interaction with human participants by the researchers.

Conflict of Interest

The author declares that there is no conflict of interest.

Author Contributions

Malak Saad: Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Resources, Data Curation, Writing – Original Draft, Writing – Review & Editing, Visualization, Project Administration and Funding Acquisition.

Disclosure of AI Use

Generative AI tools (Claude, Anthropic; ChatGPT, OpenAI) were used to support code development, statistical analysis and language editing. The author reviewed and verified all outputs and takes full responsibility for the content of the manuscript.

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Appendix A

Supplementary Sensitivity Analyses

Table A1. Sensitivity of the Association Between Digital Technology Use and Expected Employment Growth to Alternative Specifications

Specification	N	B	SE	95% CI	p-value
Primary: outcome capped at ±100	6,144	1.340	0.372	[0.591, 2.088]	< .001
Outcome capped at ±50	6,144	1.119	0.239	[0.639, 1.600]	< .001
Outcome capped at ±20	6,144	0.794	0.161	[0.469, 1.119]	< .001
Inverse hyperbolic sine, uncapped outcome	6,144	0.181	0.041	[0.098, 0.264]	< .001
Inverse hyperbolic sine, capped outcome	6,144	0.172	0.041	[0.089, 0.254]	< .001
Binary: any positive expected growth (LPM)	6,144	0.0331	0.0142	[0.005, 0.062]	.024
Binary: expected growth of at least six jobs (LPM)	6,144	0.0483	0.0147	[0.019, 0.078]	.002
Excluding observations with $\|Y\| \geq 1{,}000$, uncapped outcome	6,120	1.453	0.640	[0.164, 2.742]	.028
Uncapped outcome, retaining extreme values	6,144	284.4	475.8	[−673.9, 1,242.7]	.553
World Bank income groups (WBINC_L) instead of country fixed effects	6,144	1.372	0.370	[0.627, 2.118]	< .001

Note. N = 6,144 unless stated. All models include age, education, household income and country fixed effects (except the income-group row); standard errors are clustered by country (46 clusters), with p-values and 95% CIs from t(45). Coefficients are in expected jobs, except asinh (approximate log-point differences) and LPM (probability; ×100 = percentage points). The ±100 cap is an analytic choice, not a GEM rule; the uncapped estimate is dominated by four values near 1,000,000.

Variable Definitions

Table B1. GEM Variables Used in the Analysis

Concept	GEM variable	Description and coding
Digital Technology Use	TEACPTECH1	COVID-context item on the use of digital technologies for selling products or services (combined from sucptech1 and omcrtech1). Coded 1 = adopted, enhanced, or had already planned to use digital technologies; 0 = business could function without them.
Market scope	TEAyyMKSC	Geographic scope of the customer market: 1 = local, 2 = national, 3 = international; code 4 (scope not known) treated as missing (yy = survey year).
Expected employment growth	TEAJOBGR	Expected net change in employment over the next five years, measured in jobs. Capped at −100 and +100 for the primary analysis; valid negative values were retained.
Age	age	Respondent's age in years; the analytical sample was restricted to ages 18–64.
Educational attainment	GEMEDUC	GEM education variable, recoded into ordered education levels for analysis.
Household income	GEMHHINC	Household-income variable recoded into three ordered terciles: lowest, middle, and highest.
Survey weight	WEIGHT_L	GEM weight for the population aged 18–64, adjusted to census data. Used in the weighting sensitivity analysis.
Country income group	WBINC_L	World Bank country income-group classification, used in the alternative specification instead of country fixed effects.

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