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Factors Influencing Women's Participation in the ICT Sector of Kazakhstan: Barriers and Drivers

Peter Karacsony[1]*

[1] Obuda University, Budapest, Hungary

Corresponding author:
*Peter Karacsony – PhD, Professor, Obuda University, Budapest, Hungary. Email: karacsony.peter@uni-obuda.hu

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ABSTRACT

The participation of women in the information and communication technology (hereinafter – ICT) sector remains one of the key challenges for the digital transformation and inclusive economic development of Kazakhstan. The purpose of this study is to identify the structural, institutional and innovative factors influencing the involvement of women in entrepreneurship and management in the field of ICT. The methodological framework is based on quantitative analysis and binary logistic regression. Empirical data from the World Bank's Enterprise Survey (2024) were used, which included 1,013 companies, of which 26.9% were female-owned (≥50% female ownership or presence of a female top manager). Descriptive statistics show that most women are involved in small- and medium-sized businesses: the average company size with a female manager is 53 people versus 100 or more male employees. The econometric assessment revealed that the size of the firm is the most significant factor: an increase in the number of employees per person reduces the likelihood of female participation by 0.05 percentage points ($\beta = -0.0026$; $p < 0.01$). The remaining variables demonstrated statistically insignificant but significant negative effects. connections, which indicates the presence of hidden structural obstacles. The results confirm that the key barriers remain limited access to financial resources, weak scaling opportunities for women's businesses, and the structural concentration of women in smaller and younger ICT companies. Strengthening women's participation requires targeted support measures, including loan guarantees, scaling programs, and institutional mechanisms for the development of a gender-sensitive digital ecosystem.

KEYWORDS: Economy, Gender Economics, Women, Technological Entrepreneurship, Women's Entrepreneurship, Business Leadership, Labor Market

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1. INTRODUCTION

The information and communication technology (hereinafter – ICT) sector has become one of the most dynamic engines of economic growth and social transformation in the 21st century. However, despite its expanding role in shaping global competitiveness and innovation, gender disparities persist within ICT employment, leadership, and entrepreneurship. Women continue to represent a significantly smaller proportion of the ICT workforce, occupying fewer technical, managerial, and decision-making positions than men. This underrepresentation undermines not only principles of equity and social inclusion but also the innovative and productive potential of the digital economy. Research consistently indicates that diversity within ICT teams enhances creativity, problem-solving capacity, and organisational resilience, making women's participation both an ethical and economic imperative (Ahuja, 2002; Trauth et al., 2008; Kovaleva et al., 2023).

Gender gaps in ICT stem from a combination of social, cultural, institutional, and economic barriers. In many societies, technology-related fields are still perceived as male domains, reinforcing gender stereotypes that discourage women from pursuing ICT education or careers. These perceptions are often compounded by social expectations surrounding family responsibilities and work-life balance, which disproportionately affect women's career trajectories (Trauth et al., 2008; Ramseook-Munhurrun et al., 2023). At the organisational level, male-dominated cultures, limited mentorship opportunities, and opaque promotion practices reduce women's access to leadership roles, while at the structural level, unequal access to finance and digital infrastructure continues to constrain female entrepreneurship in the ICT sector (Sekoaila & Adebesin, 2016; Naseviciute & Jucevičienė, 2023).

The challenge is particularly relevant for developing and transition economies such as Kazakhstan, where rapid digitalisation is reshaping labour markets, innovation systems, and business models. National strategies emphasise inclusive digital transformation and the creation of high-value ICT employment. However, empirical data reveal that women remain underrepresented in technological professions, research, and entrepreneurship. Understanding the determinants of women's participation in Kazakhstan's ICT sector is therefore critical for formulating effective gender-responsive policies that align with sustainable development and human-capital goals.

Drawing on international and regional evidence, this study investigates the factors influencing women's participation in Kazakhstan's ICT sector, with a specific focus on organisational, social, and individual determinants. The research combines descriptive statistics and econometric modelling using firm-level data from the World Bank Enterprise Survey (2024) to analyse how firm size, age, financial accessibility, innovation activity, and institutional obstacles affect women's ownership and leadership in ICT enterprises. By situating the empirical findings within the broader literature on gender and technology, the paper aims to contribute to both academic debate and policy formulation concerning gender equality, digital transformation, and inclusive growth.

In doing so, this research addresses three key objectives:

(1) to assess the current level of women's ownership and leadership participation in ICT enterprises in Kazakhstan;
(2) to identify the primary structural, cultural, and institutional barriers affecting female representation in the sector; and
(3) to propose evidence-based recommendations for promoting gender inclusiveness in the digital economy through education, innovation, and policy reform.

Ultimately, the study seeks to demonstrate that enhancing women's participation in ICT is not solely a matter of social justice but a

strategic prerequisite for fostering innovation, competitiveness, and sustainable digital development in Kazakhstan and beyond.

2. LITERATURE REVIEW

The involvement of women in the information and communication technology (ICT) industry has been a research area for more than two decades. During this time, a transformation in research — from structural issues to recent studies employing concepts of intersectionality, psychological perspectives, global ICT transformation, and constraints of entrepreneurial environments, to name a few has taken place. This study proposes to highlight the transformation of research from/to more informed scholarship on gender inequality in ICT, as reflected in studies published between 2002 and 2025.

The first foundational study in this timeline is Ahuja's (2002) seminal review, which laid the groundwork for future research by highlighting the intrinsic nature of gender inequality in ICT as a profession for women. According to Ahuja, women's low representation in ICT is neither a result of individual choice nor an issue of employees' needs, but a result of structured, social, and work-related impediments to opportunities; workplace masculinity, lack of access to networks, impediments to opportunities in which careers flourish, as well as work-family conflicts.

The mid-2000s also brought greater emphasis on the multicultural, relational aspects of ICT careers, though these perspectives are subject to change over time. For instance, Trauth et al. (2008) studied ICT career choice for women in relation to a multicultural framework, which showed that people's cultures, as well as social expectations, shape women's ICT-related choices in different ways, as gender inequalities cannot be recognised from a social systems perspective because inequalities pertain to more than gender in itself.

Subsequent research by Trauth et al. (2009) further examined an organisation's analysis to examine the relationship between gendered work environments and women's retention in ICT. A set of determinants, such as mentoring programs, attitudes toward discrimination, and work-home demands, influences women's continued involvement in ICT work, as this body of research further supports the idea that ICT work is neither gender-neutral nor free from inequalities ingrained in an organisation's culture.

Between 2010 and 2015, there was an increasing trend of interest in internal processes of organisations, pathways to leadership, as well as internal cultural influences affecting women's careers in ICT. Berghi and Scorrano (2015) investigated barriers to, as well as facilitators of, women's professional ambitions in ICT, underlining that views of ICT as a man's sector impede women's confidence in, as well as interest in, a career in ICT. The results indicated a twofold barrier: general cultural stereotypes and a lack of adequate organisation-level measures to address them.

Likewise, in exploring what hampers women's movement in the ICT industry in Nova Scotia, Fauteux (2015) has established that gender-insensitive criteria for promotion, a shortage of people for women to be mentored by, as well as an undervaluing of women's input in an organisation, limit professional advancement for women in this industry. Sekoaila and Adebesin (2016) continued to augment this body of literature examining gender-related dynamics in South Africa's ICT industry. The results of this work indicated that gender discrimination is both implicit and explicit, that women lack social power in the industry, and that they are excluded from influential decision-making networks, despite formal equality in specific sectors of ICT policy advancements in the mid-2010s.

During the late 2010s, scholarship increasingly acknowledged that gender cannot be studied in a vacuum but must be understood alongside other factors. A significant body of work during this period focused on issues of intersectional inequality, in which multiple factors such as gender, race, ethnicity, class, and Internet access interact in complex ways.

Yeganehfar et al. (2018) systematic review of gender gaps in technological policy and Internet access, for example, documented how women's inequality is maintained by disparities in educational opportunities, a lack of support for digital literacy, and blind spots in technological policymaking. Contemporaneous scholarship by Kimberly (2018) and McGee (2018) explored issues of race, ethnicity, and ICT development, finding that women from minority ethnic groups experience further disadvantage due to multiple, intersecting stereotypes, as well as a lack of opportunities for mentoring and for senior positions in ICT development.

Extending this line of investigation to cover an even wider range of countries, Efobi, Asongu, and Tchamyou further analysed in 2018 the influence of ICT development on women's economic empowerment in Sub-Saharan Africa. In this study, results indicated that ICT development is an important driver of increased women's economic involvement, but structural issues, including infrastructure, human capital, and an inadequate framework, impede this. This study broke ground by exploring in detail an even more vital structural component of ICT development for women's involvement.

Huyer et al. (2019) studied the political and cultural factors influencing women's employment in ICT-related jobs worldwide and concluded that the ICT gender gap results from the interplay among structural factors in education systems, politics, and cultural discrimination. The authors state that ICT offers opportunities for women's empowerment, but only when accompanied by political support and societal acceptance. Krchová and Höesová (2021) targeted ICT transformation indicators in CEE countries, examining the influence of national GDP rates in ICT, competitiveness in ICT, as well as science, technology, engineering, and mathematics (STEM) initiatives, affecting women's representation in ICT occupations. The authors showed a significant association between macroeconomic/institutional factors and women's involvement in the profession, suggesting a strong influence of national ICT transformation agendas on gender equality outcomes.

The authors present a cultural-historical psychological approach to this issue in Adams and Mavers (2021). The authors explored how relational tensions, learning processes, and emotional issues relate to women pursuing degrees in computer science and information technology, and explained the importance of emotional conditions, identity, and culture in influencing women's retention in ICT studies.

In this phase, the literature recognised that gender inequality in ICT is no longer merely an organisational-level or individual matter, but is situated within wider social, cultural, and economic systems. From 2022 to 2024, the literature grew in coverage, encompassing concepts of entrepreneurship, institutional hurdles, inter-industry comparisons, and psychological processes in careers.

A study by Kovaleva et al. (2023) explored women's issues in the tech entrepreneurial domain, finding that women also encounter distinct challenges, such as investor bias, financial instability, cultural intolerance, and institutional constraints. Simultaneously, another study by Ramseook-Munhurrun et al. (2023) examined issues affecting women in ICT and engineering at higher levels of organisations. The study revealed that second-generation bias, which is more of an unconscious bias within an organisation, is a hindrance to women's progress even when organisations have recognised diversity initiatives in place.

Later, Naseviciute and Juceviciene (2023) further emphasised empowerment, as well as the issue of perceived fairness in an organisation. In this study, women's motivation to run for ICT positions is greatly affected by a sense of inclusion in an organisation, confidence, and opportunities for advancement in an organisation. However, Akar et al. (2024) refocused attention by proposing a psychological model that clarifies how irrational beliefs about employment influence women's lack of decisiveness in pursuing an ICT-related vocation, as mediated

by job-related positivity and perceived employability within an organisation.

Ranasinghe et al. (2024) examined international influences shaping women's employment in the ICT sector and found that industry-based gender stereotypes, underrepresentation, and a lack of professional opportunities remain widespread worldwide. The study indicated that even global digitisation does not automatically lead to the end of gender inequality in the sector, as measures must be taken to achieve equality. Raufi et al.'s (2024) study, which focused on empowerment through mentorship, found that women's involvement in technological development is strongly promoted by strong support systems within institutions, including inclusive gender-inclusive mentorship. This study indicated that gender inequalities, which have been deep-rooted in society, could be significantly diminished by support systems in organisations.

The most recent developments in this timeline of gender inequality in ICT show that inequality in ICT persists worldwide, even amid ICT transformation, equal opportunities in ICT-related education, and increased awareness of gender issues in ICT development. According to Mannan et al. (2025), research exploring women's involvement in ICT in the Philippines found that institutional, cultural, and community-level factors limit women's participation in the sector. The study explained that women's lack of confidence, opportunities, and structural inequality in ICT development result from inequalities in educational opportunities, community views, and institutional perspectives.

3. METHODOLOGY

The research employs a quantitative empirical methodology to examine the drivers of female engagement in the ICT sector in Kazakhstan, including organisational features, innovation, and institutional constraints. The research is based on the assumption that the gender gap in the ICT sector is shaped by both individual and organisational and institutional factors. The analysis relies on a dataset from the World Bank Enterprise Survey 2024, which provides a representative sample of Kazakhstani firms and covers their management structures, innovation activities, and operating conditions, among other parameters.

The empirical data set consists of 1,013 ICT-relevant firms with valid observations on all owner, management, and innovation parameters included in the WBES dataset. Missing or discordant values marked as −9 or −8 are removed from consideration. The dependent variable, female participation, was defined as a dummy variable equal to 1 if the enterprise is at least 50% female-owned (b4a >= 50) or has a female top manager (b7a = 1), and zero otherwise. Based on this definition, around 26.9% of firms fulfil the female participation condition, which highlights the gender asymmetry characteristic of technologically intensive industries.

The independent variables are categorised into structural, innovation, and institutional, all of which are obtained from tested theory and empirical studies present in the literature. The number of full-time workers was measured by size (a6c), while age (b5) was calculated as the difference between 2024 and the company's established year. The availability of finance (k30) and the corruption obstacle (j30f) are measured on a 0-4 scale, respectively, indicating the extent to which they can obstruct a company's operations.

The innovation capacity is measured through product innovation (h1) and process innovation (h5). They show whether a company has developed a new or improved product or process in the last three years. ICT web presence (c22b), a proxy for digitisation, was measured by whether the company has an official website or web-based platform: one if yes, zero if no.

Variable standardisation was performed as per the WBES guidelines, and the results included descriptive statistics to examine patterns and identify potential outliers. The results included correlation diagnostics tests to

ensure acceptable levels of multicollinearity among the independent variables.

The research estimated a binary logistic regression model to examine the likelihood that a given company is female-owned or female-managed, based on its structural and institutional features. The functional form of the model is specified as formula (1):

$$Logit(P_i) = \beta_0 + \beta_1 \text{FirmSize}_i + \beta_2 \text{FirmAge}_i + \beta_3 \text{AccessFinance}_i + \beta_4 \text{Corruption}_i + \beta_5 \text{ProductInnovation}_i + \beta_6 \text{ProcessInnovation}_i + \beta_7 \text{ICTWeb}_i + \varepsilon_i \quad (1)$$

where:

P_i – the probability of female participation in firm i;

ε_i – the error term;

Coefficients β – the log-odds of women's participation associated with a one-unit change in each explanatory variable.

The model estimation was conducted in Stata 18. The robust standard error was employed to account for heteroscedasticity. The significance of the estimated parameters was tested via the z-statistic at 1%, 5%, and 10% significance levels. Finally, marginal effects (dy/dx) are calculated to show the change in the probability of female participation for a unit change in each independent variable, thereby facilitating a more straightforward interpretation of the findings. The fit and adequacy of the model are validated by the likelihood-ratio chi-squared statistic, pseudo-R-squared, or the log-likelihood.

The choice of the logistic regression model is due to its appropriateness as a model type when the response variable is dichotomous. It enables the measurement of the strength of influence of company size, age, financial constraints, and innovation activities as determining factors influencing women's involvement in leading and owning ICTs. The model is ideal to apply when the data are cross-sectional and the desired outcome, female involvement, is categorical. Figure 1 illustrates the average firm size (measured by the number of full-time employees) comparing establishments led by female top managers and those led by male managers.

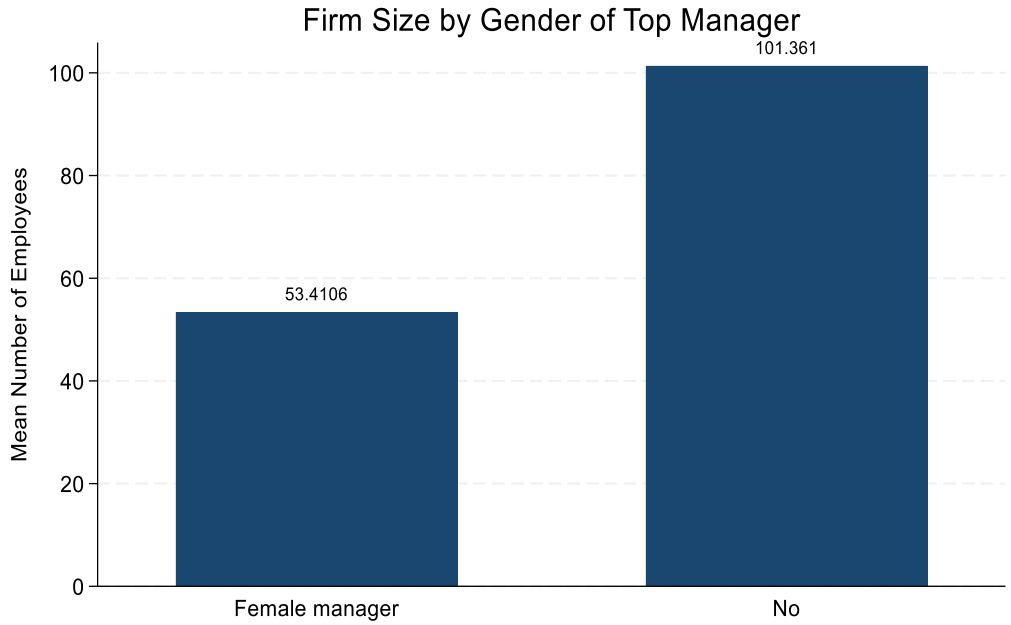

Figure 1. Firm size by gender of top manager

Firms with female managers employ, on average, approximately 53 employees, whereas firms led by male managers employ over 100 employees. The descriptive pattern indicates a substantial size differential between male-managed and female-managed establishments in Kazakhstan's business sector.

The analytical process encompassed six steps: (1) data preparation and cleaning, (2) creation of new analytic variables, (3) description and correlation analysis, (4) estimation of the logistic model, (5) calculation of marginal effects, and finally, (6) validation of results. Model building was guided by the philosophy of parsimony, which selects theoretically valid and relevant variables for inclusion in a model.

The integration of structural indicators at the company level, innovation, and institutions offers an evidence-based perspective on gender participation dynamics within the ICT sector in Kazakhstan.

The methodology developed creates a robust basis for the interpretation, as the results are explored and explained in light of gender equity, transformation, and economic development.

4. RESULTS

The descriptive analysis offers a first glimpse into gender participation and the features of firms in the ICT industry in Kazakhstan, aggregated from a dataset of 1,013 surveyed firms. The findings show that 26.9 per cent of firms are female-led or female-owned, while 73.1 per cent are male-owned or male-managed. The findings are emblematic of an existing gender disparity among ICT entrepreneurs, as seen in emerging markets, where the technology industry remains predominantly male. Nevertheless, the presence of firms with more than a quarter of their leadership being female or co-owned represents a step toward a more balanced market.

The average company hires 84 employees, suggesting that most companies are medium-sized, even though the standard deviation (203.6) is very high, ranging from 2 workers to 4,000. The average age of a company is 14.5 years, indicating that the vast majority of ICT companies are still young and growing, especially with regard to technological innovation and governance development.

The indicators of innovation activity register a moderate pace of technological innovation. The average innovation indicator values, 1.82 and 1.86, respectively representing product and process innovation, are measured on a three-point scale, indicating that almost half of all organisations achieved new or upgraded products and processes over the last three years. It should, however, be noted that innovation activities are lower than those among advanced digital economies, meaning that ICT transformation in Kazakhstan is in its nascent stage.

As regards external hindrances, a moderate level of financial and institutional barriers was apparent. The average scores of 1.50 for access to finance and 0.95 for corruption barriers, out of a scale of 0 to 4, indicate that, even if present, these are not the most serious barriers to the ICT sector. It should be noted that firms with female participation are predominantly small and face greater credit barriers, which may affect their future development and investment potential. The ICT web indicator, which indicates whether a firm has an official website or a social media account, received an average score of 1.52, indicating that cyberspace presence is a ubiquitous characteristic among firms in the ICT sector.

The descriptive statistics accurately reflect the two-tier structure of the ICT sector as a whole in Kazakhstan, comprising a small but growing number of innovative, female-headed firms and a larger body of established, male-headed firms. The following is a summary of the model variables presented in Table 1.

The involvement of females may be a characteristic predominantly found in small and medium-sized organisations, perhaps as a consequence of lower entry requirements, flexible organisational structures, and

Table 1. Descriptive statistics of key variables

Variable	Obs	Mean	Std. Dev.	Min	Max	Description
Women's participation (1=Yes)	1,013	0.27	0.44	0	1	Female ownership ≥50% or female top manager
Firm size	1,013	84.22	203.63	2	4,500	Number of full-time employees
Firm age	1,013	14.48	10.20	1	89	Years since establishment
Access to finance	1,013	1.50	1.44	–9	4	Perceived financial obstacles (0–4 scale)
Corruption obstacle	1,013	0.95	2.17	–9	4	Perceived corruption barrier (0–4 scale)
Product innovation	1,013	1.82	0.50	–9	2	Introduction of new or improved products
Process innovation	1,013	1.86	0.48	–9	2	Introduction of new processes
ICT web presence	1,013	1.52	0.50	1	2	Existence of a website or social media

Note: compiled by the authors according to calculations

emerging sectors such as internet-based services, e-commerce, and IT consulting. However, the lower innovation and greater concern expressed regarding financial constraints imply unequal gender performance in innovation potential and integration capacity.

Taking a closer look, the descriptions indicate that women's involvement in the ICT industry in Kazakhstan remains substantial but confined mainly to small, young, and less capital-intensive organisations. It is this scenario that provides a basis for moving to the next stage, an econometric analysis presented in Section 3.2.

The logistic regression model, a type of binary logistic regression, was specified to examine the influence of various company-level drivers on the involvement of women in the ICT sector in Kazakhstan, with the dependent variable measured as whether or not the company is female-owned (more than 50% female-owned or whether a female top manager heads the company). The results are represented in Table 2.

Table 2. Logistic regression results for determinants of women's participation in ICT firms.

Variable	Coefficient (β)	Std. Error	z	p > |z|	Marginal Effect (dy/dx)	Significance
Firm size	−0.0026	0.0008	−3.29	0.001	−0.00050	Significant
Firm age	−0.0069	0.0081	−0.85	0.394	−0.00133	n.s.
Access to finance	−0.0863	0.0542	−1.59	0.111	−0.01670	n.s. (marginally)
Corruption obstacle	0.0318	0.0372	0.85	0.394	0.00614	n.s.
Product innovation	−0.1237	0.1654	−0.75	0.455	−0.02392	n.s.
Process innovation	−0.0041	0.1731	−0.02	0.981	−0.00079	n.s.
ICT web presence	−0.0586	0.1515	−0.39	0.699	−0.01133	n.s.
Constant	−0.3030	0.4051	−0.75	0.454	—	—
*Model statistics: LR $\chi^2(7) = 20.49$, Prob > $\chi^2 = 0.0046$, Log Likelihood = −580.09.						

Pseudo R^2 = 0.0174, N = 1,013.

Note: compiled by the authors according to calculations

The model shows a statistically significant joint influence of the explanatory variables on the probability of female participation, proving that individual company characteristics are a collective factor influencing gender differentiation in the ICT industry ($p < 0.01$). The low value of the explained fit, or pseudo R^2, of 0.0174, nonetheless, is a characteristic indication, given that the data represent a cross-sectional observation of a rather complex socioeconomic phenomenon.

Among the various predictors, the size of the company proves to be the strongest determinant. The negative and significant result (beta = -0.0026, p-value = 0.001) reveals that large companies are less likely to be headed or owned by females. The marginal effect (dy/dx = -0.0005) reveals that an additional person reduces the female involvement rate by 0.05 percentage points. The results are consistent with the literature, which asserts that female entrepreneurship and management are predominantly seen in small and medium-scale companies, as the barriers to entry remain low, and their organisational setups remain flexible.

Other covariates are not substantial enough to achieve the significance threshold but show interesting signs. The negative sign of the access to finance covariate ($\beta = -0.086$, $p = 0.111$) indicates that financial constraints are greater among female-led firms, as hypothesised, suggesting that a lack of access to orthodox funding affects female entrepreneurship in technology sectors. The negative sign of the 'firm age' covariate ($\beta = -0.0069$, $p = 0.394$) indicates that young firms are dominated by females as managers or partners, suggesting changes in the labour market and in technology expertise among the young generation.

Interestingly, both coefficients for product and process innovation are negative but statistically insignificant, suggesting that innovation intensity is not a discriminant factor between female- and male-headed ICT firms. It could be that innovation by female ICT firms, which are often service-oriented, is embedded in their business model or customer engagement rather than in R&D expenses. The coefficient for the ICT web variable is small and statistically insignificant, suggesting that the mere adoption of internet technology does not necessarily ensure gender inclusion.

Overall, regression analysis results show that structural features of firms, namely, size and access to funding, matter much more for gender participation than operational or technological features. The following section will discuss this set of results within an institutional and policy framework, focusing on gender equity and digital economy strategies in Kazakhstan.

The regression results offer important insights into both structural and institutional drivers of women's participation in Kazakhstan's ICT sector. The influence of the significance of the model parameters, although small, shows that gender participation rates are shaped by company-specific features overall. The evidence shows that gender participation is highest in small- and medium-sized ICT firms. In contrast, large firms are still lagging far behind concerning gender inclusion rates, proving that a structural divide exists, which, among other things, is rooted in traditional gender roles exercised by women as managers, as well as their prevalence in new, less capital-intensive ICT sectors like marketing, design, or software development. The results are presented in Table 3.

Table 3. Summary of determinants and qualitative interpretation.

Determinant	Direction of Effect	Statistical Significance	Interpretation	Classification
Firm size	Negative	*p < 0.01*	Larger firms are less likely to be female-owned or led; women are concentrated in SMEs	Barrier

Firm age	Negative	n.s.	Younger firms show slightly higher female participation, possibly reflecting generational shifts.	Mild driver
Access to finance	Negative	p ≈ 0.10	Financial constraints reduce women's capacity to expand ICT enterprises	Barrier
Corruption obstacle	Positive	n.s.	Minimal impact; women-led firms may have neutral perceptions of institutional barriers	Neutral
Product innovation	Negative	n.s.	Innovation activities do not significantly differentiate female-led firms	Neutral/Barrier
Process innovation	Negative	n.s.	Technological process improvements show no gender-based differentiation	Neutral
ICT web presence	Negative	n.s.	Online visibility is widespread	Neutral

Note: compiled by the authors according to calculations

The strongest and most robust finding concerns firm size, supporting the view that structural barriers to scale are the primary hindrance faced by females in ICT entrepreneurship. The small size of female-controlled firms is attributed to their limited access to credit, venture capital, and networking, which hinder their entry into a broader, more competitive sector of the technology market. It could therefore be interpreted that gender gaps in the ICT sector are not founded solely on their innovation and skill potential. Figure 2 displays the average marginal effects derived from the logistic regression estimating the probability that a firm is female-led.

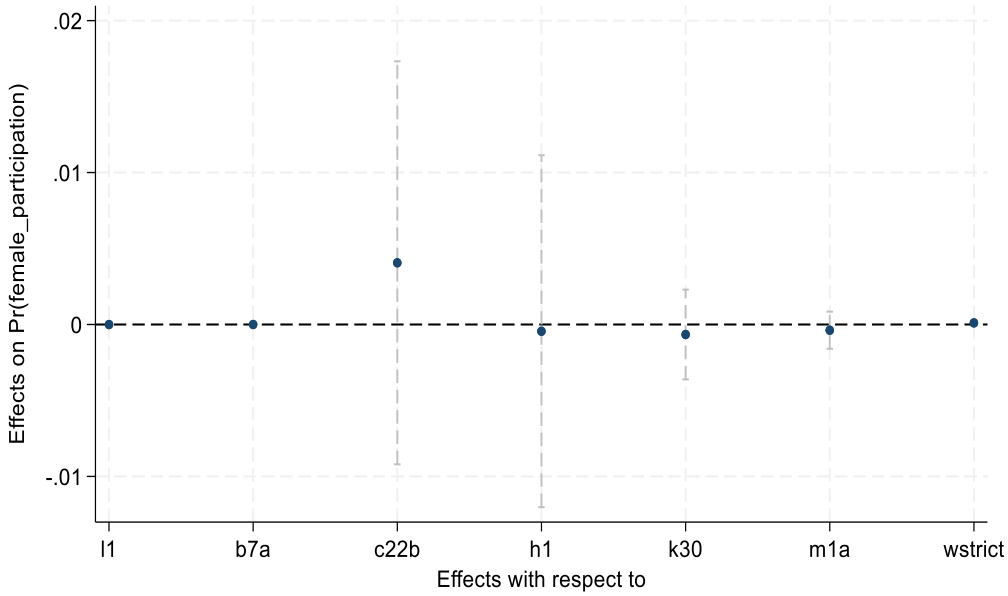

FIGURE 2. Marginal effects of regression variables on female participation

Each point represents the change in the predicted probability of female participation associated with a one-unit change in the corresponding explanatory variable, holding all other factors constant. The confidence intervals illustrate the degree of statistical precision, indicating that the included predictors exhibit relatively small and statistically insignificant marginal effects on female participation in Kazakhstan's firms.

Even if the lack of statistical significance existed for innovation and technology participation, a negative or non-positive sign indicated that female participation is not necessarily positively related to innovation and technology sophistication. It is consistent with global findings, as female participation in ICT initiatives is found to be highly vulnerable to the quality of an innovation ecosystem, including the availability of innovation inclusion programs, mentors, and technology infrastructure.

At the policy level, the conclusions point in several directions toward gender equity through the development of the Kazakhstan digital economy. Create credit lines, guarantees, and micro-financing facilities specifically targeting women-led ICT startups as a measure to reduce structural credit barriers. Include programs that mentor or train women to participate in technology-based sectors, with a focus on innovation management and scalability. Make gender-relevant criteria part of national innovation and digitisation strategies that align with ESG principles, emphasising equality, transparency, and inclusion. Enhance initiatives aimed at involving women in leadership, strengthen policies promoting gender diversity, gender inclusion and gender equality, and enhance leadership development programs designed specifically for women or targeted toward the female gender group.

The research results show that, although emerging gender diversity trends are apparent in the ICT industry in Kazakhstan, women's engagement is currently affected by company size and financial access. The development of this sector, leading to a diverse and innovative ecosystem, will depend both on technological development and institutional initiatives aimed at reducing gender-rooted barriers.

5. CONCLUSION

This study examined the determinants of women's participation in the information and communication technology (ICT) sector of Kazakhstan using firm-level data from the World Bank Enterprise Survey (2024) and insights from global empirical research. The analysis revealed that despite growing awareness and national digitalisation efforts, women's representation in ICT ownership and leadership remains limited, with only about one-quarter of firms led or co-owned by women. This underrepresentation is not an isolated phenomenon but reflects structural, institutional, and socio-cultural constraints that continue to shape gender dynamics in the labour market.

The empirical results indicate that firm size is the most significant determinant of women's participation: female-led enterprises are predominantly small and medium-sized, suggesting that scaling barriers—such as access to finance, managerial networks, and market power—restrict women's advancement into larger, more competitive segments of the ICT sector. Although other factors, including firm age, access to finance, innovation activity, and corruption obstacles, were not statistically significant, their directional effects confirm the multidimensional nature of gender disparities. Women's participation tends to be higher in younger, more innovative, and more digitally adaptive firms, suggesting that modernisation and generational change may gradually reduce gender imbalances over time.

The literature review reinforces these findings by highlighting the interplay between social expectations, cultural attitudes, organisational climates, and individual confidence in determining women's ICT careers. Gender stereotypes, lack of mentorship, and limited visibility of female role models remain significant barriers across contexts, while inclusive policies, educational empowerment, and community support emerge as enabling conditions. Comparative evidence from Africa, Europe, and Asia further demonstrates that women's participation in ICT improves when supported by digital infrastructure, gender-sensitive policies, and targeted financing mechanisms.

For Kazakhstan, these results carry important implications. Promoting gender inclusiveness in the ICT sector requires a

coordinated policy response that integrates economic incentives, educational reform, and institutional modernisation. Specifically, three strategic directions are recommended: enhancing financial inclusion and access to capital for women-led ICT startups through dedicated grant programs, credit guarantees, and venture support; embedding gender-sensitive approaches in national innovation and digitalisation strategies, including mentorship networks, flexible work arrangements, and transparent promotion systems; and strengthening ICT education and training for women and girls, particularly in rural and underserved regions, to build a sustainable talent pipeline for the digital economy.

Ultimately, the findings underscore that gender equity in ICT is not merely a social objective but a strategic driver of innovation, productivity, and sustainable growth. As Kazakhstan advances its digital transformation under initiatives, ensuring the full inclusion of women in ICT-related education, employment, and entrepreneurship will be critical for unlocking the country's human capital potential and achieving equitable participation in the global digital economy

AUTHOR CONTRIBUTION

Writing – original draft: Peter Karascony.
Conceptualization: Peter Karascony.
Formal analysis and investigation: Peter Karascony.
Funding acquisition and research administration: Peter Karascony.
Development of research methodology: Peter Karascony.
Resources: Peter Karascony.
Software and supervisions: Peter Karascony.
Data collection, analysis and interpretation: Peter Karascony.
Visualization: Peter Karascony.
Writing review and editing research: Peter Karascony.

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AUTHOR BIOGRAPHIES

***Peter Karacsony** – PhD, Professor, Obuda University, Budapest, Hungary. Email: karacsony.peter@uni-obuda.hu, ORCID ID: https://orcid.org/0000-0001-7559-0488