Digital Gender Divide and Performance of Women-led SMEs in Arab Countries

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Abstract

Despite the rapidly accelerating digitalization and improved educational outcomes, vast gender gaps in the labor market outcomes in Arab countries persist. However, research on the impact of the digital technologies on labor market outcomes and performance of women-led SMEs in the region is scarce. This paper contributes to closing this knowledge gap by linking gender, the use of digital tools and SME productivity in Egypt, Jordan and Morocco. Utilizing the recent survey data of the Economic Research Forum, we find that differences in digitalization contribute to differences in entrepreneurial outcomes in these countries. This underscores the importance of increasing women's participation in science and technology education and encouraging uptake of digital technologies, also through targeted training.

JEL classification: J4, O3

Key words: Women-led SMEs and productivity, digital gender gap, digital skills, Arab countries

1. Introduction

Policymakers in both developed and developing countries have recognized the potential of women's entrepreneurship to contribute to growth, innovation and societal well-being. At the same time, the technological advances from information and communication technologies (ICT) have been transforming the world of work, with an increasing number of firms relying on ICT in their production, marketing, and processes. This transformation has created new opportunities in the digital economy but also changes skills requirements (OECD, 2017; McKinsey Global Institute, 2016; Kollmann et. al, 2016). Digital transformation can lead to rapid, sustained growth, but only if countries invest in digital infrastructure and human capital.

According to Network Readiness Index[1] (Portulans Institute, 2022) which consists of four pillars that make up the fundamental dimensions of digitalization readiness, the MENA countries differ widely in this transformation process. Israel (15th out of 131 countries), Malta (31th) and majority of the Gulf Cooperation Council members are doing relatively well. However, Jordan (70th), Egypt (73th), Morocco (79th), Tunisia (84th) or Algeria (100th) operate at the other end of the rating scale. The pillar for the people indicates the low level of ICT skills learned in the education system and low adult literacy rate as the main problems in the sub-pillar of individuals. Low levels of GERD (gross domestic expenditures on R&D) financed by business enterprises and low levels of knowledge intensive employment present the most important issues in the sub pillar of businesses. The situation will be much worse for women as the gender gap in the use of internet places MENA countries that are not members of the Gulf Cooperation Council in the second half of the ranking.

Both topics of (i) of women's entrepreneurship and (ii) the digital gender divide have separately received wide attention among policymakers who launched measures to reduce the gender gap in digital access and skills.[2] In contrast, academic research on the digital gender divide and digital skill gaps has emerged more gradually and included works of Hargittai and Shafer, 2006; Helsper, 2010; Martínez-Cantos, 2016 and 2017, among others. Both academic and policy-oriented literature linking the digital divide with gender gaps in entrepreneurial outcomes has been particularly limited (exceptions include UNCTAD, 2014a). Moreover, the field of gender and entrepreneurship is yet to establish strong theoretical foundations; this applies also to the intersection of the digital divide, gender and entrepreneurship (Yadav and Unni, 2016; Brixiova et al., 2020). The topic of digital divide and its impact on economic outcome became even more

[1] The Network Readiness Index 2022 ranks 131 economies that collectively account for almost 95 percent of global gross domestic product (GDP). It consists of four pillars that make up the fundamental dimensions of digitalization readiness: Technology, People, Governance and Impact. Technology pillar assesses the level of technology. People pillar evaluates whether individuals and organizations have the access, resources, and skills to use technology productively. Governance pillar evaluates security in the context of the network economy, regulation and digital inclusion. Impact pillar reflects the impact of digitalization on the economic growth and societal well-being.

[2] Underscoring that globally 250 million less women than men were online in 2017, the G20 Digital Economy Ministerial Declaration (G20, 2017) placed bridging the digital gender divide and supporting the equitable participation of women and girls in the digital economy as a priority. Similarly, OECD (2018) pointed out that in 2018 around 300 mil. fewer women than men owned a smartphone.

important during and after the Covid-pandemic, which accelerated digitalization and left women not equipped with digital skills and access behind (Elam, et. al, 2022; Irene et al., 2023).

Against this background, this paper contributes to closing the gap in the academic literature and examines gender differences in ICT-based entrepreneurship through a theoretical model that links entrepreneurship to digital skills and productivity. The paper thus complements the literature that has adopted the contextual approach to gender gaps in entrepreneurial outcomes. It shows that raising entrepreneurs' digital skills and lowering women's time constraint can facilitate productive women's entrepreneurship. When potential entrepreneurs have ICT skills that are required in several high productivity sectors or ICT skills that raise the overall productivity, they are more likely to open and run highly productive firms. Further, when the value of a potential business opportunity is high, the skilled entrepreneur will raise search intensity while being also more enticed to search for opportunities in the first place.

The model captures the gender differences through several channels. First, women face greater challenges than men finding ICT-based business opportunities and turning them into firms because of their lower ICT skills, lower participation in professional networks, and often also because they have less confidence in their ICT abilities than men do (Babson College et al., 2012; European Parliament, 2018). Second, as women are underrepresented in studying math, engineering, and ICT, they tend to be less equipped than men to open technology-based firms that require some knowledge in these areas. More broadly, women often also lack ICT skills that would raise overall productivity of their firms in other sectors. Third, with bearing a larger share of family responsibilities, women face more constraints on their time. Such constraints, together with cultural barriers, discourage them from ICT-based entrepreneurship.

The model developed in this paper reflects these facts and shows that in equilibrium a higher share of men will be engaged in high productivity (ICT-based) firms. The results of the model are also consistent with several stylized facts about female entrepreneurship, such as gender differences in firm informality and utilization of ICT observed in recent (country level) World Bank Enterprise Survey aggregated data for Arab countries and the survey of over 2000 mostly small and medium-sized firms from Egypt, Jordan and Morocco, carried out by the Economic Research Forum. The paper provides several recommendations that could encourage women to enter 'non-traditional', but more productive and profitable industries and sectors.

The remainder of the paper is organized as follows. Section 2 provides a brief overview of the literature on gender gap in entrepreneurship and on the digital gender gap in MENA countries. Section 3 develops the theoretical model and derives the main results. Section 4 confronts the results with existing data from survey carried out by the Economic Research Forum for Egypt, Jordan and Morocco. Policy discussion and conclusions are in Section 5.

2. Gender gaps in SME performance and the digital divide– literature review

The literature on gender gaps in SME performance/entrepreneurship and on the digital gender gaps is by and large empirical. Various empirical studies have identified characteristics of female

entrepreneurship that distinguish it from male entrepreneurship, underscoring gender segmentation. Women tend to be concentrated in micro and small-scale enterprises as well as in basic services and other low-value added sectors while men are in larger firms and in manufacturing and other activities that tend to generate higher value added. These imbalances have implications for income, job security, and social protection (International Organization of Employers, 2008).

The empirical literature reports that in lower income countries women engage more often either in the informal sector or in the household sector activities while in higher income countries they may not enter the labor force (World Bank, 2012; Snyder, 2005). For example, Chen (2001) provides evidence that women entrepreneurs are more likely to operate in the informal sector. One of the factors that entrepreneurs take into account in decision whether to register is access credit. While credit constraint is a barrier for both men and women entrepreneurs, it is more binding for women, in part because of they own fewer assets that can be used as collateral. In turn, credit constraints and related small-scale lower firm productivity may reinforce informality.

Some studies point to unadjusted (headline) productivity gap between female- and male-led enterprises (OECD, 2017). Others have shown that, once controlled for the size of the firm, level of education, and the sector of activity, there appears to be much smaller difference in male-female productivity. For example, examining firm level data for 26 countries in Eastern and Central Europe and Central Asia while controlling for industry and country, Sabarwal and Terrell (2008) found that women entrepreneurs had smaller scales of operation, but generate similar levels of profits per revenue unit as men. Regarding drivers of the performance gap, Coleman (2007) posited that human capital, education and experience, were positively linked with profitability of women-owned firms. Guzman and Kacperczyk (2019) studied the entrepreneurial gender gap on the entire population of businesses in California and Massachusetts during 1995 – 2011. They found that the largest part of the performance gap stems from differences in the initial start-up orientation, which investors perceive as signal of growth potential. Once investors have stronger growth signals for both female-led and male-led comparable enterprises, the residual gap diminishes significantly.

Although female-owned firms create a minority everywhere (see Figure 1), their share in Middle East and North Africa (MENA) is far below the other middle-income regions of East Asia and Pacific, Latin America and the Caribbean, and Europe and Central Asia. Mainly companies with majority female ownership are very scarce, reaching only 4,3 percent of all firms (World Bank Enterprise Surveys). The World Bank´s report (Chamlou, 2008) indicates a degree of differential treatment of firms based on the gender of the principal owner in the MENA region but that the business environment is not systematically gendered. The report further identifies three factors that may explain why women are discouraged from starting a business in MENA. First, attitudes toward women and work may be less favorable to female entrepreneurship. Second, cumbersome business environments in MENA region may be more difficult for women to overcome. According to the World Bank's Doing Business Report (Doing Business, 2008), countries with more difficult business processes have smaller shares of female entrepreneurs. Third, a survey of

business lawyers (Chamlou, 2008) indicates that laws in other areas than business are gendered and can influence the implementation of business laws which are considered gender neutral.

[Figure 1]

In another stream of literature, separate from the entrepreneurship issues, the persistent digital gender divide has started to be systematically documented in various reports and empirical literature, correcting the initial lack of data in this area. Examples of this stream include Hafkin and Huyer (2007); UNCTAD (2014b); Intel (2013). This literature has shown that (i) women use ICT less than men due to both lower skills and access and (ii) when they use, they do so often for different (mostly social) purposes than men. Moreover, women entrepreneurs have less time to spend on their business or on improving their ICT skills, due to care-taking responsibilities and traditional division of labor within household (UNCTAD, 2014a).[3] As a result, in many countries, more men than women possess technological knowledge and skills needed to develop new techniques and start innovative economic activities needed for productive entrepreneurship.

Turning to the literature on the digital gender gaps in MENA region, the report by Internet Society (2017) showed the growing trend of the gender gap in Internet usage in this region that reached 20% in 2016. It was the second largest digital gender gap in 2016. According to Digital Gender Gaps Project (see Figure 2), the digital gender gap in MENA countries is lower in mobile phone than internet use. The data further shows that there are differences among MENA countries. Although two countries report no digital gender gaps at all in both measures, three countries have gender gaps in the internet use around 40 %.

[Figure 2]

In summary, the existing literature comprises mostly separate streams of empirical research, including surveys, while contributions of economic theory to the underlying causes of the gender gaps in entrepreneurship – including ICT-based entrepreneurship - have been very limited. This paper strives to close this gap with a model linking the observed gender differences in entrepreneurial outcomes with women's lower skills (both the actual digital and entrepreneurial skills and perceived ones), greater time constraints, and other obstacles (cultural barriers) that women entrepreneurs may encounter. A theoretical model along these lines is presented below.

3. The Model

The model that follows shows how that the level of skills among potential entrepreneurs combined with their responsibilities in the household sector impact their search for business

[3] Gaps in ICT usage seem to accompany pre-existing social and economic inequalities, implying that gender gaps in ICT use are likely to be larger in countries with greater overall gender inequality (Ono and Zavodny, 2005).

opportunities in the formal sector. These factors also affect the share of the formal private sector in aggregate output as well as level of unemployment and productivity.

Specifically, the search intensity of entrepreneurs working in the household drives the model results. The entrepreneurs' willingness to search for business opportunities creates firms and jobs in the formal sector. Firms' output and the output of „their workers" depends on it. Workers can't become entrepreneurs and conduct their own search; they depend on the entrepreneurs to create job opportunities. Entrepreneurs differ in their skills which translates into different search intensities consistent with different expected pay-offs from business activities and different fixed costs of search. These differences allow to introduce the gender gap in the discussion.

3.1 Economic environment

Consider a one period economy, where the population is normalized to one and consists of entrepreneurs who are endowed with one unit of time. They have the same preferences in consumption of a single good, *E(c)* where *E* denotes the expectations entrepreneurs form at the beginning of the period about the income they will receive from their activities. Furthermore, a portion p of entrepreneurs have high digital skills (to use the internet and communication technology (ICT)) and portion $1-p$ of entrepreneurs have low or no digital skills.

At the beginning of the period, all entrepreneurs are in the informal or household sector. They can decide to search for business opportunities to open firms at cost $d(x_i) = x_i^2/2\gamma$ units of consumption good, where $i\epsilon\{s,u\}$ denotes entrepreneurs who are skilled and unskilled (or less skilled) in ICT, respectively. Parameter $\gamma > 0$ denotes the search efficiency. The entrepreneurs of type i choose their search effort levels, which determine the probability of finding a business opportunity x_i. The business opportunity is of high productivity, z^h, when Internet and mobile technology is used and of low productivity, z^lotherwise. A firm of type *j*, $j\epsilon\{h,l\}$ utilizes constant returns to scale production technology $y^j = z^j n$ where z^j is the business capital and *n* number of workers employed at wage rate *w*, $w<z^j$. The firm *j* earns profit $\pi^j = z^j n - wn>0$. If the entrepreneurs do not search or search but do not find an opportunity to open firm in the formal sector, they work in the informal (household) sector earning income *b*.

Entrepreneurs who find a business opportunity are assigned to activities randomly. For the type i entrepreneur, the opportunity has high productivity z^h with probability φ_i and low productivity z^l with probability $1-\varphi_i$, where $0 < \varphi_u < \varphi_s < 1$. Put differently, entrepreneurs with high ICT skills are more likely to find an opportunity and operate highly productive firm (utilizing ICT) than entrepreneurs with low or no ICT skills.

The market clearing condition for entrepreneurs is $1= m + m_v$ where *m* is the aggregate of the number of entrepreneurs who run a firm in the formal sector and m_v are entrepreneurs who did not open firm in the formal sector and work in the household sector earning income *b*.

3.2 Entrepreneurs' optimization problem and equilibrium

The entrepreneur of type $i = s, u$, where s denotes high digital skills and u denotes low or no digital skills, solves:

$$\max E(c_i)$$

$$\text{s.t. } c_i \leq x_i\{\varphi_i \pi^h + (1-\varphi_i)\pi^l\} + (1-x_i)b - x_i^2/2\gamma \text{ and } c_i \geq 0 \quad (1)$$

According to (1), each entrepreneur i currently working in the household sector chooses whether to search for a business opportunity and how much effort to put into search. The entrepreneur searches for business opportunities in the formal sector when the payoff from such search exceeds the cost of search. Denoting $\xi_i \in \{0,1\}$ as the probability that the entrepreneur $i \epsilon \{s, u\}$ decides to search for a business opportunity, the decision to search can be described by:

$$\xi_i = \begin{cases} 1 & if \;\; x_i\{[\varphi_i \pi^h + (1-\varphi_i)\pi^l] - b\} > x_i^2/2\gamma \\ 0 & otherwise \end{cases} \quad (2)$$

When the entrepreneur i chooses search effort, x_i, the marginal cost of search equals to the expected marginal payoff, L_i:

$$\frac{x_i}{\gamma} = [\varphi_i \pi^h + (1-\varphi_i)\pi^l] - b = \pi_i^E - b = L_i \quad (3)$$

Where $\pi_i^E = \varphi_i \pi^h + (1-\varphi_i)\pi^l$ is the expected profit and L_i is the value of a random business opportunity to an entrepreneur with digital skills i. From (2) and (3) follows that an entrepreneur with skills i will choose to search for business opportunity as long as

The market clearing condition for entrepreneurs is described by:

$$1 = m^v + m = m^v + m_s + m_u \quad = m^v + m_s^h + m_s^l + m_u^h + m_u^l \quad (4)$$

where m^v is the aggregate share of the entrepreneurs who did not open firms in the formal sector and work in the household sector, m are entrepreneurs who run a firm in the formal sector. In (4), m_s are entrepreneurs with high digital skills and m_u are those with low digital skills, and m_i^j are entrepreneurs with skills i running a firm of productivity j, such that:

$$m_s \; = px_s = px_s\varphi_s + \; px_s(1-\varphi_s) = m_s^h + m_s^l \text{ and} \quad (5a)$$

$$m_u \; = (1-p)x_u = (1-p)x_u\varphi_u + (1-\; p)x_u(1-\varphi_u) = m_u^h + m_u^l \quad (5b)$$

The *equilibrium* of this economy consists of the sectoral and activity allocation of entrepreneurs with digital skills i and the probability that entrepreneurs decide to search for business opportunities such that:

(i) each entrepreneur with skills i chooses whether to search for opportunities in the formal sector, and if so, what effort to put into search; and
(ii) labor and product markets clear.

The equilibrium is described by L_i, ξ_i, m_i^j such that conditions (2) – (5) are met.

Solving the utility maximization problems of entrepreneurs and substituting from the labor market clearing conditions (5a) and (5b) yields

$$\gamma(\pi_s^E - b) = x_s = m_s/p \text{ and } \gamma(\pi_u^E - b) = x_u = m_u/(1-p) \quad (6)$$

From (6), the search intensity of an entrepreneur i, x_i, rises with the expected profit from a business opportunity π_i^E, that is with the level of φ_i and z^j as well as with the efficiency of search, γ. Equation (6) implies that the formal private sector is larger with higher expected profits π^E This is because when the value of a business opportunity is low, entrepreneurs will lower search intensity or may stop searching for opportunities altogether, i.e. ξ_i=0. The productivity of the formal private sector is higher when a larger share of entrepreneurs possesses digital skills.

3.3 The market solution and inequality

Due to their lower expected profits reflecting lower chances of finding a highly productive business opportunity, unskilled entrepreneurs put less effort into search than skilled entrepreneurs. Subsequently, they account for a smaller share of high productive firms. Specifically, denoting k_i^h be the equilibrium share of entrepreneurs with skills $i = \{s, u\}$ in their respective populations that run highly productive firms, then in equilibrium $k_s^h > k_u^h$.[4] Due to greater aptitude of skilled entrepreneurs for business opportunities requiring ICT skills, raising their pay-off to search. This higher pay-off stimulates skilled entrepreneurs to put more effort than their unskilled counterparts into search for business opportunities.

4. Empirical results and discussion

The empirical analysis below utilizes firm-level survey of 2529 mostly small and medium-sized firms in Egypt (806 firms were interviewed), Jordan (916 firms) and Morocco (807 firms), collected by the Economic Research Forum in April and August 2022. Female-led SMEs represent only 14 % of companies. These firms have lower sales of male-led firms (Figure 3).

[Figure 3]

The descriptive statistics presented in Table 1 indicate that companies with female ownership or top management exhibit lower sales and a reduced number of employees compared to firms owned or managed by males. Moreover, female-owned or managed firms demonstrate a notably lower proportion of digitally skilled managers compared to their male counterparts. Conversely, female-owned or managed enterprises display significantly higher levels of online sales and purchasing in comparison to male-led businesses.

[4] Since $\varphi_s > \varphi_u$, then $\pi_s^E > \pi_u^E$ and $x_s > x_u$. The shares of highly productive firms run by skilled and unskilled entrepreneurs are $k_s^h = m_s^{h*}/p$; *and* $k_u^h = m_u^{h*}/(1-p)$, which yields: $k_s^h = \varphi_s x_s = \varphi_s \gamma(\pi_s^E - b) > \varphi_u \gamma(\pi_u^E - b) = \varphi_u x_u = k_u^h$. From $x_s^* > x_u^*$and $\varphi_s > \varphi_u$, then $k_s^h > k_u^h$.

[Table 1]

In Table 2, we present the results of OLS regressions examining the association between companies' sales and various variables representing digital skills and the use of digital technologies in business processes. Initially, we test each digital variable in separate regressions to demonstrate its individual effect. The findings reveal a positive correlation between the sales of companies and the digital skills of managers, the presence of the firm's own website and online purchasing. Additionally, larger enterprises and those more engaged in innovation, as indicated by control variables, unsurprisingly exhibit a highly positive relationship with company sales.

We proceeded by consolidating the significant digital variables into one regression and conducting the full model analysis. The results, presented in the first column of Table 3, demonstrate that digital skills of managers, the presence of the company's own website, and online purchasing remain significant factors in relation to sales, alongside company size and innovation. Subsequently, this model underwent separate analysis for female- and male-owned/managed firms. While the results for male-owned/managed firms remained largely unchanged (except for the absence of significant online purchasing), those for female-owned/managed companies indicated a weaker correlation between digital variables and sales. In contrast to male-owned firms, digital skills (except for online purchasing alone) were not significant relative to firm performance in female-owned companies. Additionally, innovations did not exhibit significance in correlation with sales in female-owned/managed companies. Thus, the findings suggest that digital skills and technologies are more prevalently utilized in the business processes of male-owned/managed firms compared to female-owned ones.[5]

[Table 2]

[Table 3]

5. Conclusions

The model in this paper suggests that differences in digital skills and use of technology contribute to gender differences in entrepreneurial outcomes in terms of sales and innovation. In particular, the gap in digital skills may also help explain why, relative to men, women are less likely to operate high-productivity enterprises. The model also shows that due to skills gap the women entrepreneurs are more likely to end up mostly in the low productivity or household sector.

The empirical results for Egypt, Jordan and Morocco presented in our paper illustrate that in these countries female-led SMEs are minority, have lower sales than male-led companies, and their workforce and managers have lower digital skills than male-led SMEs. Regressions show that digital skills of managers are significant only for the sales of male-owned companies and

[5] In Appendix 1, we used propensity score matching to check the robustness of our results.

innovations and having own website are also more important for sale performance of male-owned companies, even though performance of female-run enterprises depends more on online sales.

The key gender differences that have been identified, women's low digital and other entrepreneurial skills as well as operating in low productivity firms, require attention from policy makers. In the following sections we make some policy recommendations.

First, skills, in particular digital skills, have been identified as a key factor in productive entrepreneurships. Second, policymakers should identify the factors that may account for high share of female entrepreneurship in the low-productivity sector.[6] Since women's lower skills are a major contributor to lower-value added, and often informal, rather than formal, entrepreneurial activity, promoting female education and skills development would help move female entrepreneurship more towards the formal sector.

Since women's entrepreneurial activities tend to interact with their housework, female entrepreneurship may have unique characteristics; and what works for male entrepreneurship may not necessarily work for female entrepreneurship. The approaches that have been trying to incentivize women in the same way as men may be ineffective for supporting women's entrepreneurship.[7] In fact, policies and policy reforms aimed at promoting entrepreneurship can sometimes have unexpected adverse effects (Iyigun and Rodrik, 2005). Hence one area of future research could focus on whether policies in Arab countries and other regions should be designed differently for female-led firms than male-led ones. Equally important would be to examine gender differences in ownership structure (family, state, international) and firm performance.

[6] Baliamoune et al; (2022) found a positive relationship between international ownership of local firms, including SMEs, and firm performance for Middle East and African countries, but they have not examined the gender gaps.
[7] Specifically, same financial incentives for men and women to participate in the entrepreneurial training may not be adequate for women to undertake it, given the higher barriers to entry associated with housework.

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Table 1. Descriptive statistics - Differences between female and male-owned companies in digital skills and using of digital technologies in business processes

	Female owner/CEO		Male owner/CEO		Mean(female) - Mean(male) (Std. Err.)	T-test of sign. of difference
	Obs (Min/Max)	Mean (Std. Err.)	Obs (Min/Max)	Mean (Std. Err.)		
Digital skills of manager	228 (0/1)	.645 (.479)	1371 (0/1)	.717 (.451)	-.072 (.033)	**
Computer usage	222 (0/100)	47.162 (39.917)	1353 (0/100)	46.403 (37.441)	.759 (2.737)	-
Digital skills of workers	228 (0/1)	.404 (.404)	1371 (0/1)	.419 (.494)	-.015 (.035)	-
Own website	338 (0/1)	.328 (.470)	2191 (0/1)	.297 (.457)	.031 (.027)	-
Online sales	338 (0/1)	.284 (.452)	2191 (0/1)	.182 (.386)	.101 (.023)	***
Online buying	228 (0/1)	.294 (.456)	1371 (0/1)	.198 (.399)	.095 (.029)	***
Innovations	338 (0/1)	.364 (.481)	2191 (0/1)	.330 (.470)	.034 (.028)	-
Firm size	338 (1/265)	10.177 (27.181)	2191 (1/1400)	16.100 (54.610)	-5.922 (3.03)	***

Source: Authors, based on the ERF data. Note: *** p<0.01, ** p<0.05, * p<0.1

Table 2. OLS regressions of companies´ sales on digital skills and using of digital technologies in business processes

VARIABLES	Digital skills of manager	Digital skills of workers	Computer usage	Own website	Online sales	Online buying
	Depvar: sales					
Digital skills of manager	0.252***					
	(0.097)					
Digital skills of workers		0.025				
		(0.091)				
Computer usage			0.002			
			(0.001)			
Own website				0.472***		
				(0.078)		
Online sales					0.138	
					(0.086)	
Online buying						0.281**
						(0.109)
Female owner/CEO	-0.195	-0.220*	-0.203	-0.190*	-0.209**	-0.238*
	(0.129)	(0.129)	(0.131)	(0.097)	(0.096)	(0.125)
Size of company	0.005***	0.005***	0.005***	0.005***	0.006***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Innovations	0.315***	0.346***	0.340***	0.295***	0.335***	0.307***
	(0.091)	(0.092)	(0.092)	(0.074)	(0.077)	(0.092)
Country dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.798***	1.965***	2.011***	1.692***	1.771***	1.953***
	(0.439)	(0.451)	(0.501)	(0.277)	(0.273)	(0.450)
Observations	790	790	776	1,246	1,246	790
Adjusted R-squared	0.119	0.111	0.114	0.171	0.144	0.120

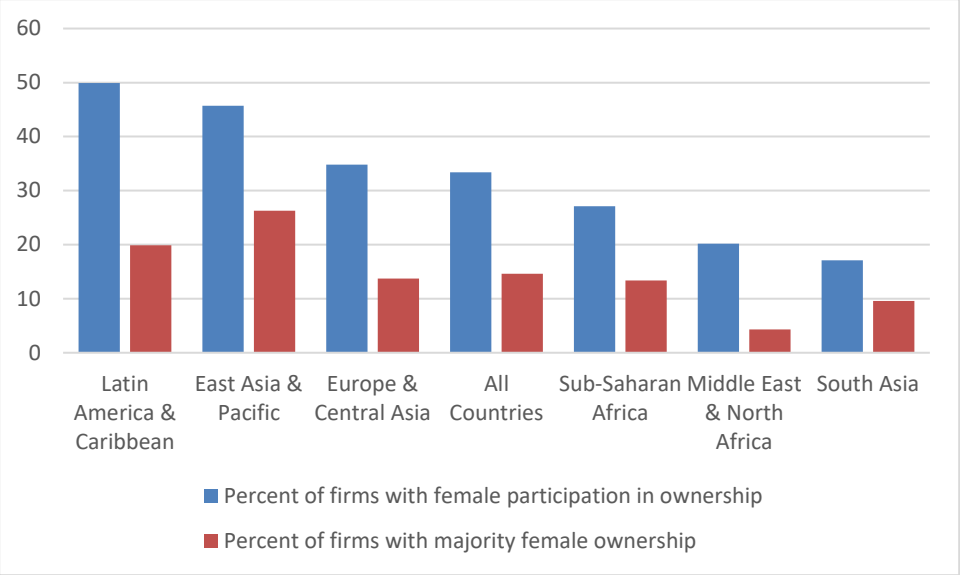
Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Source: Authors

Table 3 Different effects of digital skills and using of digital technologies on female and male-owned/managed companies

VARIABLES	Full model Depvar: sales	Male owner/CEO	Female owner/CEO
Digital skills of manager	0.194**	0.247**	-0.058
	(0.096)	(0.103)	(0.265)
Own website	0.265***	0.270***	0.318
	(0.088)	(0.095)	(0.251)
Online buying	0.235**	0.109	0.977***
	(0.112)	(0.122)	(0.310)
Female owner/CEO	-0.205*		
	(0.124)		
Size of company	0.004***	0.004***	0.014***
	(0.001)	(0.001)	(0.002)
Innovations	0.265***	0.283***	-0.152
	(0.091)	(0.098)	(0.264)
Country dummy	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Constant	1.719***	1.502***	0.895***
	(0.445)	(0.477)	(0.329)
Observations	790	692	98
Adjusted R-squared	0.135	0.122	0.316

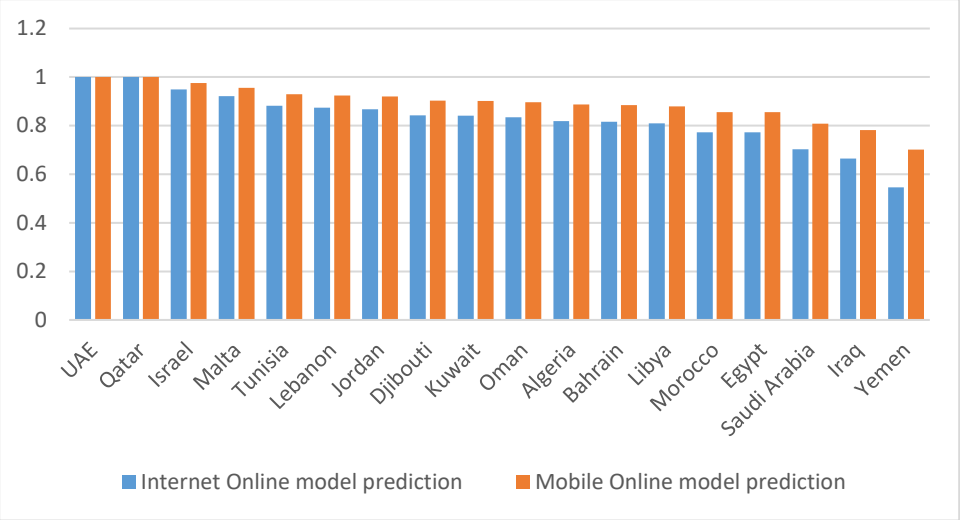
Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Source: Authors

Figure 1. Firms with female participation in ownership



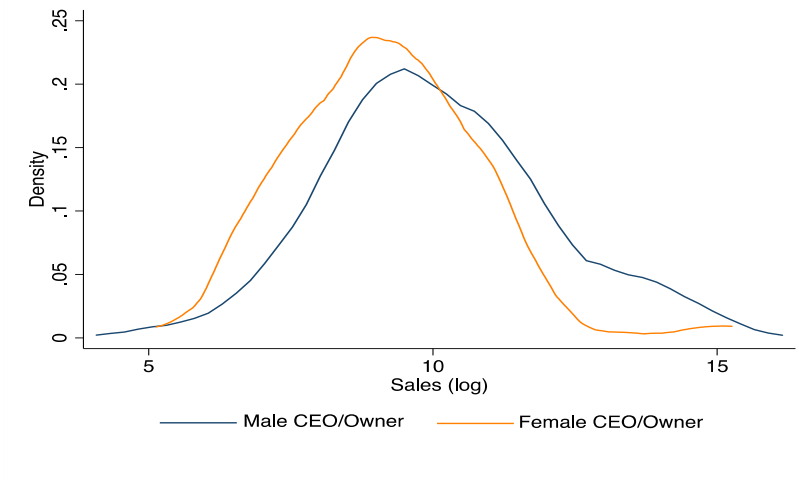
Source: World Bank Enterprise Surveys

Figure 2. Digital Gender Gap in MENA region, 8/2022



Source: Digital Gender Gaps Project

Figure 3. Kernel distribution of (log of) sales, by gender of CEO/owner



Source: Authors, based on the ERF data.

Figure legends

Figure 1. Firms with female participation in ownership, percent of firms with female participation in ownership, percent of firms with majority female ownership, according to world regions, source: World Bank Enterprise Surveys

Figure 2. Digital Gender Gap in MENA region, 8/2022, internet online model prediction, mobile online model prediction, source: Digital Gender Gaps Project

Figure 3. Kernel distribution of (log of) sales, by gender of CEO/owner, source: authors, based on the ERF data

Appendix 1.

The robustness of our results was check by using nonparametric propensity score matching method (PSM), developed by Rosenbaum and Rubin (1983). This method pairs firms with similar characteristics that differ only in a) importance of digital skills for appointing managerial staff, b) importance of digital skills for hiring employee, c) ownership of web pages, d) selling online, and e) buying online (referred to as the 'treatment') and compares the companies' sales (referred to as the 'output') between these groups. Pairing is based on the propensity score, which is the probability of being in a treatment group, to avoid dealing with many variables (2010) or Li (2013). The share of workers with a job requiring computer usage is not consider in this section, as it cannot serve as a treatment due to its non-binary nature.

It is important to note that the PSM models presented here meet a) common support condition, i.e. overlap in the distribution of propensity scores of the treated and untreated individuals (tested by histograms of the propensity score for treated and untreated individuals; not reported here), and b) balance condition, i.e., that propensity score adequately balances characteristics between treated and untreated individuals. Fulfilment of balance condition is indicated by Rubin's B and Rubin's R in Table 4, where a Rubin's B less than 25 and Rubin's R between 0.5 and 2.0 suggest sufficiently balanced samples according to Rubin (2001). Due to repeated violation of balance condition, we present results only for radius matching and kernel matching algorithms, but not for nearest neighbour matching method.

The results of propensity score matching in Table 1, Appendix 1 confirm that having own web pages and online purchasing have statistically significant positive effect on sales of these companies. These results are broadly consistent with our regression findings (Table 3) with an exception of managerial digital skills where the link is positive but not statistically significant.

Table 1, Appendix 1. Robustness check, using propensity score matching

Average treatment effect on the treated (ATT)	Radius matching r=0.001	Radius matching r=0.01	Radius matching r=0.05	Kernel matching
	(1)	(2)	(3)	(4)
Digital skills of manager	0.050	0.107	0.145	0.157
	(0.124)	(0.116)	(0.112)	(0.112)
Rubin's B < 25	18.9	16.3	18.0	14.7
Rubin's R ϵ [0.5;2]	1.03	1.14	1.11	1.14
Obs. Untreated	233	240	242	242
Obs. Treated	458	540	548	548
Obs. Off support	99	10	-	-
	(5)	(6)	(7)	(8)
Digital skills of workers	0.041	-0.041	-0.005	-0.001
	(0.109)	(0.099)	(0.096)	(0.096)

Rubin's B < 25	11.0	11.3	8.1	6.0
Rubin's R ϵ [0.5;2]	1.12	1.13	1.09	1.10
Obs. Untreated	469	469	469	469
Obs. Treated	305	318	321	321
Obs. Off support	16	3	-	-
	(9)	(10)	(11)	(12)
Own website	.381***	.446***	.449***	.449***
	(0.088)	(0.089)	(0.085)	(0.084)
Rubin's B < 25	4.7	12.9	16.2	15.4
Rubin's R ϵ [0.5;2]	1.11	1.08	1.21	1.23
Obs. Untreated	858	858	858	858
Obs. Treated	344	380	388	388
Obs. Off support	44	8	-	-
	(13)	(14)	(15)	(16)
Online sales	.0534	.119	.113	.118
	(0.101)	(0.103)	(0.097)	(0.097)
Rubin's B < 25	19.9	13.2	15.6	13.9
Rubin's R ϵ [0.5;2]	1.09	1.25	0.90	0.99
Obs. Untreated	998	998	998	998
Obs. Treated	233	248	248	248
Obs. Off support	15	3	-	-
	(17)	(18)	(19)	(20)
Online buying	.317**	.297**	.311***	.308***
	(0.125)	(0.117)	(0.115)	(0.115)
Rubin's B < 25	12.3	11.9	9.1	7.3
Rubin's R ϵ [0.5;2]	0.95	1.07	1.11	1.18
Obs. Untreated	610	610	610	610
Obs. Treated	180	180	180	180
Obs. Off support	9	-	-	-

Source: Authors, based on ERF data.