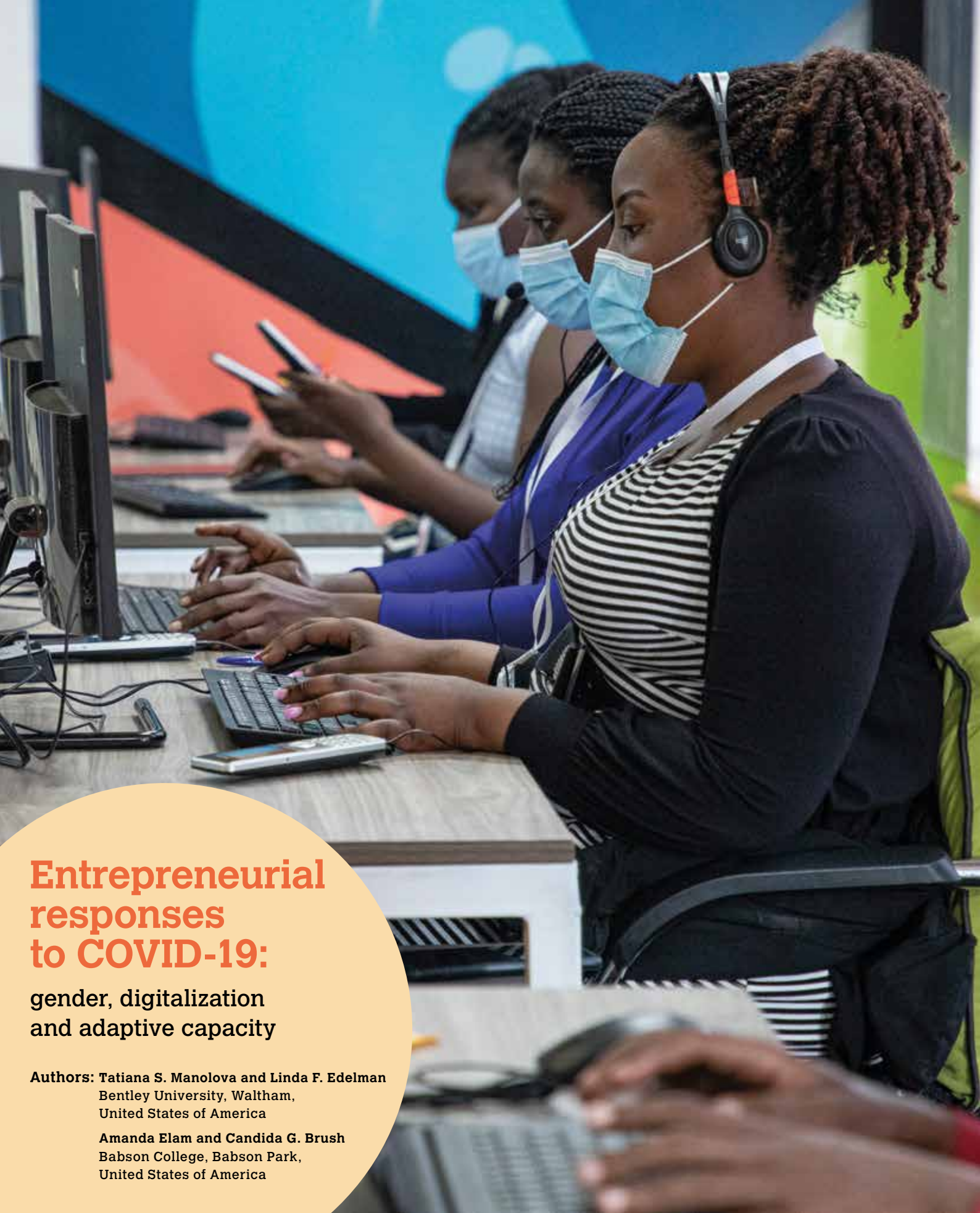

Entrepreneurial responses to COVID-19:

gender, digitalization and adaptive capacity

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Abstract

Women entrepreneurs were hit disproportionately hard by the COVID-19 pandemic, as their firms are generally younger, smaller and concentrated in industry sectors affected the most by economic shutdowns. However, very little research has addressed the ways in which women-led firms navigated these challenges. In this study, we investigate the ways in which women entrepreneurs adapted to the business repercussions of the COVID-19 pandemic. In particular, we focus on the implementation of digital tools as a viable instrument for building adaptive capacity.

Using data collected in December 2020 from 41,383 business leaders in 107 WTO members and observers, we explore two research questions: (1) What are the gendered differences in the adoption and use of digital tools for small businesses during times of market disruption? (2) Has the adoption of digital tools alleviated the pandemic impacts on women-led business (sales, employment) in different contexts of government response? We find that digitalization is an important source of adaptive capacity for all firms, but with limited potential to help women-led firms overcome the systemic inequalities, like sectoral and business size differences that put women-led firms at a significant disadvantage in the COVID-19 global pandemic crisis. Theoretical, practitioner and public policy implications are provided.

Introduction

Within months after the first known cases of COVID-19 emerged in December 2019, a global crisis arose causing lockdowns, social distancing and other protocols to contain and slow the spread of the virus. This exogenous shock caused severe economic disruptions to small businesses, causing them to quickly adopt new approaches to continue operations. From the beginning of the crisis, research findings showed disproportionate impacts on women-led businesses (Manolova *et al.*, 2020). These impacts were largely attributable to three main factors: (1) women-owned businesses are more often found in industries and markets most heavily impacted by the pandemic; (2) women-owned businesses are more likely to be new or small, hence more vulnerable to external shocks; and (3) women business owners/managers are more likely to bear the brunt of increased family demands due to childcare, school and elderly care closures.

However, relatively little research has addressed the ways in which women-led firms (firms owned/managed by women) navigated these impacts.[1] Even though it is much harder for new and small businesses, especially those run by women, to acquire resources needed

to automate, market online or access new markets, particularly international markets, the pandemic forced the need for creative solutions (Berger and Kuckertz, 2016; Khlystova *et al.*, 2022). A recent study in Europe and the United States found that the use of a high number of digital tools was associated with 80 per cent more revenue for women-led companies, compared to an average increase of 60 per cent across all firms (Connected Commerce Council, 2021). In this way, digital technology served as an important source of "adaptive capacity" for alleviating the impacts of the COVID-19 crisis on small and medium-sized enterprises (SMEs).

Focusing specifically on the gendered effects of digitalization on sales revenue growth, including through internationalization, digital technologies can have a powerful "democratizing" effect by leveling the playing field, providing access to international market knowledge, and facilitating interactions with customers and trading partners across national borders. For example, a recent study of a representative sample of 300 Bulgarian SMEs documented that female entrepreneurs leveraged the enabling effects of digital technologies more than their male counterparts in adapting to, and benefiting from, international trade opportunities (Pergelova *et al.*, 2019).

We frame our inquiry around the concept of adaptive capacity (Chakravarthy, 1982), complemented by a gender lens. Adaptive capacity is the ability of a system (or a social organization) to handle stresses and to adjust and respond to the effects caused by those stresses (Smit *et al.*, 2001). We argue that one way to build adaptive capacity is through the use of digital tools but we add a gender lens to this perspective. In sum, we argue that digitalization is a critical component of adaptive capacity for small firms under stress and a source of resilience and flexibility during a period of humanitarian crisis and extreme market disruption.

To explore the phenomenon of interest to our investigation, we ask two broad research questions, each looking at the different ways in which firms apply adaptive capacity to deal with the COVID-19 pandemic. More specifically, we ask: (1) What are the gendered differences in the adoption and use of digital tools for small businesses during times of market disruption? (2) Has the adoption of digital tools alleviated the pandemic impacts on women-led business (sales, employment) in different contexts of government response? We find that digitalization is an important source of adaptive capacity for all firms, but with limited potential to help women-led firms overcome the systemic inequalities, like sectoral and business size differences, that put women-led firms at a significant disadvantage in the COVID-19 global pandemic crisis.

Our study makes two main contributions. First, within the theoretical stream on adaptation and adaptive capacity, we explore some of the mechanisms of building adaptive capacity,

> We find that digitalization is an important source of adaptive capacity for all firms, but with limited potential to help women-led firms overcome the systemic inequalities.

namely the use of digital tools, in a unique sample of 41,383 business leaders from 107 WTO members and observers around the world, and in the context of their experiences coping with the COVID crisis. We also explore the boundary conditions on the introduction and effectiveness of these mechanisms by stratifying our sample by the degree of severity of the crisis, specifically the strength of government response (both in terms of containment measures and in business support). Second, we contribute to the growing literature on the gendered patterns of technology adoption (Jome *et al.*, 2006; Pergelova *et al.*, 2019), by exploring some of the gender-specific antecedents to and outcomes of digitalization.[2]

We proceed as follows. After a brief review of the literature, we develop our arguments on gendered response to market disruptions and the role of digital tools as important coping mechanisms under different regimes of government response. We then present our methodology, followed by the results from our statistical analysis. We conclude by discussing the theoretical, practitioner and public policy implications of our study.

Literature review

Adaptive capacity is a "dynamic process of continuous learning and adjustment that permits ambiguity and complexity" (Staber and Sydow, 2002). Organizations with adaptive capacity can reconfigure themselves quickly in changing environments, and this ability is often rooted in the information processing ability of an organization (Chakravarthy, 1982). Theory argues that organizations need to build adaptive capacity in order to be effective in hypercompetitive environments, by developing the ability to cope with unknown future circumstances, anticipate changes, and reconstruct environments "in ways that change the conditions to which they then adapt" (Staber and Sydow, 2002). This ability depends on their stocks of "organizational slack", which is an actual or potential resource allowing an organization to negotiate internal or external pressures (Cyert and March, 1963).

Market disruption and adaptive capacity

When it comes to coping with market disruption, the COVID-19 pandemic offers a unique context for which there is no documented equivalent in the entrepreneurship literature. However, we can draw on the broader stream of literature from crisis management to inform us, at least in some part, of the ways in which small businesses were impacted by the COVID crisis and how they adapted. Pearson and Clair (1998) defined a crisis as "a low probability, high-impact situation that is perceived by critical stakeholders to threaten the viability of the organization". One stream of crisis management literature explores country-level institutional change in the face of widespread crises. This work finds that as institutions change in response to a crisis, entrepreneurial ventures fare poorly (Williams and Vorley, 2015). This is particularly salient in entrepreneurial finance, where cash and credit are more readily available to larger and older firms than to smaller businesses. Specifically, micro-businesses tend to fare the worst, with medium-sized and small-sized businesses 19 and 12 per cent more likely to be offered the finance required, respectively (Cowling *et al.*, 2012).

However, in contrast to the traditional view that SMEs are subject to financial constraints during crises, Cosh *et al.* (2009) found no evidence of financial hardship. Instead, the businesses they studied suffered more from loss of customers or markets. This suggests that market-building strategies are increasingly important for firms undergoing crises. Alternatively,

previous studies show that despite the reduction in money or changes in markets during a crisis (Cowling *et al.*, 2012; Williams and Vorley, 2015), there is evidence of adaptive capacity in the form of resilience (Doern, 2017). A study of the economic crisis in Greece found that resilience considers the processes by which firms assemble and then use resources before, during and after a crisis (Williams *et al.*, 2017). In essence, it is resilience that enables organizations to respond to crisis and then to recover (Linnenluecke, 2017; Shin *et al.*, 2012; Vogus and Sutcliffe, 2007). Studies document that small businesses employ a variety of strategies to cope with crises, including cost-cutting, market building and reliance on relational capabilities (Belitski *et al.*, 2022; Block *et al.*, 2022; Radziwon *et al.*, 2022; Williams, 2017).

Women entrepreneurs and crisis response

Research suggests that men and women business leaders respond differently to external shocks. Men are more likely to continue operating and women are more likely to close their businesses (Bradshaw, 2013; Young *et al.*, 2017). This translates into the way they manage their ventures, with women exhibiting more risk aversion than their male counterparts (Gimenez-Jimenez *et al.*, 2020.) Studies also point to physiological differences between men and women, which translate into differences in risk perceptions (Apicella *et al.*, 2015). These studies posit that men perceive risky situations as calls for participation, while women view similar situations as threats that encourage avoidance (Croson and Gneezy, 2009). Unfortunately, these differences can lead to firm failure, as Marshall *et al.* (2015) found in their study of gendered responses to Hurricane Katrina in the United States.

There is compelling evidence that the COVID-19 pandemic disproportionately impacted women entrepreneurs (UN Women, 2020; Werner, 2020). For example, women were more likely to suffer earnings losses, layoffs, reduced working hours and employee salary reductions (Birhanu *et al.*, 2022; Graeber *et al.*, 2021; Yavorsky *et al.*, 2021). This is due to key structural differences between men and women-owned businesses, whereby women-owned businesses are typically concentrated in industry sectors hardest hit by economic shutdowns, specifically consumer-based retail, food and other service ventures. Women-owned businesses also tend to be smaller, younger and less well-financed than men-owned businesses. Consider recent data from the Global Entrepreneurship Monitor showing that 50 per cent of women entrepreneurs operate in the wholesale/retail trade sector, compared to 42.6 per cent of men and that 17.2 per cent of women operate in government/health/education and social services, compared to 10.1 per cent of men (Elam *et al.*, 2019). These sectors tend to have business-to-consumer business models as compared to the more popular business-to-business models. In addition, these sectors are characterized by a high threat of new entrants and high rivalry, leading to fierce competition, which often results in a race to the bottom.

“ Women-owned businesses are typically concentrated in industry sectors hardest hit by economic shutdowns, specifically consumer-based retail, food and other service ventures.

Finally, contextual factors also impact women's response to the pandemic. Women bear a disproportionate amount of childcare responsibility. While daunting in non-pandemic times, this heavy burden of family responsibilities became greater during the pandemic when traditional preschools and K-through-12 schools shut down. A quote from a female Indian IT executive interviewed by Venkataraman and Venkataraman (2021) is illustrative:

> "I have always thought I am good at multitasking, but during the lockdown, it is difficult for me to prioritize my work whether it is work calls, household chores, or online classes for my kid.... I am struggling because my fears and pessimism have overtaken me."

In summary, there is evidence from past crises, including Hurricane Katrina and others, as well as from studies of COVID-19 effects, that women-led businesses were disproportionately affected when compared with men-led firms.

Digitalization, adaptive capacity and gender

Digital tools take three main forms, digital artifacts, digital platforms and digital architectures (Nambisan, 2017). A digital artifact is "a digital component, application, or media content that is part of a new product (or service) and offers a specific functionality to the user" (Nambisan, 2017), for example an application running on a smartphone or a smartwatch. A digital platform is defined as "a shared, common set of services and architecture that serves to host complementary offerings, including digital artifacts" (Nambisan, 2017). Finally, digital architecture is defined as "digital technology tools and systems (e.g. cloud computing, data analytics, online communities, social media, 3D printing, digital makerspaces, etc.) that offer communication, collaboration, and/or computing capabilities to support innovation and entrepreneurship" (Nambisan, 2017). Digital architectures, in particular, are credited with creating a powerful "democratizing effect" because they lower the barriers to entry and allow a greater number and a diverse set of people to engage in business exchange, including international market exchange (Aldrich, 2014; Nambisan, 2017; Pergelova *et al.*, 2019). The adoption of digital technologies and the development of strategic, managerial and digital skills to increase business efficiency can enable adaptation to the COVID-19 pandemic (Audretsch and Belitski, 2021).

In response to the COVID crisis, many small firms moved operational activities online to connect with users, markets and suppliers, sell products and manage financial transactions, and oversee employees (Connected Commerce Council, 2021). On the surface, the benefits of digitalization to small businesses for marketing, communication and operations are intuitive, however, there is also the possibility that small firms may have invested in digital tools and platforms that were costly, required a steep learning curve or did not work.

Studies about women entrepreneurs and use of digital technologies are mixed, with some showing that continuous change in technology can be challenging (Rajahonka and Villman, 2019), while other studies show that these can be beneficial for engagement in social media, to connect with networks or to manage employees (Bernhard and Olsson, 2020). Empirical research using large datasets from developing countries has established that – contrary to popular beliefs – when controlling for education, income and employment, women are more enthusiastic and more active users of digital tools than men (Hilbert, 2011). However, some women entrepreneurs experienced challenges in the adoption of digital technologies,

especially social media, because of a blurring of work and family (Rajahonka and Villman, 2019). A qualitative study found that women entrepreneurs' use of digital technologies was challenging because of limited resources, a lack of training, and stress and burn-out related to external demands of online presence (Bernhard and Olsson, 2021).

In a systematic review of the literature on the economic effects of the COVID-19 pandemic on entrepreneurship and small business, Belitski *et al*. (2022) reported that "the emergence of digital technologies has significantly reduced the economic costs of data – search, storage, computation, transmission – and enabled new economic activities during the COVID-19 pandemic and a change in lifestyle". Still, there is a gap in understanding which digital tools and capabilities are most effective, or need to be further developed, in order for firms to respond to the opportunities presented by COVID-19 for digitalization and business model change (Seetharaman, 2020). There is an even greater gap in understanding the gender dynamics in the adoption of, and effectiveness of, digital tools, contingent on the level of market disruption and type of government response.

Thus, almost a quarter of the women entrepreneurs surveyed by the Diana International Research Institute reported business model changes, with the transition or expansion to online services and sales stated as a clear opportunity, followed by over 15 per cent identifying online marketing and better financial management and planning as needed going forward (Manolova *et al*., 2020). However, taking advantage of these digital affordances is heavily contingent on women's access to information and communication technologies, and time constraints in getting the required knowledge and digital skills. Over half of the global female population (52 per cent) is still not using the Internet, compared to 42 per cent of all men (ITU, 2019); and more men than women use the Internet in every region of the world except the Americas, which has near-parity (ITU, 2019). In their white paper on COVID-19 response strategies, addressing digital gender divides, Nefesh-Clarke *et al*. (2020) conclude that although "digital solutions exist to mitigate the impacts of the pandemic on women workers and entrepreneurs, girls' and women's lack of connectivity, access to devices, low literacy and lack of digital skills are significant impediments to benefiting from these and other COVID-19 relief measures."

Even in areas where women entrepreneurs have good access to information and communication technologies, such as the EU area, there remain gaps in the utilization of advanced digital technologies. A recent study by the European Investment Bank documented that while female-led firms are more likely to have a website compared to male-led companies, they lack in the deployment of more advanced technologies, such as cognitive technologies, blockchain or the Internet of Things (EIB, 2022). In this study, therefore, we are specifically interested in the gendered usage of digital tools as instruments of adaptive capacity during a period of severe market disruption.

> "Some women entrepreneurs experienced challenges in the adoption of digital technologies, especially social media, because of a blurring of work and family.

Methodology

Source of data

We explore our two research questions using data from the last wave (December 2020) of the Future of Business Survey run by Facebook (Meta, since October 2021), in collaboration with the Organisation for Economic Co-operation and Development and the World Bank. The initial sample included 41,894 business leaders (firms) in 107 WTO members and observers. Missing data in some of the categories resulted in a usable sample size of 41,383, for which we report the results from statistical testing.

Measures

Our dependent variables include two business outcomes, year-on-year (YoY) performance in sales and YOY performance in employment, from November 2019 to 2020. We operationalize "adaptive capacity" as the levels and types of digitalization used by the business leaders in our sample (firm-level). Digitalization measures include digital tool use, types and uses of digital tools, obstacles and impacts of digitalization. For data at the level of WTO members and observers, we draw on indicators from the Oxford COVID-19 Government Response Tracker (OxCGRT), which includes information on the types and timing of containment and relief measures taken by governments around the world.[3] We use two index measures characterizing the government response in each WTO members and observers to segment them in our sample: stringency and economic support. Stringency of government response to the pandemic consists of nine items, including: school closures; workplace closing; cancellation of public events; restrictions on gatherings; public transportation; stay at home orders; restrictions on internal movement; international travel controls; and public information campaigns. Economic support included two items: income support and debt/contract relief for households. To answer our two research questions, we performed a regression analysis to identify significant associations, net key control variables, coupled with correlation and cross-tabulation analysis to quantify rates and gender differences in digitalization and YoY performance outcomes.

Sample description

Among the 107 WTO members and observers in the sample, the OxCGRT ranged from 23 to 80 with a mean value of 57.26. More than two-thirds (69) scored in the top third for stringency of the government response to the pandemic, with 31 in the middle third and only seven in the lower third. The OxCGRT Economic Support Index for November 2020 ranged from zero to 100, with a mean value of 53. The majority of WTO members and observers (43) scored in the top third for economic support in response to the pandemic, with 40 in the middle third and 24 in the lower third. The distribution of WTO members and observers across the three levels of stringency of government response and government economic support is reported in Table 1.

Table 1: WTO members and observers, by level of stringency and economic support

Level of stringency	Level of economic support		
	Lower third	Middle third	Upper third
Lower third	Burkina Faso Nicaragua Tanzania	Chinese Taipei	Lao People's Democratic Republic New Zealand Senegal
Middle third	Angola *Belarus* *Bosnia and Herzegovina* Botswana Cameroon Dominican Republic *Ethiopia* Ghana Guinea Kenya Liberia Malawi Mali Mozambique Nigeria Sierra Leone Trinidad and Tobago Uganda Zambia	Albania *Azerbaijan* Benin Brazil Bulgaria Cambodia Costa Rica Croatia Germany Guatemala Haiti Hungary India Indonesia *Iraq* Korea, Rep. of Lithuania Morocco Nepal Norway Paraguay Qatar Russian Federation Saudi Arabia, Kingdom of Serbia Sweden Switzerland United Arab Emirates Viet Nam	Australia Belgium Colombia Denmark Ecuador Egypt El Salvador Finland Hong Kong, China Israel Japan Netherlands Oman Pakistan Panama Singapore South Africa Thailand Togo Türkiye Uruguay
Upper third	Bolivia, Plurinational State of *Libya*	*Algeria* Bangladesh Canada Czech Republic France Jordan Kuwait, the State of Lebanese Republic Peru United States of America	Argentina Austria Chile Cyprus Greece Honduras Ireland Italy Malaysia Mexico Myanmar Philippines Poland Portugal Romania Slovak Republic Spain Tunisia United Kingdom

Source: Future of Business Survey, December 2020, authors' calculations. WTO observers are in italics.

As reported in Table 2, the average age of the business leaders surveyed was about 40 years old with no significant gender difference. However, women leaders were slightly more educated (75 per cent of women vs 70 per cent of men had secondary school or higher; $p < 0.001$). Significant gender differences were found for business characteristics. Women reported slightly younger firms (36.6 per cent of women vs 28.7 per cent of men with firms less than one year old; $p < 0.05$) and were twice as likely to report having no employees: 19.1 per cent of women versus 9.8 per cent of men; $p < 0.05$). Women-led firms showed significantly lower presence in traditionally male-dominated sectors, including information, computers and technology, manufacturing and transportation, and agriculture and construction ($p < 0.001$). While the majority of respondents reported businesses in whole/retail and consumer services and other sectors, 86 per cent of women operated in services and other sectors versus 66 per cent of men ($p < 0.001$).

Table 2: Individual sample description (n = 41,383)

Variables	N	Total	Women	Men	Sig
Female	41,383	37%	15,312		
Age (mean years)	41,142	39	40	39	ns
Secondary education or more	40,040	72.3%	75.7%	70.3%	*
Business age < 1 year	37,574	31.6%	36.6%	28.7%	*
Business size (employees)	29,766				
No employees (%)		13.2	19.1	9.8	*
1-24 employees (%)		79.1	75.4	81.2	*
25 or more employees (%)		7.8	5.6	9.0	*
Industry	39,294				
Internet, computers and technology (%)		9.0	5.7	10.9	***
Wholesale/retail and consumer services (%)		32.8	36.2	30.8	***
Manufacturing and transportation (%)		5.8	2.6	7.6	***
Agriculture and construction (%)		10.8	5.4	14.0	***
Other (%)		41.6	50.0	36.7	***
YoY sales change	13,476				
Lower than last year (%)		64.60	60.20	66.90	**
Same or higher than last year (%)		35.40	39.80	33.10	**
Digital use change	15,363				
Same or lower than last year (%)		53.60	49.80	55.50	**
Increased (%)		46.40	50.20	44.50	**

Source: Future of Business Survey, December 2020, authors' calculations. Significance level (Sig) is the level of probability (p) that the null hypothesis is rejected when it is true. A significance level of 0.05 indicates a 5% chance of concluding there is a difference between the two groups when there is no actual difference; a significance level of 0.01 indicates a 1% chance, and a significance level of 0.01 indicates a 0.1% chance. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Results

Research question 1: Gendered differences in the adoption and use of digital tools

At the correlation level of analysis (see Table 3), on average, and across all levels of government response, there is a positive association between female leadership and starting/increasing digital tool usage, as well as the change to digital tools being permanent. However, the association between female leadership and the number of digital tools being used is negative. In terms of the types of digital tools being used, the association between female leadership and usage of digital tools is mostly negative, with one exception – online sales platforms. However, female entrepreneurs demonstrate great versatility of digital tool usage, with positive associations across advertising, communications, e-commerce and online payments. The association, however, is negative for government transactions and R&D.

Table 3: Partial Pearson correlations

	Female
YoY sales 2019-2020	-0.033**
YoY employment 2019-2020	0.038**
Individual age	0.021**
Individual education	0.058**
Business age < 1 year	-0.097**
Business size (employees)	-0.106**
Internet, computers and technology	-0.088**
Wholesale/retail services	0.053**
Manufacturing and transportation	-0.104**
Agriculture and construction	-0.132**
Digital change	
Digital use start/increase	0.077**
Digital change permanent	0.020**
Digital tool number	-0.039**
Digital tool types	
Broadband	0
Teleworking (>50% employees)	-0.033**
Online sales	0.076**
Cloud computing	-0.040**
Enterprise resource planning	-0.066**
Supply chain	-0.063**
Customer relationship management	-0.033**

	Female
Digital tool uses	
Advertising	0.060**
Communications	0.042**
E-commerce	0.025**
Payments	0.031**
Government	-0.049**
R&D	-0.015*
Digitalization obstacles	
Lack of knowledge	0.033**
Cost of purchase	0
Integration difficulty	-0.038**
Lack of user skills	0.041**
Digitalization impacts	
Increase sales	-0.015
Lower costs	-0.063**
Increase customers or suppliers	-0.014
Access business intelligence	-0.047**
Increase employment	-0.069**
No impact	0.027**
Government response impact	
Economic support Nov20	0.095**
Stringency Nov20	0.025**

Source: Future of Business Survey, December 2020, authors' calculations. ** $p < 0.01$; * $p < 0.05$; Pearson correlation (2-tailed).

Lack of knowledge and user skills are the obstacles significantly associated with female business leaders, as opposed to integration difficulty, which shows a negative association, or cost of purchase, where the association is not significant (i.e. there is gender parity in the importance of cost of purchase). Interestingly, women were more likely to report that digitalization had no significant impact on their businesses. Finally, in line with our interest in the effect of digitalization on female entrepreneurs' performance under different regimes of government response, women were significantly affected by both the economic support of the government, and by the stringency of the response measures.

In further analyses, we took a finer-grained look at the gendered differences in digitalization across different levels of government response.[4] Half of the women across 107 WTO members and observers used new digital tools in response to the pandemic, compared to 44.6 per cent of men ($p < 0.001$). This gender difference was consistent across all levels of stringency

and economic support. Please note, however, that the correlation data were analysed at the population level, precluding finer-grained analysis by economic sector. The highest rates for women were found in the lower third level of economic support (57.1 per cent) and the highest third level of stringency (53.3 per cent). The lowest rates by levels of government response were found in the middle third categories of both stringency and economic support.

Over 70 per cent of women leaders said the use of the new digital tools would be permanent compared to 68.2 per cent of men ($p < 0.001$). The higher rate of women reporting a permanent use of new digital tools was consistent across all levels of government response, except for the middle third level of economic support where women were closest to parity with men. The median number of new digital tools adopted by men and women was one new digital tool, but there was a significant difference in the mean number of new tools reported with men reporting a slightly higher average number of new digital tools (1.57 for women vs 1.68 for men; $p < 0.001$).

Across levels of government response, women were more likely than men to report using e-commerce tools at all levels of stringency and economic support except in the lower third level of stringency. In fact, the lowest levels of adoption of most types of digital tools for women were found in WTO members and observers in the lower third level of stringency. Meanwhile the highest rates of adoptions for different tools were scattered across levels of government response and are best explained by the types of businesses women and men lead.

As reported above, women were significantly more likely than men to report using new digital tools adopted because of the pandemic for advertising, communications, e-commerce and payments, while the reverse was true for government transactions and R&D. The gender pattern in rates was generally consistent across all levels of government response with two exceptions. Women were equally likely to use new digital tools for advertising in lower third level stringency contexts (54.2 per cent of women vs 54.9 per cent of men). Women were also close to parity with men in the upper third level of economic support (33.3 per cent of women vs 32.9 per cent of men).

Women leaders were significantly more likely than their male peers to report lack of knowledge (31.8 per cent vs 29.1 per cent; $p < 0.001$) and lack of user skills (29.5 per cent vs 26.0 per cent; $p < 0.001$) as obstacles to the adoption of new digital tools. However, the most commonly reported obstacle was the cost of purchasing new digital tools with 54 per cent of both women and men citing this obstacle. Women were significantly less likely than men to cite integration difficulty as an obstacle to digitalization (26.1 per cent vs 29.2 per cent; $p < 0.001$). Lack of knowledge was more often reported by women at the lower third level stringency context (36.8 per cent) and the upper third level of economic support (33.6 per cent). For cost of purchase as a digitalization obstacle, women were close to parity with men in contexts in the upper third level of stringency and upper third level of economic support. However, women in the lower third of economic support were the most likely to report cost as a digitalization obstacle. Gender differences in integration difficulty was consistent across all levels of government response, but not so for lack of user skills. Women were actually less likely than men to report lack of user skills as an obstacle to digitalization in the lower third level of stringency and economic support.

> Half of the women across 107 WTO members and observers used new digital tools in response to the pandemic, compared to 44.6 per cent of men.

When asked how the use of new digital tools has impacted the business, women were significantly more likely than men to report no impact on the business (34.3 per cent vs. 31.6 per cent; $p < 0.001$). Even when they did report a positive impact of new digital tool use, women were significantly less likely than men to cite lower operations costs (15.1 per cent vs 20.7 per cent; $p < 0.001$), access to digital solutions or business intelligence (22.1 per cent vs 23.9 per cent; $p < 0.001$), and increased employment (5.8 per cent vs 9.2 per cent; $p < 0.001$). No significant gender differences were observed for the most commonly reported impacts: increased sales (24.4 per cent vs 26.5 per cent) and increased customers or suppliers (22.1 per cent vs 23.9 per cent).

Research question 2: Digitalization effects

Regression results provided significant associations between our two measures of business performance, YoY sales and YoY employment change and digitalization, controlling for key individual and business characteristics. We started with a basic model including the key structural variables (gender, response stringency and economic support), then added the key individual and business characteristics, and then explored sequentially different aspects of digitalization.

Year-on-year sales change

For YoY sales change, Model 1 showed significant negative relationships for being female, stringency of the government pandemic response and government economic support. Controlling for individual and business characteristics explained the relationship between economic support on YoY sales change but did not explain the gender effect or the influence of stringency on YoY sales across Models 2-7 (see Table 4). Among the controls, YoY sales change was significantly and negatively associated with the age of the business leader and the age of the business, but significantly and positively associated with the size of the business across Models 2-7. The influence of sectoral differences on YoY sales varied depending on the digitalization variables tested. In Model 2, significant positive effects were found for the Internet, computers and technology, and agriculture and construction sectors, while a significant negative effect was found for wholesale/retail and consumer services, and manufacturing and transportation sector in reference to other industries sectors, net all other factors.

Table 4: Regression results for year-on-year sales change

Variable	Model 1 stand B (se)	Model 2 stand B (se)	Model 3 stand B (se)	Model 4 stand B (se)	Model 5 stand B (se)	Model 6 stand B (se)	Model 7 stand B (se)
Response stringency	-0.046*** (0)	-0.04*** (0)	-0.034** (0)	-0.038*** (0)	-0.04*** (0)	-0.039*** (0)	-0.042*** (0)
Economic support	-0.037*** (0)	-0.002 (0)	0.008 (0)	0.005 (0)	0.005 (0)	-0.001 (0)	0.014 (0)
Female	-0.028*** (0.01)	-0.025** (0.02)	-0.052*** (0.02)	-0.04*** (0.02)	-0.041*** (0.02)	-0.044*** (0.02)	-0.042*** (0.02)
Individual age		-0.045*** (0.01)	-0.029* (0.01)	-0.036** (0.01)	-0.034** (0.01)	-0.03** (0.01)	-0.014 (0.01)
Individual education		-0.005 (0.02)	-0.008 (0.03)	-0.007 (0.02)	-0.007 (0.02)	0 (0.02)	-0.02 (0.02)
Business age < 1 year		-0.137*** (0.01)	-0.138*** (0.01)	-0.13*** (0.01)	-0.127*** (0.01)	-0.137*** (0.01)	-0.123*** (0.01)
Business size (employees)		0.068*** (0.01)	0.033** (0.01)	0.038*** (0.01)	0.038*** (0.01)	0.042*** (0.01)	0.047*** (0.01)
Internet, computers and technology		0.027** (0.03)	0.023 (0.03)	0.019 (0.03)	0.026* (0.03)	0.015 (0.03)	0.031** (0.03)
Wholesale/retail and consumer services		-0.046*** (0.02)	-0.045*** (0.02)	-0.044*** (0.02)	-0.051*** (0.02)	-0.046*** (0.02)	-0.057*** (0.02)
Manufacturing and transportation		0.002 (0.03)	-0.006 (0.05)	0.003 (0.04)	0.007 (0.04)	0.002 (0.04)	0.01 (0.04)
Agriculture and construction		0.027** (0.02)	0.035** (0.03)	0.047*** (0.03)	0.039*** (0.03)	0.045*** (0.03)	0.045*** (0.03)
Digital change							
Digital use start/increase			0.1*** (0.01)	0.091*** (0.01)	0.098*** (0.01)	0.1***	0.099*** (0.01)
Digital change permanent			-0.115*** (0.02)				
Digital tools number			0.057*** (0.01)				
Digital tool types							
Broadband				-0.002 (0.02)			
Teleworking (>50% employees)				-0.007 (0.03)			
Online sales				0.000 (0.02)			
Cloud computing				0.064*** (0.03)			
Enterprise resource planning				0.035** (0.03)			

Variable	Model 1 stand B (se)	Model 2 stand B (se)	Model 3 stand B (se)	Model 4 stand B (se)	Model 5 stand B (se)	Model 6 stand B (se)	Model 7 stand B (se)
Supply chain				0.002 (0.04)			
Customer relationship management				0.005 (0.03)			
Digital tool uses							
Advertising					-0.047*** (0.002)		
Communications					-0.019 (0.02)		
E-commerce					0.02 (0.02)		
Payments					0.019 (0.02)		
Government					-0.008 (0.03)		
R&D					0.006 (0.02)		
Digitalization obstacles							
Lack of knowledge						-0.025* (0.02)	
Cost of purchase						-0.069*** (0.02)	
Integration difficulty						-0.041*** (0.02)	
Lack of user skills						-0.032** (0.02)	
Digitalization impacts							
Increase sales							0.115*** (0.02)
Increase employment							0.071*** (0.04)
Lower operations costs							-0.082*** (0.02)
Increase customers of suppliers							0.007 (0.02)
Access to digital solutions or business intelligence							-0.004 (0.03)
Constant	1.98*** (0.03)	2.267*** (0.04)	2.112*** (0.06)	2.005*** (0.06)	2.059*** (0.06)	2.126*** (0.06)	1.912*** (0.06)
Adjusted R^2	0.006	0.034	0.05	0.043	0.04	0.043	0.064

Source: Future of Business Survey, December 2020, authors' calculations. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 5: Regression results for year-on-year employment change

Variable	Model 1 stand B (se)	Model 2 stand B (se)	Model 3 stand B (se)	Model 4 stand B (se)	Model 5 stand B (se)	Model 6 stand B (se)	Model 7 stand B (se)
Response stringency	-0.046*** (0)	-0.04*** (0)	-0.034** (0)	-0.039*** (0)	-0.038*** (0)	-0.039***	-0.041*** (0)
Economic support	-0.037*** (0)	-0.002 (0)	0.008 (0)	0.089*** (0)	0.089*** (0)	0.094*** (0)	0.09*** (0)
Female	-0.028*** (0)	-0.025** (0.02)	-0.052*** (0.02)	0.015 (0.01)	0.012 (0.01)	0.012 (0.01)	0.021* (0.01)
Individual age		-0.045*** (0.01)	-0.029* (0.01)	-0.009 (0.01)	-0.009 (0.01)	-0.004 (0.01)	0.009 (0.01)
Individual education		-0.005 (0.02)	-0.008 (0.03)	-0.004 (0.01)	-0.004 (0.01)	0.008 (0.01)	-0.018 (0.01)
Business age < 1 year		-0.137*** (0.01)	-0.138*** (0.01)	-0.073*** (0.01)	-0.068*** (0.01)	-0.071*** (0.01)	-0.067*** (0.01)
Business size (employees)		0.068*** (0.01)	0.033** (0.01)	-0.048*** (0.01)	-0.046*** (0.01)	-0.046*** (0.01)	-0.045*** (0.01)
Internet, computers and technology		0.027** (0.03)	0.023 (0.03)	-0.011 (0.02)	-0.006 (0.02)	-0.006 (0.02)	0.004 (0.02)
Wholesale/retail and consumer services		-0.046*** (0.02)	-0.045*** (0.02)	-0.06*** (0.01)	-0.061*** (0.01)	-0.061*** (0.01)	-0.063*** (0.01)
Manufacturing and transportation		0.002 (0.03)	-0.006 (0.05)	-0.011 (0.02)	-0.011 (0.02)	-0.006 (0.03)	-0.011 (0.03)
Agriculture and construction		0.027** (0.02)	0.035** (0.03)	0.015 (0.02)	0.011 (0.02)	0.01 (0.02)	0.009 (0.02)
Digital change							
Digital use start/increase			0.1*** (0.01)	0.085*** (0)	0.09*** (0)	0.095*** (0)	0.103*** (0.01)
Digital change permanent			-0.115*** (0.02)				
Digital tools number			0.057*** (0.01)				
Digital tool types							
Broadband				0.027** (0.01)			
Teleworking (>50% employees)				-0.013 (0.02)			
Online sales				-0.001 (0.01)			
Cloud computing				0.061*** (0.02)			
Enterprise resource planning				0.011 (0.02)			
Supply chain				0.008 (0.02)			

Variable	Model 1 stand B (se)	Model 2 stand B (se)	Model 3 stand B (se)	Model 4 stand B (se)	Model 5 stand B (se)	Model 6 stand B (se)	Model 7 stand B (se)
Customer relationship management				0.015 (0.02)			
Digital tool uses							
Advertising					-0.025 (0.01)		
Communications					0.033*** (0.01)		
E-commerce					0.006 (0.01)		
Payments					0.017 (0.01)		
Government					-0.01 (0.02)		
R&D					0.016 (0.01)		
Digitalization obstacles							
Lack of knowledge						-0.014 (0.01)	
Cost of purchase						-0.028** (0.01)	
Integration difficulty						-0.022* (0.01)	
Lack of user skills						-0.01 (0.01)	
Digitalization impacts							
Increase sales							0.048*** (0.01)
Increase employment							-0.006 (0.02)
Lower operations costs							0.07*** (0.02)
Increase customers of suppliers							-0.077*** (0.02)
Access to digital solutions or business intelligence							0.009 (0.01)
Constant	1.98*** (0.03)	2.267*** (0.04)	2.112*** (0.06)	1.811*** (0.03)	1.807*** (0.03)	1.827*** (0.04)	1.77*** (0.03)
Adjusted R^2	0.006	0.034	0.05	0.034	0.03	0.029	0.043

Source: Future of Business Survey, December 2020, authors' calculations. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

As shown in Model 3, the use and number of new digital tools were significantly and positively correlated with YoY sales change (0.1, $p < 0.001$; 0.057, $p < 0.001$), while the permanence of these changes was significantly and negatively correlated with YoY sales change (-0.115, $p < 0.001$), net all the control variables. Model 4 showed significant positive associations between two types of digital tools, cloud computing (0.064, $p < 0.001$) and enterprise resource planning tools (0.035, $p < 0.01$). Model 5 showed a significant negative effect of digital tool use for advertising on YoY sales change (-0.047, $p < 0.001$). Model 6 showed significant negative effects for all four digitalization obstacles tested – lack of knowledge (-0.025, $p < 0.05$), cost of purchase (-0.069, $p < 0.001$), integration difficulty (-0.041, $p < 0.001$) and lack of user skills (-0.032, $p < 0.01$). Finally, Model 7 showed significant positive effects of three digitalization impacts on YoY sales change – increase in sales (0.115, $p < 0.001$), increase in employment (0.071, $p < 0.001$), and lower operations costs (-0.082, $p < 0.001$).

Year-on-year employment change

For YoY employment change, we followed the same logic for specifying the regression equations. Model 1 showed significant negative relationships for being female, stringency of the government pandemic response and government economic support (see Table 5). Controlling for individual and business characteristics (Model 2) explained the effect of economic support on YoY sales but did not explain the gender effect or the influence of stringency on YoY sales. Among the controls, YoY employment change was significantly and negatively associated with the age of the business leader and the age of the business, but significantly and positively associated with the size of the business across Models 2-7, indicating that older and smaller companies and those led by older entrepreneurs added fewer employees. Sectoral influence on YoY sales varied depending on the digitalization variables tested. Significant positive effects were found in Model 2 for the Internet, computers and technology, and agriculture and construction sectors, while a significant negative effect was found for wholesale/retail and consumer services, and manufacturing and transportation sectors in comparison to other industries sectors, net all other factors.

The use and number of new digital tools were significantly and positively correlated with YoY employment change (0.1, $p < 0.001$; 0.057, $p < 0.001$), while the permanence of these changes was significantly and negatively correlated with YoY sales change (-0.115, $p < 0.001$), net all the control variables (Model 3). Model 4 showed significant positive associations between only two types of digital tools, broadband (0.027, $p < 0.01$) and cloud computing (0.061, $p < 0.001$). Among the digital tool use measures tested in Model 5, only one was significant: communications showed a significant positive effect on YoY employment change (0.033, $p < 0.001$). In Model 6, only two digital obstacles showed significant results – cost of purchase (0.028, $p < 0.01$) and integration difficulty (-0.022, $p < 0.05$). Three digitalization impact measures were significant in Model 7 – increase sales (0.048, $p < 0.001$), lower operations costs (0.07, $p < 0.001$), and increase in customers or suppliers (-0.077, $p < 0.001$).

Discussion

In this study, we addressed two broad research questions, pertaining to the gendered adoption of digital tools as essential instruments in building adaptive capacity to cope with an unprecedented and multiplex exogenous shock to markets and businesses. We did this

in different government response contexts. Below, we discuss our major findings, and their theoretical, practitioner and public policy implications.

Gendered differences in the adoption and use of digital tools

Women business leaders were more likely than men to use new digital tools in response to the pandemic and more likely to describe the new digital tools as a permanent change. However, they reported significantly fewer new digital tools being used, though the average difference with male-led businesses was small. The higher uptake of new digital tools during the pandemic by women may be explained by the higher rates of market disruption for women-led businesses and the over-representation of women among the smallest and most vulnerable businesses, especially in sectors most impacted by the pandemic.

When it comes to types of new digital tools adopted, women were more likely than men to report new e-commerce tools, which is consistent with the higher participation of women in the retail, education and healthcare services sectors, as well as the significantly higher rate of women leaders running businesses with no employees compared to men. In contrast, men were much more likely to report using tools most often used in very large employer firms, such as enterprise resource planning, customer relationship management or cloud computing.

Women were more likely than men to report using new digital tools for advertising, communications, e-commerce and payments processing. In contrast, men were more likely than women to report using new digital tools for R&D and government interactions. Again, these findings are predictable given the observed gender differences in sectoral distribution and business size. With respect to obstacles, women more often cited a lack of knowledge or user skills. Surprisingly, cost was not a more significant obstacle for women compared to men. One explanation is that while the smaller average size of women-led businesses might have made them more sensitive to the cost of purchasing new digital tools, the enterprise digital tools are often value priced and can pose high entry points and switching costs for very large firms, predominantly led by men.

Women business leaders were significantly less likely than men to report a positive impact of the new digital tools on their business and more likely to report no impact at all. However, women were just as likely as men to report an increase in sales, customers or suppliers resulting from the use of new digital tools. Regarding specific positive impacts, it is not surprising that women were less likely to report employment increases, lower operations costs and more access to digital solutions or business intelligence given the observed gender differences in business size and sector.

> “Women were more likely than men to report using new digital tools for advertising, communications, e-commerce and payments processing.

Effects of digitalization on performance in different contexts of government response

Regression models for both YoY sales and YoY employment changes confirm the findings showing that women were less likely than men to report an increase in sales or employment over 2022. Both the stringency of government responses and the level of economic support provided to individuals and businesses was negatively associated with YoY sales and employment changes. High rates of government stringency resulted in significant market disruption, which would naturally impact YoY sales and employment. Moreover, we would expect a gender effect given the higher impacts on sectors where women-led businesses are well represented and on the smallest firms. However, the negative relationship with government economic support is more complex and perhaps best explained by the greater need for economic support in contexts where the government response to the pandemic resulted in greater market disruption. Larger businesses and those located in more traditionally male-dominated sectors, such as the Internet, computers and technology, and agriculture and construction, tended to fare better in terms of both YoY sales and employment impacts.

The use and number of new digital tools helped to boost YoY sales numbers, particularly enterprise digital tools, which favours the types of businesses women are less often involved in as leaders. Women were more likely than men to report use of new digital tools for advertising, but this measure actually showed a negative correlation with YoY sales. As reported in the Digitally Driven Europe and US studies (Connected Commerce Council, 2021), it could be that digital tools helped to reduce losses but did not result in sustained or increased sales over the course of the first six months of the pandemic for firms in the wholesale/retail and consumer services and other sectors where women are highly represented. Not surprisingly, all digitalization obstacles were negatively associated with YoY sales changes and several measures of positive impacts showed positive associations, net of the controls for sector, size and other key factors. Still, the gender differences in YoY sales persisted suggesting that women business leaders faced more challenges in the adoption and deployment of new digital tools during the pandemic.

In contrast to the findings on YoY sales impacts, the regression results suggest a different story when it comes to pandemic impacts on employment for women-led businesses. Business size and sectoral differences explained the association of economic support with YoY employment, but did not explain the negative associations of being female and stringency of the pandemic response with YoY employment. Larger firms, especially those in the Internet, computers and technology, and agriculture and construction, had the best advantage when it came to increasing employment during the pandemic, while smaller, younger firms were more likely to suffer. Importantly, the use of new digital tools, the permanence of new digital tool adoption, and the number of new tools adopted doubled the significant negative association for women leaders. However, the types of tools used, the uses of new digital tools, and

> “ Women business leaders faced more challenges in the adoption and deployment of new digital tools during the COVID-19 pandemic.

digitalization obstacles all explained gender differences in YoY employment changes. These findings suggest that digitalization played an important role in mitigating the negative impacts of the pandemic and market disruptions on employment, including both preserving jobs and creating more jobs, for women-led firms.

Finally, levels of government response, particularly the stringency of response, had a significant negative influence on YoY sales and employment. This finding is hardly surprising given the extreme market disruptions that resulted from lockdowns and other government mitigation policies. However, the extent to which economic support for individuals and businesses helped to mitigate the business impacts resulting from market disruption is less clear. Moreover, the impact of different contexts on outcomes for women-led versus men-led firms is highly varied and warrants further investigation.

Our study has a few limitations for consideration in the interpretation of results. The respondents are all Facebook users, so our sample is likely biased towards those with strong technology skills. The data collected are all self-reports, which are subject to biased responses resulting from recall and social desirability. The study design is cross-sectional and not suitable for drawing conclusions about causal relationships. The analysis is restricted to responses from one month following the start of the pandemic. We chose December 2020 to capture responses at a time point where the disease spread, and government responses were well in process for most countries. Still these data are subject to high variability in temporal factors related to the pandemic impacts on individuals and markets. Nonetheless, very few studies have addressed the mitigation of digitalization on gender differences in pandemic business impacts across countries. For that reason, this study offers important insights into gender, business and digitalization in the context of an unprecedented global economic crisis.

Conclusion

The purpose of this study was to investigate the extent to which digitalization mitigated the disproportionate impact of the pandemic market disruptions on women-led businesses. Women tend to run younger, smaller firms concentrated in the industry sectors affected the most by economic shutdowns. We found that digitalization did help to mitigate the impact on sales and employment in the first six months of the pandemic. However, women business leaders still felt the business impacts more on average than their male peers, due largely to gender differences in business size and industry sector. Digitalization mitigated the impact on employment for women-led businesses, more so than impacts on sales. Moreover, there was little evidence that economic relief served to mitigate the impact of economic shutdowns on women-led firms. Further research is required to unpack the complexity and influence of government responses to the pandemic on sales and employment of women-led firms.

Our findings hold important implications for research on gender differences in pandemic business impacts. Business size and sectoral differences are incredibly important predictors of gender differences in business outcomes under normal market operations and also for gender differences in the impact of market disruptions in times of natural disasters, pandemics and economic crises. The impacts on women-led firms, on average, will depend largely on the disruption in those industry sectors where women-led firms are highly represented and on access to policy interventions and economic relief for small firms and self-employed workers.

> Systemic inequality contributes in significant ways to the persistence of negative stereotypes about women business leaders, ranging from theories of female underperformance to risk aversion in business leadership.

Systemic inequality contributes in significant ways to the persistence of negative stereotypes about women business leaders, ranging from theories of female underperformance to risk aversion in business leadership.

The policy implications of our findings are clear. In times of a global pandemic crisis, policies should be directed towards the sectors most affected by market disruptions, especially towards the smallest most vulnerable businesses. Policies and programmes that help business leaders overcome the obstacles to technology adoption should also be tailored to different sectors and stages of business growth, based on our findings. Programming for the smallest and newest firms could be particularly impactful for women-led firms. Common sense also dictates that policies should be directed towards better support for families in the event that schools and care facilities are shut down, forcing parents, and especially mothers, to juggle business and family demands in an intense and overwhelming fashion.

For practitioners, our findings offer some important implications regarding the importance of digitalization for increasing sales, accessing new customers and supplies, expanding employment, supporting remote workers and reducing the costs of operations, thus building resilience and adaptability. Digital tools adopted in order to better reach customers through advertising, online sales and communications may be most useful for small firms and may at least offset losses during an economic crisis.

In sum, our findings suggest that digitalization is an important source of adaptive capacity for all firms, but with limited potential to help women-led firms overcome the systemic inequality characterized largely by the sectoral and business size differences that put women-led firms at such a disadvantage compared to men-led firms in the context of a global pandemic crisis.

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Endnotes

1. The Future of Business survey targets administrators of business pages which could include business owners, managers and employees. Following the recommendations in the survey methodology (see https://dataforgood.facebook.com/dfg/tools/future-of-business-survey#methodology), as well as prior research based on the Future of Business survey (e.g. see Goldstein *et al.*, 2019), we restrict the analysis to self-identified owners and managers of small and medium-sized enterprises. Here and throughout the chapter, we refer to firms with women owners/managers as "women-led firms".
2. Throughout the text, we use the term digitalization to refer to the business usage of digital tools, such as broadband Internet connection, teleworking, online sales or purchases, cloud computing, enterprise resource planning systems, supply chain management software or customer relationship management software.
3. Available at https://www.bsg.ox.ac.uk/research/covid-19-government-response-tracker.
4. Cross tabulation tables are not presented but are available from the authors upon request.