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Digitalization and Employment Gender Gaps during the COVID-19 Pandemic: Evidence from Latin America and the Caribbean

Prepared by Yuanchen Yang, Manuk Ghazanchyan, Silvia Granados-Ibarra, and Gustavo Canavire-Bacarreza

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ABSTRACT: Despite its negative effects, the COVID-19 pandemic has also accelerated Latin America and the Caribbean's digitalization. The rapid increase in connectivity and digital services was helpful in mitigating the pandemic's negative impact on the labor markets, especially for those with enough flexibility to continue working from home. The shock particularly affected women due to their household responsibilities and labor market characteristics. This paper examines how digitalization may have affected gender gaps in employment and job loss in the context ofthe COVID-19 crisis. Using a sample of countries from Latin America and the Caribbean, our findings suggest that higher levels of digitalization are associated with increased female employment and reduced job losses for both men and women. These findings hold even after controlling for factors such as child care, household chores, and the COVID-19 shock. Our results are also robust to various econometric techniques.

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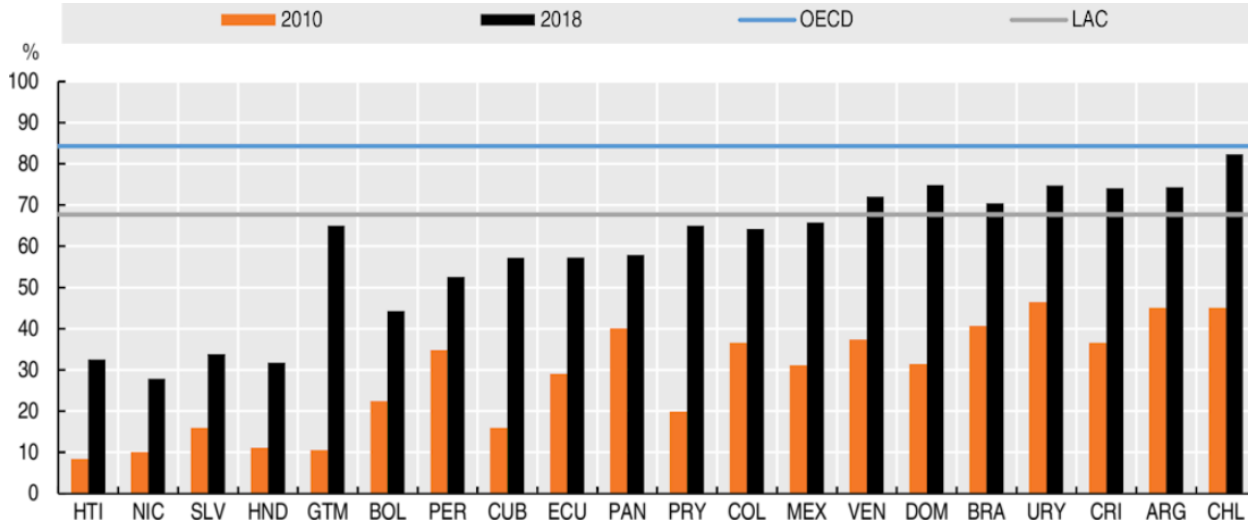
Introduction

Latin America and the Caribbean (LAC) has historically faced challenges in digital development due to important gaps in infrastructure for connectivity, high levels of informality, and a largely unbanked population. The COVID-19 pandemic accelerated a shift towards digitalization in the region in various areas; for example, in less than two years, e-commerce in the region increased by 36.7 percent relative to pre-pandemic levels, with over 13 million people across LAC completing an online transaction for the first time in 2020 (Statista, 2023).

While the pandemic significantly accelerated digitalization in the region, the expansion of the internet predates the pandemic. In 2018, 68 percent of the population used the internet regularly – almost twice the share in 2010, although lagging behind the OECD average of 84 percent (Figure 1). In addition, while 75 percent of the richest population in Latin America uses the internet, only 37 percent of the poorest population does. The difference between the rich and the poor is much higher (almost 40 percentage points) than in OECD countries (below 25 percentage points). Digital transformation comes with stark challenges, with over 20 percent of jobs in some countries likely to undergo some kind of automation. High levels of informality in LAC's labor force (on average, only 20 percent of jobs can be done remotely, compared to 41 percent in the United States) and the aging population (LAC is aging faster than any other region) lead to larger negative impacts of crises on the region's labor markets and present additional obstacles going forward. Therefore, the region needs substantial new investments in education, including for women, and training to equip workers with the necessary digital skills.

Figure 1. Percentage of internet users in selected Latin American and Caribbean countries 2010 and 2018 (or latest available year)



Sources: ITU, World Telecommunications/ICT Indicators Database (2020), International Telecommunications Union.

The COVID-19 pandemic has also accelerated the adoption of digital technologies in other sectors, such as education, healthcare, and the labor markets, which have seen a significant increase in the use of digital technologies that were not expected to happen at such a rapid pace. The way education is delivered dramatically changed during the pandemic allowing for the continuation of classes through digital technologies despite the costs in quality that these strategies entail. The use of telemedicine boomed, increasing access to healthcare for patients who would otherwise not have had a chance due to the saturation of health systems. This impressive adoption of digital technologies may have permanently changed public behavior, from online purchasing to telemedicine, in a region that had long lagged behind in its adoption of digital technologies.

Digitalization has had a mixed impact on labor markets during the pandemic. On the one hand, it created new job opportunities in fields such as e-commerce, digital marketing, and software development, which can be done remotely. Moreover, the digitalization of work has made it easier for people to work remotely, which became increasingly important during the pandemic. While these sectors have been mostly governed by male workers, in part explained by gender stereotypes, unconscious bias, and the lack of access to education and training, the number of women working in these sectors has increased over the past years (OECD, 2021). This has the potential to reduce gender gaps in employment since women who may have been excluded from traditional job markets due to household responsibilities or other related factors can now access these new opportunities.

However, the evidence (OECD, 2021) shows that the pandemic had disproportionately affected women's employment, with women more likely to work in sectors that have been hit hard by the pandemic, such as hospitality, retail, and healthcare. In addition, women are also more likely to work in informal jobs, which are less likely to offer the flexibility and benefits needed to balance work and caregiving responsibilities. Moreover, not all women have equal access to digital technologies, which can further exacerbate gender gaps in employment. Women are more likely to have caregiving responsibilities, which can limit their ability to access and use digital technologies for work. Additionally, women are more likely to work in low-paying jobs, which may not provide the resources needed to access digital technologies.

Using high frequency surveys produced by the World Bank for 22 countries in Latin America and the Caribbean, we find that higher levels of digitalization are associated with increased female employment and reduced job losses for both men and women. Digitalization also mitigates the negative impact of household chores on job losses, especially for women and also it alleviates the burden of childcare responsibilities for women and promote their participation in the labor market. We also find that digitalization mitigates the negative relationship the impact of the pandemic type shocks on female employment.

The remainder of this paper proceeds as follows: Section 2 presents the context of digitalization in Latin America and the Caribbean along with a literature review. The data and methodology for the microeconomic and macroeconomic approaches, are presented in Section 3. The key findings are reported in Section 4. Section 5 presents robustness test reuslt and Section 6 concludes.

Where do we stand? A brief review of the literature

1. A brief context of digitalization in Latin America and the Caribbean

Digital infrastructure is a key area of development in the LAC region. While the region has made progress in this area, it still lags behind other regions such as Western Europe and the Asia Pacific region. The LAC region has 46 percent fixed broadband access, compared to 57 percent in Eastern Europe, 87 percent in Western Europe, and 59 percent in the Asia Pacific region. This suggests that there is still a significant gap in digital infrastructure between the LAC region and other regions worldwide. Digital public platforms are another important area of development in the LAC region. These platforms can help improve government services and increase transparency and accountability. Argentina, Brazil, Chile, and Uruguay are among the top 50 performers in 2018, performing slightly below the OECD average. However, Belize, Cuba, Haiti, and Nicaragua were among the worst LAC performers. This highlights the need for continued investment in digital public platforms to ensure all citizens benefit from these services.

In terms of digital financial transactions, the LAC region is still facing challenges. While mobile money accounts are becoming more popular, the growth rate in the LAC region is lower than in other regions, such as Western Africa. According to the data provided, in 2019 the LAC region experienced the lowest growth rate in the number of registered mobile money accounts (+2.5 percent, Western Africa 14.5 percent) and the lowest growth rate in transaction value (+1.4, Western Africa +34.9 percent). This suggests that there may be barriers to adopting digital financial services in the LAC region that must be addressed. On the other hand, venture capital investments in digital business are showing positive trends in the LAC region. For example, in 2019, Brazil and Mexico led the region in terms of the number of deals and volume transacted. However, the region still lags behind the Asia Pacific region in terms of attracting investment. According to KPMG's 2019 report, the LAC region attracts less investment than the Asia Pacific region. This highlights the need for policies and initiatives that can help attract more investment to the region.

The LAC region faces a significant challenge in education and training in digital skills. As mentioned earlier, the levels of education and training in digital skills in the LAC region are low compared to advanced countries. IDC's 2017 report estimates that there are more than 450 thousand unfilled jobs in the technology area due to the lack of trained professionals. This skills gap can make it difficult for the region to fully realize the potential of digital technologies, which can significantly impact economic growth. However, the potential benefits of digital

transformation are significant. According to GSMA, a 10 percent increase in mobile internet penetration can increase GDP by 1.2 percent, while a 10 percent increase in a country's digitalization can generate 1.9 percent in GDP growth. This highlights the importance of investing in digital infrastructure and skills to realize the potential of digital technologies fully.

From another angle, most Latin American countries' competitiveness is largely based on abundant natural resources or low-skilled labor. This has resulted in a poorly diversified production structure, entailing low value added and an export specialization concentrated in goods with low technological content. While this structure can provide periods of rapid growth, sustained productivity growth requires incorporating technology and production diversification towards dynamic sectors, both in technology and in terms of international demand (ECLAC, 2012; OECD et al., 2019).

To escape the productivity trap, the LAC region must take advantage of the digital transformation and promote production transformation. Some countries in the region are already incorporating policies to boost the development of emerging technologies, such as advanced robotics and artificial intelligence (AI), to improve productivity. Examples of such efforts include Brazil's National Internet of Things Plan, Colombia's Fourth Industrial Revolution Centre operated by the Ruta N Corporation in Medellin, and Uruguay's digital manufacturing laboratory (LACVA, 2020). Challenges remain, especially in the productive application of digital technologies, development of digital entrepreneurship, and business heterogeneity. A large share of smaller businesses have difficulties adopting new technologies. Furthermore, despite the rapid pace of technological change and its potential to improve efficiency, aggregate productivity growth, including in LAC, has slowed over the past decade, giving rise to a productivity paradox (OECD, 2017a, 2017b).

2. Digitalization and gender

Technological progress related to digitalization has the potential to impact labor market outcomes through various channels, as highlighted by recent studies (Loko and Yang, 2022; Bakker et al., 2023). On the one hand, digitalization can enhance labor market efficiency by improving access to information about job openings, reducing recruiting expenses for employers, and improving job matching quality (Autor, 2001). On the other hand, it can lead to increasing flexibility and deregulation, characterized by a reorganization of work tasks and a liberalization of employment forms (Eichhorst and Tobsch, 2015).

Moreover, an increasing number of empirical studies suggest that internet access has a more significant and positive impact on women than men. For instance, Klonner & Nolen (2010) reveal significant impacts of network expansion on labor market outcomes, highlighting notable gender-specific differences. When a community gets network coverage, employment grows by 15 percentage points. However, a gender-disaggregated analysis indicates that the majority of this impact is driven by increased female employment. This suggests that digitalization can promote gender equality in the labor market by providing women with better access to job opportunities and reducing gender-based employment gaps.

Similarly, recent studies have shed light on the potential impact of digitalization on labor force participation and household consumption. For instance, Dettling (2016) uses an instrumental variables approach that leverages state-level variations in the availability of residential broadband internet access to demonstrate that the use of high-speed internet leads to a substantial 4.1 percentage point increase in labor force participation for married women. However, no such effect is observed for single women or men. Further analysis indicates that using the internet for telework and saving time in household activities can account for the increase in participation. These findings suggest that access to home internet can improve work-family balance and promote gender equality in the labor market.

Similarly, Bahia et al. (2020) exploit a unique dataset that merges information from a national longitudinal household survey on living standards with data from Nigerian mobile operators concerning the rollout of mobile broadband coverage from 2010 to 2016. They show that mobile broadband coverage had significant and positive impacts on household consumption levels, which grew over time, although at a declining rate. Furthermore, mobile broadband coverage helped to decrease the percentage of households living below the poverty line, mostly by boosting food and non-food consumption in rural households. These outcomes were primarily attributed to increased labor force participation and employment, especially among women. These findings suggest that digitalization can promote economic development and reduce poverty, particularly in rural areas, by providing better access to job opportunities and improving household consumption levels.

Kumar and others (2023) identify key drivers of digital adoption, estimate fiscal costs to provide internet subsidies to households, and calculate social dividends from digital adoption. Using cross-country panel regressions and machine learning, the authors find that digital infrastructure coverage, internet price, and usability are the most statistically robust predictors of internet use in the short run. Based on estimates from a model of demand for internet, the authors find that demand is most price responsive in low-income developing countries and almost unresponsive in advanced

economies. The authors also claim that thre aree substantial aggregate and distributional gains from digital adoption for education quality, time spent doing unpaid work, and labor force participation by gender.

3. COVID-19 and gender

Evidence in a recent study by Abidi and others (2022) suggest that the COVID-19 pandemic resulted in an unprecedented shock to firms, with adverse consequences for existing productive capacities. Digitalization, on the other hand, played a vital role to mitigate economic losses from the pandemic. The authors claim that firms facing digital constraints are less resilient to supply shocks. The paper uses firm-level data to investigate whether digitally enabled firms were able to mitigate economic losses arising from the pandemic better than digitally constrained firms in the Middle East and Central Asia region using a difference-in-differences approach. Controlling for demand conditions, the authors find that digitally-enabled firms faced a lower decline in sales by about 4 percentage points during the pandemic compared to digitally-constrained firms, suggesting that digitalization acted as a hedge during the pandemic.

Previous economic recessions have shown that male employment is typically more affected than that of women, largely due to the fact that male-dominated sectors such as construction and manufacturing are typically hit harder during recessions compared to female-dominated industries such as education and health care, as demonstrated by Coskun and Dalgic (2020) and Smith and Villa (2013).

However, the COVID-19 pandemic impacted women's employment more than men's. The literature has identified two primary factors contributing to this gender disparity. Firstly, lockdown measures and concerns about contagion disproportionately affected industries and occupations with a higher proportion of female employees. For instance, the hospitality and retail sectors, which employ a large number of women, were severely impacted by the pandemic. [1]Secondly, the closure of schools and daycare facilities and the transition to remote learning increased the need for childcare, resulting in many parents, particularly mothers, having to choose between their jobs and being responsible for taking care of their household and all that comes with it. This significantly reduced women's labor force participation and employment, as highlighted by recent studies (e.g., Alon et al., 2020; Adams-Prassl et al., 2020).

[1] Owing to the lack of consistent data on sectoral employment by gender in the respective household sectors for sll countries, this study does not address the compratives and the teleworkability and female employment sectoral intensity.

Women, young workers, and those with low levels of education and limited internet connectivity were disproportionately affected by the economic downturn caused by the pandemic-related lockdowns in Latin America and the Caribbean. The Covid-19 crisis also brought historically high levels of absences from work, particularly for women and independent workers. Absences preceded job losses, with almost one in five absent workers losing their employment after two months (World Bank, 2021).

Extensive literature has demonstrated that women's employment in certain occupations and industries has led to higher unemployment rates than men. Recent studies, such as Adams-Prassl et al. (2020), using real-time survey data from the United Kingdom, the United States, and Germany during the pandemic, have found that workers who are engaged in alternative work arrangements or have jobs that do not allow remote work are more prone to experience a reduction in working hours, job loss, and decreased earnings. These findings suggest that the pandemic disproportionately affected women's employment, particularly those in non-standard work arrangements.

Similarly, Bluedorn et al. (2021) show significant diversity across countries, with more than half to two-thirds experiencing greater decreases in women's than men's employment rates. These gender disparities caused by COVID-19's effects are usually temporary, lasting only for an average of one or two quarters. Furthermore, the study demonstrates that the gender-based recession is closely connected to COVID-19's influence on the distribution of employment shares between genders within sectors.

Women often assume the role of primary caregiver, which has implications for their employment during the COVID-19 crisis. According to survey data collected by the American Time Use Survey (ATUS, 2021), married women tend to provide more childcare than married men on average. The data reveals that, among all married couples with children, husbands provide an average of 7.4 hours of childcare per week, whereas wives provide an average of 13.3 hours.

Research by Alon et al. (2020) found that when childcare needs increase, as they had during the pandemic, women are more likely to leave their jobs to care for children. The closure of schools and daycare centers also resulted in a substantial increase in childcare needs, disproportionately affecting working mothers. The negative impact on working mothers is also likely to be long-lasting, due to high returns to experience in the labor market.

These findings suggest that the COVID-19 pandemic had a unique and disproportionate impact on women's employment, highlighting the need for policies that address the specific challenges women face in the labor market. Such policies could include measures to support the childcare needs of working parents and targeted support for industries and occupations with a higher proportion of female employees.

Empirical strategy and data

To examine the relationship between digitalization and employment, we use two different approaches. On the one hand, we exploit data from household surveys developed by the World Bank and UNDP to capture variation across households and countries. This allows us to identify the effects of digital availability on employment and job losses. On the other hand, we employ cross-country panel data to understand the effects of the expansion of internet availability on employment rates by gender in LAC.

1. Household-level analysis

1.1 Data

The data used in this section comes from the second phase of the High Frequency Phone Survey, wave 2 in LAC. The data was collected between October and December of 2021 as part of a global-scale effort to better understand the effects of the pandemic and their mechanisms, led by the World Bank Group and the UNDP. The survey covered 22 countries in Latin America and the Caribbean and included questions regarding individual and household demographics, income, employment, health, education, among other topics. It is important to note that this survey is not a panel, and the latest information available is from wave 2, which we are using for this paper. As explained in the paper by Ambel, McGee & Tsegay (2021), phone surveys usually are subject to coverage and non-response bias, and this biases can be alleviated by sample reweighting; we apply this methodology so that the estimates are as unbiased as possible.

The analysis focuses on two main outcome variables: 1. "job loss," which is a binary variable that takes a value of one for individuals who reported not currently working and having lost their pre-pandemic job; and 2. "employed," which is also a binary variable that takes a value of one if the individual reported having worked in the last week.

The main independent variable of the analysis is called "Women with internet," which is an interaction variable of the dummies for being a woman (1 if woman and 0 otherwise) and having an internet connection in the household (1 if yes and 0 otherwise). Hence, this interaction variable only takes a value of one for women with an internet connection in their household. The analysis also includes control variables such as country, state, education level, and marital status, which are included as fixed effects.

The last group of variables are complementary variables that allow us to further explore the main hypothesis by splitting the sample to check how the results vary between groups with certain characteristics. We use four binary variables for this purpose: 1. "income reduced," which is

assigned a value of one for individuals who reported a decrease in household income compared to the previous wave (around June 2021), and zero otherwise; 2. "High Covid-19 level," which is a dummy variable that takes a value of one if the country had a rate of COVID-19 cases higher than the world median; 3. "Increased household chores," which is a dummy variable that takes a value of one if the individual reported an increase in household chores since the beginning of the pandemic; and 4. "Household with children," which is a binary variable that takes a value of one if there is at least one child in the household. Similarly, for each regression we control for important covariates that might be influencing the behavior of the labor market, such as if the woman has an smartphone or if there are children in the household.

Descriptive statistics of key variables are presented in Table 1. It is important to note that, although there is no income level information in this survey, we use the question "Your household income has stayed the same, decreased or increased compared to the previous wave (around June 2021)?" to assign a value of one to individuals who reported a decrease in household income.

Table 1. Summary Statistics for Household-level Analysis

	No. Obs	Job loss (%)	Employed (%)	Women (%)	Internet access (%)	Women with internet access (%)	Increased household chores (%)	Household with children (%)
Belize	898	22,9	57,7	50,3	69,3	34,3	31,3	67,1
Guatemala	1.521	15,9	66,9	51,9	33,3	17,1	20,6	72,7
El Salvador	812	13,7	66,1	55,3	47,3	24,8	20,3	63,5
Honduras	1.004	21,2	57,8	52,5	42,1	20,1	20,3	76,2
Nicaragua	865	13,2	67,5	51,8	32,6	15,9	23,4	72,5
Costa Rica	905	18,7	60,8	49,9	62,2	31,1	28,2	50,2
Panama	986	25,6	53,1	50,3	58,3	29,8	26,4	60,3
Haiti	2.361	33,3	46,2	51,6	9,0	3,9	35,4	74,8
Peru	1.302	21,9	67,7	50,7	48,9	24,0	33,2	69,0
Mexico	2.511	14,7	66,0	52,0	68,6	34,0	30,4	58,1
Argentina	1.321	13,1	65,6	51,8	76,9	39,3	25,8	49,4
Chile	1.329	13,1	62,5	51,1	73,6	32,9	37,9	45,2
Colombia	1.376	26,5	58,9	52,1	58,5	30,1	27,9	64,5
Bolivia	1.183	13,7	74,0	50,3	59,9	30,6	22,9	67,8
Guyana	875	16,3	63,1	49,8	70,3	34,2	37,7	61,6
Ecuador	1.615	17,3	64,7	50,6	74,2	36,6	25,8	71,8
Paraguay	1.061	10,9	77,4	50,0	51,9	22,2	20,7	61,8
Uruguay	930	16,8	61,0	52,3	72,4	35,9	22,6	42,8
St Lucia	860	13,2	69,1	50,7	81,5	42,4	31,0	47,2

Dominica	879	15,1	66,0	49,6	83,2	43,8	37,7	51,6
Dominican Republic	1.197	20,8	61,4	50,5	57,0	29,1	28,8	63,5
Jamaica	871	14,4	65,7	51,0	71,0	36,2	35,4	57,2
Total	26.662	17,4	64,4	51,7	62,4	31,0	28,7	60,5

Table 1 presents the mean values of all variables included in the analysis for the entire sample (row "total"), as well as disaggregated by country. Regarding the variables of interest, the percentage of individuals who lost their pre-pandemic job and are not currently working is around 17 percent, with some variation across countries such as Haiti, Panama, and Colombia. The employment variable has an average value of 64 percent and shows less variation among countries than the job loss variable.

The percentage of women and households with children has a small variation, with an average of 52 percent and 60 percent, respectively. In contrast, internet access shows significant variation among countries, with an average access rate of 61 percent. However, this mean is driven by countries with high rates such as Dominica (83 percent), St. Lucia (81 prcent), and Jamaica (71 percent), while some countries have extremely low rates such as Haiti (9 percent).

1.2 Empirical strategy

To examine the effects of internet connectivity on female employment, we employ a fixed effects model utilizing female and internet access dummies, as well as their interaction. This constitutes the primary specification of our analysis and can be expressed through the following equation:

$$Y_i = \alpha + \beta_1 Female_i * Internet_i + \beta_2 Female_i + \beta_3 Internet_i + \delta_i + \varepsilon_i \quad (1)$$

Where Y_i is either the outcome variables "employment" or "job loss", and δ_i represents the fixed effects for country, state, marital status, and education level for each individual. In equation 2, the coefficient of interest is β_1, as it represents the effect of being female and having internet access on the labor market outcomes we are analyzing, compared to women without internet access. Hence, this coefficient can give us an idea of the effect of internet on female labor market outcomes, including employment. It is important to note that this specification is likely to suffer from bias as it is likely that some unobserved variables are related both to the outcome and to having internet access, so the coefficient cannot be understood as a causal effect but more as correlations between the variables we are analyzing.

In addition, to study how these correlations change for different groups, we apply equation 2, to a sample split by the group variable. These analyses can be represented as:

$$Y_i = \alpha + \beta_1 Female_i * Internet_i + \beta_2 Female_i + \beta_3 Internet_i + \delta_i + \varepsilon_i \quad if\ group_i = 1 \qquad (2)$$
$$Y_i = \alpha + \beta_1 Female_i * Internet_i + \beta_2 Female_i + \beta_3 Internet_i + \delta_i + \varepsilon_i \quad if\ group_i = 0$$

In the previous equation $group_i$ represents the variables that allow identifying different groups "High Covid-19 level", "Decreased income", "Increased household chores", and "Household with children". In addition, for all the estimations we use clustered standard errors at the individual level and survey weights for country population.

2. Country-level analysis

2.1 Data

To measure a country's level of digitalization, we construct two main indicators. Our first indicator $Digitalization$ is the percentage of internet users in total population.[2] We also collect data on the natural logarithm of the number of individuals using the internet in a given country as an alternative measure. We define women's labor force participation rate, $Female\ LFPR$, as the ratio of female population aged 15 and older that is economically active and supplies labor for the production of goods and services. We also use the female employment to population ratio as an alternative measure. Male LFPR and employment ratio are also obtained for comparison.

To establish the relation between digitalization and female employment, we control for an array of variables that reflect a country's economic, social, and institutional status. $GDP\ Per\ Capita$ is the natural logarithm of a country's per capita GDP, indicating the level of economic development. $Account$ is proportion of women owning an account at a financial institution. We also included $Schooling$ variable, defined as average year of total school for population above 15, to account for a country's human capital. Women law, a score ranging from 0 to 100, symbolizes the level of female protection in a country. The higher the score, the more effective the legal system is at safeguarding women's rights.

[2] It should be noted that digitalization is a nultifaceted concept and the ITU offers additional indicators, such as mobile and fixed broadband subscriptions, the number of mobile subscriptions. Due to its multidimensional nature, it cannot be fully assessed solely through internet user statistics. For coherency of the analysis, however, we used one definition of deigitalization – the percentage of internet users in total population.

To incorporate the economic mechanisms underlying the relationship between digitalization and female employment, we explore how digitalization exerts a differential effect in countries with varying degrees of household burden, COVID conditions, income levels and geographic locations. More specifically, we focus on the following four variables: $Trained\ teachers$ measures the number of trained teachers over the total number of teachers in a country. The higher the ratio, the better the teaching quality. $COVID-19$ is a dummy variable that takes the value of one if the number of COVID-19 cases in a country is above median. $Income\ Level$ is the classification of countries based on gross national income per capita data in U.S. dollars, converted from local currency using the World Bank Atlas method to smooth exchange rate fluctuations. LAC is a dummy that equals one if the country is located in the Latin American and Caribbean region, and zero otherwise.

Descriptive statistics of key variables are presented in Table 2.

Table 2. Summary Statistics for Country-level Analysis

Variable	No. of Obs.	Mean	Stdev	Min	Max
Female LFPR	5,600	50.6	16.4	6.0	90.6
Male LFPR	5,600	72.9	9.3	40.6	96.2
Percent of Internet Users	4,445	25.0	28.9	0	99.7
GDP Per Capita	5,600	8.4	1.5	5.1	11.7
Schooling	5,600	7.3	3.0	0.2	13.2
Women, Business and Law	5,600	75.7	29.1	0.0	100.0

2.2 Empirical strategy

To estimate the relation between digitalization and female employment, we construct the following baseline model:

$$Female\ LFPR_{i,t} = \beta_0 + \beta_1 Digitalization_{i,t-1} + \beta_2 X_{i,t-1} + \theta_i + \mu_t + \varepsilon_{i,t} \qquad (3)$$

where $Female\ LFPR_{i,t}$ refers to women's participation in the labor force of country i in year t, measured by the ratio of female workers in the labor force. $Digitalization_{i,t-1}$ captures the level of digitalization of country i in year $t-1$, measured by the ratio of internet users in the population. $X_{i,t-1}$ is a vector of country-level controls, including the natural logarithm of per capita GDP, the proportion of female account ownership at a financial institution, the average year of total

schooling, and the level of women, business and law protection. All explanatory variables are lagged by one year to mitigate endogeneity concerns.

By including θ_i, we account for country fixed effect that absorbs systematic differences across countries in terms of economic development, government policies, ICT-specific reforms, etc. μ_t denotes year fixed effect that picks up any variation in the outcome that happens over time and that is not attributable to other explanatory variables.

The coefficient of interest is β_1, which is associated with digitalization variables. If it is found to be positive and significant, we can conclude that a higher level of digitalization is associated with higher female representation in the workforce, hence a lower degree of gender inequality. If it is negative and significant, we can infer a negative correlation between digitalization and female employment.

2.3 Regressions with interaction terms

We proceed with fixed-effect regressions with interaction terms, hoping to shed light on the mechanisms through which digitalization exerts an impact. By estimating various forms of the model below, we examine the differential effects of digitalization on female employment.

$$\begin{aligned} Female\ LFPR_{i,t} &= \alpha + \beta\left(Digitalization_{i,t-1} \times Country_i\right) + \gamma Digitalization_{i,t-1} \\ &+ \delta I_{i,t-1} + \theta_i + \mu_t + \varepsilon_{i,t} \end{aligned} \tag{4}$$

where $Country_i$ refers to country-level characteristics, including overall household burden, income level, and geographical location, that capture economic mechanisms and help with identification. All explanatory variables are lagged by one year to mitigate simultaneity concerns. The sign and magnitude of coefficient is of interest to our study.

The COVID-19 pandemic swept across the world. As social what??? became compulsory and telework becomes the new trend, access to digital resources should give women an advantage in participating in the labor market. To test whether digitalization has helped women get through the pandemic, we created a dummy variable $COVID-19$, which takes the value of one if a country has above-median COVID confirmed cases, and zero otherwise, and rerun model (4).

Results

3.1 Household-level results

Table 3 presents the results for both outcome variables: job loss in panel A and employment in panel B, as well as a secondary outcome in panel C for hours worked per week. In the first two columns, we run a simple regression to check the correlation between labor market outcomes and having an internet connection, with and without fixed effects. These results are in line with the expected direction in theory, that is, having access to the internet increases the probability of being employed and decreases the probability of losing one's job and being unemployed. In both cases, the coefficients have the expected signs and are statistically significant.

In column (3), we present our main results from Equation (1). Here, we find that the coefficient of interest displays a positive correlation between being a woman with internet access and being employed and a negative correlation with job loss. Additionally, this relationship holds when we control for living in a household with children, having increased household chores, or having an smarphone; the first two variables can be proxies for other common reasons why a woman may decrease her labor supply, and the presence of an smartphone allows us to distinguish the effect of having a mobile device. To further explore whether women with different contexts, such as having children in the household, present a different relationship between internet and labor outcomes, we proceed with Equation 4 and split the sample into different groups. Tables 4 and 5 provide the associated results.

Table 3. Household Level Results

	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A. Job loss			
Women with internet			-0.0515*	-0.0523**	-0.0510*	-0.0524**
			(0.0263)	(0.0262)	(0.0264)	(0.0264)
Women			0.185***	0.187***	0.178***	0.186***
			(0.0228)	(0.0225)	(0.0227)	(0.0228)
Internet	-0.0798***	-0.0585***	-0.0290	-0.0281	-0.0288	-0.0250
	(0.0153)	(0.0152)	(0.0186)	(0.0185)	(0.0188)	(0.0189)
Household with children				-0.0164		
				(0.0123)		
Increased household chores					0.0589***	
					(0.0137)	

Has an smartphone						-0.0642
						(0.0442)
Constant	0.225***	0.212***	0.125***	0.134***	0.111***	0.184***
	(0.0130)	(0.0122)	(0.0162)	(0.0191)	(0.0173)	(0.0442)
			Panel B. Employment			
Women with internet			0.0403*	0.0425*	0.0397	0.0427*
			(0.0245)	(0.0244)	(0.0245)	(0.0245)
Women			-0.241***	-0.248***	-0.236***	-0.244***
			(0.0189)	(0.0187)	(0.0189)	(0.0189)
Internet	0.0612***	0.0315**	0.00223	-0.000671	0.00331	-0.00793
	(0.0144)	(0.0141)	(0.0190)	(0.0189)	(0.0190)	(0.0190)
Household with children				0.0558***		
				(0.0124)		
Increased household chores					-0.0533***	
					(0.0140)	
Has an smartphone						0.143***
						(0.0383)
Constant	0.605***	0.623***	0.754***	0.725***	0.766***	0.623***
	(0.0105)	(0.0105)	(0.0150)	(0.0169)	(0.0157)	(0.0390)
			Panel C. Hours worked			
Women with internet			0.0403*	0.0425*	0.0397	0.0427*
			(0.0245)	(0.0244)	(0.0245)	(0.0245)
Women			-0.241***	-0.248***	-0.236***	-0.244***
			(0.0189)	(0.0187)	(0.0189)	(0.0189)
Internet	0.0612***	0.0315**	0.00223	-0.000671	0.00331	-0.00793
	(0.0144)	(0.0141)	(0.0190)	(0.0189)	(0.0190)	(0.0190)
Household with children				0.0558***		
				(0.0124)		
Increased household chores					-0.0533***	
					(0.0140)	
Has an smartphone						0.143***
						(0.0383)
Constant	0.605***	0.623***	0.754***	0.725***	0.766***	0.623***
	(0.0105)	(0.0105)	(0.0150)	(0.0169)	(0.0157)	(0.0390)
Observations	26,662	26,507	26,507	26,507	26,507	14,217
R-squared	0.012	0.087	0.135	0.137	0.137	0.143
Country FE	YES	YES	YES	YES	YES	YES
State FE	NO	YES	YES	YES	YES	YES
Education FE	NO	YES	YES	YES	YES	YES

Marital status FE	NO	YES	YES	YES	YES	YES

Notes: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In Table 4, we find that the interaction coefficients are larger for individuals who experienced an increase in household chores when analyzing the variable 'Job loss.' However, for the variable 'Employed,' we do not find a significant effect with the split sample, although the coefficients remain positive. This suggests that digitalization may be more effective in mitigating the negative impact of household chores on job loss than in promoting employment.

Similarly, when we split the sample between individuals living in households with and without children, we find that for the variable 'Job loss,' the interaction coefficients are negative and larger for those living in households with children, as shown in columns (3) and (4) of Table 4. This could be due to the possibility that the internet plays a more important role for women who have more responsibilities at home, as it allows them to work from home when possible and provides them with more flexibility. These findings highlight the potential of digitalization to help alleviate the burden of childcare responsibilities for women and promote their participation in the labor market.

In Table 5, we observe that the differential effects on income are reduced, and we find that the coefficients of the interaction between female and internet are larger for individuals whose household income was reduced. This suggests that digitalization can be particularly beneficial for women in households experiencing income shocks, as it provides opportunities for remote work and reduces the need for physical presence in the workplace. A similar pattern can be observed in columns (3) and (4) of Table 5, for the sample of individuals living in countries with higher rates of COVID-19 cases, highlighting the potential of digitalization to mitigate the negative relationship of the pandemic on female employment.

Overall, our findings suggest that digitalization can play an important role in promoting gender equality in the labor market, particularly in contexts where women face significant household and childcare responsibilities. However, additional policies and investments may be necessary to fully realize the potential of digitalization in these contexts.

Table 4. Household Level Results by Household Chores and Children in the Households

	(1)	(2)	(3)	(4)
	Household chores increased	Household chores NOT increased	Household with children	Household without children
	Panel A. Job loss			
Women with internet	-0.0904*	-0.0527*	-0.0631**	-0.0440
	(0.0481)	(0.0298)	(0.0292)	(0.0424)
Women	0.217***	0.174***	0.225***	0.125***
	(0.0390)	(0.0254)	(0.0234)	(0.0373)
Internet	0.00182	-0.0269	-0.00649	-0.0384
	(0.0379)	(0.0201)	(0.0190)	(0.0312)
Constant	0.131***	0.115***	0.0944***	0.151***
	(0.0293)	(0.0173)	(0.0149)	(0.0267)
Observations	5,402	11,731	10,982	6,164
R-squared	0.191	0.163	0.173	0.181
	Panel B. Employment			
Women with internet	0.0555	0.0352	-0.000933	0.0974**
	(0.0441)	(0.0277)	(0.0281)	(0.0389)
Women	-0.219***	-0.247***	-0.252***	-0.235***
	(0.0353)	(0.0214)	(0.0210)	(0.0317)
Internet	-0.0309	0.0117	0.0131	-0.0177
	(0.0369)	(0.0209)	(0.0216)	(0.0304)
Constant	0.727***	0.765***	0.784***	0.719***
	(0.0290)	(0.0168)	(0.0163)	(0.0246)
Observations	8,147	18,334	16,594	9,886
R-squared	0.187	0.159	0.169	0.179

Country FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES
Education FE	YES	YES	YES	YES
Marital status FE	YES	YES	YES	YES

Notes: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The difference between groups is only statistically significant for women with internet on employment when comparing by children in the household.

Table 5. Household Level Results by Income Status and COVID-19 Levels

	(1)	(2)	(3)	(4)
	Income reduced	Income reduced	NOT High Covid-19	Low Covid-19
			Panel A. Job loss	
Women with internet	-0.0902**	-0.0525*	-0.0527*	-0.0472
	(0.0428)	(0.0295)	(0.0275)	(0.0362)
Women	0.223***	0.184***	0.187***	0.138***
	(0.0332)	(0.0246)	(0.0240)	(0.0280)
Internet	-0.0517*	0.00330	-0.0274	-0.0629***
	(0.0302)	(0.0180)	(0.0193)	(0.0236)
Constant	0.178***	0.0817***	0.122***	0.193***
	(0.0234)	(0.0144)	(0.0170)	(0.0157)
Observations	5,685	11,273	13,205	3,995
R-squared	0.210	0.147	0.128	0.146
			Panel B. Employment	
Women with internet	0.0401	0.0534*	0.0441*	0.0135
	(0.0395)	(0.0284)	(0.0260)	(0.0337)
Women	-0.253***	-0.251***	-0.247***	-0.176***
	(0.0284)	(0.0222)	(0.0205)	(0.0218)
Internet	0.0336	-0.0206	0.000520	0.0111
	(0.0308)	(0.0212)	(0.0200)	(0.0264)
Constant	0.715***	0.781***	0.759***	0.674***
	(0.0226)	(0.0164)	(0.0161)	(0.0154)
Observations	8,527	17,557	19,744	6,763
R-squared	0.187	0.154	0.135	0.126
Country FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES

Education FE	YES	YES	YES	YES
Marital status FE	YES	YES	YES	YES
	(1)	(2)	(3)	(4)
	Income reduced	Income NOT reduced	High Covid-19	Low Covid-19
	Panel A. Job loss			
Women with internet	-0.0902**	-0.0525*	-0.0527*	-0.0472
	(0.0428)	(0.0295)	(0.0275)	(0.0362)
Women	0.223***	0.184***	0.187***	0.138***
	(0.0332)	(0.0246)	(0.0240)	(0.0280)
Internet	-0.0517*	0.00330	-0.0274	-0.0629***
	(0.0302)	(0.0180)	(0.0193)	(0.0236)
Constant	0.178***	0.0817***	0.122***	0.193***
	(0.0234)	(0.0144)	(0.0170)	(0.0157)
Observations	5,685	11,273	13,205	3,995
R-squared	0.210	0.147	0.128	0.146
	Panel B. Employment			
Women with internet	0.0401	0.0534*	0.0441*	0.0135
	(0.0395)	(0.0284)	(0.0260)	(0.0337)
Women	-0.253***	-0.251***	-0.247***	-0.176***
	(0.0284)	(0.0222)	(0.0205)	(0.0218)
Internet	0.0336	-0.0206	0.000520	0.0111
	(0.0308)	(0.0212)	(0.0200)	(0.0264)
Constant	0.715***	0.781***	0.759***	0.674***
	(0.0226)	(0.0164)	(0.0161)	(0.0154)
Observations	8,527	17,557	19,744	6,763
R-squared	0.187	0.154	0.135	0.126
Country FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES
Education FE	YES	YES	YES	YES
Marital status FE	YES	YES	YES	YES

Notes: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The differences between groups are not statistically significant.

3.2 Country-level results

Our results on country-level analysis are provided in Table 6. In Column (1), we estimate equation (3) using the ratio of female workers as the dependent variable and the level of digitalization as the independent variable. After dropping missing values, we end up with a sample of 169 countries. The coefficient on digitalization is positive and significant at the 1 percent level. The result is consistent with our hypothesis that digitalization is associated with a significant increase in female labor force participation rate. More specifically, a 1 percent increase in the level of digitalization is associated with a 0.07 percentage points increase in the ratio of female workers in our sampled countries. It is worth noting that, the coefficient on digitalization is also significant when the dependent variable is replaced by male labor force participation rate, though with smaller magnitude than that for female.

In order to analyze the varying impacts of digitalization on female and male labor force participation, we introduce a variable known as the female-to-male labor force participation ratio. The coefficient derived from our analysis reveals a positive and statistically significant value (Column 6), indicating that women are more profoundly affected by digitalization compared to men.

Table 6. Country Level Results

VARIABLES	(1) Female LFPR	(2) Female LFPR	(3) Male LFPR	(4) Male LFPR	(5) Female to Male LFPR	(6) Female to Male LFPR
Percent of	0.073***	0.065***	0.028***	0.025**	0.085***	0.074***
Internet Users	(0.013)	(0.013)	(0.009)	(0.011)	(0.017)	(0.015)
GDP Per Capita		-3.895***		-0.536		-3.630***
		(1.073)		(0.995)		(1.258)
Account		0.753**		0.120		1.102***
		(0.306)		(0.183)		(0.418)
Schooling		0.196		-0.258		0.249
		(0.344)		(0.273)		(0.459)
Women Law		0.011		-0.011		0.022
		(0.022)		(0.011)		(0.025)
Constant	48.895***	77.702***	71.866***	79.188***	68.013***	91.787***

	(0.320)	(9.440)	(0.232)	(8.427)	(0.406)	(11.418)
Observations	4,216	4,036	4,216	4,036	4,162	4,036
R-squared	0.970	0.971	0.948	0.945	0.971	0.973
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

3.3 Impact of Digitalization Across Countries

In this section, we interact the digitalization variable with various country characteristics, hoping to shed light on the economic mechanisms underlying the positive relation between digitalization and female employment. The variable *Trained Teachers* reflects the availability of teachers' services to their students and teachers' workload (Digest of Education Statistics, 2014). The higher the trained teacher ratio in primary school, the better the availability of teacher services to students, the lower the childcare burden relegated to households, and in most cases women. In Column (1) in Table 7, the interaction term of internet and trained teacher ratio—our chosen proxy for availability of childcare—is negative and statistically significant, indicating that the effect of digitalization is less important in countries with more childcare resources. In other words, digitalization synergizes with the availability of childcare resources to alleviate the household responsibilities faced by women, thus facilitating their reintegration into the workforce.

Table 7. Regressions with Interaction Between Digitalization and Household Burden

VARIABLES	(1) Female LFPR	(2) Female LFPR	(3) Male LFPR	(4) Male LFPR
Percent of Internet Users	0.098***	0.087***	0.037***	0.035***
	(0.015)	(0.014)	(0.009)	(0.009)
Percent of Internet Users * Trained Teachers	-0.030*	-0.027*	-0.011	-0.012
	(0.016)	(0.014)	(0.009)	(0.009)
Trained Teachers	3.159***	3.025***	0.964***	1.031***
	(0.453)	(0.440)	(0.351)	(0.355)
GDP Per Capita		-3.876***		-0.455
		(0.353)		(0.295)

Account		0.719***		0.115*
		(0.095)		(0.063)
Schooling		0.140		-0.261***
		(0.111)		(0.086)
Women Law		0.014**		-0.010***
		(0.006)		(0.004)
Constant	46.351***	75.412***	71.066***	77.660***
	(0.400)	(3.083)	(0.307)	(2.551)
Observations	4,176	4,006	4,176	4,006
R-squared	0.970	0.971	0.948	0.946
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Next, we use high income countries as the control group and put both low and middle income into the same regression, the two interaction terms are both negative and significant, indicating that compared with high income countries, lower income countries lack the institutional capacity to fully tap the potential of digitalization. However, the negative effect is insignificant when it comes to male labor force participation rate. (Table 8)

Table 8. Regressions with Interaction Between Digitalization and Income Levels

VARIABLES	(1) Female LFPR	(2) Female LFPR	(3) Male LFPR	(4) Male LFPR
Percent of Internet Users	0.078***	0.069***	0.028***	0.026**
	(0.014)	(0.014)	(0.010)	(0.011)
Percent of Internet Users * Low Income	-0.048	-0.007	-0.032	-0.021
	(0.059)	(0.057)	(0.062)	(0.062)
Percent of Internet Users * Middle Income	-0.049***	-0.030*	-0.017	-0.011
	(0.017)	(0.016)	(0.013)	(0.012)
GDP Per Capita		-3.272***		-0.303
		(1.042)		(0.909)

Account		0.726**		0.100
		(0.303)		(0.174)
Schooling		0.203		-0.254
		(0.347)		(0.273)
Women Law		0.012		-0.010
		(0.022)		(0.011)
Constant	49.252***	72.498***	72.016***	77.258***
	(0.342)	(9.408)	(0.269)	(7.695)
Observations	4,216	4,036	4,216	4,036
R-squared	0.970	0.971	0.948	0.946
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

We then zoom in on the LAC region, where gender inequality in labor force participation is a major concern due to the existence of a disproportionately large informal sector. The sample has a rather extensive coverage of countries in the region, covering 33 countries. The complete list of Latin American and Caribbean countries is available in the Appendix. The results, which are summarized in Table 9, suggest that digitalization exerts a positive effect on countries in Latin America and the Caribbean, with a significantly larger magnitude compared to other regions when all control variables are included. Again, the additional positive effect is muted for males.

Table 9. Regressions with Interaction Between Digitalization and LAC dummy

VARIABLES	(1) Female LFPR	(2) Female LFPR	(3) Male LFPR	(4) Male LFPR
Percent of Internet Users	0.069***	0.060***	0.028***	0.026**
	(0.013)	(0.013)	(0.009)	(0.011)
Percent of Internet Users * LAC	0.052**	0.053**	-0.009	-0.008
	(0.021)	(0.022)	(0.012)	(0.013)
GDP Per Capita		-3.765***		-0.557
		(1.063)		(0.996)
Account		0.707**		0.127
		(0.300)		(0.182)
Schooling		0.260		-0.268
		(0.339)		(0.274)
Women Law		0.004		-0.010
		(0.022)		(0.011)
Constant	48.801***	76.756***	71.883***	79.341***
	(0.325)	(9.316)	(0.231)	(8.433)
Observations	4,216	4,036	4,216	4,036
R-squared	0.970	0.971	0.948	0.946
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

3.3 Impact of Digitalization in Different Sectors

Could the positive effect of digitalization on female employment be driven by sectoral differences? Digitalization often enables remote work through telecommuting and flexible work arrangements in the service sector, particularly knowledge-intensive services. This can be especially beneficial for women who may have caregiving responsibilities at home. They can work from home or choose flexible hours, making it easier to balance work and family life.

To test this hypothesis, we collect data on the size of the service sector in each country and interact it with our digitalization indicator. The service sector size is a dummy variable that takes the value of one if the service sector share of employment is above the average share of all countries in a given year, and zero otherwise. The results in Table 10 indicate that countries with a larger service sector see a notable rise in female labor force participation, as suggested by the significant and positive sign on the interaction term. The ratio of female to male labor force participation is also raised. The impact on men's labor force participation ratio, however, is not statistically significant.

Table 10. Regressions with Interaction Between Digitalization and Service Sector Size

VARIABLES	(1) Female LFPR	(2) Female LFPR	(3) Male LFPR	(4) Male LFPR	(5) Female to Male LFPR	(6) Female to Male LFPR
Percent of Internet Users	0.097***	0.080***	0.020	0.020	0.110***	0.091***
	(0.021)	(0.019)	(0.017)	(0.016)	(0.022)	(0.021)
Percent of Internet Users* Service Sector Size	-0.019	-0.010	0.009	0.007	-0.018	-0.010
	(0.025)	(0.024)	(0.020)	(0.020)	(0.025)	(0.025)
Service Sector Size	-3.785***	-3.100***	-0.696	-0.618	-4.264***	-3.716***
	(0.785)	(0.695)	(0.663)	(0.575)	(0.966)	(0.971)
GDP Per Capita		-2.103**		-0.106		-1.574
		(1.016)		(0.930)		(1.267)
Account		0.558**		0.062		0.886**
		(0.276)		(0.174)		(0.392)
Schooling		0.148		-0.271		0.196
		(0.338)		(0.274)		(0.447)
Women Law		0.007		-0.012		0.017
		(0.022)		(0.010)		(0.025)
Constant	51.315***	65.761***	72.320***	76.304***	70.712***	78.116***
	(0.477)	(8.864)	(0.461)	(7.978)	(0.623)	(11.204)

Observations	4,216	4,036	4,216	4,036	4,162	4,036
R-squared	0.972	0.972	0.948	0.946	0.975	0.974
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

3.4 Did Digitalization Help Women Get Through COVID-19?

When distinguishing between countries with better/worse COVID-19 impact, we find that the benefits of digitalization are larger in the latter, as indicated by the positive and significant coefficient on the interaction term of digitalization and COVID-19 dummy. The results in Table 11 are consistent with our hypothesis that digitalization, to some extent, helps women participate in the labor force during the pandemic. We do not observe substantial digitalization benefits for male workers during the COVID-19 period.

Table 11. Regressions with Interaction Between Digitalization and COVID dummy

	(1)	(2)	(3)	(4)
	Female	Female	Male	Male
VARIABLES	LFPR	LFPR	LFPR	LFPR
Percent of Internet Users	0.054***	0.041***	0.017	0.014
	(0.015)	(0.014)	(0.012)	(0.013)
Percent of Internet Users * COVID-19	0.024*	0.029**	0.013	0.014
	(0.014)	(0.013)	(0.010)	(0.010)
GDP Per Capita		-3.795***		-0.504
		(1.085)		(1.016)
Account		0.715**		0.103
		(0.299)		(0.183)
Schooling		0.340		-0.194
		(0.363)		(0.267)
Women Law		0.010		-0.012
		(0.022)		(0.011)
Constant	48.871***	76.062***	71.840***	78.552***

	(0.312)	(9.657)	(0.234)	(8.638)
Observations	4,199	4,025	4,199	4,025
R-squared	0.970	0.971	0.947	0.945
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Robustness checks

In the section of household-level results, although our main specification involves an OLS estimation with fixed effects, we also conduct estimations using logistic regressions to account for the binary nature of our dependent variables, "Lost job" and "Employment." According to Angrist & Pischke (2009), this is the recommended approach even when dealing with binary dependent variables. As shown in Table 12, the results from the logistic regressions confirm our main findings: there is a positive correlation between internet access and its interaction with being a woman for employment, as indicated by positive coefficients and greater-than-one odds ratios. Additionally, there is a negative relationship between internet access and job loss. These results provide further support for the positive effect of digitalization on female employment and the potential of digitalization to mitigate the negative impact of a pandemic on female employment.

Table 12. Household Level Results Using Logistic Regression

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. Job loss					
	Coefficients	Odds ratio	Coefficients	Odds ratio	Coefficients	Odds ratio
Women with internet					-0.0235	0.977
					(0.195)	(0.190)
Women					1.203***	3.331***
					(0.158)	(0.527)
Internet	-0.543***	0.581***	-0.416***	0.659***	-0.384**	0.681**
	(0.0993)	(0.0577)	(0.103)	(0.0677)	(0.173)	(0.118)
Constant	-0.849***	0.428***	-1.140	0.320	-2.037**	0.130**
	(0.132)	(0.0566)	(0.835)	(0.267)	(0.863)	(0.113)
	Panel B. Employment					
	Coefficients	Odds ratio	Coefficients	Odds ratio	Coefficients	Odds ratio
Women with internet					0.134	1.144

					(0.124)	(0.142)
Women					-1.135***	0.321***
					(0.0954)	(0.0307)
Internet	0.268***	1.307***	0.148**	1.159**	0.0372	1.038
	(0.0630)	(0.0824)	(0.0643)	(0.0746)	(0.105)	(0.109)
Constant	0.124	1.132	0.263	1.301	1.010**	2.746**
	(0.0940)	(0.106)	(0.452)	(0.589)	(0.421)	(1.157)
Obs	26,662	26,662	26,448	26,448	26,448	26,448
Country FE	YES	YES	YES	YES	YES	YES
State FE	NO	NO	YES	YES	YES	YES
Education FE	NO	NO	YES	YES	YES	YES
Marital status FE	NO	NO	YES	YES	YES	YES

Notes: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

For country-level results, using alternative measurement of digitalization and female employment, the results remain robust.

Table 13. Country Level Results Using Alternative Variables

VARIABLES	(1) Female Employment Ratio	(2) Male Employment Ratio	(3) Number of Female Employees	(4) Number of Male Employees
Percent of Internet Users	0.080***	0.032***		
	(0.013)	(0.011)		
Number of Internet Users			0.027***	0.037***
			(0.007)	(0.005)
GDP Per Capita	-1.615	0.802	-0.302***	-0.256***
	(1.220)	(1.209)	(0.082)	(0.061)
Account	0.744**	0.066	0.011	-0.009
	(0.300)	(0.226)	(0.014)	(0.007)

Schooling	0.295	-0.107	-0.006	-0.011
	(0.359)	(0.321)	(0.019)	(0.015)
Women Law	0.008	-0.009	0.001	0.001
	(0.021)	(0.015)	(0.001)	(0.001)
Constant	52.430***	60.614***	21.817***	21.764***
	(10.724)	(9.972)	(0.646)	(0.504)
Observations	4,036	4,036	4,029	4,029
R-squared	0.965	0.940	0.996	0.997
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

To further alleviate endogeneity concerns, we adopt GMM models (see Table 14) which control for endogeneity by internally transforming the data and by including lagged values of the dependent variable. The results remain statistically significant and consistent with our hypothesis, suggesting a robust positive relation between digitalization and female labor force participation.

Table 14. GMM Results

VARIABLES	(1) Female LFPR	(2) Female LFPR	(3) Female Employment Ratio	(4) Female Employment Ratio
Percent of Internet Users	0.002*	0.004*	0.004***	0.005**
	(0.001)	(0.002)	(0.001)	(0.002)
GDP Per Capita		-0.358*		-0.222
		(0.194)		(0.212)
Account		0.029		0.097*
		(0.052)		(0.053)
Schooling		0.119*		0.119*
		(0.063)		(0.066)
Wome Law		-0.008*		-0.010**
		(0.004)		(0.005)
Constant	6.986***	10.661***	8.921***	11.045***

	(0.522)	(1.805)	(0.599)	(1.974)
Observations	3,987	3,816	3,904	3,785

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Conclusions

This paper provides a comprehensive analysis of the effects of digitalization on female employment, using both micro and macro-level data and accounting for shocks such as the COVID-19 pandemic and household chores and childcare responsibilities. Our findings suggest that higher levels of digitalization are associated with higher employment and lower job loss in the LAC region.

Furthermore, our results indicate that digitalization has the potential to significantly alleviate the impact of shocks on employment and job loss, including for women, as evidenced by the COVID-19 crisis. We also find that the effect of digitalization is stronger in countries with fewer childcare resources, highlighting the potential of digitalization to help alleviate the burden of childcare responsibilities for women and promote their participation in the labor market.

However, our analysis also reveals that the positive effects of digitalization can be limited by institutional weaknesses in countries with already aggravated structural vulnerabilities. Therefore, policies aimed at improving institutional capacity, such as investments in education and infrastructure, may be necessary to fully realize the benefits of digitalization in these contexts. Overall, our findings contribute to the growing literature on the relationship between digitalization and female employment and provide important insights for policymakers seeking to promote gender equality and economic development.

Finally, while COVID-19 pandemic provided a useful example of an economic shock and its differential gender impact, it is premature to generalize these findings. Future research should include estimating an all-encompasssing expected vulnerabilities of women to digitalization, which could be useful for social and economic policy discussions.

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Appendix I

Table A1. Household Level Results by Household Chores

	(1)	(2)	(3)	(4)
	Household chores increased	Household chores NOT increased	Household chores increased	Household chores NOT increased
	Panel A. Job loss			
Women with internet			-0.0904*	-0.0527*
			(0.0481)	(0.0298)
Women			0.217***	0.174***
			(0.0390)	(0.0254)
Internet	-0.0577**	-0.0532***	0.00182	-0.0269
	(0.0288)	(0.0178)	(0.0379)	(0.0201)
Constant	0.257***	0.190***	0.131***	0.115***
	(0.0216)	(0.0141)	(0.0293)	(0.0173)
Observations	5,402	11,731	5,402	11,731
R-squared	0.160	0.129	0.191	0.163
	Panel B. Employment			
Women with internet			0.0555	0.0352
			(0.0441)	(0.0277)
Women			-0.219***	-0.247***
			(0.0353)	(0.0214)
Internet	0.0130	0.0358**	-0.0309	0.0117
	(0.0256)	(0.0162)	(0.0369)	(0.0209)
Constant	0.592***	0.638***	0.727***	0.765***
	(0.0196)	(0.0121)	(0.0290)	(0.0168)
Observations	8,147	18,334	8,147	18,334

R-squared	0.157	0.107	0.187	0.159
Country FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES
Education FE	YES	YES	YES	YES
Marital status FE	YES	YES	YES	YES

Notes: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A2. Household Level Results by Children in the Household

	(1)	(2)	(3)	(4)
	Household with children	Household without children	Household with children	Household without children
	Panel A. Job loss			
Women with internet			-0.0631**	-0.0440
			(0.0292)	(0.0424)
Women			0.225***	0.125***
			(0.0234)	(0.0373)
Internet	-0.0510***	-0.0542**	-0.00649	-0.0384
	(0.0173)	(0.0265)	(0.0190)	(0.0312)
Constant	0.212***	0.200***	0.0944***	0.151***
	(0.0131)	(0.0211)	(0.0149)	(0.0267)
Observations	10,982	6,164	10,982	6,164
R-squared	0.121	0.167	0.173	0.181
	Panel B. Employment			
Women with internet			-0.000933	0.0974**
			(0.0281)	(0.0389)
Women			-0.252***	-0.235***
			(0.0210)	(0.0317)
Internet	0.0319*	0.0254	0.0131	-0.0177

	(0.0171)	(0.0234)	(0.0216)	(0.0304)
Constant	0.633***	0.612***	0.784***	0.719***
	(0.0123)	(0.0177)	(0.0163)	(0.0246)
Observations	16,594	9,886	16,594	9,886
R-squared	0.107	0.150	0.169	0.179
Country FE	YES	YES	YES	YES
State FE	YES	YES	YES	YES
Education FE	YES	YES	YES	YES
Marital status FE	YES	YES	YES	YES

Notes: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A3. Household Level Results by Income Status

	(1)	(2)	(3)	(4)	(5)	(6)
	Income reduced	Income NOT reduced	Income reduced	Income NOT reduced	Income reduced	Income NOT reduced
	Panel A. Job loss					
Women with internet			-0.0902**	-0.0525*	-0.0867**	-0.0517*
			(0.0428)	(0.0295)	(0.0428)	(0.0295)
Women			0.223***	0.184***	0.217***	0.177***
			(0.0332)	(0.0246)	(0.0332)	(0.0246)
Internet	-0.0867***	-0.0315*	-0.0517*	0.00330	-0.0543*	0.00349
	(0.0250)	(0.0176)	(0.0302)	(0.0180)	(0.0303)	(0.0179)
Increased household chores					0.0535**	0.0595***
					(0.0224)	(0.0163)
Constant	0.281***	0.170***	0.178***	0.0817***	0.163***	0.0690***
	(0.0186)	(0.0139)	(0.0234)	(0.0144)	(0.0250)	(0.0145)
	Panel B. Employment					

Women with internet			0.0401	0.0534*	0.0364	0.0533*
			(0.0395)	(0.0284)	(0.0395)	(0.0284)
Women			-0.253***	-0.251***	-0.245***	-0.247***
			(0.0284)	(0.0222)	(0.0284)	(0.0222)
Internet	0.0471**	0.0212	0.0336	-0.0206	0.0362	-0.0193
	(0.0232)	(0.0171)	(0.0308)	(0.0212)	(0.0308)	(0.0211)
Increased household chores					-0.0765***	-0.0509***
					(0.0218)	(0.0165)
Constant	0.579***	0.645***	0.715***	0.781***	0.738***	0.791***
	(0.0159)	(0.0130)	(0.0226)	(0.0164)	(0.0242)	(0.0167)
Observations	8,527	17,557	8,527	17,557	8,527	17,557
R-squared	0.139	0.107	0.187	0.154	0.192	0.157
Country FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
Education FE	YES	YES	YES	YES	YES	YES
Marital status FE	YES	YES	YES	YES	YES	YES

Notes: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A4. Household Level Results by COVID-19 Levels

	(1)	(2)	(3)	(4)	(5)	(6)
	High COVID-19	Low COVID - 19	High COVID - 19	Low COVID - 19	High COVID - 19	Low COVID - 19
	Panel A. Job loss					
Women with internet			-0.0902**	-0.0525*	-0.0867**	-0.0517*
			(0.0428)	(0.0295)	(0.0428)	(0.0295)
Women			0.223***	0.184***	0.217***	0.177***
			(0.0332)	(0.0246)	(0.0332)	(0.0246)
Internet	-0.0867***	-0.0315*	-0.0517*	0.00330	-0.0543*	0.00349

	(0.0250)	(0.0176)	(0.0302)	(0.0180)	(0.0303)	(0.0179)
Increased household chores					0.0535**	0.0595***
					(0.0224)	(0.0163)
Constant	0.281***	0.170***	0.178***	0.0817***	0.163***	0.0690***
	(0.0186)	(0.0139)	(0.0234)	(0.0144)	(0.0250)	(0.0145)
	Panel B. Employment					
Women with internet			0.0401	0.0534*	0.0364	0.0533*
			(0.0395)	(0.0284)	(0.0395)	(0.0284)
Women			-0.253***	-0.251***	-0.245***	-0.247***
			(0.0284)	(0.0222)	(0.0284)	(0.0222)
Internet	0.0471**	0.0212	0.0336	-0.0206	0.0362	-0.0193
	(0.0232)	(0.0171)	(0.0308)	(0.0212)	(0.0308)	(0.0211)
Increased household chores					-0.0765***	-0.0509***
					(0.0218)	(0.0165)
Constant	0.579***	0.645***	0.715***	0.781***	0.738***	0.791***
	(0.0159)	(0.0130)	(0.0226)	(0.0164)	(0.0242)	(0.0167)
Observations	19,744	6,763	19,744	6,763	19,744	6,763
R-squared	0.139	0.107	0.187	0.154	0.192	0.157
Country FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
Education FE	YES	YES	YES	YES	YES	YES
Marital status FE	YES	YES	YES	YES	YES	YES

Notes: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix II

Appendix Table 1. List of Latin American and Caribbean Countries Covered in the Sample

Antigua and Barbuda	Dominica	Nicaragua
Argentina	Dominican Republic	Panama
Aruba	Ecuador	Paraguay
Bahamas The	El Salvador	Peru
Barbados	Grenada	St. Kitts and Nevis
Belize	Guatemala	St. Lucia
Bolivia	Guyana	St. Vincent and the Grenadine
Brazil	Haiti	Suriname
Chile	Honduras	Trinidad and Tobago
Colombia	Jamaica	Uruguay
Costa Rica	Mexico	Venezuela

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